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Editorial

In an era where artificial intelligence (AI) is fundamentally reshaping the contours of knowledge creation and dissemination, libraries are no longer mere repositories of the analog past but vibrant forges of equitable, inclusive innovation. The Library Association of Bangladesh (LAB) International Conference on Reimagining Librarianship: Forging the Future with AI Technologies (ICRL), successfully held on 12–13 December 2025 at the historic Nabab Nawab Ali Chowdhury Senate Bhaban, University of Dhaka, Bangladesh, brought together more than 600 librarians, scholars, technologists, and policymakers from across the globe. Over two intensive days, participants engaged in critical discussions on the transformative potential of AI in librarianship while candidly addressing persistent challenges such as the global digital divide, ethical implications of algorithmic systems, data sovereignty, and the imperative of human-centered design in library services. The conference underscored that the future of librarianship lies not in resisting technological change but in actively shaping it to uphold the core values of access, equity, and intellectual freedom for all. The specific objectives of the ICRL were to explore nine key tracks: AI-enabled library operations and workflow automation; personalized services and user engagement; AI and innovative library services; AI in digital preservation and archiving; research, innovation, and future directions; ethical, legal, and privacy issues; capacity development and new literacies; community engagement with AI; and policy frameworks and changing job structures in the AI age. Serving as a vibrant international forum, the conference provided students, researchers, faculty members, and library and information professionals from around the world a welcoming platform to share fresh ideas, present original research findings, and exchange practical experiences across all areas of library and information science, including artificial intelligence, data science, big data, knowledge management, data mining, databases, and data visualization. This year, we received 41 research papers from authors in Bangladesh and India. Each submission underwent a rigorous peer-review process conducted by two independent reviewers under a single-blind protocol. The initial evaluations were deliberated among the reviewers and finalized by the convener of the conference's National Steering Committee. As a result, 21 papers (51.22%) were accepted as full papers, 3 papers (7.32%) as short papers, and 15 papers (36.59%) for publication as abstracts in the conference proceedings, while 2 papers (4.88%) were rejected.

We highly appreciate the conference organizing national steering committee members, all sub-committee members and external reviewers for their technical effort in providing straightforward comments and impartial judgment in the review process of ICRL-25. Our deepest gratitude goes to our distinguished Chief Guest, Professor Dr. Chowdhury

RafiqulAbrar, honorable Adviser, Ministry of Education, Interim Government of Bangladesh; the Guest of Honor, Professor Niaz Ahmed Khan, *PhD*, honorable Vice-Chancellor of the University of Dhaka; and the Special Guest, Dr. A. S. M. Amanullah, honorable Vice-Chancellor of the National University of Bangladesh, for their gracious presence at this conference. We extend our sincere gratitude to the keynote speaker, Emily Drabinski, immediate past president of the American Library Association and associate professor at the graduate school of information studies, City University of New York, USA, for her inspiring presence and invaluable contributions. We are confident that LIS scholars and professionals worldwide will remain deeply grateful for her steadfast commitment and collaborative spirit. Finally, we extend our heartfelt thanks to all authors and conference participants for their invaluable contributions and unwavering support. We hope that everyone seized this opportunity to share and exchange ideas with fellow scholars, while enjoying ICRL-25 on the splendid campus of the University of Dhaka, Bangladesh.

Due to time constraints, there may be some typographical errors or inaccuracies. We sincerely apologize for any oversights. We firmly believe that these proceedings are more than mere reading material—they serve as a catalyst for reflection and action. As AI reshapes the landscape of libraries, we must navigate this transformation with thoughtful stewardship to ensure equity and sustainability for all. The papers in these proceedings advance us from superficial AI integrations to authentic partnerships: ethical, inclusive, and profoundly transformative. Our deepest thanks go to all our supporters, particularly the University of Dhaka for waiving the additional charges for the conference hall, and to our sponsors for their generous financial contributions. May these insights ignite meaningful progress, illuminating the path for libraries to lead us through the era of AI.

Md. Shiful Islam

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&

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“Measuring Information Literacy Competency among Undergraduate Students of Dhaka University”

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Sk. Mamun Mostofa (Corresponding Author)²

Abstract

Introduction: Information Literacy (IL) has become an urgent need in today's competitive and technologically advanced world, where information is being produced every second. Therefore, undergraduates must be information literate, which will help them become lifelong learners.

Aim/ Objectives: The main aim of this study is to measure the IL competency of undergraduate students of Dhaka University (DU), Bangladesh, and to know the perception about the urgent need for an IL program. The other objectives are to determine the understanding of IL, recognize how relevant information is obtained, identify the challenges faced when dealing with information, and understand the perceptions of undergraduates regarding the development of an IL program in higher education.

Methodology: Quantitative method was employed to measure the IL competency of DU undergraduates and to determine the perceptions toward building IL programs. A structured questionnaire was developed to collect primary data. A total of 280 responses were gathered via Google Forms. Data has been analyzed through the R Programming language (RStudio). Descriptive statistics have been performed to analyze the data.

Results: The results show that the level of understanding of IL among students is inadequate for being an information literate person. The study highlights that the majority of students are in favor of including an information literacy program in the undergraduate curriculum. It is also revealed that undergraduates' limited ability to assess the credibility and relevance of the information they find directly addresses where and how they get information. In addition, students face notable challenges related to accessing and evaluating information.

Implications: This study provides critical insights into students' interaction with IL, providing a valuable foundation for the development IL competency integration in both Bangladesh and global higher educational landscapes.

Conclusion: The study provides an overview of the IL competency of DU undergraduate students and their perception of how IL programs can be improved or started in some cases. Optimistically, the concerned authorities would take appropriate initiatives to improve information literacy competency among their students.

Keywords: Information Literacy (IL) competency, Information Literacy (IL), Undergraduates, Dhaka University (DU), Information Literate person.

1. Introduction

The concept of IL has become more crucial than ever due to the rapid growth of ICT,

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widespread use of media devices, and the overwhelming availability of information resources. These circumstances are compelling postgraduate students to develop the knowledge and skills necessary to access, evaluate, and use information effectively and responsibly. To make the best use of ICT and media resources, postgraduates must be able to meet their academic, and research demands by applying critical thinking and ethical use of information. They are required to independently identify their information needs, locate suitable resources, and use them appropriately to bridge information gaps, complete academic tasks, and solve problems (Olatope Oyedokun et al., 2019). IL is also necessary for global, social, or individual well-being by identifying the differences among Misinformation, Disinformation, Malinformation.

In today's information-driven era, being information literate is an essential skill, just like digital, media, numeric, and visual literacies. This is particularly important for the "Google generation" of students who are constantly exposed to a vast and rapidly increasing amount of online information, much of which may be unreliable or low in quality (Foo et al., 2017). In countries where most have already incorporated or are trying to incorporate information literacy at the school or high school level, just like the United States, Canada, Thailand, Singapore, we are still struggling with it at the higher education level. At this stage, it is essential to prioritize policy building for Information Literacy (IL) programs and to make proper arrangements for training educators and students. Establishing clear policies will provide a structured framework for integrating IL into the curriculum, while targeted training will equip stakeholders with the necessary skills to implement and benefit from these initiatives effectively. The term 'Information Literacy (IL)' is being used significantly in today's knowledge-based society. It enables individuals to 'recognize when information is needed and it gives them the ability to locate, evaluate and use effectively the needed information' (ACRL, 2014).

This study will measure the competency among undergraduate students at DU, Bangladesh. The findings will help the authorities to take initiatives to improve the students' literacy competency and enable them to contribute to society by being independent and lifelong learners. Because of the information explosion, the term 'Information Literacy' is becoming more valuable day by day. The world is writing so much about the importance of information literacy. The work on information literacy in Bangladesh is not enough compared to this. Limited studies have been done on measuring IL competency of DU students and their perceptions toward building an IL program. This study will contribute to the existing literature on the importance of undergraduates' IL. This would help the university authority take initiatives to improve the information literacy competency of undergraduate students by incorporating an IL program into their courses.

2. Problem Statement

Without developing IL in its students, a country cannot uphold its position in a technologically changing world. Developing lifelong learners is a fundamental goal of higher education. Universities and colleges aim to nurture reasoning and critical thinking skills while equipping students with strategies for independent learning, laying the groundwork for personal and professional growth as well as responsible citizenship. IL

plays a vital role in this process, as it supports learning beyond the classroom and encourages self-directed inquiry in academic, professional, and personal contexts. By strengthening students' ability to evaluate, manage, and apply information effectively, IL is increasingly recognized by academic accreditation bodies as an essential learning outcome (Information Literacy Competency Standards for Higher Education, n.d.). For improving literacy competency, students' level of expertise should be measured. Islam and Tsuji (2010) have worked on IL, which is entitled "Assessing information literacy competency of Information Science and Library Management graduate students at Dhaka University," in which they showed their assessment results of IL competency in the department of Information Science and Library Management (ISLM) graduate students and determined their strengths and weaknesses. They also found that the students' skills about IL and other related terms were limited, and the curriculum did not discuss elaborately about these terms. They gave suggestions to incorporate the IL program in the course curriculum and also discussed the importance of IL among the students and made them aware. Shoeb & Chowdhury (2016) worked on exploring the IL of IUB, a private University of Bangladesh, students. Research on IL proficiency and competence of LIS students of National University, Bangladesh by Aktar & Islam (2020) showed that students lacked adequate competencies in solving information-related queries despite having basic awareness of IL. Though Ferdows & Ahmed (2015) investigated information skills among undergraduate students at DU, Information skills are presented as a singular component that contributes to overall competency, alongside other essential elements like Knowledge and attitude (Anunobi & Udem, 2014). So, there is not enough research about this topic.

From the above discussion, it is very clear that no such work has yet been done on measuring IL competency of undergraduate students at DU. Islam & Rahman (2014) conducted a study on assessing IL competency of arts faculty students at the University of Dhaka, but not the whole university. As a result, it becomes necessary to measure the competency of undergraduate students and know their perceptions toward building an IL program. These factors highlight the rationale for carrying out this study.

3. Research Objectives

The main aim of this study is to measure the IL competency of undergraduate students of DU, Bangladesh, and to know the perception about the urgent need for an IL program.

The following are the research objectives (ROs):

RO1: Determine the understanding of IL among undergraduates of DU.

RO2: Know the perceptions of undergraduates for building an IL program at higher education.

RO3: Recognize how relevant information is obtained by the undergraduates.

RO4: Identify the challenges faced by undergraduate students at the time of dealing with information.

4. Research Questions

The main research question of this study is how relevant information is obtained by the

undergraduates of Dhaka University and their perceptions toward building an IL program. Based on the other research objectives, the following research questions (RQs) are formulated:

RQ1: What is the level of understanding of IL among undergraduates of DU?

RQ2: What are the perceptions of undergraduates regarding the need for an IL program in higher education?

RQ3. How do undergraduate students at DU obtain relevant academic information?

RQ4. What challenges do undergraduate students face while dealing with academic information?

5. Literature Review

This literature review seeks to present a comprehensive overview of existing research on IL competency within higher education, with particular emphasis on undergraduate students. Relevant studies were identified through manual searching and systematic review methods, following established guidelines for academic reviews. Search queries were formulated in line with the research objectives, focusing on keywords: “information literacy competency and Dhaka University”, “Information literacy” and “Dhaka University”, “information literacy competency” and “undergraduates”, “measuring information literacy competency in higher educational institutions”, “measuring information literacy competency among postgraduates”, and “Bangladesh”. Databases such as ScienceDirect and Google Scholar were used to retrieve literature. Only peer-reviewed journal articles and conference papers published in English between 2014 and 2025 were included to ensure the review’s quality and relevance. Only one paper from 2010 was included for its highest relevance to the topic. After screening related literature, 19 full-text studies are included in this chapter. The detailed findings of these studies are given in Table 1.

5.1 Concept of IL

The phrase “IL” was first introduced in a 1974 report by Paul G. Zurkowski for the National Commission on Libraries and Information Science, where he described it as the techniques and skills needed by individuals to effectively use a broad range of information tools and primary sources for solving their problems. Traditionally, IL has been understood from a library and information science perspective. But in today’s information explosion era, IL has exceeded the traditional definition. Now, IL is more about integrated abilities that help to understand the originality of information, evaluate information properly, retrieve information pinpointedly that leads to build a literate society. “Information literacy is the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning” (Association of College and Research Libraries, 2016, p. 3). So, IL is not a single competency but a combination of competencies that helps a person to identify when, where, and which information is needed and how to acquire that information cautiously. These competencies consequently help them to apply information to create new knowledge for an innovative society.

5.2 IL Model

Many scholars have proposed different information literacy models to explain the competencies of an information literate person. Among them information SCONUL's IL model is the most popular and used model. In 1999, the SCONUL Working Group on IL introduced the Seven Pillars of Information Skills model in its publication *Information Skills in Higher Education: A SCONUL Position Paper* (SCONUL, 1999). Since then, it has been widely used by librarians and educators globally to support the teaching of information skills. By 2011, the evolving information environment made it necessary to update the model. Although the core principles remained applicable, the revision expanded its scope to include a wider range of concepts and terminology linked to "Information Literacy." The updated version was presented as a generic core model for higher education, designed to be adaptable through various "lenses" to meet the needs of different learner groups and age levels. Only a literate person can be a lifelong learner, and a lifelong learner can contribute to society throughout their whole life. Individuals with IL skills enhance both their academic success and overall quality of life. Such skills assist in making informed choices in daily activities-whether buying a house, selecting a school, investing, or participating in elections. They are also essential for achieving educational objectives. Indeed, IL is a cornerstone of a democratic society.

5.3 IL Competency

IL competency refers to the capacity to identify, evaluate, and effectively apply information across diverse contexts. In today's digital environment, it represents a vital skill for academic achievement, professional advancement, and active citizenship. More than technical proficiency, it requires critical thinking, ethical use of knowledge, and the creative application of information for problem-solving and decision-making. Despite its acknowledged importance, approaches to integrating and teaching ILC within educational programs vary (Kumar & Bhatt, 2023). The terms 'Information Literacy Competency' and 'Information Literacy Skills' are often used interchangeably. But these two terms are different. This holistic combination enables an individual to recognize the need for information and then to effectively and ethically find, evaluate, manage, apply, synthesize, and communicate it. In contrast, skill is presented as a singular component that contributes to overall competency, alongside other essential elements like Knowledge and attitude (Anunobi & Udem, 2014). In this study, the term "Information Literacy Competency" was used. Research is one of the core functions of a university, alongside teaching and community service. Because it helps in knowledge creation and quality education. For doing these research activities, students need IL competencies. Postgraduate students who have strong information literacy skills are more likely to be better at doing research (Olatope Oyedokun et al., 2019). Literacy competency is needed in every sphere of our lives. It helps to transform every student into active citizen. For building a better world there is no alternative to active citizens. An active citizen is a person who takes responsibility in their community and society by participating in activities that promote social, cultural, political, or environmental improvement. "Literacy unlocks the door to learning throughout life, is essential to development and

health, and opens the way for democratic participation and active citizenship” (Kofi Annan, former United Nations Secretary General). So, the importance of IL competency among postgraduates is beyond question.

5.4 Perceptions of undergraduates toward building the IL Program

Several studies were conducted to determine the perceptions of undergraduates toward building IL programs. Research on undergraduate students’ perceptions consistently highlights a recognition of the need for structured IL programs. Studies at DU (Islam & Rahman, 2014; Islam & Tsuji, 2010) reveal that while students can identify their information needs, they lack adequate skills in evaluating sources, advanced searching, and referencing. These gaps create strong demand among undergraduates for formal IL integration into the curriculum. Similar findings are echoed in other contexts, such as Slovenia and Nigeria, where students performed poorly in critical evaluation. Both the study recommended that information literacy skills should be enhanced through special training, internship, introduction of IL program into educational system, and practical skill acquisition (Petermanec & Šebjan, 2017; Anunobi & Udem, 2015). The evidence suggests that undergraduates perceive IL instruction not as an optional skill but as a necessary academic support mechanism, with many recommendations between faculty and librarians to build sustainable IL programs (Shoeb & Chowdhury, 2016). strong recognition among LIS students at the National University of the need for formal Information Literacy Education (ILE) to improve academic and professional competencies (Aktar & Islam, 2020). Another study showed that information literacy and competency levels are low among public university students. There was a demand to include IL program, training, and education courses among the students (Helen, 2018). Embedding information literacy within the academic curriculum can greatly strengthen students’ competencies, which is essential for both their academic achievement and practical success (Akter & Ahmed, 2024). Ranaweera (n.d. stated that Information literacy is now a vital skill for individuals and society, and libraries must help people develop it. By implementing these programs, library staff can transform users into lifelong learners and critical thinkers. The success of these initiatives depends on cooperation between the library, teaching, and administrative staff. When this happens, librarians can assume a more significant role in serving their clients. Kumar & Bhatt (n.d. recommend embedding IL into education and carrying out extended studies that strengthen students’ research and critical thinking skills. Ali et al. (2022); Sparks et al. (2016); Olatope Oyedokun et al. (2019) found that students demonstrate weak evaluation abilities despite basic searching skills, and postgraduates lack research methodology knowledge. To address these gaps, studies recommend authentic, task-based assessments, stronger IL programs with librarian–faculty support, incentives and training, better library resources, and integration of IL instruction into curricula.

Research on IL competency of undergraduates in higher education

Table 1 displays the results of previous studies related to the topics that are included in this paper.

Table 1: The detailed findings from the previous study

No	Title	Authors and Years	Sample	Method	Findings
1	Assessing Information Literacy Competency of Information Science and Library Management graduate students of Dhaka University	(Islam & Tsuji, 2010)	50 graduate students from ISLM	Quantitative approach	Students had Limited IL skills; they can identify information needs but are weak in evaluating sources, using advanced search strategies, and citing properly. There was a clear lack of formal IL training, and students suggest curriculum integration of IL instruction.
2	Assessing Information Literacy Competency of Arts Faculty Students at the University of Dhaka.	(Islam Rahman, 2014)	250 questionnaires were distributed, of which 207 were received and analyzed.	Quantitative method	Limited IL Skills, curricular deficiencies, and strong demand for IL integration.
3	An empirical investigation of information skills among undergraduate students at Dhaka University.	(Ferdows & Ahmed, 2015)	199 undergraduate students responded to it. Males were 111 and females were 88.	Quantitative method	The study identified that undergraduates' IL skills were poor and barriers to IL.
4	Measuring information literacy competency of some selected public university students: A study Master of philosophy.	(Helen, 2018)	447 MPhil students were used the sample size.	The study used quantitative measures.	The study showed that IL and competency level is low. Demand to include IL program, training and education courses.

5	Information Literacy Proficiency and Competence of LIS Students of National University, Bangladesh	(Aktar Islam, 2020)	& 100 students attended the study.	The study used quantitative measures	Students lacked adequate competencies in solving information-related queries despite having basic awareness of IL. Strong recognition among students of the need for formal IL education to improve academic and professional competencies.
6	University students' information literacy skills and the impact of training in Bangladesh	(Akter Ahmed, 2024)	& The sample collection was 257.	Quantitative method was used.	Pre-training performance was low, and after training, performance improved from 28.4% to 57.1%.
7	Investigating the impact of demographic and academic variables on assessing students' perceived information literacy self-efficacy.	(Atikuzzaman & Ahmed, 2023)	408 students participated in the study. Among them, 287 were undergraduate students and 121 were postgraduate students.	Quantitative method.	Moderate self-efficacy levels and significant differences in IL self-efficacy were observed across age and computer proficiency levels.
8	Information Literacy Competencies of Library and Information Science Postgraduate Students in South East Nigeria Universities: A Focus on the Knowledge and Skill Level	(Anunobi Udem, 2015)	& 72 postgraduate students, including PhD and master's level.	Quantitative survey.	LIS postgraduate students demonstrated strong theoretical knowledge, and differences were found between Nnamdi Azikiwe University (NAU) and University of Nigeria, Nsukka (UNN) on both knowledge and skill measures.
9	Measuring Information Literacy Skills of MBBS Students.	(Ali et al., 2022)	Sample size was 337.	Quantitative method.	Basic competency in seeking information and weak critical evaluation skills. Universities need to establish IL programs and assessments that accurately measure student skills.

- These programs should utilize task-based assignments and be supported by both librarians and faculty. To motivate students, incentives like rewards and orientation sessions should be provided. For success, universities must hire qualified librarians and ensure all staff, including teachers, are regularly trained. Finally, libraries should promote their resources and have sufficient staff to provide technical assistance to students.
- 10 Exploring Information Literacy: Pedagogical Possibility for IUB Students for Effective Learning. (Shoeb Chowdhury, 2016) Undefined participant scope. Entirely qualitative observation of student interactions during faculty workshops run by the study suggests that the integration of IL curriculum is needed through faculty librarian collaboration or IL programs.
 - 11 Evaluation components of information literacy in undergraduate students in Slovenia: An experimental study (Petermanec & Šebjan, 2017) The total sample size was 197 second-year undergraduate economics students and 153 students completed both initial and final assessments. The study used Quantitative measures. The study found that an IL program significantly improved Slovenian undergraduate students' skills, particularly in information searching, knowledge, and use. However, evaluation of sources remained the weakest area. Overall, IL competency showed measurable positive growth.
 - 12 Advancing Information Literacy Skills of Postgraduate Students in University of Nigeria (Okpala et al., 2017) 270 postgraduate students participated in the study. Quantitative method Most postgraduate students had basic IL skills (98%) but lacked knowledge in emerging areas—use of social media for research (31%), Zotero/Mendeley (9.2%), and online referencing tools (0%).

				Many needed training in research writing (84.4%) and online communities (29.5%).	
13	Assessing Digital Information Literacy in Higher Education: A Review of Existing Frameworks and Assessments With Recommendations for Next-Generation Assessment	(Sparks et al., 2016)	224 first-year undergraduate students.	Quantitative method	The study found that existing digital information literacy assessments in higher education often lack coverage of higher-order skills and real-world contexts, relying too much on outdated or basic tasks. It recommends developing authentic, scenario-based, and adaptable assessments with strong validity evidence to better reflect complex digital information skills.
14	Importance of Information Literacy skills for an Information Literate society	(Ranaweera, n.d.)	16 references	Literature review	Developed IL skills in library users and the wider community is now essential for navigating the modern world. To achieve this, libraries must implement IL programs with the goal of turning users into lifelong learners and critical thinkers. These programs will be most effective when library staff collaborate with teaching and administrative staff. Furthermore, by running these programs, librarians will be able to take on a more significant role in serving the patrons.
15	Assessing information literacy skills among young information age students in Singapore	(Foo et al., 2017)	2399 young age students	Quantitative method	Grade 5 students in Singapore scored 53.39, below the 60–70 benchmark, with the weakest skills in using information and seeking sources. Girls and those with home internet scored

				higher. Findings show a need to improve IL education, curriculum, and training.
16	Information Literacy Competencies: A Conceptual Analysis	(Anunobi & Udem, 2014)	27 references	Conceptual literature review of existing frameworks and models. The paper found that the terms IL competency and information skills do not refer to the same concept.
17	A Systematic Review of Information Literacy Competency	(Kumar & Bhatt, 2023)	22 references	Systematic literature review and synthesis of research spanning “more than ten years. The review found that integrating IL into curricula improves critical thinking and research skills, but faces challenges like limited resources, uneven digital literacy, and the digital divide. It recommends embedding IL in education and conducting long-term studies.
18	Information Literacy (IL) Initiatives in Bangladesh: a case study	(Dhaka, 2014)	3 academic libraries and different organizations	Qualitative case study The study highlights the necessity of IL in Bangladesh to effectively manage the continuously increasing flow of information and to aid the country’s progress.
19	Information Literacy Determinant Research Competency among Postgraduates	(Olatope as Oyedokun et al., 2019)	331 postgraduate students	Quantitative method The study found that while postgraduate students had high levels of IL and research competency, they lacked skills in research methodology and the ability to effectively discuss their findings. The research concluded that IL positively influences research competency and recommended implementing policies to promote research and methodology courses, provide better library resources, and integrate library instruction into postgraduate studies.

Gaps in existing literature

The findings and gaps of the previous studies on information literacy competency among undergraduates and their perceptions toward building an IL program.

Table 2: Gaps in existing literature

Title	Author and year	Findings	Gaps
Assessing information literacy competency of Information Science and Library Management graduate students of Dhaka University.	(Islam & Tsuji, 2010)	Students had limited IL skills, they can identify information needs but are weak in evaluating sources, using advanced search strategies, and citing properly. There was a clear lack of formal IL training, and students suggested curriculum integration of IL instruction.	Limited qualitative insights, focus on ISLM students only.
Assessing Information Literacy Competency of Arts Faculty Students at the University of Dhaka.	(Islam & Rahman, 2014)	Limited IL skills, curricular deficiencies, and strong demand for IL integration.	Lack of qualitative insights, limited scope of assessment tools, and sample size were also poor.
An empirical investigation of information skills among undergraduate students at Dhaka University.	(Ferdows & Ahmed, 2015)	The study identified that undergraduates' IL skills were poor and barriers to IL.	Lack of qualitative insights and sample size was poor. The sample was not fully representative of all faculties or departments, which limits the generalizability of the findings. Focused on general ICT skills, not on structured information literacy competencies (like evaluating sources, citation skills, and ethical use).
Measuring Information Literacy Competency of Some Selected Public	(Helen, 2018)	The study showed that IL and competency levels	Limited sample size and scope, lack of qualitative

university students: A study Master of philosophy.		are low. Demand to include the IL program, training and education courses.	insight, and no comparative or benchmarking framework.
Investigating the impact of demographic and academic variables on assessing students' perceived information literacy self-efficacy.	(Atikuzzaman & Ahmed, 2023)	Moderate self-efficacy levels and significant differences in IL self-efficacy were observed across age and computer proficiency levels. Students lacked adequate competencies in solving information-related queries despite having basic awareness of IL. Strong recognition among students of the need for formal Information Literacy Education (ILE) to improve academic and professional competencies.	The study was conducted with students from a single university, which limits the generalizability and Overreliance on Self-Reported Data. Lack of in-depth studies at National University (NU) and lack of IL integration in the LIS curriculum.
Information Literacy Proficiency and Competence of LIS Students of National University, Bangladesh	(Aktar & Islam, 2020)	Students lacked adequate competencies in solving information-related queries despite having basic awareness of IL. Strong recognition among students of the need for formal Information Literacy Education (ILE) to improve academic and professional competencies.	Lack of in-depth studies at National University (NU) and lack of IL integration in the LIS curriculum.
University students' information literacy skills and impact of training in Bangladesh	(Akter & Ahmed, 2024)	Pre-training performance was low, and after training, performance improved from 28.4% to 57.1%.	Small sample size in experimental phase, single institution focus, short-term measurement.
Exploring Information Literacy: A Pedagogical Possibility for IUB Students for Effective Learning.	(Shoeb & Chowdhury, 2016)	The study suggests that the integration of IL curriculum is needed through faculty librarian collaboration or IL programs.	It was not a survey-based study, so the sample size was unclear. It was based on one institution that lacks generalizability.

From the comprehensive study, it is clear that no study has been made on measuring the information literacy competency of undergraduate students of DU. Though Ferdows and Ahmed (2015) conducted a study titled “An empirical investigation of information skills

among undergraduate students at Dhaka University”, the focus was on information skills, which is a singular component that contributes to the overall competency, alongside other essential elements like knowledge and attitude. The terms are used interchangeably, but they are different (Anunobi et al). In this study, they focused on general ICT skills, not on structured information literacy competencies (like evaluating sources, citation skills, and ethical use). No study was made directly to measure information literacy competency among undergraduate students at DU. All the previous studies make it necessary to research measuring information literacy competency among undergraduate students at DU. This gap is filled by the main objectives and RO1. According to these studies, there was a strong IL program demand by ISLM graduates and arts faculty students. However, there is no study about the perceptions of IL program integration among the DU students. This gap was filled by RO2. Islam & Rahman (2014) conducted a study on assessing information literacy competency of arts faculty students at the University of Dhaka, and Islam & Tsuji (2010) conducted a study on assessing information literacy competency of Information Science and Library Management graduate students of DU. Therefore, no effort has been made to know how relevant information is obtained by the undergraduates of DU, and this gap was met by RO3. Similarly, few studies have been made to identify the challenges faced by undergraduate students at the time of dealing with information. This gap was addressed in RO4, which is about the challenges faced by undergraduate students at the time of dealing with information and perceptions of undergraduates for building an IL program at higher education. Quantitative methods were applied to collect and analyze data from the students of DU. Since this study is unique, there is no study on measuring information literacy competency of DU undergraduate students.

6. Methodology

The undergraduates of DU were the participants of this study. It was a questionnaire-based survey. The questionnaire was divided into 5 sections. The first section was for gathering demographic information from undergraduates of DU. The second section consisted of an IL task to determine the concept of IL among the undergraduates. The third section was developed with a series of IL tasks to know the attitude of undergraduates towards accessing and retrieving information. Whereas section four was about the questions related to challenges faced by the undergraduates of DU. The last section, section five, was about the perceptions of undergraduates toward building IL programs. These task questions were developed with simple words, keeping in mind the general students, and kept as short as possible to retain the attention level of the responders and to ensure the accuracy of the responses.

6.1 Population, Sample Size, and Sampling Procedure

To determine the minimum required sample size, Slovin’s formula was applied.

$$n = N / (1 + N e^2)$$

Here n represents the sample size, N is the total population, and e is the confidence level. For calculating the sample size for this study, where: N, population=30,000; n, confidence level = 95%=0.05;

$$\text{Sample size } n = 30000 / \{1 + 30000 * (.05)^2\} = 394.74 = 395$$

Therefore, the sample size of 395 fits the study. The questionnaire was sent to 450 undergraduate students. Among these, 280 were used for analysis of this study, which represents a standard number for social science research. Quantitative approach was applied to this study, for which a questionnaire was developed with closed-ended questions. Students from different departments filled in the form. The method used for sampling is “Convenient Sampling,” which means data were collected from students who were easily accessible. Most responses were gathered from researcher’s district-based groups, university dormitories and the common room. This approach helped the researcher obtain the required 280 responses quickly and efficiently. So, no purposive method of sampling was used in this sampling procedure. A five-point Likert scale was applied to gather participants’ responses, offering options from “strongly disagree” to “strongly agree.” This scale helped capture subtle variations in opinions, making it a suitable tool for examining the research questions. To improve both content and face validity, the questionnaire underwent careful review and refinement.

7. Analysis and Interpretation

Google Forms (<https://forms.gle/at1iDZ839QmYzMfbA>) are sent to the undergraduates through Messenger (mostly), WhatsApp, and Telegram. The duration of data collection is (08/08/2025 - 07/09/25), nearly 1 month. The study’s data were processed using frequencies and percentages, results were presented in tables. Descriptive statistics were applied to present a summary of the findings. Data is analyzed through the R programming language (RStudio).

7.1 Demographic Information

A total of 280 undergraduate students participated in the study. The sample consisted of 175 males (62.5%) and 105 females (37.5%), indicating a higher proportion of male respondents. Most participants were aged 23–25 years (58.9%), followed by 20–22 years (33.6%), while only a few were below 20 (3.9%) or above 25 (3.6%). In terms of academic year, the majority were in their 4th year (59.6%), with smaller shares from 3rd year (16.8%), 2nd year (12.9%), and 1st year (10.7%). This suggests the findings largely represent senior students, who are likely to have greater exposure to academic resources and information literacy practices.

Table 3: Demographic Characteristics of Respondents (N = 280)

Variable	Category	N	Percent (%)
Gender	Female	105	37.5
	Male	175	62.5
Age	20–22	94	33.6
	23–25	165	58.9
	Above 25	10	3.6
	Below 20	11	3.9
	1st Year	30	10.7
Year of Study	2nd Year	36	12.9
	3rd Year	47	16.8
	4th Year	167	59.6
	Total	280	100

7.2 Concept of IL

Most respondents (64.3%) recognize that IL encompasses multiple aspects, suggesting good conceptual understanding. Fewer respondents associated IL specifically with bibliographic instruction (10.7%), information retrieval skills (14.6%), or user education (10.4%), indicating that many students perceive IL as a broad, integrated skill rather than isolated components. Awareness of Aigiarism is moderate, with 46.8% correctly identifying it as copying AI-generated content without acknowledgment, while 38.2% are unsure, highlighting gaps in AI ethics knowledge. When identifying fake posts, 30.7% recognize the example as disinformation, and 7.5% do not know rest of the students give wrong answers, indicating low awareness of digital media literacy concepts. Regarding information-literate individuals, 53.9% of respondents identify the correct option. This shows that students do not have the proper knowledge about information literate people.

Table 4: Understanding of Information Literacy and AI-related Concepts (N = 280)

Question	Response	N	Percent(%)
Information Literacy is related to	All of the above	180	64.3
	Bibliographic instruction (guidance on how to find and cite sources)	30	10.7
	Retrieving information skillfully	41	14.6
	User education	29	10.4
	Copying AI-generated content without proper acknowledgment, I don't know	131	46.8
		107	38.2
“Aigiarism” refers to			
	Programming errors in AI systems	6	2.1
	Using AI tools for research	36	12.9

Which of the following is an example of Aigiarism?	Asking AI for topic ideas and then writing the assignment yourself	34	12.1
	Copying text from an AI tool and submitting it as your own without citation	127	45.4
	I don't know	105	37.5
	Using AI to check grammar before submitting an assignment	14	5.0
A fake post claims the DUCSU election in September is cancelled without official notice.	Disinformation	86	30.7
	I don't know	21	7.5
	Malinformation	42	15.0
	Misinformation	131	46.8
What is your opinion about an information-literate person?	All of the above	151	53.9
	Always evolves with new information. Can find and retrieve information efficiently	27	9.6
	84	30.0	
	Knows all about Information Retrieval Techniques	18	6.4
Total		280	100

7.3 Accessing and Retrieving Information

Respondents mainly use AI tools (80%) and Google (78.6%) for academic purposes. YouTube/video platforms are moderately used (59.3%), while traditional academic sources like JSTOR, online databases, and university library catalogs have lower usage (25–33.9%). Social media is the least used (26.4%). Overall, digital and AI-assisted sources dominate academic information retrieval among respondents.

Table 5: Sources Usually Used for Academic Purposes (N = 280)

Source	Responses	Percent	Percent of Cases (%)
AI tools	224	21.6	80
Google	220	21.2	78.6
JSTOR	95	9.1	33.9
Online Academic Databases (e.g Springer)	95	9.1	33.9
Social Media	74	7.1	26.4
University Library Catalog	70	6.7	25
YouTube/Video platforms	166	16	59.3
Total	1039	100	371

The findings show that most respondents (60.4%) correctly identify “Social media AND mental health” as the most effective search strategy, although 21.4% admit they do not know. When asking about specificity in climate change topics, nearly half (46.8%) select “Global warming and weather”, while only 27.1% choose the most precise option, “Effects of climate change on rice farming in coastal Bangladesh”. Regarding Boolean search skills, 35% correctly apply the NOT operator for excluding laptops from a search,

indicating a moderate understanding of search syntax. In terms of the work of the index, 67.5% of students give the right answer, and 56.4% do not know how to find related literature in a book.

Table 6: Survey Results on Search Strategies, Index Use, and AI-generated Content

Question	Response	N	%
To find articles on both social media and mental health, which search will work best?	I don't know	60	21.4
	Social media AND mental health	169	60.4
	Social media NOT mental health	15	5.4
	Social media OR mental health	36	12.9
Which is the most specific topic on climate change?	Climate change	50	17.9
	Effects of climate change on rice farming in coastal Bangladesh	76	27.1
	Global warming and weather	131	46.8
	Impact of climate change on agriculture	23	8.2
Need information on mobile phones but not laptops — which search strategy would you use?	“mobile phone information”	86	30.7
	“mobile phone” NOT “laptop” Latest mobile phone features	98	35.0
	2025 mobile AND features	68	24.3
		28	10.0
What does an index in a book help you do?	Check the publication date	12	4.3
	Find the summary of the entire book	57	20.4
	Locate specific topics or keywords quickly	189	67.5
	Understand the author's background	22	7.9
Which term helps find related literature in a book?	Abstract	62	22.1
	Footnotes	15	5.4
	Index	81	28.9
	References	122	43.6
Total		280	100

The results indicate that participants most frequently associated AI-generated social media content with overly formal or robotic language (27.9%, 59.3% of cases), followed by the absence of personal stories or emotions (22.7%, 48.2% of cases) and the presence of explicit AI labels (22.7%, 48.2%). Repetition of ideas or phrases is also commonly recognized (20.0%, 42.5%). By contrast, only a small proportion (6.7%, 14.3% of cases) consider spelling, and grammar mistakes a strong indicator. This suggests that respondents are more attuned to stylistic and structural cues than to surface-level language errors when identifying AI-generated text. When evaluating information credibility, respondents most frequently rely on whether the source was peer-reviewed or from a trusted publisher (25.6%, 58.2% of cases), closely followed by the author's qualifications (24.2%, 55.0% of cases). Other common indicators include the date of publication (19.2%, 43.6%) and the number of views or likes on posts or videos (18.2%, 41.4%). Fewer participants considered the domain extension (edu. or .gov) a key factor (12.7%, 28.9%). These results suggest that respondents place stronger emphasis on

source authority and publication quality than on technical domain signals or popularity metrics.

Table 7: Perceived Signs of AI-generated Content and Indicators of Information Credibility

Option	Responses (N)	Percent (%)	Percent of Cases (%)
Perceived Signs of AI-generated Content			
Contains lots of spelling and grammar mistakes	40	6.7	14.3
Lack of personal stories or emotions	135	22.7	48.2
The content repeats the same ideas or phrases	119	20.0	42.5
The language sounds overly formal or robotic	166	27.9	59.3
The post includes an explicit label like “Generated by AI”	135	22.7	48.2
Total	595	100.0	212.5
Indicators Used to Judge Information Credibility			
Author’s qualifications	154	24.2	55.0
Date of publication	122	19.2	43.6
Number of views or likes (on videos/posts)	116	18.2	41.4
Whether it is peer-reviewed or from a trusted publisher	163	25.6	58.2
Whether the site ends in edu. or .gov	81	12.7	28.9
Total	636	100.0	227.1

Information Literacy Skills: Students showed moderate confidence, strongest in locating reliable sources ($M = 3.52$), awareness of plagiarism/AIgiarism risks ($M = 3.48$), and keyword use ($M = 3.48$). Confidence in Boolean operators was lowest ($M = 3.14$), indicating limited advanced search skills.

Table 8: Assessment of Information Literacy Skills

Statement	Mean	SD	Agree/Strongly Agree (%)
Information Literacy Skills			
I am aware of the risks of plagiarism and AIgiarism and how to avoid them	3.48	1.107	56.4
I am confident in locating reliable academic sources for study and research	3.52	1.012	59.3
I am familiar with using Boolean operators (AND, OR, NOT) to refine search results	3.14	1.176	42.1

I can identify whether a source is credible and trustworthy	3.38	1.009	51.8
I know how to properly cite and reference information in my assignments	3.39	1.085	50.0
I know how to use effective keywords when searching for information	3.48	1.126	55.4
I understand how to evaluate information for accuracy, relevance, and bias	3.45	1.032	51.8
I understand the differences between misinformation, disinformation, and malinformation	3.42	1.136	55.0

7.4 Challenges Faced

Key challenges included accessing authentic resources (M = 3.43), information overload (M = 3.42), and getting accurate information (M = 3.36). These suggest a need for support in critical evaluation and managing online information effectively.

Table 9: Assessment of Perceived Challenges of Undergraduates

Statement	Mean	SD	Agree/Strongly (%)	Agree
Perceived Challenges				
I find it difficult to evaluate the credibility of online sources	3.20	1.059	45.7	
I find it difficult to get access to authentic resources	3.43	1.152	56.8	
I often feel overwhelmed by the amount of information available online	3.42	1.074	53.2	
I often find it difficult to get accurate information on my topic	3.36	1.136	53.9	

7.5 Perceive the need for IL

Most undergraduates (82.5%) strongly support the inclusion of information literacy in the curriculum, reflecting widespread recognition of its importance in academic development. A smaller proportion (14.3%) were uncertain, while only 3.2% opposed its inclusion. These results show that integrating information literacy as a formal component of undergraduate education would likely be well received and address a clear student need.

Table 10: Students’ Opinions on Including Information Literacy in the Undergraduate Curriculum

Response	N	Percent (%)
Yes	231	82.5
Not sure	40	14.3
No	9	3.2
Total	280	100

The findings reveal that students suggest multiple approaches for strengthening information literacy (IL). The most common recommendations include providing IL guidelines for students (41.8%), offering user education or training (39.6%), and starting IL programs immediately (37.5%). A notable share (36.8%) also favored adopting all strategies simultaneously. Additionally, recruiting skilled library personnel (30.7%) and adding IL directly to the syllabus (24.3%) were also recognized as important steps. Very few respondents (2.9%) suggested other recommendations. Overall, the results highlight a strong student demand for structured support systems, practical training, and institutional commitment to make IL an integral part of undergraduate education.

Table 11: Recommendations for Enhancing Information Literacy (IL) Among Undergraduates

Recommendation	Responses (N)	Percent (%)	Percent of Cases (%)
Add IL to the syllabus	68	11.4	24.3
Offer user education or training	111	18.6	39.6
Provide IL guidelines for students	117	19.6	41.8
Recruit skilled library personnel	86	14.4	30.7
Start IL programs immediately	105	17.5	37.5
All of the above	103	17.2	36.8
Others	8	1.3	2.9
Total	598	100	213.6

8. Findings and Discussions

Based on the research questions, the findings are given below-

RQ1 survey revealed that most respondents (64.3%) recognized that information literacy (IL) encompasses multiple aspects, suggesting a good conceptual understanding, though some key gaps exist, especially regarding AI-related ethics and advanced skills. Awareness about the term "AIgiarism" is moderate (46.8%) among the students of undergraduates. However, a significant portion (54.6%) were unsure of the definition. This suggests that a good portion of students lack AIgiarism literacy while the maximum students use AI tools for their academic purposes (80%). Most students don't have the proper knowledge about misinformation, disinformation, and malinformation(61.8%), while 7.5% don't have an idea about this term. Almost half of the students out of 280(46%) do not have proper knowledge about an information-literate person. These findings suggest that the level of understanding of IL among students is inadequate for being an information-literate person. This aligns with the statement of Ferdows & Ahmed (2015), indicating that undergraduates' information skills were poor. RQ2 measured that a substantial majority of students (82.5%) are in favor of including an information literacy program in the undergraduate curriculum. This result is in line with Helen (2018), who declared that for improving the information literacy situation, almost all participants (89.00%) want to start information literacy activities such as departmental IL program, user education training program, trained and skilled library personnel in seminar libraries, information literacy guidelines for the student, etc., in their

departments. Islam & Rahman (2014) also urge the same thing in their study. Only a small minority (3.2%) opposed the idea. RQ3 survey examined that most of the students rely heavily on AI tools (80%) and Google (78.6%) for their academic purposes. This shows limited skill in assessing credibility, relevance, and authority of information. Regarding Boolean search skills, 39.7% were unable to apply the AND operator, and 65% to apply the NOT operator, indicating a significant lack of fundamental search strategies and the ability to effectively and precisely retrieve information. Students cannot select a specific term on a topic (72.9%), revealing low competency in defining information needs. More than half of the students (56.4%) are stuck in a single source and cannot find other information to support their ideas, and a significant portion (32.5%) do not know how to efficiently find specific information in a book. In terms of using academic sources, fewer participants considered the domain extension (edu. or gov.) a key factor (12.7%, 28.9%). Results suggest that respondents place stronger emphasis on source authority and publication quality than on technical domain signals or popularity metrics (12.7%, 28.9%). These results show their limited ability to assess the credibility and relevance of the information they find, directly addressing where and how they get information. This result supports the findings of Ferdows & Ahmed (2015). They found that students were unaware of various information sources and the kinds of information obtainable from them and lacked the information skills required to retrieve information from these sources. RQ4 observed that undergraduates struggle with accessing authentic resources for academic work (M=3.43), managing the vast amount of online information(M=3.42), assessing its quality, and getting accurate information(M=3.36). Students face notable challenges related to accessing and evaluating information. This result is validated by Islam and Tsuji (2010). They stated that the knowledge needed for increasing information literacy capability, such as how to access information, when information is needed, and how to use advanced-level search formulations.

9. Conclusion

The study reveals different insights. Regarding the concept of IL undergraduate students at DU demonstrating some conceptual awareness of information literacy, their overall competency remains inadequate for achieving the characteristics of an information literate person. Most respondents have a foundational understanding of IL. However, this recognition does not translate into practical ability. Students showed considerable gaps in advanced IL skills, particularly in areas connected to the ethical use of artificial intelligence. This reflects a gap between the adoption of digital technologies and the ethical or responsible application of these tools. The findings clearly demonstrate that undergraduate students heavily depend on easily accessible platforms such as AI tools and Google for academic purposes, reflecting convenience-driven information-seeking behavior but limited evaluative ability. Their weak command of Boolean search strategies indicates a lack of fundamental retrieval skills. Similarly, the inability of students to define specific search terms reflects low competency in articulating and refining information needs. Reliance on a single source by more than half of the students and the inability of a good portion of students to locate specific information in books further highlight their restricted search practices. Students placed more emphasis on perceived

authority and publication quality, which shows some evaluative judgment but an incomplete and unsystematic approach. Overall, these findings suggest that students' ability to retrieve, diversify, and critically assess information remains underdeveloped. This underlines the urgent need for targeted training in search strategies, critical evaluation, and the use of academic sources to strengthen their overall information literacy competence.

Furthermore, the findings reveal that undergraduate students experience considerable challenges in accessing authentic academic resources, managing the overwhelming volume of online information, and evaluating its quality. These results suggest that students lack adequate strategies and skills to effectively filter, assess, and select reliable information for academic use. Consequently, their ability to produce well-informed academic work is compromised. Strengthening training in resource discovery, critical evaluation, and information management is therefore essential to meet these challenges. The findings also indicate that undergraduate students strongly recognize the importance of formal information literacy instruction. A substantial majority supported the inclusion of an information literacy program in the undergraduate curriculum, while only a small minority opposed it. This demonstrates a clear demand among students for structured guidance to develop essential skills in locating, evaluating, and using information effectively. The strong student support underscores the need for integrating an IL program into the curriculum to enhance academic competence and prepare students to navigate the complex information landscape responsibly. In conclusion, the overall findings suggest that undergraduate students at DU are not yet fully equipped with the competencies required to be considered information literate in today's complex digital and AI-driven environment. Their reliance on convenient tools without adequate critical evaluation skills underscores the urgency of introducing a formal IL program. Such a program should focus on enhancing students' ethical understanding, search and retrieval strategies, and evaluation of resources, thereby preparing them to engage responsibly and effectively with information in academic and real-world contexts.

10. Limitations of the Study and Further Research Scope

Although this study provides valuable insights, there are some limitations. The survey was confined to a single university, and only quantitative data was taken into consideration. Lack of Qualitative insights and a broader scope can limit the generalizability of the study. Further research can be conducted to compare the information literacy competency of students from public and private universities. Besides quantitative methods, qualitative methods can be adopted for providing a deep understanding of the challenges students face and the needs they perceive. This would examine the differences between the public and private university students' IL competency and the reasons behind these differences. These directions help to provide a comprehensive understanding of how IL competency can be improved.

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Innovating Academic Library Service Using Smart Devices: Insights and Views of Information Professionals

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Abstract

To keep pace with the present world, libraries are required to introduce with a handy and user-friendly smart service system. This research aims at identifying the existing scenario of using smart devices in providing services at academic libraries in Bangladesh as well as exploring the possible services that can be provided with the help of smart devices (i. e. smart phone, laptop, notebook, notepad, tablets etc.). It also concentrates toward developing an innovative library service delivery model where users can have access to their library from anywhere, at any time through smart devices. The study is mainly based on analysis of the previous literature and questionnaire survey. A closed-ended questionnaire was distributed among the 100 information professionals of the selected libraries for survey and 79 of them were analyzed using SPSS and general statistics. The study indicates that library professionals find it very useful and easy to provide library services through smart devices and they wish to deliver all of their services in a more innovative way to enhance better library services. This study also identifies the barriers or challenges faced by the library professionals of providing smart services. It explores the benefits of using smart devices in academic library service delivery system and provides a number of recommendations to develop smart library services in future. The proposed “Library Service Innovation Model” will be unique in nature providing actionable insights for sustainable service augmentation and it will be helpful for the academic libraries and the information professionals to enhance/promote their library services.

Keywords

Academic Libraries, Smart Devices, Library Services, Service Innovation, Information Professionals.

1. Introduction

The motto of a library is to fulfill the information needs of its users. To this end in view, library services should be flexible and open to meet the needs of the users with new technologies. To keep pace with the present world, libraries are required to introduce with a handy and user-friendly smart service system. The smart service system is a new service system that meets users' needs with the digital and intelligent guidance and unlimited time and space of the smart libraries (Zhang, 2019). The task of libraries is to exploit new technology in a more effective way to promote and integrate them into the design of future library services in a cost-efficient manner (Malathy & Kantha, 2013).

The widespread evolution of smart devices such as smartphones, tablets, and laptops has revolutionized information access and fundamentally reshaped service delivery worldwide. Academic libraries, traditionally dependent on physical infrastructure, are increasingly adopting mobile technologies to provide their services anytime-

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anywhere. The use of internet and smartphone being increased remarkably in Bangladesh, library services can be provided in a cost-effective manner.

Academic libraries have already begun to integrate smart devices into a wide range of functions including OPAC/database searching, circulation services, current awareness service (CAS), selective dissemination of information (SDI), and e-learning support. Despite this potential, the adoption and effectiveness of smart-device-enabled library operations in universities remains limited. The survey data collected from 79 respondents across 20 public and private universities show diversity in device preferences, service delivery and infrastructure readiness. This study examines the current scenario of using smart devices in academic libraries, the types of services the professionals deliver to their users, the benefits and barriers of using smart devices and the measures that can strengthen the development of smart library services. The research will explore the possible services that can be provided with the help of smart devices (i. e smart phone, laptop, notebook, notepad, tablets, iPods and MP3 players, etc.). It will also concentrate toward developing a proposed service innovation model for library professionals.

2. Literature Review

Jantz (2012) defined Innovation as the introduction into the organization of a new product, a new service, a new technology, or a new administrative practice; or a significant improvement to an existing product, service, technology, or administrative practice. The services of modern libraries must transform its services from single one to multiple ones and from passive services to active services. Library services need to be transformed from offline model to online model and from manual services to smart self-service ways for users (Zhang, 2019). Just as library systems provide services to regular students; it is the task of the university libraries to equally make available equal services to distance learners (Cox, 2004). Libraries need to deliver services and resources to the virtual environment used by students, faculty and researchers or risk alienating their clienteles. In this information and technology age, libraries need to provide services that run on the media used by the library users, such as mobile phones, smart phones, tablets, laptops, and personal computers (PC) (Lowry et al., 2009). The rapid growth in use of mobile technology is based on factors such as simplicity of use technology, cost and portability. Students can access a wide range of digital resources and library services and truly engage in learning activities using any mobile devices wherever and whenever they choose, not just as their desktop PCs (Nalluri & Gaddam, 2016). The implementation of digital format to library resources is the current trend that libraries must take into consideration as users might want to access easily and remotely. With current widely used gadgets such as smart phones and tablets, more information could be accessed anywhere at any time (Mishra, 2020). In short, libraries have a long way to go to provide high-quality information and knowledge services with the Internet-based transformation. This requires deeper organizational reconstruction, management optimization and reform (Zhang, 2019).

3. Aims and Objectives

The aim of the study is to explore the current status of academic library service delivery system using smart devices and build a proposed service innovation model for academic libraries in Bangladesh.

The more specific objectives of the study are as follows:

- assess the current status of smart-device adoption in university libraries.
- identify preferred devices and existing services delivered by the library professionals.
- analyze the types of services provided through smart devices.
- evaluate perceived usefulness of providing smart library services.
- determine benefits, barriers, and recommended measures for improvement.

4. Research Methodology

A quantitative survey approach was employed for the study. A number of 100 structured questionnaire was distributed randomly to library professionals across 10 public and 10 private universities in Bangladesh. For this study, the universities were selected by using random sampling approach from Dhaka, Chattogram and Rajshahi Division. A total of 79 valid responses were received (46 public, 33 private). Respondents represented various designations, predominantly librarian, assistant librarians, deputy librarians, and library officers. Data were analyzed using descriptive statistics (frequencies, means, percentages) in Microsoft Excel and SPSS. Data were collected using a close ended questionnaire covering smart device use, service types, preferences and usefulness, benefits and challenges, recommendations etc.

5. Findings

This section presents a comprehensive analysis and interpretation of the data collected from 79 respondents across 20 public and private universities in Bangladesh. The purpose of this section is to examine the current status, usage pattern, perceived usefulness, barriers, and future prospects of delivering library services through smart devices in academic libraries. The analysis follows the sequential arrangement of tables and provides an in-depth interpretation of the findings.

5.1 Respondent Libraries:

For this study, a number of 100 questionnaire was distributed among the professionals of 10 public university library and 10 private university library (5 in each). The list of the participating libraries is as follows –

Table 1: List of the participating public and private universities

Public University	No. of Respondents
Dhaka University (DU)	5
Bangladesh University of Engineering and Technology (BUET)	5
Bangabandhu Sheikh Mujib Medical University (BMU, former BSMMU)	4
University of Rajshahi (RU)	3
Chittagong University (CU)	5
Noakhali Science and Technology University (NSTU)	5
Chittagong University of Engineering and Technology (CUET)	4
Comilla University (CoU)	6
Jagannath University (JnU)	5
Rajshahi University of Engineering and Technology (RUET)	4
Total Public Universities	46
Private University	
North South University (NSU)	5
Independent University, Bangladesh (IUB)	5
East West University (EWU)	0
University of Liberal Arts Bangladesh (ULAB)	5
International Islamic University Chittagong (IIUC)	4
Southeast University (SEU)	4
Ahsanullah University of Science and Technology (AUST)	3
Stamford University Bangladesh (SUB)	3
Bangladesh Army International University of Science and Technology (BAIUST)	0
Asian University for Women (AUW)	4
Total Private Universities	33

Table 1 presents the distribution of respondents across participating public and private universities. A total of 79 respondents participated, with 46 from public universities and 33 from private universities whereas EWU and BAIUST have no responses.

5.2 Designation of Respondents:

Professionals and staffs from different public and private universities responded regarding the servicesthey provide in their libraries through smart devices. Table 2 categorizes respondents by designation from Librarian to Library Attendant.

Table 2: Designation of respondents

Rank	Designation / Position	Frequency (No. of mentions)	Category
1	Assistant Librarian	15	Professional
2	Deputy Librarian	12	Professional (mid-senior)
3	Library Officer	6	Professional
4	Senior Assistant Librarian	5	Professional
5	Section Officer (Library)	5	Professional / Administrative
6	Librarian	4	Top-level professional
7	Assistant Library Officer	4	Professional
8	Book Sorter	3	Support staff
9	Senior Library Assistant	3	Professional
10	Junior Librarian	4	Professional
11	Documentation Officer	2	Professional
12	Circulation Officer	2	Professional
13	Assistant Director (Library)	2	Professional/administrative
14	Junior Assistant Librarian	2	Entry-level professional
15	Joint Librarian (Head of the Library)	1	Top-level
16	Deputy Chief Librarian	1	Senior management
17	Senior Cataloguer	1	Professional
18	Library Attendant	1	Support staff
19	Computer Operator	1	Technical support
20	Junior Assistant Library Officer	1	Para-professional
21	Manager (Library)	1	Top-level
22	Deputy Director	1	Senior management
23	Senior Deputy Director	1	Senior management
24	Cataloguer	1	Professional

The table above categorizes respondents: Assistant Librarians (15) and Deputy Librarians (12) form the largest groups, demonstrating that mid-level professionals contributed the most. Other significant categories include Library Officers, Senior Assistant Librarians, and Section Officers. Senior managerial positions (Librarian, Joint Librarian, Deputy Chief Librarian) are few in number.

This distribution indicates that the study captures insights primarily from those who are directly engaged in day-to-day library operations and smart service management—making the findings operationally reliable and relevant.

5.3 Status of the University libraries

Table 3 illustrates the status of smart device usage across universities. It casts a view on the way universities are weaving smart devices into their library service frameworks. It asserts the adoption of smart devices across public and private universities.

Table 3: Status of the University libraries both public and private regarding using smart devices for providing the services

Category	University	Yes	No	Remarks
Public	DU	5	0	Full adoption.
	BUET	5	0	Full adoption.
	BMU	4	0	Strong adoption.
	RU	3	1	Mostly yes.
	CU	4	1	Mostly yes.
	NSTU	5	0	Full adoption.
	CUET	4	0	Strong adoption.
	CoU	4	1	Moderate adoption.
	JnU	5	0	Full adoption.
	RUET	3	0	Strong adoption.
	NSU	5	0	Full adoption.
Private	IUB	5	0	Full adoption.
	EWU	0	0	No data provided.
	ULAB	5	0	Full adoption.
	IHUC	4	0	Strong adoption.
	SEU	4	0	Strong adoption.
	AUST	4	0	Moderate adoption.
	SUB	3	0	Moderate adoption.
	BAIUST	0	0	No data provided.

The analysis indicates high adoption in both sectors, especially at DU, BUET, NSTU, JnU, NSU, IUB, ULAB, SEU, and IIUC. Moderate adoption in CoU, AUST, and SUB. No data from EWU and BAIUST.

Public engineering universities and leading private universities demonstrate the strongest adoption trends. The findings show that smart-device-based services have become typical in academic libraries.

5.4 Preferences of smart devices to provide library services

In this study, the respondents were asked about which device they prefer most to provide library services. Table 4 shows the preferable devices used by professionals respectively.

Table 4: Preferences of smart devices to provide library services

Device	Public (n=10)			Private (n=10)			Total (n=20)
	Mean	SD	Median	Mean	SD	Median	Mean
Smartphone	3.70	1.16	4.0	2.50	1.58	3.0	3.10
Laptop	3.40	1.07	3.5	2.70	1.95	3.0	3.05
Notebook/Notepad	0.50	0.85	0.0	1.20	1.23	1.0	0.85
Tablet	0.50	1.08	0.0	1.20	1.48	1.0	0.85
iPod	0.00	0.00	0.0	0.70	1.16	0.0	0.35
MP3 Player	0.00	0.00	0.0	0.20	0.42	0.0	0.10

Here the smartphones and laptops are the only devices with mean 3.10 and 3.05 respectively. Also, it reveals that smartphones and laptops are the most preferred devices in both public and private universities. Tablets, notebooks, iPods, and MP3 players receive significantly lower preference scores. These results reflect practical considerations—smartphones and laptops dominate due to portability, affordability, and multi-functionality. It would be clearer with the help of the following Table 5.

Table 5: Aggregated preferences by device type

Device	Public (n=10)	Private (n=10)	Total (n=20)
Smartphone	37	25	62
Laptop	34	27	61
Notebook/Notepad	5	12	17
Tablet	5	12	17
iPod	0	7	7
MP3 Player	0	2	2

Table 5 further strengthens the finding that smartphones (62 total points) and laptops (61 points) dominate device preference. Other devices remain far behind.

5.6 Frequency of free internet facilities to users

Respondents were enquired of how frequently their libraries provide internet facilities to their users. Some libraries always provide free internet to their users while a few provide the facility rarely.

Table 6: Frequency of free internet facilities to users

University	Always	Most often	Frequently	Sometimes	Rarely	Total	Score (out of 4)
NSTU	5	0	0	0	0	5	4.00
CUET	5	0	0	0	0	5	4.00
IUB	5	0	0	0	0	5	4.00
ULAB	5	0	0	0	0	5	4.00
BMU	4	0	0	0	0	4	4.00
BUET	4	0	0	0	1	5	3.20
NSU	4	1	0	0	0	5	3.80
RUET	3	1	0	0	0	4	3.75
CU	3	0	1	0	0	4	3.50
SEU	3	1	0	0	0	4	3.75
AUW	3	0	0	0	0	3	4.00
DU	2	2	1	0	0	5	3.00
RU	2	1	0	0	0	3	3.67
AUST	2	0	1	0	0	3	3.33
SUB	2	0	2	0	0	4	3.00
CoU	1	0	0	0	4	5	0.80
IIUC	0	0	1	0	0	1	2.00

Table 6 shows universities such as NSTU, CUET, IUB, and ULAB scoring the highest (4.00), indicating consistent free internet access. DU and SUB score moderate access, IIUC scores 2.00 indicating poor availability and CoU scores the lowest (0.80). Private universities generally perform better in ensuring seamless internet connectivity. Internet quality remains a foundational requirement for effective smart library services.

5.7 Services provided by libraries using smart devices

The respondent libraries provide a variety of services such as Online Public Access Catalogue (OPAC) /Database search, Reference, Current Awareness Service (CAS), and Selective Dissemination of Information (SDI) etc.

Table 7: Types of library services provided using smart devices

University	OPAC	Reserve	Alerts	Renew	Reference	E- Learning	CAS	SDI	Total Score (max 40)	Mean per Service
BUET	5	4	3	3	5	4	4	4	32	4.00
IUB	5	4	4	5	4	2	2	5	31	3.88
ULAB	5	0	5	1	5	5	5	2	28	3.50
SEU	4	4	4	4	3	4	3	3	29	3.63
NSU	4	5	4	3	3	3	2	2	26	3.25
AUW	4	3	4	3	4	4	4	3	29	3.63
CUET	4	2	4	4	4	4	4	2	28	3.50
IIUC	4	3	3	4	3	1	3	3	24	3.00
DU	5	1	1	2	4	0	3	1	17	2.13
BMU	4	0	0	0	4	0	4	3	15	1.88
RU	3	2	3	2	3	1	3	3	20	2.50
NSTU	5	0	0	0	3	2	3	3	16	2.00
JnU	5	0	0	0	2	4	4	1	16	2.00
CU	4	1	0	1	3	2	3	1	15	1.88
CoU	3	2	3	1	1	0	3	0	13	1.63
AUST	3	1	0	1	1	0	1	1	8	1.00
SUB	3	0	2	0	2	0	3	1	11	1.38
RUET	1	0	0	0	1	0	1	1	4	0.50
EWU	0	0	0	0	0	0	0	0	0	0.00
BAIUST	0	0	0	0	0	0	0	0	0	0.00

Table 7 reveals that OPAC/Database search is the most widely used service across all universities that responded. Reference, CAS, and SDI services also show good adoption. Reservation, renewal, and alert services vary significantly by institution. Universities such as BUET, IUB, SEU, AUW, ULAB, and CUET provide the most diverse range of smart services. EWU and BAIUST reported zero usage due to lack of data.

5.8 The usefulness of using smart devices

Most of the professionals and library staffs find it very useful to provide library services through smart devices which indicate their positive approach towards further service innovation in their libraries in future.

Table 8: The usefulness to provide library services through smart devices

University	Very Useful	Useful	Neutral	Total	% Positive (Very Useful)
BUET	5	0	0	5	100%
JnU	5	0	0	5	100%
NSU	4	0	1	5	80%
BMU	4	0	0	4	100%
CUET	4	0	0	4	100%
ULAB	4	1	0	5	100%
IIUC	4	1	0	5	100%
AUW	4	0	0	4	100%
DU	3	2	0	5	100%
IUB	3	2	0	5	100%
NSTU	3	2	0	5	100%
SEU	3	1	0	4	100%
SUB	3	0	0	3	100%
AUST	3	0	0	3	100%
RU	2	1	0	3	100%
CU	2	2	0	4	100%
RUET	2	0	0	2	100%
CoU	1	2	0	3	100%
EWU	0	0	0	0	—
BAIUST	0	0	0	0	—

Table 8 reveals that BUET and JnU libraries felt that smart devices are very useful to provide library services where NSU, BMU, CUET, ULAB, IIUC and AUW are the second in ranking regarding the usefulness of smart devices. No data has been found from EWU and BAIUST. The findings confirm that digital transformation through smart devices is perceived very positively in academic libraries.

5.9 Ease of using smart devices

Professionals and staffs across universities generally find library services easy to deliver via smart devices. Their response reflects that smart technology-based services can usher a new dimension to their existing library services.

Table 9: Ease of using smart devices to render library services

Rank	University	Very Easy (5)	Easy (4)	Neutral (3)	Mean Score	Total Responses
1	JnU	5	0	0	5.00	5
2	AUST	3	0	0	5.00	3
3	RUET	2	0	0	5.00	2
4	IUB	4	1	0	4.80	5
5	BUET	4	1	0	4.80	5
6	AUW	3	1	0	4.75	4
7	DU	3	2	0	4.60	5
8	NSTU	3	2	0	4.60	5
9	NSU	3	1	1	4.40	5
10	BMU	0	4	0	4.00	4
11	ULAB	2	3	0	4.40	5
12	IIUC	1	3	0	4.25	4
13	SEU	1	3	0	4.25	4
14	CU	2	2	0	4.50	4
15	RU	1	2	0	4.33	3
16	CUET	1	2	1	4.00	4
17	CoU	2	1	0	4.67	3
18	SUB	2	1	0	4.67	3

Table 9 demonstrates that three universities achieved a perfect 5.0 (JnU, AUST, RUET). Only two universities scored below 4.5: BMU (former BSMMU) and CUET (both 4.0). Even the “lowest” scoring universities in this dataset are still rated as solidly “Easy” on average. This indicates strong staff readiness and smooth operational handling of smart device-based services.

Table 10: Other library services professionals intend to provide using smart devices

University	OPAC	RES	ALERT	REN	REF	E-LEARN	CAS	SDI	Total Score (out of ~40)	Average per service
BUET	4	3	3	5	3	2	2	2	27	3.38
CUET	4	4	3	2	2	3	3	4	25	3.13
IIUC	3	3	4	3	3	3	2	2	23	2.88
ULAB	2	5	0	1	1	1	1	1	12 (but 5 in RES)	1.50
JnU	3	2	4	3	1	0	0	0	13	1.63
NSTU	3	3	1	2	2	1	1	1	14	1.75
CoU	3	1	3	3	1	2	3	3	19	2.38
IUB	1	1	3	1	1	4	4	2	17	2.13
CU	0	4	4	4	0	1	0	1	14	1.75
DU	3	1	2	0	1	2	1	2	12	1.50
RU	2	1	2	2	2	2	2	2	15	1.88
NSU	1	1	2	1	2	2	2	2	13	1.63
AUST	3	1	1	1	0	1	1	3	11	1.38
SUB	0	1	3	2	2	2	2	3	15	1.88
BAIUST	3	3	0	0	0	0	0	0	6	0.75
BMU	0	0	0	0	0	4	0	0	4	0.50
EWU	0	0	0	0	0	0	0	0	0	0.00
RUET	1	0	0	1	1	0	1	0	4	0.50
SEU	0	0	0	1	0	1	1	1	4	0.50
AUW	1	0	1	1	1	1	0	2	7	0.88

Table 10 reveals demand for further expansion of services. Most high-performing institutions want further enhancement of OPAC, SDI, and E-learning. Technologically advanced libraries - BUET, CUET, and IIUC have the strongest desire to expand smart-device-based services across multiple areas (mean > 3.00). Lower-performing institutions show minimal interest, perhaps due to limited existing infrastructure.

5.11 Benefits of integrating smart devices

The respondents believe that providing library services through using smart devices is highly beneficial for them and it augments their engagement with the users along with lessening their workload.

Table 11: Benefits of integrating smart devices into library services

University	PHYS↓	STAFF↓	ENGAGE↑	NEED↓	Total Agreements	Avg per impact
BUET	3	2	5	3	13	3.25
IUB	1	3	4	0	8	2.00
ULAB	1	4	4	1	10	2.50
JnU	1	2	4	4	11	2.75
RU	2	2	3	3	10	2.50
NSTU	1	3	3	1	8	2.00
CUET	2	2	3	2	9	2.25
SEU	2	3	4	1	10	2.50
BMU	0	4	0	4	8	2.00
CU	1	4	2	2	9	2.25
IUC	1	2	2	3	8	2.00
AUST	0	2	3	–	5	~1.67
AUB	1	2	3	0	6	1.50
NSU	1	1	4	0	6	1.50
CoU	2	1	0	0	3	0.75
RUET	1	1	1	0	3	0.75
DU	3	3	3	0	9	2.25
EWU	0	0	0	0	0	0.00
SUB	0	0	3	0	3	0.75
BAIUST	0	0	0	0	0	0.00

Table 11 shows that the most widely recognized benefit is “Enhanced user engagement and access to resources” which has the clearest positive outcome — 13 out of 20 universities have ≥ 3 respondents agreeing, with BUET achieving perfect agreement. Reduced staff workload is notable at several universities (BMU, CU, ULAB). Only a minority strongly agree that digital services have reduced the need for physical library space/services.

5.12 Other merits of providing library services through smart devices

The other benefits of providing library services using smart devices are user friendly, save time and money, unlimited access from anywhere, multiple users access and personalized service etc. Among them, the respondents cited unlimited access from anywhere and multiple user access most.

Table 12: Other merits of providing library services through smart devices

University	FRIEND	SAVE	ANYWHERE	MULTI	PERSON	Total	Average per advantage
IUB	4	3	5	4	3	19	3.80
BUET	4	3	3	4	2	16	3.20
BMU	0	4	4	4	4	16	3.20
JnU	3	4	4	4	1	16	3.20
DU	4	3	2	3	3	15	3.00
SEU	4	2	4	4	3	17	3.40
IIUC	3	3	3	4	3	16	3.20
ULAB	3	3	4	3	3	16	3.20
RU	3	3	3	3	3	15	3.00
NSTU	4	3	3	1	0	11	2.20
AUST	3	3	3	3	2	14	2.80
CUET	2	3	3	3	2	13	2.60
AUW	3	3	4	2	0	12	2.40
CU	1	3	4	1	0	9	1.80
NSU	2	2	1	1	1	7	1.40
SUB	2	0	0	1	0	3	0.60
RUET	2	1	0	0	0	3	0.60
CoU	1	2	1	0	0	4	0.80
EWU	1	0	0	0	0	1	0.20
BAIUST	0	0	0	0	0	0	0.00

Table 12 shows that the private universities (especially IUB and SEU) and the medical university particularly BMU responded to the variables most. “Unlimited access from anywhere” and “Multiple user access” are the two most frequently cited advantages. “Personalized service” is the least convincing benefit overall; only BMU users strongly agree. A few universities (SUB, RUET, CoU) have very low recognition of any advantages, suggesting their digital library services are either underdeveloped or not well known/used.

5.13 Barriers of providing library services through smart devices

Lack of skilled or trained library staffs, constraints of fund, poor network system and low power supply are the major impediments that can hinder the smooth run of smart library service delivery system.

Table 13. The barriers of providing library services through smart devices

Category	Public Mean	Public Std	Public Median	Private Mean	Private Std	Private Median
Inadequacy of funds	2.30	1.49	2.50	1.80	1.48	2.00
Lack of skilled library staff	2.50	1.27	3.00	1.40	1.43	1.50
Poor network system	1.70	1.34	1.50	1.80	1.40	1.50
Costly (implementation/ subscription cost)	1.80	1.23	1.50	1.60	1.65	1.50
Insufficient power supply	1.30	1.06	1.00	0.70	0.82	1.00

Table 13 exhibits that across the public and private universities, the largest roadblocks to successful smart library servicedevelopment and implementation are (1) lack of skilled library staffs(2.50 vs. 1.40) and (2) inadequacy of funds(2.30 vs. 1.80).Privates show marginally higher network concerns (1.80 vs. 1.70) but lower power issues (0.70 vs. 1.30). High subscription costs for e-resources, unreliable internet, and power shortages are notable but secondary concerns. Therefore, the top challenges are funds and staff dominate (~40% of total severity), critical for operational sustainability—prioritize training programs and grants.

5.14 Measures taken to develop smart library services

To develop a smart device-based library service, increasing library budget, enhancing power supply, hi-speedy internet, trained library staffs and digitization of library materials are essential preferences suggested by the professionals and staffs.

Table 14: Measures can be taken to develop smart library services

- ☐ BUDGET = Increasing library budget
- ☐ POWER = Improving power supply
- ☐ INTERNET = Fast-paced internet access

☐ STAFF = Ensuring trained library staff

☐ DIGIT = Digitization of library materials

University	BUDGET	POWER	INTERNET	STAFF	DIGIT	Total	Average per measure
BUET	5	1	2	4	3	15	3.00
JnU	5	1	0	5	4	15	3.00
IUB	4	1	3	4	4	16	3.20
BMU	4	0	4	4	4	16	3.20
IUC	3	2	4	4	3	16	3.20
DU	4	1	2	3	3	13	2.60
ULAB	3	2	2	4	5	16	3.20
SEU	4	1	4	3	3	15	3.00
NSTU	3	2	2	3	2	12	2.40
CUET	3	2	2	3	2	12	2.40
AUST	3	2	3	2	3	13	2.60
RU	3	2	3	2	3	13	2.60
AUW	3	1	2	3	4	13	2.60
NSU	2	0	3	1	3	9	1.80
CoU	3	0	1	2	2	8	1.60
SUB	2	1	2	0	0	5	1.00
CU	1	2	3	4	0	10	2.00
RUET	1	0	0	0	1	2	0.40
EWU	0	0	0	0	0	0	0.00
BAIUST	0	0	0	0	0	0	0.00

Table 14 outlines the top recommendations where respondents prioritize the two most critical actions- (1) increasing library budgets and (2) ensuring trained library staffs. These two dominate in almost every university that gave responses. Digitization is the third preference especially valued at private universities (ULAB = 5, IUB/AUW = 4) and BMU. Improving power supply and fast-paced internet access are moderately important. From the findings, it is clear that library professionals and staffs prefer smart phones and laptops most than other smart devices. As they find it handy and useful, they are eager to provide all library services through these devices. However, lack of fund and skilled staffs impede the way to achieve their desired goal.

6. Discussion

This study reveals that smart devices have been widely adopted in both public and private university libraries in Bangladesh. Smartphones and laptops dominate as the device of choice. The library professionals and staffs highly appreciate the usefulness and ease of delivering services via smart devices.

Across the universities surveyed for this study, OPAC/Database search is the most widely used service. Reference, CAS, and SDI services also show good adoption respectively. Technologically advanced libraries have desire to expand smart-device-based services across multiple areas such as reservation, renewal and real time alert through smartphones. With this end in view, a mobile-optimized version of the library catalogue can allow users to search for books, journals, and other resources on the go. This service may include features like checking item availability, reserved items and renewing loans directly from a smartphone.

Enhanced user engagement as well as access to resources is one of the most widely recognized benefits of using smart devices in university libraries. Some universities assume that providing library services through smart device can reduce staff workload. Only a minimal number of universities think that digital services have reduced the need for physical library space/services. The findings of table 7 clearly show that professionals of the respondent libraries provide reference services to their users mostly. A chat-based reference service, integrated into a mobile app or website, would allow users to ask questions and receive immediate assistance from a librarian. This can provide a more convenient and less intimidating way for library users to seek help with their research.

Table 6 shows that most of the respondent libraries always provide free internet services to their users. In large academic libraries, a mobile app with indoor navigation can help students locate specific book sections, study rooms, or even a librarian's desk. This can significantly enhance the user experience and reduce search time.

To the library professionals, "Unlimited access from anywhere" and "Multiple user access" are the two most frequently cited advantages of using smart device to deliver their library services. Table 4 reveals that Smartphones and laptops are the most preferred devices in both public and private universities for providing smart library services. A mobile app or a dedicated website can provide a single point of access to the library's

extensive collection of e-books, e-journals, and research databases, ensuring that users can access these resources anytime, anywhere.

Towards successful smart library service development and implementation, the major impediments are lack of trained and skilled library staff and constraints of funds. The respondents recommended that increasing library budgets, arranging training for the existing staffs as well as focusing on skilled staff recruitment can be the most fruitful measures that can be adopted to enhance better smart library services.

7. Proposed Service Innovation Model

The proposed model for service innovation in academic libraries in Bangladesh is a user-centric, integrated framework that prioritizes smart devices. It is a six-step process that will enable the libraries to promote or enhance and or innovate their library services:

- (a) **Assessment:** The initial phase involves a thorough analysis of user needs and technological infrastructure. This includes conducting surveys to gather specific data on device preferences and service expectations, and assessing the library's current digital capabilities.
- (b) **Planning:** The second step includes making a plan based on the data found in the assessment stage. This phase focuses on how the library services can be provided more conveniently, who will receive the services and what types of smart devices can be used to provide these services.
- (c) **Development:** This phase focuses on building the necessary infrastructural and skilled resource development. This includes developing a mobile-first website, a dedicated mobile application (for both Android and iOS), and integrating these systems with the existing Library Management System (LMS) to ensure real-time data flow. It also includes providing necessary training to the library staffs.
- (d) **Implementation:** Following development, in this stage, the innovative services such as online reservation and renewal, getting alert for due dates etc. via smart devices can be launched or implemented. Through this service innovation, library professionals will be able to render better smart services to the users.
- (e) **Promotion:** This phase includes promotion campaign to ensure users are aware of the new service offerings. Workshops and tutorials can be provided to train users on how to effectively use the new services.
- (f) **Evaluation:** The final step is an ongoing process of monitoring and evaluation. User feedback, usage statistics, and performance metrics are continuously collected to identify areas for improvement. This iterative process ensures the model remains relevant and responsive to changing user needs and technological advancements.

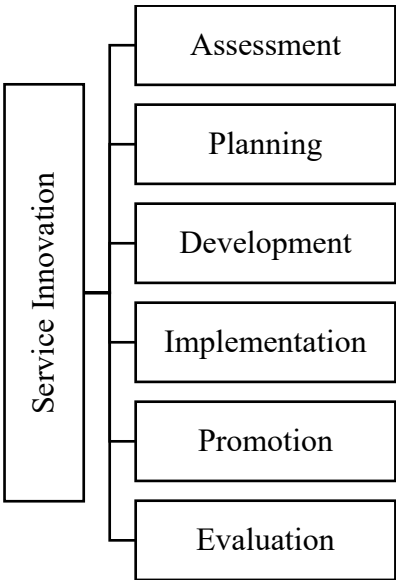


Figure 1: Proposed Service Innovation Model

This proposed service innovation model can be adapted across different university settings to enhance user experience and make library services smarter and more accessible. For real world application, the university libraries could introduce mobile apps that allow users to check book availability and receive instant alerts and/or to placeQR codes on bookshelves in orderthat users can scan them with their phones to access digital guides, reading lists, or subject-specific e-resources. In addition, the libraries might implement a chatbot within their mobile app, helping users get quick answers about opening hours, database access, and citation help. Last but not the least, workshops could be organized to train both the staffs and users to increase digital literacy and improve access to library materials.

8. Recommendations

Based on the findings, the following recommendations are proposed for library professionals.

8.1 Increase library budget: University authorities and the University Grants Commission should significantly increase library budgets to support digital subscriptions and infrastructure.

8.2 Capacity building and training: Comprehensive training programs for library staff to develop the technical skills required to manage and promote smart device-based services must be institutionalized.

8.3 Expand digitization initiatives: To enable remote access to library materials and expansion of advanced services via smartphone-optimized platforms, libraries should prioritize on digitization of their existing resources.

8.4 Investment in Infrastructure: Academic libraries must allocate sufficient funds for robust, high-speed internet connectivity, reliable power supply, and the necessary hardware and software to support digital services.

8.5 Collaboration and Partnerships: Libraries should establish national-level collaboration for shared e-resources and technical infrastructure to reduce individual institutional costs. They can also collaborate with university IT departments and external technology providers to ensure the smooth integration and maintenance of new systems.

8.6 Policy and Strategic Planning: University and library management should create a clear strategic plan for developing and implementing a technology-based library service with a focus on long term vision for a smart library.

9. Limitations and Future Directions

The study has focused on a few universities of some regions across the country. So, the results may not represent all universities and may not reflect the actual scenario in other areas of the country. The study may have excluded other institutions that could have provided different results. Due to the constraints of fund and time, the study has been conducted in a limited scope. However, it will pave the way to conduct further research on the scope of using smart devices in providing academic library services in a large scale all over the country.

10. Conclusion

Smart devices hold immense potential to renovate academic library services in Bangladesh. The integration of smart devices into academic library services is not merely an option, rather a necessity for the future of information provision. Library professionals assess library services through smart devices as highly useful, easy to implement, and capable of enhancing user engagement while reducing staff workload. Academic libraries can transform traditional library services into dynamic, user-centric technology-based services by understanding user behavior, developing relevant smart device-based services, and following a structured innovation model. However, progress can be uneven and constrained due to insufficient funding and lack of trained personnel. The recommendations mentioned in this study and proposed service innovation model offer a clear path forward for libraries to overcome existing challenges and embrace the digital future. It will ultimately enhance the academic experience and support the next generation of researchers and scholars.

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The Role of Institutional Repository in Ensuring Sustainable Digital Preservation in Selected University Libraries in Bangladesh

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Abstract

Background/Purpose: Preserving the library materials and making them accessible to scholars and general users is very important for university libraries. The purpose of the study was to investigate the role of IR for sustainable digital preservation in selected university libraries in Bangladesh. **Methodology:** The study used a quantitative research approach. The population and sample were covered by librarians/library administrators, and library users from the 15 selected university libraries. The researcher distributed a total of 700 structured questionnaires among the teachers, students, and researchers of the selected university libraries. Out of 700 questionnaires, a total of 433 filled questionnaires were received with a response rate of 61.85%. Collected data were analyzed using SPSS 23rd version. **Findings:** The findings from this study revealed that university libraries in Bangladesh were significantly affected by the changes to the digital environment. Overall, the majority of universities, comprising 93.93 percent of the total surveyed, have an institutional repository in place for digital preservation while a small percentage, 6.7 percent, do not. The establishment years of IR systems in the selected universities range from as early as 2007 to as recent as 2024. The study also found that DSpace which is the open source institutional repository software is adopted in the selected university libraries for digital preservation because of its user-friendly and effective modules. The study identified some challenges to establish IR software for sustainable digital preservation. **Originality/Value:** The study provides empirical evidence on how IR supports durable digital preservation in Bangladeshi university libraries. By combining responses from both professionals and users across 15 universities, the study offers practical insights into IR adoption, operational challenges, and areas for improvement. **Conclusion:** The study concludes that institutional repositories play a vibrant role in sustaining digital preservation within Bangladeshi university libraries, with most institutions successfully accepting DSpace to defend and ensure access to the digital resources. Despite the progress, overcoming identified challenges is crucial to fortifying the sustainability and efficiency of digital preservation efforts.

Keywords

Institutional Repository, Digital Preservation, Preservation Policy, University Library, Bangladesh

1. Introduction

The world is currently under the influence of the information era, which is altering all fields of knowledge and turning it into an information society. Institutional sustainability factors played a crucial role in the sustainability of IRs (Onsinyo&Saurombe, 2025). The management and dissemination of scholarly materials as an activity in libraries is particularly influenced by the advent of institutional repositories and integration of digital platforms to preserve and provide access to scholarly output produced by institutions

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(Ismail et al., 2025). An institutional repository (IR) can support research, learning and administrative process (Shoeb, 2010). Institutional repositories serve as a vital reservoir of research data, providing a centralized and secure platform for storing, preserving and disseminating datasets generated by academic institutions (Dube, 2025). Institutional repositories have developed to be an important way for academic and research organizations to collect, preserve, and guarantee long-term access to digital resources. Despite the increasing amount of born-digital information in all sectors, digital preservation techniques are still far behind in Bangladeshi university libraries.

2. Objectives of the study

1. To assess the current condition of Institutional Repositories (IR) in selected university libraries.
2. To investigate the IR software used in these university libraries.
3. To explore the IR policies/guidelines at the chosen university libraries.
4. To identify the challenges associated with developing IR in the selected university libraries.

3. Methodology

Data were collected from the 15 selected university libraries, including 10 public university libraries and 5 private university libraries in Bangladesh. Two different sets of structured questionnaires were utilized to collect quantitative data from two distinct groups: librarians/library administrators of libraries and library users. The IBM® SPSS® Statistics Version 25 software was employed to analyze the collected data for this study in order to produce precise, representative insights from the data collected through questionnaires.

4. Literature Review

4.1 Present Condition of IR

Islam et al. (2020) found that university libraries in Bangladesh carry out digital preservation activities through institutional repositories. The study also found that Bangladeshi university libraries have been using DSpace, an open source institutional repository software, for digital preservation due to its user-friendly and effective modules. The study provided several recommendations for addressing challenges and highlighted specific difficulties associated with the implementation of institutional repository (IR) software for open access in digital preservation.

4.2 Software used for IR

In view of the widespread adoption of open-source applications for information management systems and libraries in the current global digital information ecosystem, Meitei & Devi (2009) highlight the benefits and advantages of open source software in digital preservation. The study also touches on a few significant open-source software repository systems and digital preservation initiatives in India.

4.3 Policy Frameworks

Ndegwa et al. (2022) showed that the organizations lacked the necessary infrastructure to facilitate prolonged digital preservation. Policies were insufficient, and there were no plans established for assisting them are implemented. The study also found that even though the IRs was supposed to preserve digital content, their strategies and policies lacked concrete measures. The study offers some recommendations, such as defining objectives for digital preservation that will direct the creation of policies and involving several stakeholders in the process. Kakai (2018) opines that IR policies should be developed using a top-down approach where government and funding bodies are involved in the development of IR policies.

Saini (2018) found that when library managers are required to produce IRs, define IR policies, inspire faculty, create budget projections, and other tasks, they frequently become confused. The study also attempted to provide knowledge of digital preservation and a number of theoretical elements pertaining to the establishment and upkeep of an IR in an academic setting. Silva & Borges (2017) stated that almost all libraries have come up with detailed policies but lack standalone, detailed IR policies that guide the access of content in the IRs.

4.4 Challenges of Institutional Repository

Wardiyono et al. (2024) revealed that the repositories faced challenges mostly related to technical issues, organization and policy, and the sustainability of the resources for future communities as they worked toward the mission and achieved the goals. Posigha&Idjai (2022) revealed some policies regarding IR for the implementation and management of content in institutional repositories. The study also found several challenges that repository manager sand librarians encounter when creating and executing IRs in Nigerian universities. Among the challenges are lack of funding, inadequate facilities, lack of IR-related policies, and the difficulty of gathering content from different contributors, copyright concerns, no mandatory self-archiving policy, and contributors' disinterest in submitting to IR.

5. Results and Findings

Table 1 and Figure 1 provide insights into the status of Institutional Repositories (IR) for digital preservation across public and private universities: Among public universities, 90.0% have established an institutional repository for digital preservation, while only 10.0% do not have one. In contrast, all private universities included in the study (100.0%) have implemented an institutional repository for digital preservation. Overall, the majority of universities, comprising 93.3% of the total surveyed, have an institutional repository in place for digital preservation, while a small percentage, 6.7%, do not.

Table 1: University category wise institutional repository (IR) state

IRState	Public (10)		Private (5)		Total (15)	
	T	%	T	%	T	%
Yes	9	90.0	5	100	14	93.3
No	1	10.0	0	0	1	6.7

T=Total

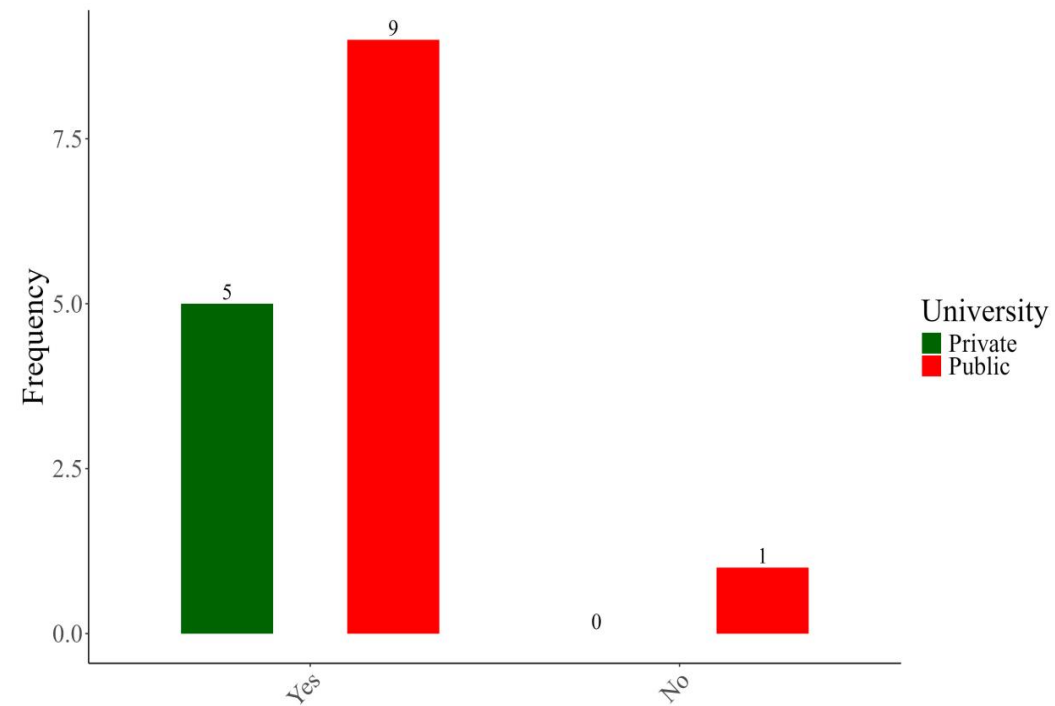


Figure 1: University category wise institutional repository (IR) state

Table 2 outlines the institutional repository (IR) software utilized by various universities along with the respective establishment years of their IR systems. Most universities employ DSpace for their IR platforms, with establishment years ranging from as early as 2007 for institutions like BRACU to as 2024 for JU. The adoption of DSpace, an open source digital repository system, underscores a common approach among universities in Bangladesh towards managing and preserving their digital assets. Notably, some universities, such as the CU, lack data on their IR software and establishment year. Overall, the prevalence of DSpace across these institutions reflects a concerted effort to establish robust digital preservation infrastructures to manage scholarly works and research outputs effectively.

Table 2: Institutional repository software and establishment year of IR

SL.No.	NameofUniversity	IRSoftware	Est.YearofIR
1.	AUST	DSpace	2021
2.	BMU	DSpace	2015
3.	BAU	DSpace	2011
4.	BRACU	DSpace	2007
5.	GAU	DSpace	2011
6.	BUET	DSpace	2014
7.	EWU	DSpace	2014
8.	IUB	DSpace	2013
9.	JU	DSpace	2024
10.	NSU	DSpace	2023
11.	SUST	DSpace	2023
12.	SAU	DSpace	2016
13.	CU	N/A	N/A
14.	DU	DSpace	2013
15.	RU	DSpace	2013

Table 3 and Figure 3 provide insights into the types of materials stored in Institutional Repositories (IR) categorized by university type. According to the study, across the public and private universities, master's theses stand out with the highest presence, accounting for 93.33% and 90% and 100% in public and private universities, respectively. Following closely are PhD theses and MPhil theses, with 73.33% and 66.66% prevalence in public universities, and 40% and 20% in private universities, respectively. However, conference papers exhibit a lower prevalence across both types of universities, with 26.66% in private universities and 10% in public universities. In terms of university categories, public universities tend to have a higher overall presence of materials in their IRs, accounting for 48.75% of the total presence, compared to private universities, which represent 72.50%.

Table 3: University category wise types of materials kept in IR

Resources	Public (10)		Private (5)		Total (15)	
	T	%	T	%	T	%
PhD Thesis	9	90.0	2	40.0	11	73.33
M. Phil Thesis	9	90.0	1	20.0	10	66.66
Journal	4	40.0	4	80.0	8	53.33
Research Article	2	20.0	4	80.0	6	40.00
Research Report	2	20.0	5	100	7	46.66
Master’s Thesis	9	90.0	5	100	14	93.33
Annual Reports	3	30.0	5	100	8	53.33
Conference Paper	1	10.0	3	60.0	4	26.66
Overall		48.75		72.50		56.66

T=Total

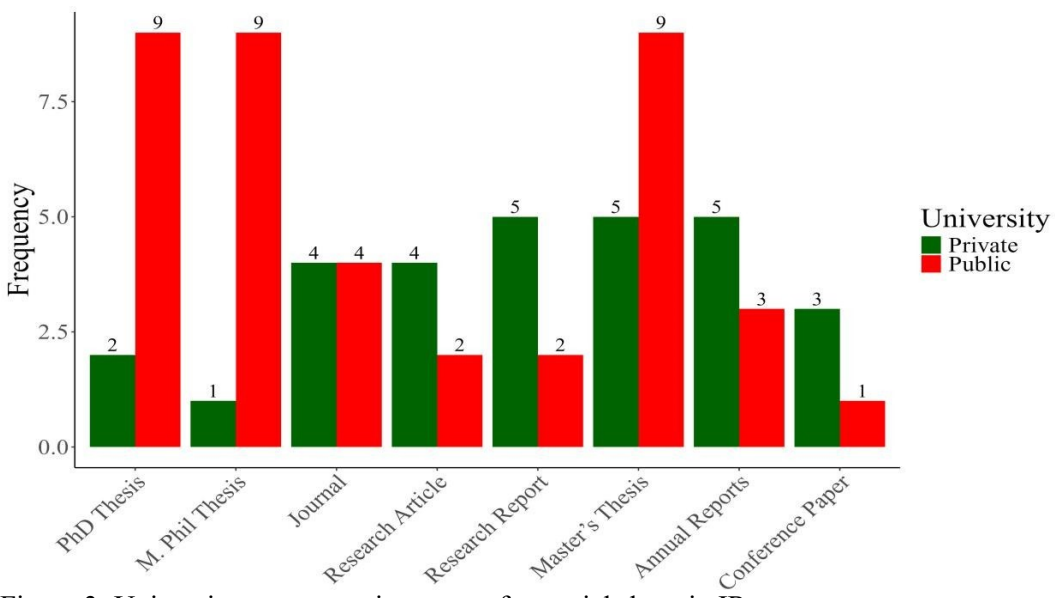


Figure 3: University category wise types of materials kept in IR

Table 4 illustrates the existence of Institutional Repository (IR) policies in university libraries, categorized by public and private institutions. Among public universities, 50% have established IR policies, while 50% do not. In contrast, among private universities, a higher percentage, 80%, have implemented IR policies, with only 10% lacking such policies. Overall, 60% of the universities surveyed have IR policies, indicating a significant presence of structured guidelines and regulations governing the operation of institutional repositories in these academic institutions.

Table 4: Institutional repository (IR) policy in university libraries

IR Policy	Public (10)		Private (5)		Total (15)	
	T	%	T	%	T	%
Yes	5	50.0	4	80.0	9	60.0
No	5	50.0	1	10.0	6	40.0

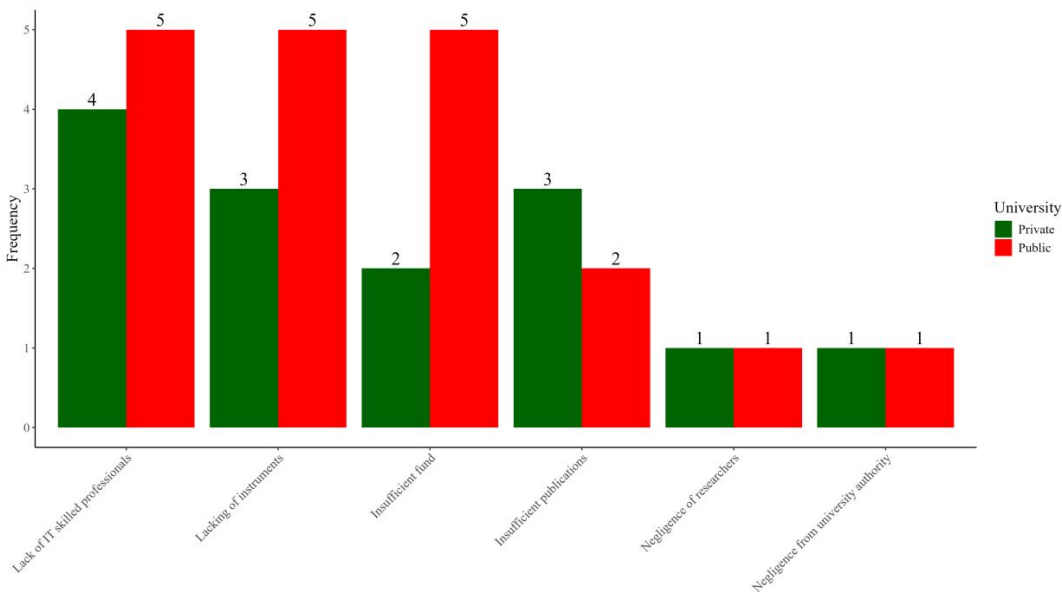
T=Total

Table 5 and Figure 5 outline the challenges faced by library staff in building Institutional Repositories (IR). Among the issues highlighted, "Lack of IT skilled professionals" emerged as a significant concern, with 50.0% of respondents from public universities and 80.0% from private universities citing this problem. Similarly, "Lacking of instruments" and "Insufficient fund" were reported as prominent obstacles, with 50.0% and 50.0% of respondents from public universities, respectively, and 60.0% and 40.0% from private universities, respectively, mentioning these challenges. "Insufficient publications" was identified as a problem by 20.0% of respondents from public universities and 60.0% from private universities. Additionally, "Negligence of researchers" and "Negligence from university authority" were cited by a smaller proportion of respondents. Overall, the challenges varied, but common themes included resource constraints and a lack of necessary expertise.

Table 5: Challenges faced by library staff for building institutional repository (IR)

Problems	Public (10)		Private (5)		Total (15)	
	T	%	T	%	T	%
Lack of IT skilled professionals	5	50.0	4	80.0	9	60.0
Lacking of instruments	5	50.0	3	60.0	8	53.33
Insufficient fund	5	50.0	2	40.0	7	46.66
Insufficient publications	2	20.0	3	60.0	5	33.33
Negligence of researchers	1	10.0	1	20.0	1	6.66
Negligence from university authority	1	10.0	1	20.0	1	6.66

Figure 5: Challenges faced by library staff for building IR



6. Recommendations

1. University libraries need to invest in robust and scalable digital repository infrastructure, including reliable storage solutions and backup systems to ensure long-term preservation of digital content.
2. Universities need to establish comprehensive policies and guidelines that define the scope, responsibilities and standards for sustainable digital preservation within institutional repositories.
3. Library staff and stakeholders should receive ongoing training in digital preservation techniques, metadata standards and repository management to maintain and improve the quality of digital collections.
4. Encourage collaboration between university libraries, public agencies and other partners to share best practices, resources and knowledge about digital preservation strategies.
5. Implement recognized digital preservation frameworks and metadata standards (e.g. OAIS, Dublin Core) to improve the interoperability and sustainability of digital repository.
6. University libraries need to push for dedicated funding and institutional commitment to support the continuous development, maintenance and conservation activities of institutional repositories.
7. Universities should establish mechanism for periodic assessment of repository preservation practices, technology updates and content integrity to ensure ongoing effectiveness.
8. Promoting open access policies to ensure long-term preservation of digital content as well as increase visibility and accessibility.

7. Conclusion

Digital preservation services in libraries are of immense importance in building a smart Bangladesh in the future. Digitization offers many benefits for university libraries. University libraries are becoming more and more interested in digital preservation as a result of the growing need of users for information. Institutional repositories play a fundamental role in ensuring the sustainable preservation of digital scholarly and cultural content. Institutional repositories should be set up in university libraries for the following four reasons. These are (1) Collects fragmented research output across departments and disciplines (2) Increase the visibility of the university (3) Build intellectual leadership and credibility and (4) Preservation of scholarly work.

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Impact of Adapting Generative AI in Academic Libraries: Student Perceptions, Learning Outcomes, and Ethical Challenges

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Abstract

Purpose – The aim of this research is to identify the impact of Generative AI on the users in public university libraries in Bangladesh, having due consideration to the perception of students about GenAI, the use of Generative Artificial Intelligence in improving the learning process, as well as the ethical issues associated while using GenAI. The research will identify how Generative AI can revolutionize conventional library services, bringing a positive impact on the involvement of students in their studies.

Design/Methodology/Approach – The quantitative descriptive research design was applied, with an online based structured survey questionnaires dispensed to students in three public universities: University of Dhaka, University of Rajshahi, and Noakhali Science and Technology University. Convenience sampling was utilized in the selection of library users. Data were collected for approximately three months (June–August, 2025). A total of 500 questionnaires were distributed, and 442 responses were obtained, indicating an 88.4% response rate. Data were analyzed using SPSS 25 and Microsoft Excel 2019 using descriptive statistics and nonparametric tests such as Mann-Whitney U and Kruskal-Wallis H to determine differences based on gender, and level of study.

Findings – Results indicate that student attitudes toward GenAI in libraries are generally positive, with 57.9% reporting positive attitudes. The most used tool was ChatGPT, reflecting the popularity of chat-based AI. Students valued quick access to information, personalized recommendations, and efficient research processes. GenAI played a significant role in the effectiveness of resource discovery and enabling interactive learning but was moderately influential in critical thinking, independent research, and upper-order cognitive outcomes. Ethical concerns took center stage, with 92.3% of the students expressing privacy concerns, and trust in AI-generated information was moderate.

Research Limitations/Implications – The study is limited to students of Bangladeshi public universities and based on self-reported data, which may not reflect actual behavior. It also reflects short-term perceptions without accounting for long-term learning effects. The findings underscore the importance of policy development, user training, and stronger ethical safeguards in AI-driven library services.

Originality/Value – This study provides one of the first empirical investigations into the impact of GenAI on library services in Bangladesh. It contributes to the global discourse by introducing context-specific insights, balancing the benefits of AI-driven efficiency with ethical concerns, and delivering actionable implications for librarians, educators, and policymakers.

Keywords:

Artificial Intelligence, Generative Artificial Intelligence (GenAI), Library Services, Academic Libraries, Bangladesh.

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1. Introduction and Background

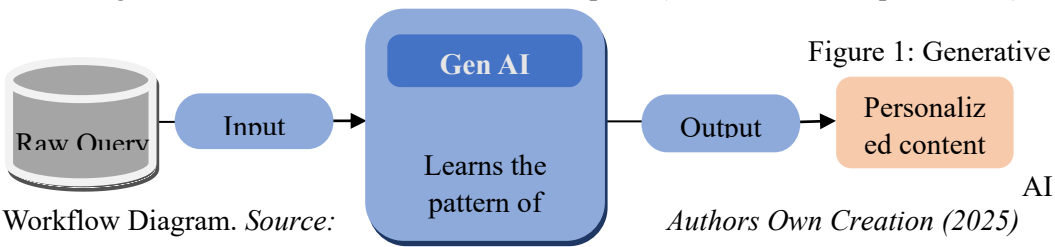
The American Library Association Center for the Future of Libraries identified a number of tech trends, which have a potential impact on the services and operations of the libraries, including a different approach to accessibility, improvement in the delivery of services, as well as improvement in the services for the users (Bolt, 2014). The term AI can be considered as a scientific undertaking, as it aims to comprehend human intelligence, while it is also referred to as a field of engineering, as it attempts to build machines having human-like abilities. Unfortunately, it has been observed that AI initiatives often lack a strong cognitive foundation, as indicated in the following point (Davenport, 2013).

1.1 Artificial Intelligence (AI) Vs Human Intelligence (HI)

Human intelligence and artificial intelligence are two kinds of intelligence, each with special traits and constraints. Artificial Intelligence is based on human insights that can be used in making decisions, enabling machines to perform tasks with ease, from simple to complicated ones. Human intelligence or the behavior of the human being has come from past experiences and the doings based upon situation, and environment. (Korteling et al., 2021). Human intelligence emphasizes in the foundation on which artificial intelligence provides cognitive structures and processes from which AI can simulate decision-making, problem-solving, and creativity (Sostaka et al., 2024). AI has several advantages over Human Intelligence such as processing vast amounts of data much faster than humans, working around the clock without needing breaks or rest, and performing tasks that are too dangerous or difficult for humans (RL, 2024). In conclusion, both Artificial Intelligence and Human Intelligence have their own strengths and weaknesses.

1.2 Generative Artificial Intelligence (GenAI)

According to the World Economic Forum (2023) “Generative AI as a category of artificial intelligence (AI) algorithms that generate new outputs based on the data they have been trained on. It uses a type of deep learning called generative adversarial networks and has a wide range of applications, including creating images, text and audio.” Jonathan McMichael has stated that the growing ubiquity of generative AI means that libraries risk irrelevance by ignoring this technology. He believes that generative AI will be a big part of many students’ and users’ lives and should be integrated into the classroom and other learning opportunities. Generative artificial intelligence can make powerful artifacts when used at scale, but developing trust in these artifacts and controlling their creation are essential for user adoption (Jovanovic & Campbell, 2022).



1.3 Objectives:

1. To Identify the library users' perception about use of generative AI in library
2. To Assess the adaptation of generative AI in Library Service has impacted library users' learning processes and Outcomes.
3. To Look after ethical consideration regarding usage of AI in Library.

1.4 Research Questions

The subsequent study questions were generated based on the previously discussed extensive literature review.

RQ1.How can library users' perception of the use of generative AI be differentiated from traditional library services?

RQ2. What are the factors that influence adaptation of generative AI in libraries and impacted users' learning processes and outcomes?

RQ3.What are the ethical considerations be addressed to ensure best practices of generative AI in libraries?

1.5 Rationale

The significance of this study is demonstrated as it addresses the use of Generative AI on the interaction between students in university library services in Bangladesh. The role of libraries has transformed from being a book repository to a digital collaborator for education. The study provides a valuable contribution for librarians, educators, and policy-makers as it enables a perspective on beliefs, impact on learning outcomes, ethical implications, so facilitating improvement in AI use in academia. Interestingly, despite the steady rise in the adaptation of Generative AI in academia, it has a limited role in university library services, unprobed appropriately as per the context of Bangladesh. Reliance on AI-driven applications for instance ChatGPT is on the rise on a continuous basis amongst university students for their academic purposes, despite uncertainty about the impact of such applications on their learning process, development in critical thinking, trust on the sources of knowledge. It has been identified from earlier studies that while AI increases efficacy, resource search, it has a mixed impact on deep level results, poses ethical issues (Meakin, 2024). The study attempts to address the lack of empirical knowledge on the use of Generative AI, impact on ethical handling, so impact on the future of university library services. The study focuses on the perceptions, experiences, ethical issues from university students from public universities in Bangladesh. The attention remains limited to Generative AI applications, specifically on tools such as ChatGPT, so excluding the broader context of AI. Even though the findings have huge value, as it provides insight from the selected members, it might lack applicability on instances, such as Private universities or overseas environments. The utilization of self-reported survey data adds the potential for bias, as replies may represent perceptions rather than actual behavior

2. Literature Review

Generative Artificial Intelligence (GenAI) is redefining information management and service delivery within library and academic contexts. Scholars increasingly acknowledge its transformative potential while emphasizing the ethical complexities it introduces.

2.1 Perceptions and Adaptation of GenAI in Libraries

Library professionals, as well as library users, have demonstrated inconsistent attitudes toward the adoption of GenAI tools. Chen et al. (2024) & Adigun & Igboechesi (2024) found that the adoption of GenAI tools such as auto-cataloging, semantic searching, and virtual reference services improves efficiency in services, making it possible for librarians to give personalized and responsive service. Furthermore, user attitudes towards AI tools are found to be positive as they consider the tools to be user-friendly and a time-saving device that makes access to complicated information sources simpler. Again, Meakin (2024) and Khan et al. (2023) found that AI tools in discovery systems are able to refine user queries, provide context-based recommendations, and promote inclusiveness in digital environments. However, this optimism has been countered by certain reservations. Subaveerapandiyan (2023) and Hosseini and Holmes (2023) found that the lack of transparency in GenAI tools decision-making capabilities and the spread of misinforming aspects lead to a lack of confidence and expertise in library services. This conflict had been foreseen by Massis (2018), where AI is believed to be both a challenge and an opportunity in the evolution of library services as a whole.

2.2 Impact of GenAI on Learning Processes and Academic Outcomes

The impact of GenAI is not only operational in nature; rather, it pervades many dimensions of the user's learning activities, including cognitive involvement, learning practices, and research achievements. According to Liu et al., (2023), and Cooper (2023), respectively, GenAI enhances personalized learning experiences with the help of adaptive tutoring systems and automatic grading and feedback systems. In the context of education-based libraries, these systems help in advanced dynamic knowledge-building activities that involve optimizing queries, co-authoring, and simulating research tasks with unparalleled efficiency. Similarly, Barrett and Pack (2023) also found that there is a point of convergence between teachers' and learners' perceptions that GenAI assists in idea generation and conceptual investigation activities yet there are reservations about the misapplication of GenAI in writing and feedback activities. Various empirical studies conducted by Meakin (2024) and Kizilcec et al., (2024) clarify that GenAI-based library environments not only raise the digital literacy skills and productivity levels of learners in conducting research activities but also promote in-depth involvements in scholarly engagements. Nevertheless, this positive phenomenon is occurring amidst growing reservations and misgivings over intellectual dependence, a lack of analytical sophistication, and decay in authentic academic activities. Smolansky et al., (2023) also explain that notwithstanding a moderate adoption rate, there is a lack of agreement among instructors and personnel in education institutions regarding the pedagogical acceptability of AI tools and applications.

2.3 Ethical and Institutional Considerations

Of the various sources, the theme of ethical accountability is the one that comes out as a dominant concern in the field. From the interplay of AI, data ethics, and scholarly communication, it's clear that a sophisticated environment has been created which necessitates remedy via policy. The studies by Ganguly et al. (2025) & Andersen et al. (2025) studied the governance structures of GenAI in U.S. universities and showed that most of these universities use AI in ways described as fair, secure, and held accountable by the user. Still, in these structures, the construction of ethics is only piecemeal, making ethical accountability of researchers the dominant issue. The same issue of varied use of AI is what Nicholas et al. (2024), and Mironova et al. (2024) address in a way that suggests the use of AI is only making academic inequality worse. In the library, ethical considerations are heightened three-fold due to the interaction of user, data, and algorithms. From sources such as Subaveerapandiyana (2023), Fernandez (2023), Hosseini and Holmes (2023), there is a call for the accommodation of AI into ethical collections as a significant factor in AI implementation in the library. However, as found in source authors Bell & Bell (2023), and Hsu and Ching (2023), the implementation of AI is called upon as a factor that needs to incorporate education policy as a way of sustainable integration.

2.4 Research Gap

Although the application of Generative AI has attracted considerable interest in integrating education and information management, there are considerable research gaps in its application within Academic Libraries, especially within developing countries like Bangladesh. Almost all previous studies have covered AI applications within broader educational or technological settings but rarely explored user experiences, learning outcomes, and ethical considerations within Academic Library settings and, as such, require contextual filling within the broader Western-centric literature on AI applications regarding its effects on learning and research behavior and resource reliance of students within South Asian countries' universities and institutions of higher learning.

3. Methodology

3.1 Research Design

This study has been applied a quantitative research approach to analyze the Impact of Generative AI Adaptation on Library Users i.e., Student's in University Libraries of Bangladesh. In this descriptive study the researcher adapted both online and offline based survey method to gather the relevant data generated from the respondents.

3.2 Research Site and Population Selection

Among the Fifty-five public Universities in Bangladesh (UGC Website, 2025), the researcher selected 3 public universities. i.e., Noakhali Science and Technology University (NSTU), University of Dhaka, University of Rajshahi. These Universities were chosen for their strategic location with the highest importance attached to library education in context of public universities in Bangladesh. The study primarily targeted library Users i.e., students as the population of the study.

3.3 Sample and Sampling Technique

The researcher conducted a survey using online methods. Out of 500 students’ respondents were invited to participate, 442 willing to completed the survey with a response rate of 88.4%, A non-probability sampling technique named convenience sampling was applied in this study. Researchers opt for convenience sampling to select participants who allows quick and readily available for data collections.

3.4 Data Processing, Analysis, and Presentation

The survey responses were collected and analyzed using statistical analysis software such as SPSS 25, and figures were visualized using Microsoft Excel 2019. Based on relevant literature, the instrument included four sections: (i) demographic information, (ii)Library User Perceptions About Generative AI in Library (iii) Assess how the Adaptation of Generative AI in Library has impacted students Learning Processes and Outcomes, and (iv) Ethical Consideration Regarding Usage of AI in Library. The data were compiled and analyzed to describe the central tendencies, variability, and distribution of the key variables using descriptive statistics such as frequency distributions, means, and standard deviations. Some questions used to analyze through nonparametric tests like Mann-Whitney U and Kruskal-Wallis H to assess the level of AI knowledge and measure the familiarity with Generative AI technologies can be applied in libraries with respondents’ Gender, Age and education level.

4. Results

Table 1: Demographic Information of Respondents

Variables	Category	Frequency (F)	Percentage (%)
Gender	Male	237	53.6
	Female	205	46.4
Total		442	100
Age Group	18-21 years	47	10.6
	21-24 years	175	39.6
	24-26 years	168	38.0
	Above 26	52	11.8
Total		442	100
Educational Level	1 st Year	26	5.9
	2 nd Year	21	4.8
	3 rd Year	117	26.5
	4 th year	122	27.6
	Masters	156	35.3
Total		442	100

Table 1 describes demographic profile of the 442 respondents, among 237 males (53.6%) and 205 females (46.4%), indicating a slight male predominance. In matters of age, most of the respondents fall within the group of young adults since 175 of them (39.6%) are between the age brackets of 21-24 years, followed by those between 24-26 years where 168 of them (38.0%) belong, contributing a combined three-quarters of the respondents.

Fewer respondents fall between the brackets of 18-21 years (10.6%) and over 26 years (11.8%), indicating that the respondents mainly comprised people in the early to mid-life bracket. In matters of education level attained, most respondents are already in advanced levels of education since 117 of them (26.5%) are in their third year of education, followed by those in their fourth year where 122 of them (27.6%) belong, with a combined three-fifths of the respondents pursuing a Master’s level of education as 156 of them (35.3%) pursue this level of education. Few respondents are in their first year (5.9%) and second year (4.8%).

4.1Based on Research Objective 1: Library User Perceptions About Generative AI in Library

Table 2: Level of knowledge about Artificial Intelligence

Category	Frequency (F)	Percentage (%)
Beginner	70	15.8
Intermediate	239	54.1
Advanced	97	21.9
Expert	36	8.1
Total	442	100.0

Table 2 shows respondents’ knowledge of AI indicates that most participants possess a moderate understanding of the subject. Out of 442 respondents, 239 (54.1%) identified themselves as having intermediate knowledge, A smaller portion, 97 respondents (21.9%), reported an advanced level of knowledge, while only 36 respondents (8.1%) considered themselves experts in the field. Additionally, 70 respondents (15.8%) are beginners, indicating limited familiarity with AI.

Table 3: Significant Association in the level of familiarity with Generative AI tools between Gender of library users

Variables	Gender	N	Mean Rank	Mann-Whitney U	Z	P- Value
Generative AI Familiarity	Male	236	195.89	18264.0	-4.795	0.0
	Female	206	250.84			

Table 4: Significant Association in the level of familiarity with Generative AI tools between Education Level of library users

Variables	Gender	N	Mean Rank	Kruskal Wallis H	df	Sig. Value
Generative AI Familiarity	1st Year	26	244.27	46.687	4	0.0
	2nd Year	21	202.93			
	3rd Year	117	269.93			
	4th Year	122	234.66			
	Masters	156	173.59			

Table 3 and 4 provide insight into how students’ familiarity with Generative Artificial Intelligence (AI) varies according to gender and educational level. Starting with gender, the Mann–Whitney U test (U = 18264.0, Z = −4.795, p = 0.0) shows a statistically

significant difference between male and female participants. The mean rank for females (250.84) is notably higher than that of males (195.89), suggesting that female respondents demonstrate greater familiarity and engagement with Generative AI tools and concepts. This could imply that female students are becoming increasingly involved in AI-related learning and applications, possibly due to growing inclusivity and awareness initiatives in technology education. In terms of educational level, the Kruskal–Wallis H test ($H = 46.687, p = 0.0$) indicates a significant difference across academic years. The mean ranks reveal that third-year students (269.93) are the most familiar with Generative AI, followed by first-year (244.27) and fourth-year students (234.66). Interestingly, master’s students (173.59) reported the least familiarity. This trend may reflect that undergraduate students, particularly those in their mid-program years—are more exposed to or enthusiastic about new AI technologies through coursework or informal learning opportunities. In contrast, postgraduate students might focus more on research or theoretical aspects rather than direct interaction with emerging AI tools. Overall, these results suggest that gender and academic standing significantly shape students’ familiarity with Generative AI. The higher familiarity among females and undergraduate students underscores the importance of integrating practical AI literacy and exposure into higher education curricula, ensuring all learners, especially those at advanced levels—remain engaged with rapidly evolving AI technologies. Since the p-value is below ($p < 0.05$) the significance par, the null hypothesis (H_01 and H_02) is rejected.

Table 5: Respondent’s thoughts on the role of generative AI in enhancing library services

Category	Frequency (F)	Percentage (%)
Very Positive	106	24.0
Somewhat Positive	150	33.9
Neutral	94	21.3
Somewhat Negative	78	17.6
Very Negative	14	3.2
Total	442	100.0

Table 5 depicts respondents’ opinions on the role of generative AI in enhancing library services reveal a generally positive outlook. Out of 442 participants, 106 (24.0%) expressed a very positive view, while 150 (33.9%) indicated a somewhat positive perspective, together showing that more than half of the respondents recognize the potential benefits of generative AI in library services. A smaller group, 94 respondents (21.3%), remained neutral, suggesting uncertainty or limited exposure to AI applications in libraries. On the other hand, 78 respondents (17.6%) expressed a somewhat negative opinion, and only 14 (3.2%) were very negative, reflecting minimal skepticism.

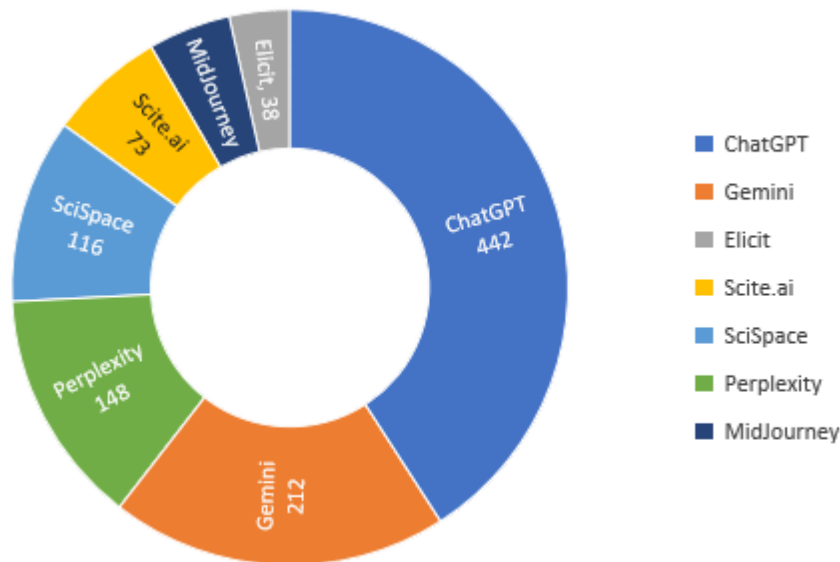


Figure 2: Respondents’ Experience with Generative AI Tools for Academic Activities. Figure 2 shows usage of generative AI tools for academic purposes indicates that ChatGPT is the most widely used tool among respondents, with 442 mentions (40.89%) out of a total of 1,081 responses. Other popular tools include Gemini (212 responses, 19.61%), Perplexity (148 responses, 13.69%), and SciSpace (116 responses, 10.73%). Lesser-used tools include Scite.ai (73 responses, 6.75%), MidJourney (52 responses, 4.81%), and Elicit (38 responses, 3.52%). The data reflects multiple responses, indicating that many respondents use more than one AI tool for their academic work.

Table 6: Significant Association in library users’ perception of AI-enhanced library services across different educational levels.

Statements	Mann–Whitney U	Z	Sig. Value	Kruskal–Wallis H	P-Value
Quick access to Information	23661.0	-0.806	0.420	24.561	0.000
Personalized Recommendations	24031.5	-0.234	0.815	1.893	0.755
Simplification of Research Processes	14082.0	-8.638	0.000	38.867	0.000
Enhanced Interactive Learning and Communication	15445.5	-7.325	0.000	62.702	0.000
New Topic Exploration Assistance	24216.5	-0.076	0.940	47.764	0.000
Query Understanding	19490.5	-3.740	0.000	32.412	0.000
Realtime Content Generation and Personalization	18418.5	-4.667	0.000	30.377	0.000

Table 6 summarizes respondents’ perceptions of how generative AI tools enhance their library service experience, analyzed using non-parametric tests (Mann–Whitney U, Wilcoxon, and Kruskal–Wallis H). The results show that some AI features were viewed as significantly beneficial, while others showed no notable difference in perception

among groups. Specifically, Quick Access to Information ($H = 24.561$, $p = 0.0$), Simplification of Research Processes ($H=38.867$, $p=0.0$), Enhanced Interactive Learning and Communication ($H = 62.702$, $p = 0.0$), Query Understanding ($H = 32.412$, $p = 0.0$), and Realtime Content Generation and Personalization ($H = 30.377$, $p = 0.000$) all demonstrate statistically significant differences in agreement levels. These findings suggest that respondents perceive these features as particularly effective in improving library operations, facilitating research, and promoting user interaction and engagement. Conversely, Personalized Recommendations ($p = 0.755$) and New Topic Exploration Assistance ($p = 0.940$) did not show significant differences, indicating that users across groups held similar neutral or consistent views regarding these aspects.

Table 7: Respondent’s Thoughts on usage of AI-driven library services to traditional library services

Category	Frequency (F)	Percentage (%)
Much better	24	5.4
Slightly better	296	67.0
Neutral	110	24.9
Slightly worse	5	1.1
Very worse	7	1.6
Total	442	100.0

Table 7 respondents’ comparison of AI-driven library services with traditional library services indicates a generally favorable perception of AI integration. Out of 442 participants, 296 (67.0%) consider AI-driven services slightly better, while 24 respondents (5.4%) view them as much better, a significant portion, 110 respondents (24.9%), remained neutral. Only a small minority perceived AI-driven services as slightly worse (5 respondents, 1.1%) or very worse (7 respondents, 1.6%) compared to traditional methods.

Table 8: Level of Convenience Experienced by Respondents in Using Generative AI Tools

Statements	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean (SD)
Generative AI tools can enhance my overall library experience	12 (2.7)	7 (1.6)	0 (0.0)	18 (4.1)	405 (91.6)	1.20 (0.76)
The Integration of AI tools in libraries make the library more effective in user experience	7 (1.6)	16 (3.6)	7 (1.6)	377 (85.3)	35 (7.9)	2.06 (0.62)
Generative AI tools would be a great asset in effective information retrieval	19 (4.3)	0 (0.0)	288 (65.2)	95 (21.5)	40 (9.0)	2.69 (0.81)
Generative AI tools help me simplify my search for academic resources in the library	7 (1.6)	124 (28.1)	129 (29.2)	164 (37.1)	18 (4.1)	2.86 (0.93)
Generative AI Tools make easier to navigate and save times to	78 (17.6)	124 (28.1)	23 (5.2)	118 (26.7)	99 (22.4)	2.92 (1.46)

accessing the resources						
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*Note: 1 = Strongly agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly disagree

4.2Based onResearch Objective 2: Assess how the Adaptation of Generative AI in Library has impacted students Learning Processes and Outcomes

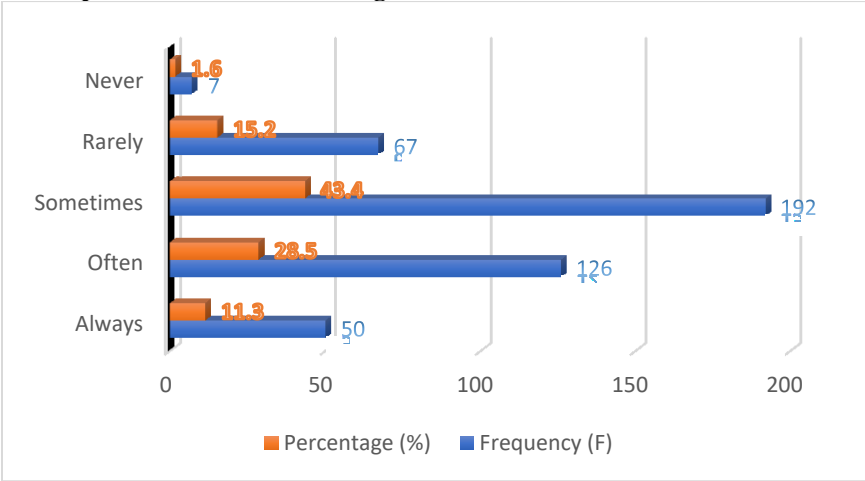


Figure 3:Frequency of Generative AI Tools Assisting in Locating Relevant Academic Resources

Figure 3 represents respondents’ perspectives on how generative AI tools have helped them locate relevant academic resources indicate varying levels of effectiveness. Out of 442 participants, 192 (43.4%) reported that AI tools sometimes help them find academic resources efficiently, while 126 respondents (28.5%) said often, and 50 respondents (11.3%) indicated always. A smaller portion, 67 respondents (15.2%), reported that these tools rarely aid in locating resources, and only 7 respondents (1.6%) stated never.

Table 9: Influence of Generative AI on Respondents’ Research and Study Habits.

Category	Frequency (F)	Percentage (%)
Improved research efficiency	187	33.75
Helped in understanding complex topics	122	22.02
Made learning more interactive	145	26.17
No Significant impact	93	16.79
Negative Impact	7	1.26

Table 9 shows respondents’ views on the influence of generative AI on their research and study habits reveal a largely positive impact. Out of 554 multiple responses, 187 (33.75%) indicated that AI tools have improved research efficiency, while 145 responses (26.17%) reported that AI has made learning more interactive. Additionally, 122 responses (22.02%) stated that AI tools have helped in understanding complex topics. A

smaller proportion, 93 responses (16.79%), indicated no significant impact, and only 7 responses (1.26%) reported a negative impact.

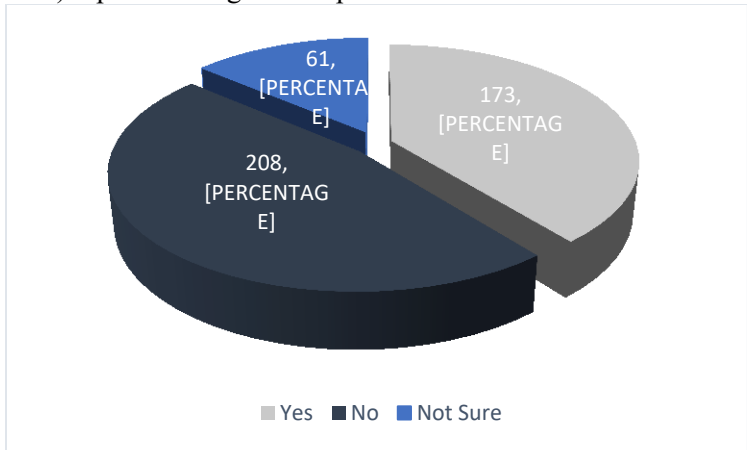


Figure 4: Respondents’ Perceptions of How AI-Driven Tools Have Improved the Quality of Their Learning Outcomes.

Figure 4 respondents’ opinions on whether AI-driven tools have improved the quality of their learning outcomes reveal a mixed perspective. Out of 442 participants, 173 respondents (39.1%) believe that AI tools have positively enhanced their learning outcomes, while a slightly larger portion, 208 respondents (47.1%), feel that AI has not improved their learning outcomes. Additionally, 61 respondents (13.8%) reported being not sure.

Table 10: Perceived Impact of Generative AI Tools in Library Services on Learning Outcomes

Statements	1 (%)	2(%)	3 (%)	4(%)	5(%)	Mean (SD)
Generative AI has improved students' ability to find relevant academic resources efficiently.	19 (4.3)	0 (0.0)	0 (0.0)	375 (84.8)	375 84.8	4.41 (0.73)
The use of generative AI in the library has enhanced critical thinking and analytical skills among students.	7 (1.6)	12 (2.7)	38 (8.6)	14 (3.2)	14 (3.2)	3.19 (1.12)
AI-based library tools have made the learning process more engaging and interactive.	23 (5.2)	41 (9.3)	138 (31.2)	108 (24.4)	108 (24.4)	3.57 (1.14)
Generative AI has contributed to better understanding and retention of academic concepts for students.	49 (11.1)	131 (29.6)	39 (8.8)	92 (20.8)	92 (20.8)	3.12 (1.39)
The availability of AI-generated summaries and recommendations has reduced the time students spend on research.	138 (31.2)	64 (14.5)	63 (14.3)	67 (15.2)	67 (15.2)	2.65 (1.50)

Generative AI tools in the library have encouraged self-directed and independent learning among students.	112 (25.3)	112 (25.3)	31 (7.0)	63 (14.3)	63 (14.3)	2.45 (1.46)
AI-driven library services have improved collaboration among students during group projects and research.	40 (9.0)	95 (21.5)	112 (25.3)	90 (20.4)	90 (20.4)	3.25 (1.27)

*Note: 1 = Not at all Impact, 2 = Slightly Impact, 3 = Moderate Impact, 4 = Significant Impact, 5 = Extreme Impact

The findings indicate that generative AI tools have had a generally positive but varied impact on students’ learning processes and outcomes through library services. The strongest effect was seen in enhancing students’ ability to find relevant academic resources efficiently ($M = 4.41$, $SD = 0.73$), where the vast majority reported significant or extreme benefits. Moderate positive impacts were also noted in making learning more engaging and interactive ($M = 3.57$, $SD = 1.14$) and improving collaboration during group projects ($M = 3.25$, $SD = 1.27$). However, the influence on critical thinking and analytical skills ($M = 3.19$, $SD = 1.12$) and conceptual understanding and retention ($M = 3.12$, $SD = 1.39$) was less pronounced, suggesting that while AI tools support academic processes, their role in deeper learning outcomes may be limited. Conversely, students perceived weaker impacts regarding time reduction in research ($M = 2.65$, $SD = 1.50$) and encouraging independent learning ($M = 2.45$, $SD = 1.46$), where responses leaned more toward minimal or slight effects.

4.3 Based on Research Objective 3: Ethical Consideration Regarding Usage of AI in Library

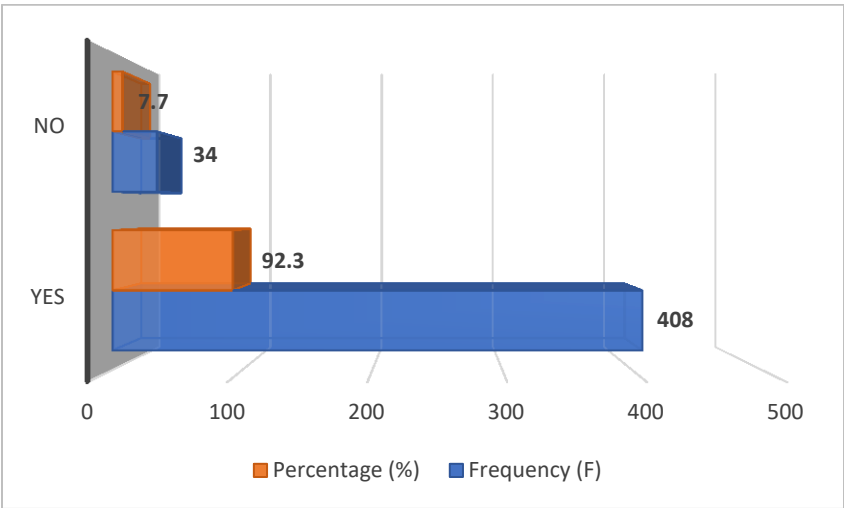


Figure 5: Respondents’ Level of Concern About Privacy When Using AI Tools

The respondents’ perspectives on privacy concerns when using AI tools indicate a high level of awareness and caution. Out of 442 participants, a substantial majority, 408 respondents (92.3%), reported that they are seriously concerned about privacy, while only 34 respondents (7.7%) indicated no concern. This demonstrates that privacy is a critical issue for most users when engaging with AI tools, reflecting growing awareness of data security, confidentiality, and ethical considerations in digital and academic contexts. Overall, the findings highlight the importance of addressing privacy safeguards and providing transparent information to build trust in AI technologies.

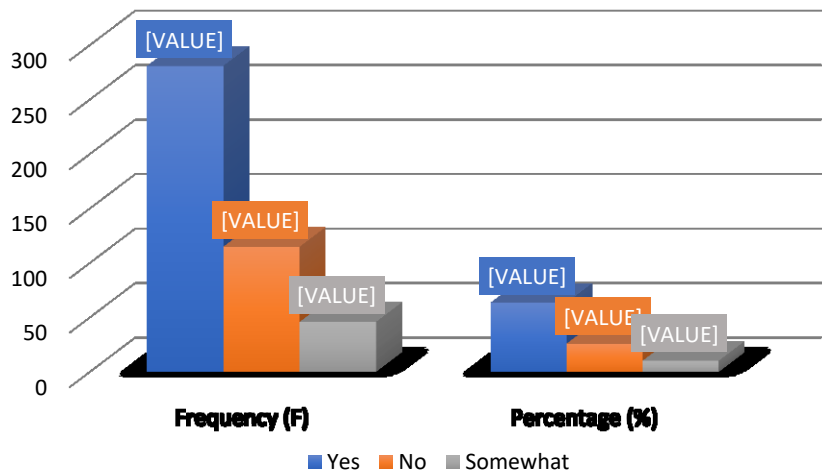


Figure 5:Trust in the Accuracy and Reliability of AI Tools within Library Environments. The respondents’ views on the accuracy and reliability of information provided by AI tools in library settings show a generally positive perception, though with some reservations. Out of 442 participants, 281 respondents (63.6%) reported that they trust the information provided by AI tools, while 46 respondents (10.4%) indicated that they somewhat trust it. However, 115 respondents (26.0%) expressed no trust in the accuracy and reliability of AI-generated information.

Table 11: Recommended Actions for Libraries to Address Ethical Issues in Generative AI Use

Category	Frequency (F)	Percentage (%)
Provide training on AI tool usage	320	34.30
Ensure privacy and data protection policies	280	30.01
Improve transparency of AI systems	108	11.58
Regularly validate AI-generated content	192	20.58
All of the above	33	3.54

*Note: Number of Multiple Responses

The respondents’ views on steps that libraries should take to address ethical concerns related to generative AI indicate a strong focus on training, privacy, and content validation. Out of 933 multiple responses, 320 responses (34.30%) suggested that libraries should provide training on AI tool usage, while 280 responses (30.01%)

emphasized the importance of ensuring privacy and data protection policies. Additionally, 192 responses (20.58%) recommended regularly validating AI-generated content, and 108 responses (11.58%) highlighted the need to improve transparency of AI systems. A small portion, 33 responses (3.54%), believed that all of the above measures should be implemented together.

Table 12: Respondents’ Level of Agreement with Ethical Considerations of Using AI in Library Services

Statements	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean(SD)
AI in libraries must ensure data privacy and confidentiality for all users.	406 (91.9)	19 (4.3)	0 (0.0)	0 (0.0)	17 (3.8)	4.46 (0.74)
The implementation of AI should prioritize inclusivity and accessibility for diverse user groups.	29 (6.6)	396 (89.6)	0 (0.0)	7 (1.6)	10 (2.3)	3.79 (0.66)
AI-based systems in libraries should avoid biases in information retrieval and recommendations.	122 (27.6)	171 (38.7)	108 (24.4)	34 (7.7)	7 (1.6)	3.55 (0.91)
Libraries using AI should maintain transparency about how user data is collected and used.	91 (20.6)	171 (38.7)	88 (19.9)	85 (19.2)	7 (1.6)	3.79 (0.81)
Ethical guidelines for AI use in libraries should be developed and strictly enforced.	134 (30.3)	106 (24.0)	139 (31.4)	38 (8.6)	25 (5.7)	3.88 (0.84)
AI should complement, not replace, the role of human librarians in delivering personalized services.	41 (9.3)	241 (54.5)	66 (14.9)	35 (7.9)	59 (13.3)	3.39 (1.17)

*Note: 1 = Strongly agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly disagree

The results highlight strong consensus among respondents on the ethical priorities for AI in library services. Ensuring data privacy and confidentiality received the highest agreement (M = 4.46, SD = 0.74), with over 90% strongly supporting it, reflecting the critical importance of user trust and security. Inclusivity and accessibility were also highly valued (M = 3.79, SD = 0.66), with nearly all respondents agreeing that AI should serve diverse user groups. Avoiding bias in AI systems (M = 3.55, SD = 0.91) and maintaining transparency in data use (M = 3.79, SD = 0.81) gained moderate agreement, indicating awareness of fairness and accountability issues. Similarly, the development and enforcement of ethical guidelines (M = 3.88, SD = 0.84) was strongly supported, showing recognition of the need for structured governance. Interestingly, opinions were more divided regarding whether AI should complement rather than replace librarians (M = 3.39, SD = 1.17), suggesting concerns about balancing technological efficiency with human-centered services. Respondents strongly emphasize privacy, inclusivity, and ethical accountability in AI-enabled libraries, though there is ongoing debate about AI’s role alongside human professionals

5. Discussions

5.1 RQ1. How can library users’ perception of the use of generative AI be differentiated from traditional library services?

According to the findings, students generally have favorable opinions on how generative AI is incorporated into library services. The majority of respondents (57.9%, which included both very positive and slightly positive attitudes) had positive opinions, whilst 20.8% had negative sentiments and roughly 21.3% were neutral. This implies that despite the substantial enthusiasm for adopting AI, some doubt and skepticism still exist. Such conflicting views are a reflection of both interest in the potential of AI and reluctance brought on by insufficient exposure or dependability worries. With 40.9% of all responses, ChatGPT was the most popular platform when looking at actual tool usage. Gemini and Perplexity came in second and third, respectively, with 19.6% and 13.7% of all respondents. Because conversational AI is so popular, students choose research and academic writing tools that allow for instant communication. For example, rapid information access ($M = 4.74$, $SD = 0.80$), tailored suggestions ($M = 4.38$, $SD = 0.77$), and research process simplification ($M = 4.22$, $SD = 0.78$), were all highly valued, indicating that consumers value efficiency and customization the most. According to Molaudzi and Ngulube (2025), these findings support the idea that AI technology in libraries improve accessibility and cut down on wait times, which in turn boosts patron happiness. AI solutions also improve inclusivity and usability, giving students more access to resources, according to Mosha (2025). Together, the prior and current data show that students view AI as a tool that facilitates access, efficacy, and convenience; nevertheless, a smaller percentage of respondents shows concerns.

5.2 RQ2. What are the factors that influence adaptation of generative AI in libraries and impacted users' learning processes and outcomes?

The generative AI demonstrates a generally positive, though variable, impact on students' learning processes. A significant proportion indicated that AI assists in locating academic resources: 43.4% reported sometimes, 28.5% frequently and 11.3% always. In addition to resource discovery, enhancements in research efficiency were reported by 33.8% of respondents, while 26.2% noted improvements in interactive learning. A smaller proportion, 22.0%, indicated that support in knowing complex topics was beneficial. However, a notable minority (16.8%) did not report significant effects, while 1.3% indicated negative outcomes. The most significant outcome was the enhanced ability to locate relevant resources efficiently ($M = 4.41$, $SD = 0.73$). The impact of AI on enhancing engagement in learning was assessed as moderate ($M = 3.57$, $SD = 1.14$), as was its role in facilitating collaboration in group projects ($M = 3.25$, $SD = 1.27$). Critical thinking and analytical skills exhibited weaker effects ($M = 3.19$, $SD = 1.12$), as did conceptual retention ($M = 3.12$, $SD = 1.39$) and independent learning ($M = 2.45$, $SD = 1.46$). This pattern indicates that although AI tools effectively assist with basic academic tasks such as discovery and engagement, their contribution to supporting deeper learning outcomes remains underdeveloped. These findings are consistent with Meakin (2024), who observed that although AI improves discovery and engagement with library resources, it does not reliably promote higher-order skills like critical thinking. Mosha (2025) similarly asserts that AI improves efficiency and interactivity; however, it requires improved integration to optimize deep learning outcomes. The evidence indicates that AI

is most effective as a supportive academic assistant, requires more structured use, training, and pedagogical integration to fully realize its educational potential.

5.3 RQ3. What are the ethical considerations be addressed to ensure best practices of generative AI in libraries?

The participants showed strong awareness of ethical issues. A vast majority of participants, namely 92.3%, showed serious care about the issue of privacy while using AI, recognizing confidentiality of data as a topmost goal. The trust in the accuracy of AI results had a substantial difference, as 63.6% showed trust in the results, while 26.0% showed a lack of trust, being 10.4% undecided. This indicates a lack of absolute user confidence in AI despite recognizing benefits, so trust in reliability remains a point of reservation. In response to a question about what action the libraries could take, the measures suggested most often were training on AI tool use, suggested by 34.3% participants, followed by the implementation of privacy/protection policies on data use, advocated by 30.0% participants, followed finally by validation of AI results, advocated by 20.6% participants. The expectations on ethical standards were supplemented in response to a question on a Likert scale on preferred standards, as a top agenda item were standards concerning data confidentiality, as per mean values ($M = 4.46$, $SD = 0.74$), followed as usual in descending order were following ethical standards, as per mean values ($M = 3.88$, $SD = 0.84$), supplemented respectively as a next topmost topic, as per mean values, use of data transparency, as per mean values ($M = 3.79$, $SD = 0.81$). The views on AI, human, and librarian use were graded differently as per mean values, grader on use, human/librarian, as per mean values ($M = 3.39$, $SD = 1.17$), because of a fear of job displacement. The views on ethical perspectives were in conformity, as per perspective, on transparency, as per mean values, so as per reference work, on AI, as per 2024, as cited in Kavak 2024, as a cited work, on AI, suggesting ideally a top agenda concerning privacy, as per cited work, on AI, substantiating supporting, on transparency, as per cited work, because AI, requires transparency as per cited views. Similarly, as per another supporting view, on ethical perspectives, as per AI perspective, as per Tammaro and Casarosa 2024, as cited work on decision-making on AI. The Journal of Information & Knowledge Management

6. Conclusions and Recommendations

The study has examined the impact of Generative Artificial Intelligence on the user community of the academic libraries of Bangladesh. The findings indicate that students perceive AI-integrated services positively. While accessibility, personalized learning, and research and study systems are better provided by ChatGPT and Gemini, their effects are average on higher-order thinking, autonomous learning, and critical thinking. Ethic-driven aspects have been highly stressed, especially relating to privacy, transparency, and trust in AI-driven systems. The importance of the responsible use of AI has been demonstrated, with a particular focus on ethical implementation. The results have established the fact that Generative AI has enabled a transformation from static conventional libraries to interactive user-driven environments. However, this needs a balanced approach between technological advancements within AI and maintaining AI-

driven ethical purity. Long-term effects on cognitive development and AI adaptation in different organizational set-ups need future research. The importance of AI literacy trends would also be worth analysis. Delving deep into the role of an AI-literate human resource, especially focusing on a strong AI-driven data defense framework, would be highly obligatory. To derive maximal advantages from Generative AI, AI literacy, reinforcement of privacy and transparency, and the development of ethical determination would be paramount. Implementation of AI within the context of higher education could enable cooperative human-AI working which could supplement rather than replace human expertise. Regular research on Generative AI would be integral based on continuous user feedback. One future success story concerning Generative AI within the context of academic libraries would be to develop a balanced, equal, transparent, human-focused AI-driven environment which enhances both maximum use value and ethical development.

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The Role of Public Libraries in Bangladesh in Achieving Sustainable Development Goals: A User-Centered Study

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Abstract

Purpose: Public libraries in Bangladesh play an increasingly important role in providing equitable access to information, learning, and social engagement. This study investigates how and why these institutions contribute to achieving the United Nations Sustainable Development Goals (SDGs) by analyzing the experiences and perceptions of library users.

Methodology: Statistical analyses, including Mann–Whitney U tests, Pearson correlations, and factor analysis, highlight significant relationships between demographics,

visit frequency, and satisfaction levels, while also pointing to systemic challenges. Using data from 185 respondents across national, divisional, and district libraries, the research identifies library usage patterns, levels of satisfaction, and awareness of SDGs. **Findings:** Findings reveal that libraries are primarily used for education, career development, and information access, with books and newspapers as the most frequently used resources. However, user familiarity with SDGs remains low, and infrastructural limitations—such as inadequate ICT facilities, power interruptions, and insufficient digital services—constrain their potential. **Originality:** The study is the first attempt to assess the contribution of public libraries from a user-centered perspective using robust statistical evidence and identifies the current contributions and key gaps, offering practical insights for authorities. **Conclusion:** This study demonstrates that libraries are already essential community institutions, but their role in advancing the SDGs can only be fully realized through strategic investments in ICT infrastructure, professional training, and user-centered services. The research underscores why public libraries matter for sustainable development in Bangladesh and how they can be

repositioned as catalysts for achieving the SDG agenda.

Keywords

public libraries, sustainable development goals, SDGs, Bangladesh, user-centered study, library services

1. Introduction

Public libraries, often considered the foundation of knowledge and information dissemination, have an indispensable role in shaping the socio-economic fabric of a nation. In the context of Bangladesh, a country that has set ambitious targets for achieving the Sustainable Development Goals (SDGs), the role of public libraries becomes particularly significant. Access to information is crucial for achieving SDGs, with libraries as key partners. SDG success should focus on data utilization to solve

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citizen problems. Information centers are adapting through professional development and re-skilling efforts (Kabatangare, 2021). Sustainable Development Goals are a universal call to action to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity by 2030. The Sustainable Development Goals (SDGs) are a framework for tackling urgent environmental and socioeconomic issues that have drawn a lot of attention from around the world (Panda et al., 2023). The effectiveness of public libraries in Bangladesh in contributing to these goals needs to be thoroughly examined. It goes without saying that libraries play a crucial role in providing information for development. Without pertinent data to support its sustainable growth, no country can advance. Libraries' operations include gathering, organizing, disseminating, and preserving information for future generations (Onoyeyan&Adesina, 2014).

Sustainable development is defined as meeting present needs without compromising future generations' ability to meet their own needs. Sustainable development encompasses economic development, social equity, and environmental protection. The Sustainable Development Goals (SDGs) are applicable to all countries, with a focus on addressing issues such as child poverty, poor health, gender imbalance, and income differences in both developed and developing nations (Chowdhury &Koya, 2017). Effective SDG achievement requires collaboration between government, public, and enterprises (Gunawan et al., 2020).

Libraries can play a key role in the attainment of the SDGs by repositioning themselves to provide target-specific information services through partnerships with other institutions and agencies (Benson et al., 2019).In Bangladesh, public libraries are managed mainly by the Department of Public Libraries under the Ministry of Cultural Affairs. This system includes the National Library in Dhaka, divisional libraries, and a wide network of district libraries. Despite this coverage, many face structural and resource-based challenges, including outdated collections, insufficient ICT facilities, funding shortages, and staffing constraints. Nonetheless, public libraries continue to be highly valued by students, job seekers, and community members who rely on them for educational resources and access to information that may otherwise be unavailable.

Previous studies in Bangladesh have recognized the potential of libraries, but very few have captured the user perspective in detail. Yet, it is through the lens of users—the primary stakeholders—that the actual impact of library services can be understood. This study addresses that gap by examining how people use public libraries, how satisfied they are with existing services, their awareness of the SDGs, and what improvements they recommend. A user-centered approach not only highlights present contributions but also reveals the barriers that must be addressed for libraries to function as genuine development partners.

2. Objective

The prime aims of the study to evaluate the role of public libraries in Bangladesh in advancing the Sustainable Development Goals (SDGs) from a user-centered perspective. Specific Objectives are:

- ✓ To analyze library users' perceptions, usage patterns, and satisfaction with public library services.
- ✓ To evaluate users' familiarity with SDGs and perceptions of libraries' contributions to development.
- ✓ To identify the barriers users face in accessing and benefiting from libraries.
- ✓ To gather recommendations for strengthening libraries as active partners in achieving SDGs.

3. Literature Review

Public libraries play a crucial role in local communities, especially in rural and disadvantaged areas. They are not just places with books; they serve as social and cultural institutions that provide a variety of resources for community members (Abu et al., 2011). Libraries can serve as welcoming environments for individuals experiencing homelessness, offering resources such as access to computers, educational programs, and social services (Bunic, 2016). Academic libraries and librarians contribute significantly in supporting educational institutions, which is vital for sustainable development (Osinulu, 2021). Dadzie et al. (2016) evaluated the contribution of libraries towards achieving Sustainable Development Goal, which focuses on ensuring healthy lives and promoting well-being for all. This assessment is conducted through a case study approach involving interviews with ten librarians. Understanding the evolution of public libraries in Bangladesh provides insights into the historical context in which these institutions have developed. Since knowledge and information enable people to make well-informed decisions that can enhance their lives, access to them is a prerequisite for opportunity everywhere (Ogunmodede et al., 2023). The SDGs can serve as a benchmarking tool for libraries, encouraging them to set ambitious targets aligned with the 2030 agenda (Thorpe & Gunton, 2002).

A number of variables affect sustainable library services, and the costs as well as the availability and support of technology provide obstacles (Ahmed, N. 2024). Global examples of library initiatives for sustainable development serve as valuable case studies to understand the diverse ways in which libraries contribute to the achievement of SDGs. Islam et al (2024) aims to explore the awareness of Sustainable Development Goals (SDGs) among public librarians in Bangladesh and their understanding of how public libraries can contribute to achieving these goals. Public libraries' contributions to the promotion of the SDGs have received little attention. The strategic role public libraries can play in advancing the SDGs was investigated by Aregbesola et al. (2024), who also proposed important tactics for public libraries to support sustainable development.

In Bangladesh, research by Islam, Sultana & Widén (2024) and the Library Association of Bangladesh (2022) acknowledges that public libraries have potential for advancing education and inclusion but also identifies low awareness of SDGs, weak ICT infrastructure, and underutilization as major obstacles. Very few studies foreground user experiences and perceptions.

Public libraries play a crucial role in advancing the United Nations Sustainable

Development Goals (SDGs) by providing access to information, promoting literacy, supporting education, and fostering social inclusion and community engagement Nigeria (Islam, Sultana, & Widén, 2022). Research highlights that public libraries serve as knowledge hubs that can educate, inform, and mobilize communities toward sustainable development, although their potential is often underutilized due to challenges like low awareness of SDGs, limited ICT infrastructure, and insufficient policy support, as seen in Bangladesh and (Aregbesola, Owolabi&Adebisi, 2023). Case studies from Jordan and Indonesia demonstrate that libraries contribute significantly to various SDGs, including quality education (SDG 4), decent work and economic growth (SDG 8), and reduced inequalities (SDG 10), through targeted programs such as entrepreneurship incubation and social inclusion initiatives (Haryanto,Laugu&Zulaikha, 2024). However, gaps remain in fully aligning library services with all SDGs, with some goals like peace, justice, and zero hunger receiving less attention (Tbaishat, D. (2020). Methodological frameworks have been developed to evaluate and enhance libraries' contributions to the SDGs, emphasizing the need for strategic planning, impact assessment, and increased advocacy within the library and information science field (Kosciejew, 2020). Overall, public libraries are recognized as vital community institutions that can drive sustainable development by expanding social capital, promoting equity, and supporting lifelong learning, but realizing this potential requires overcoming infrastructural and awareness barriers (Williams-Cockfield & Mehra, 2024).

This research builds on that gap by presenting empirical evidence from 185 library users, highlighting both the strengths and the shortcomings of public libraries in their alignment with the SDG agenda.

4. Research Methodology

This study employed a quantitative research methodology to evaluate the role of public libraries in achieving the Sustainable Development Goals (SDGs) from a user-centered perspective. Data were collected from 185 users across the National Library, divisional libraries, and district libraries of Bangladesh. A purposive sampling technique was used to ensure representation of users from different levels of the public library system.

A structured questionnaire was designed and distributed between July 2024 and January 2025. It covered demographic information, library usage patterns, satisfaction with resources and services, awareness of SDGs, perceptions of libraries' developmental contributions, and user recommendations. The collected data were analyzed using the 23rd version of SPSS. Descriptive statistics such as frequencies, percentages, and means were applied to identify usage patterns and satisfaction levels. Inferential analyses—including the Mann–Whitney U test and Pearson correlation analysis—were used to explore differences and relationships between demographic variables and library use. In addition, Exploratory Factor Analysis (Principal Component Analysis with Varimax rotation) was conducted to uncover underlying dimensions of user experiences, satisfaction, challenges, and recommendations.

This methodological design provided a rigorous basis for understanding how library users

perceive and engage with public library services, ensuring that the findings reflect real user experiences and highlight actionable strategies for strengthening libraries' roles in Bangladesh's SDG agenda.

5. Data Analysis and Findings

The Data Analysis section serves as a foundation for understanding the insights gathered from both public library administrators and users. This section systematically analyzes quantitative and qualitative data to uncover the status, challenges, and opportunities of public libraries in Bangladesh. The analysis aims to evaluate the services and facilities offered by public libraries, assess their alignment with Sustainable Development Goals (SDGs), and understand user behavior, satisfaction, and expectations. Through statistical techniques, including descriptive analysis, reliability tests, and inferential statistics, the findings highlight key patterns, relationships, and perceptions within the library ecosystem. The analysis not only explores the current state of public libraries but also sheds light on their potential to act as catalysts for societal development through education, community engagement, and technological adaptation. This section sets the stage for meaningful discussions and recommendations to enhance the efficiency and impact of public libraries in Bangladesh.

5.1 Demographic Information of Library Administrators

The demographic profile of the library administrators (N=23) indicates a predominance of male participants (69.6%), with female respondents comprising 30.4%. In terms of designation, the majority were librarians (52.2%), followed by assistant librarians (21.7%) and assistant directors (17.4%). Both deputy librarian and principal librarian roles were represented by a single respondent each (4.3%). The age distribution reveals that most administrators fall within the 30-39 years age group (47.8%), while 26.1% were aged 50-59 years, and 21.7% were between 40-49 years. Only one respondent (4.3%) was under the age of 30, highlighting a relatively mature workforce within the public libraries. This demographic diversity provides a balanced perspective on the challenges and opportunities in achieving sustainable development goals through library services.

5.2 Demographic Information (User)

The demographic information of public library users shows a diverse group. The majority (58.4%) use district government public libraries, followed by 31.4% using divisional government public libraries and 10.3% using the national public library. The gender distribution indicates a higher proportion of male users (57.3%) compared to female users (42.7%). Regarding profession, students form the largest group (55.1%), followed by local people (20%), teachers (6.5%), and smaller groups of businessmen, researchers, job holders, housewives, and retired persons. In terms of age, the largest age group is 20-29 years (41.6%), followed by 30-39 years (23.2%) and under 20 years (13.5%). Smaller percentages fall within the 40-49 years (9.7%), 50-59 years (5.9%), and 60 and above years (5.9%) age groups.

Table1:DemographicInformationofUsersofPublicLibrary (n=185)

	Frequency	Percent	Valid%	Cumulative%
DistrictGovt.PublicLibrary	108	58.4	58.4	58.4
Divisional Govt. PublicLibrary	58	31.4	31.4	89.7
NationalPublicLibrary	19	10.3	10.3	100.0
Gender				
Male	106	57.3	57.3	57.3
Female	79	42.7	42.7	100.0
Total	185	100.0	100.0	
Profession				
Teacher	12	6.5	6.5	6.5
Student	102	55.1	55.1	61.6
Researcher	5	2.7	2.7	64.3
Businessman	9	4.9	4.9	69.2
Localpeople	37	20.0	20.0	89.2
Jobholder	6	3.2	3.2	92.4
Housewife	7	3.8	3.8	96.2

5.3 Frequency of Library Visit

The frequency of library visits among users shows that 41.6% visit occasionally, while 25.4% visit daily. Smaller groups visit 2-3 times a week (9.7%), weekly (15.7%), or monthly(7.6%). This distribution highlights that while a significant portion of users visit occasionally, there is still a notable group of regular visitors, especially those who visit daily.

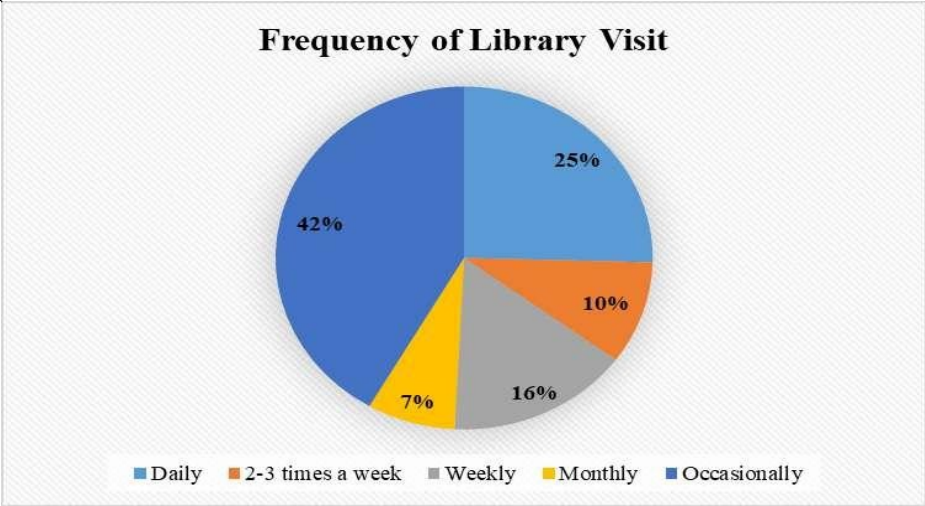


Figure5.2:Frequencyof LibraryVisit
Figure 1: Frequency of Library Visit by the Users

The cross-tabulation shows that male respondents visit the library more frequently than females. Of the 106 male users, 37 visit daily, while 10 females out of 79 do so. More females(17)visitweeklycomparedtomales(12),andahigherpercentageoffemales(41) visit occasionally. Overall, 47 visit daily, 18 visit 2-3 times a week, 29 visit weekly, 14 visit monthly, and 77 visit occasionally.

Table 2: Gender* FrequencyofLibraryVisit(Crosstabulation)

		Frequency					Total
		Daily	2-3times aweek	Weekly	Monthly	Occasionally	
Gender	Male	37	12	12	9	36	106
	Female	10	6	17	5	41	79
Total		47	18	29	14	77	185

5.4 Data NormalityTest

The tests of normality (Kolmogorov-Smirnov and Shapiro-Wilk) indicate that the frequencyof libraryvisits does not follow anormal distribution forboth male and female respondents. For males, the Kolmogorov-Smirnov test statistic is 0.222 (p = 0.000), and theShapiro-Wilkteststatisticis0.788(p=0.000).Forfemales,theKolmogorov-Smirnov statisticis0.318(p=0.000),andtheShapiro-Wilkstatisticis0.769(p=0.000).Bothtests have significant p-values, confirming non-normality in both groups.

Table 3: Tests ofNormality

	Gender	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Howoftendo you visit the library?	Male	.222	106	.000	.788	106	.000
	Female	.318	79	.000	.769	79	.000
a.LillieforsSignificanceCorrection							

5.5 Mann-Whitney U-Test

The Mann-Whitney U test results indicate a significant difference in the frequency of library visits between male and female respondents. The Mann-Whitney U statistic is 3060.500, and the Wilcoxon W statistic is 8731.500. The Z value is -3.284, with an asymptotic significance (2-tailed) of 0.001, which is below the threshold of 0.05, suggesting that gender significantly influences library visit frequency.

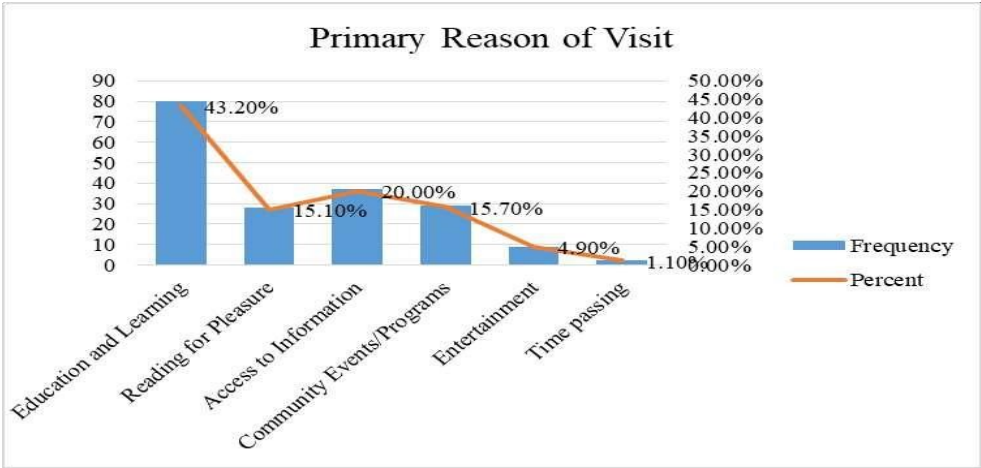
Table 4:TestStatistics

	Howoftendoyouvisitthe library?
Mann-WhitneyU	3060.500
WilcoxonW	8731.500
Z	-3.284
Asymp.Sig.(2-tailed)	.001
a.GroupingVariable:Gender	

5.6 Primary Reasons of Library Visit

The primary reasons for library visits among the respondents are as follows: 43.2% visit for education and learning, 20% for access to information, 15.7% for community events or programs, 15.1% for reading pleasure, 4.9% for entertainment, and 1.1% for passing time. The majority of users (58.4%) identified education and learning or access to information as their main reason for visiting.

Figure2: PrimaryReasonforLibrary Visits



5.7 Use of Reading Materials

The most frequently used reading materials at the library are books, with 75.7% of users engaging with them, followed by newspapers at 63.2%, and journals at 33.5%. Other materials used include magazines (30.8%), reports (17.3%), thesis papers (14.1%), non-book materials (21.1%), news clippings (11.9%), audio-visual materials (4.9%), and memorabilia (9.2%). Overall, users reported 521 instances of material usage, indicating a total of 281.6% usage across different categories.

Table5:UseFrequenciesofReading Materials

ReadingMaterials	Responses		PercentofCases
	N	Percent	
Book	140	26.9%	75.7%
Journal	62	11.9%	33.5%
Newspaper	117	22.5%	63.2%
Magazine	57	10.9%	30.8%
Audio visual	9	1.7%	4.9%
None-bookmaterials	39	7.5%	21.1%
Reports	32	6.1%	17.3%
Newsclippings	22	4.2%	11.9%
Thesispaper	26	5.0%	14.1%
Memorabilia	17	3.3%	9.2%
Total	521	100.0%	281.6%

5.8 PurposeofPublicLibraryUse

The primary purposes for using the public library include academic purposes (48.9%), career development (29.3%), and subjective knowledge (29.9%). Other significant uses are for entertainment (27.7%), research (14.7%), and project work (12.5%). Smaller percentages are for activities such as article writing (13.6%), study for jobs (9.8%), thesis/dissertation writing (4.9%), and presentation preparation (12.0%). In total, 382 instances of library use were reported, resulting in a cumulative percentage of 207.6%.

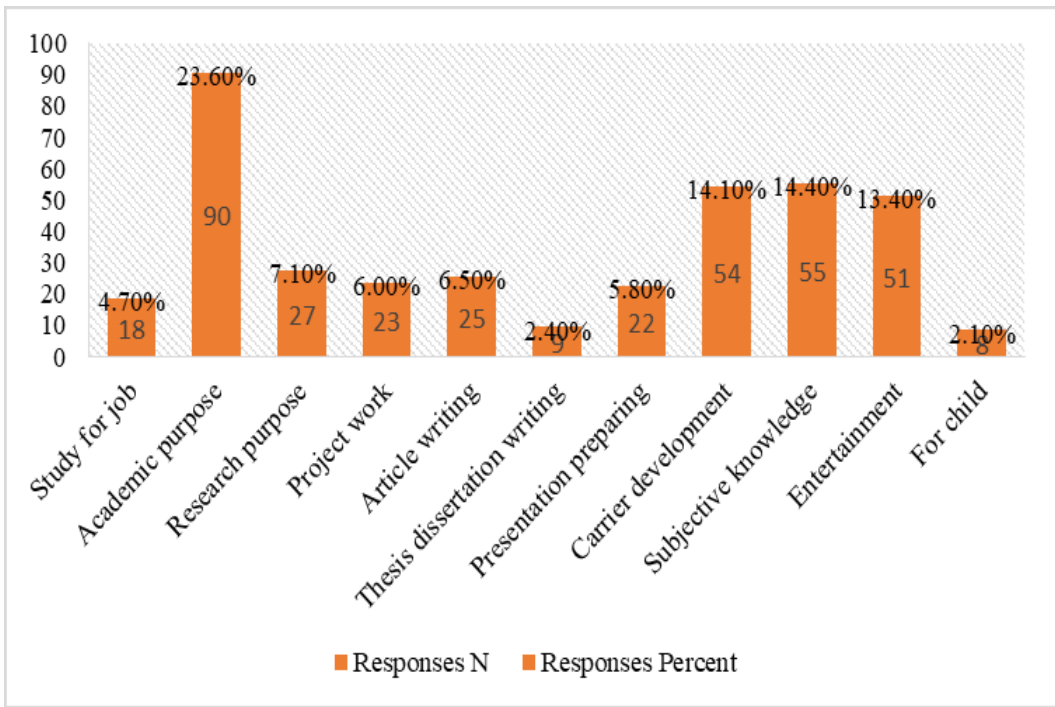


Figure 3: Purpose of Public Library Use

5.9 Familiarity with Sustainable Development Goals (SDGs)

The familiarity with Sustainable Development Goals (SDGs) among library users varies, with 28.1% being slightly familiar, 21.1% moderately familiar, and 19.5% somewhat familiar. A smaller percentage, 20.5%, reported being not at all familiar with SDGs, while 10.8% were extremely familiar. The total number of respondents was 185.

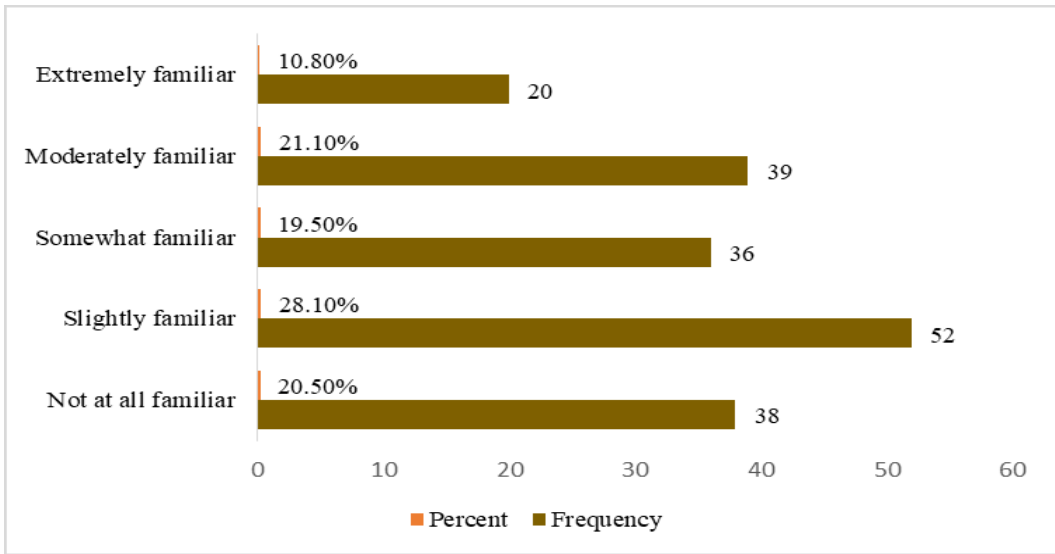


Figure4 : Familiarity with Sustainable Development Goals (SDGs)

5.10 Belief in Public Libraries' Influence on Achieving SDGs

The belief that public libraries can influence society and its people to achieve the SDGs varies among respondents. A significant portion, 22.2%, believes libraries are very influential, while another 22.2% considers them somewhat influential. Additionally, 20.5% view them as slightly influential, and 19.5% believe they are extremely influential. However, 15.7% of respondents feel that libraries are not at all influential. The total number of respondents was 185.

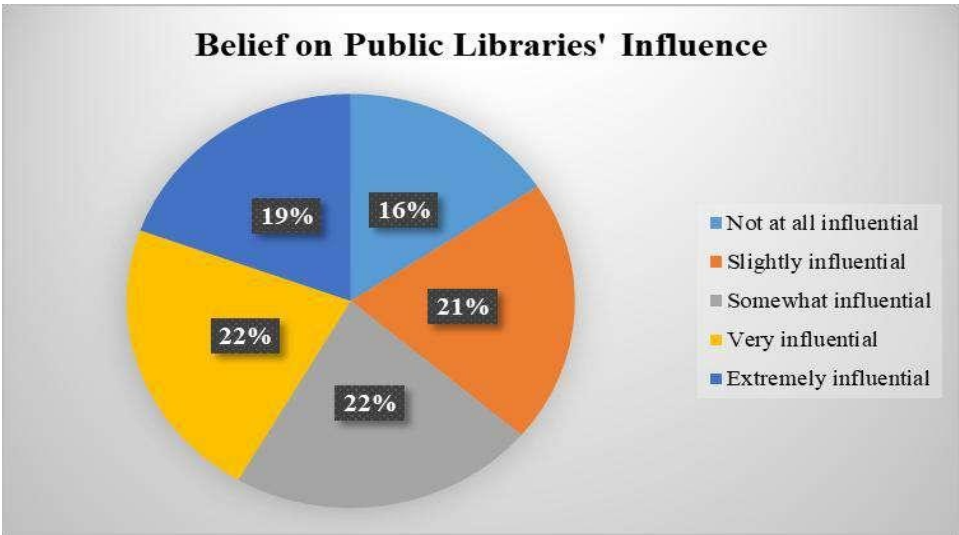


Figure 6: Belief in public library influences

5.11 Descriptive Statistics for Reading Materials Used by Users

The descriptive statistics reveal the frequency of different reading materials used by library patrons. Books are the most frequently used, with a mean of 0.76, followed by newspapers at 0.63. Journals and magazines are used less frequently, with means of 0.34 and 0.31, respectively. Audio-visual materials have a very low mean(0.05), indicating rare use. Non- book materials, reports, news clippings, thesis papers, and memorabilia are also in frequently used, with respective means ranging from 0.09 to 0.21. The distributions for most materials are skewed, with books and newspapers showing more balanced usage, while materials like audio-visuals, reports, and memorabilia exhibit extreme skewness, indicating low but concentrated usage.

Table 6: Descriptive Statistics

	N	Mini mum	Maxi mum	Mean	SD	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Book	185	0	1	.76	.430	1.207 ⁻	.179	-.550	.355
Journal	185	0	1	.34	.473	.704 ⁻	.179	1.521 ⁻	.355
Newspaper	185	0	1	.63	.483	-.554 ⁻	.179	1.712 ⁻	.355
Magazine	185	0	1	.31	.463	.838 ⁻	.179	1.312 ⁻	.355
Audio visual	184	0	1	.05	.216	4.217 ⁻	.179	15.959 ⁻	.356
None book materials	185	0	1	.21	.409	1.430 ⁻	.179	.044	.355
Reports	185	0	1	.17	.379	1.743 ⁻	.179	1.051	.355
News clippings	185	0	1	.12	.325	2.374 ⁻	.179	3.675	.355
Thesispaper	185	0	1	.14	.348	2.085 ⁻	.179	2.375	.355
Memorabilia	185	0	1	.09	.290	2.849 ⁻	.179	6.182	.355

5.12 Descriptive statistics for the purpose of library use

The descriptive statistics for the purpose of library use show varying frequencies for different activities. The most common purpose is academic use, with a mean of 0.49, followed by career development (0.29) and subjective knowledge (0.30). Other purposes like article writing (0.14), research purpose (0.15), and project work (0.12) are used less frequently. Thesis-dissertation writing (0.05) and study for job (0.10) are the least frequent uses. The distributions show skewness for many activities, such as thesis-dissertation writing and study for job, indicating rare but concentrated use. Most activities exhibit high kurtosis, indicating a leptokurtic distribution with few extreme values.

Table 7: Descriptive Statistics									
	N	Mini mum	Maxi mum	Mean	SD	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic		Statistic	Std. Error
Study for job	185	0	1	.10	.297	2.740	.179	5.567	.355
Academic purpose	185	0	1	.49	.501	.055		-2.019	.355
Research purpose	185	0	1	.15	.354	2.022		2.112	.355
Project work	185	0	1	.12	.331	2.296		3.306	.355
Article writing	185	0	1	.14	.343	2.152		2.660	.355
Thesis- dissertation writing	185	0	1	.05	.216	4.230	.179	16.07 0	.355
Presentation preparing	185	0	1	.12	.325	2.374		3.675	.355
Carrier development	185	0	1	.29	.456	.923		-1.161	.355
Subjective knowledge	185	0	1	.30	.458	.894	.179	- 1.214	.355
Entertainment	185	0	1	.28	.448	1.012	.179	-.986	.355
For child	185	0	1	.04	.204	4.528		18.70 4	.355

5.13 Exploratory Factor Analysis

5.13.1 KMO Value

The Kaiser-Meyer-Olk in (KMO) measure of sampling adequacy is 0.855, indicating that the sample size is appropriate for conducting fact or analysis. Bartlett's Test of Sphericity results inachi-square value of 4649.919 with703 degrees offered mind assign nuisance value of 0.000, which is less than 0.05, suggesting that the correlation matrix is significantly different from an identity matrix and thus suitable for factor analysis.

Table 8 : KMO and Bartlett's Test

Kaiser-Meyer-Olk in Measure of Sampling Adequacy.		.855
Bartlett's Test of Sphericity	Approx. Chi-Square	4649.919
	df	703
	Sig.	.000

5.13.2 Communalities

The communalities table from the Principal Component Analyst is (PCA) highlight show well each item is represented by the extracted factors. Items such as "Satisfaction with the use of textbooks" (0.750), "Satisfaction with the use of online databases" (0.743), and

"Recommend ensuring user-friendly environment" (0.778) exhibit strong representation, indicating their significance in explaining variance. Similarly, technical challenges like *"Face low bandwidth"* (0.770) and *"Face lack of air conditioning facility"* (0.782) are highly influential in the factor structure. However, items such as *"Satisfaction with the use of photocopy services"* (0.598) and *"Face noisy environment"* (0.597) have lower communalities, suggesting a relatively lesser contribution while remaining relevant. Overall, the factor model effectively captures the variance of most items, supporting its adequacy.

Table 9: Communalities

Item		Initial	Extraction
S1	Satisfaction with the use of text books	1.000	.750
S2	Satisfaction with the use of manuscripts	1.000	.772
S3	Satisfaction with the use of journal	1.000	.735
S4	Satisfaction with the use of periodicals	1.000	.697
S5	Satisfaction with the use of reference books	1.000	.614
S6	Satisfaction with the use of audio-visual materials	1.000	.591
S7	Satisfaction with the use of computer	1.000	.637
S8	Satisfaction with the use of air-condition	1.000	.669
S9	Satisfaction with the use of archives	1.000	.729
S10	Satisfaction with the use of on line database	1.000	.743
S11	Satisfaction with the use of e-books	1.000	.749
S12	Satisfaction with the use of there adingarea facility	1.000	.681
SS13	Satisfaction level on Reference service	1.000	.686
SS14	Satisfaction level on Internet services	1.000	.702
SS15	Satisfaction level on indexing and abstracting services	1.000	.764
SS16	Satisfaction level on online service-	1.000	.697
SS17	Satisfaction level on CAS & SDI services	1.000	.753
SS18	Satisfaction level on Bibliographical services	1.000	.660
SS19	Satisfaction level on Photocopy services	1.000	.598
SS20	Satisfaction level on Inter-library loan	1.000	.604
SS21	Satisfaction level on Required information	1.000	.689
PCB1	Face in sufficient sources	1.000	.648
PCB2	Facedown and width-	1.000	.770
PCB3	Face server problem to access repository	1.000	.755
PCB4	Face lack of computer accessories	1.000	.701

PCB4	Face lack of co-operation from library staff	1.000	.694
PCB4	Face disorder shelving system-	1.000	.774
PCB4	Face lack of constant power supply-	1.000	.655
PCB4	Face noisy environment-	1.000	.597
PCB4	Face lack of air conditioning facility	1.000	.782
R1	Recommend creating a user-friendly website	1.000	.664
R2	Recommend increasing internet speed-	1.000	.752
R3	Recommend increasing the number of books -	1.000	.710
R4	Recommend ensuring uninterrupted power supply	1.000	.753
R5	Recommend ensuring sufficient computer-	1.000	.741
R6	Recommend ensuring skilled personnel to solveany problem-	1.000	.772
R7	Recommend arranging in-house training/information literacyprogram-	1.000	.700
R8	Recommend ensuring user-friendly environment	1.000	.778
	Extraction Method: Principal Component Analysis.		

5.13.3 Scree Plot Test

The screeplotvisualizes the eigenvalues of the component sinde scending order, indicating the variance explained by each component. The "elbow" of the plot, where the curve flattens, is critical point for determining the number off actors to retain. In this case, the first few components (likely around 3 to 5) exhibit large eigenvalues, suggesting they explainthemajorityofvariance.Componentsbeyondthispointshowdiminishingreturns, astheireigenvaluesdropbelow1,indicatinglimitedcontributiontotheoverallvariance.This scree plot supports the retention of a small number of significant components for further analysis.

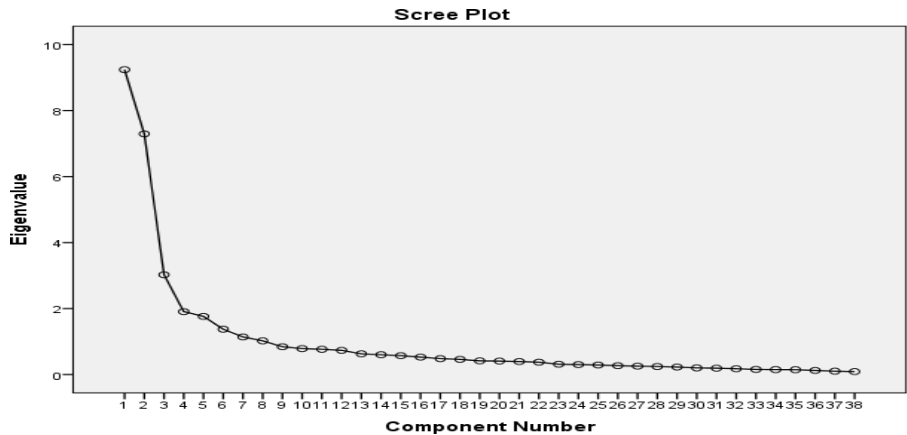


Figure6:Scree PlotTestof UserData

5.13.4 Total Variance Explained

The "Total Variance Explained" table outlines the contribution of each component to the total variance in the data. Initially, four component collectively account for approximately 56.49% of the cumulative variance, with Component1explaining 24.32%, Component 2 adding 19.20%, Component 3 contributing 7.96%, and Component 4adding 5.02%. After rotation, which redistributes the explained variance more evenly across components, the first four components explain 17.03%, 15.29%, 13.14%, and 11.02% of the variance, respectively, maintaining the cumulative variance of 56.49%.This suggests that these four components are key to summarizing the dataset effectively while retaining meaningful patterns. Components beyond the fourth contribute minimally to the variance, as their eigenvalues drop below 1, indicating limited explanatory power.

Table10 :Total Variance Explained						
Component	Initial Eigenvalues			Rotation Sums of quared Loadings		
	Total	% of Variance	Cumulative%	Total	% of Variance	Cumulative%
1	9.240	24.316	24.316	6.472	17.033	17.033
2	7.294	19.195	43.510	5.810	15.288	32.321
3	3.024	7.959	51.470	4.995	13.144	45.465
4	1.907	5.017	56.487	4.188	11.022	56.487

5.13.5 Rotated Component Matrix

The "Rotated Component Matrix" highlights how individual variables load onto four distinct components after applying the Varimax rotation method. This rotation enhances interpretability by assigning variables more strongly to specific components, summarized as follows:

Component 1: Strongly associated with satisfaction related to various library resources and services, such as journals, periodicals, audio-visual materials, indexing and abstracting services, and CAS & SDI services. The sevariables have high positive loadings, indicating their shared variance.

Component 2: Primarily linked to recommendations for improving library in frastructure and services. Variables such as ensuringuser-friendly environments, increasing internet speed, adding more books, and providing skilled personnel show strong loadings on this component.

Component 3: Focused on challenges faced by users, such as insufficient resources,lowbandwidth,serverissues,lackofcomputeraccessories,andshelving disorder. These variables demonstrate high loadings, suggesting they represent a cohesive set of issues.

Component 4:Relatedtosatisfactionwithspecificfacilities,suchasreadingareas, reference services, and photocopy services, with notable positive loadings. This component captures users' satisfaction with physical library amenities.

TheDataAnalysissectionprovidescriticalinsightsintothefunctioningandperceptionof public

libraries in Bangladesh. The findings highlight the dual role of libraries in offering traditional services, such as access to books and reference materials, alongside emerging digital services that cater to modern information needs. The analysis underscores the contribution of libraries to societal development through educational programs, skill-building initiatives, and community engagement aligned with SDGs. However, challenges such as financial constraints, technological gaps, and limited awareness of SDG-related efforts pose significant barriers. Despite these hurdles, opportunities for growth exist, including digital transformation, capacity-building for library staff, and the introduction of user-centered programs. The insights from this section offer a robust foundation for the subsequent discussions and recommendations aimed at strengthening public libraries' roles in meeting the evolving needs of society.

6. Discussion

The findings of this study reveal that public libraries in Bangladesh remain vital community institutions, particularly for students and young adults, who form the majority of users. Libraries are primarily used for educational purposes and access to information, reaffirming their role in advancing SDG 4 (Quality Education). However, usage patterns indicate that a large proportion of users visit occasionally rather than regularly, which reflects both opportunities and challenges. While the demand for educational resources is high, infrastructural and technological shortcomings—such as limited bandwidth, insufficient resources, and outdated facilities—discourage more frequent use.

Gender-based analysis further underscores disparities in library use. Male users tend to visit libraries more frequently than females, a finding consistent with socio-cultural barriers and the lack of gender-friendly facilities in many libraries. Addressing these disparities is essential for ensuring inclusivity and advancing SDG 5 (Gender Equality) and SDG 10 (Reduced Inequalities).

The study also reveals that awareness of the Sustainable Development Goals among users remains moderate to low. While many users recognize the broader social role of libraries, only a small proportion report being highly familiar with SDGs. This suggests that the contribution of libraries to SDG 16 (Peace, Justice, and Strong Institutions)—specifically in promoting access to information—is not being fully realized. Public libraries could serve as important platforms for SDG advocacy, but this potential is currently underutilized.

Exploratory factor analysis highlights four key dimensions shaping user experience: satisfaction with core resources, infrastructure needs, technical challenges, and satisfaction with specific facilities. These findings suggest that while libraries continue to fulfill their traditional mandate effectively, their ability to adapt to the digital age is limited. This reinforces the need for policy and infrastructural support to modernize libraries and align them more closely with global development agendas.

Overall, the findings position public libraries as essential but under-resourced partners in achieving the SDGs. Their community reach, cultural legitimacy, and accessibility make them uniquely placed to address educational gaps, reduce inequalities, and foster social inclusion. However, systemic challenges must be addressed to unlock their full potential.

7. Recommendations

Based on the study's findings, the following recommendations are proposed:

- a. **Strengthening ICT and Digital Infrastructure:** The public library authority should upgrade internet bandwidth and ensure uninterrupted power supply. Expand digital resources, including e-books, online databases, and open-access repositories. Develop user-friendly library websites and mobile applications. The finding supported by Rahmanova (2025) and Horban, Kasian&Prokopenko (2025).
- b. **Enhancing Resource Availability and Services:** The authority can increase the number and variety of books, journals, and digital materials that are reinforced by Agina-Obu& Evelyn (2023). Ensure regular updating of collections to meet user demands, particularly for students and professionals. Provide improved physical facilities such as air-conditioned reading rooms and organized shelving.
- c. **Capacity Building and Human Resources:** Authority should recruit and train skilled personnel to manage ICT services and digital collections. Introduce continuous professional development programs for librarians on SDGs, ICT, and information literacy. Encourage library staff to act as community facilitators rather than only custodians of books.
- d. **Promoting SDG Awareness and Engagement:** Public library can organize awareness campaigns, workshops, and exhibitions connecting library services to attain SDGs. Develop SDG-focused programs such as literacy drives, environmental initiatives, and women's empowerment activities. Partner with schools, universities, and NGOs to integrate SDG-related activities in library programs.
- e. **Policy and Institutional Support:** The Government should increase the funding and policy recognition of libraries as SDG stakeholders. Adopt national policies encouraging automation and modernization of public libraries. Strengthen collaboration with international bodies (IFLA, UNESCO, ALA) for knowledge sharing and best practices.
- f. **Inclusive and Community-Centered Approaches:** Authority should create safe and gender-sensitive spaces for female users. Expand services to underserved rural communities to reduce regional inequalities. Promote participatory library governance by engaging users in service planning and feedback mechanisms.

8. Conclusion

This user-centered study demonstrates that public libraries in Bangladesh play a significant role in supporting education, information access, and community engagement, thereby contributing to the achievement of the Sustainable Development Goals. However, their impact is constrained by limited infrastructure, technological deficiencies, and insufficient awareness of SDGs among both users and staff. The findings highlight that libraries are especially influential in advancing SDG 4 (Quality Education), while also having untapped potential in promoting SDG 5 (Gender Equality), SDG 10 (Reduced Inequalities), SDG 11 (Sustainable Cities and Communities), and SDG 16 (Peace, Justice, and Strong Institutions). By addressing challenges such as outdated

infrastructure, digital gaps, and lack of professional capacity, libraries can transform into modern hubs of knowledge and community empowerment. The study underscores the urgency of adopting a forward-looking policy framework that recognizes libraries as active development partners. Investments in ICT, inclusive services, and SDG advocacy are essential for making libraries relevant in the digital age and maximizing their contribution to national and global development agendas. In conclusion, public libraries in Bangladesh, if adequately supported, have the capacity to evolve into agents of social transformation, ensuring equitable access to knowledge, fostering lifelong learning, and advancing the Sustainable Development Goals for a more inclusive and sustainable society.

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Integration of the Library and Information Science Subject in the Curriculum of Higher Secondary Education

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Abstract

Purpose: The purpose of the study is to examine the importance, perceived benefits, and process of integration of Library and Information (LIS) subject at the higher secondary level in the Bangladeshi education system, and propose a prototype model.

Methods: The quantitative and thematic approach was applied to conduct the study, distributing a set of structured questionnaires to 200 educators, library professionals, and students. Among them, 131 valid responses were returned, yielding a response rate is 65.5%. Several statistical analyses, like descriptive statistics, frequency distributions, and thematic analysis, were used to examine the opinions and perceptions of the respondents.

Findings: The study found that the majority of the respondents (93.9%) provided their opinion to include the LIS subject in higher secondary school (HSC) level, and 59.5% believe this as the most appropriate level for integrating the subject. The result recognized the key benefits such as improved information literacy (49.9% of cases), enhanced library use (44.6%), digital literacy development (30.8%), and stronger research support (44.6%). However, notable challenges include a lack of trained teachers/professionals, limited infrastructure, curriculum overload, and inadequate awareness among policymakers.

Originality: This initiative empirically examines the stakeholders' perceptions regarding the LIS education at the middle stage of education level, demonstrating quantitative evidence and thematic insightful recommendation from the ground level to assist the curriculum reform.

Conclusion: Adding the LIS curriculum at the HSC level is both possible and effective. It will enable students to have fundamental use and retrieval skills and ensure smoother transitions to university-stage research and learning activities. The study finally concludes that LIS incorporation needs policy and mental support, and curriculum modification—but not supplementary economical means.

Keywords

Library and Information Science (LIS), Higher Secondary Education, Curriculum Integration, Information Literacy, Library Skills, Educational Innovation

1. Introduction

Technological education is a subject of practice all over the world. Every country emphasizes the importance of the introduction and development of the education system in terms of its objectives and needs. The mainstream of a country's education system changes

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considerably at different times and in different situations. Again, identifying the changing issues of a country's education system carries great significance in the primary and economic development. In an era of technological advancement, Library and Information Science (LIS) plays a great role in developing competencies by promoting information literacy, digital literacy, ethical information practices, and critical thinking among learners (Velip&Misal,2025; Machin-Mastromatteo, 2021). At stage of HSC stage, most students usedigital platforms profoundly for academic activities, yet many scarcities the basic skills needed to circumnavigatea multifaceted information atmosphere. The professionals and skilled persons claim that assimilating LIS education at this level empowers the students' promptness for tertiary education, increases educational performance, and contributes to responsible citizenship (Roca et al., 2024; Yaseen et al., 2025).

Internationally, education systems assimilated information literacy and investigation skills into school syllabuses to make students proficient in learning and participatory in information society, knowledge culture, and intellectual society(Sayekti, 2025). Nonetheless, in many underdeveloped countries, LIS curriculum remains inattentive from the secondary level, leading to noteworthy gaps in students' capacity to involveefficiently with digital properties and academic study (Raju, Chu & Cunningham, 2023; Johnson, 2007).Recognizing these issues, the present study inspects the potential benefits, possibility, and deceptiveneedof familiarizing LIS education at the higher secondary level.

Information literacy and digital library skills are now indispensable capabilities for learners in the present knowledge society (Akter& Ahmed, 2024). Though in our country, the higher secondary education curriculum has not yet officially assimilated LIS as a subject. Students often lack guidance in developing proper information-seeking behavior, evaluating resources, and using libraries effectively (Hossain &Sormunen, 2019; Hossain, Biswas & Khan, 2025). As a result, when they start university education, they feel the shortage of knowledge of article writing, thesis preparation, referencing, content writing, plagiarism, etc.Assimilating LIS at this level can play a great role by preparing students with research skills, literacy competency, and enduringknowledgecustoms.

2. Objective of the Study

The study aims to contribute in curriculum reform and highlight the significance of preparinglearnerswith the aptitudesrequired for academic achievement.The primary objectives of the study are:

- to examine the importance of adopting LIS in the higher secondary education system,
- identify the issues and benefits, and
- to propose a prototype model syllabus for LIS education.

3. Literature Review

Library and information science education isextensivelyaccepted as a decisivemelement in makingstudents for knowledge society (Rathod, 2025). The purpose of LIS education is

to enhance the capabilities of students in information retrieval, searching, knowledge organization, and literacy skills that are common for academic accomplishment and ultimate success in life (Hussain, Ali & Jan, 2025). Information literacy should be familiarized as the relatively early stage of education to help the students to accelerate the efficacy. Studies further stress that secondary-level students in digital content but often lack the structured direction obligatory to judge and relate information in academic backgrounds (Fitria, 2023; Moore, 2021). This stresses the consequence of implanting LIS within intermediate curricula to shape introductory skills before students' conversion to graduate level.

Studies in both developed and underdeveloped nation expose the constructive results of LIS education at pre-university stages. Incorporating information literacy into intermediate curricula reinforces problem-solving aptitudes and decreases the threats connected with misrepresentation (Mubofu, & Mambo, 2023; Rafique et al., 2021). In South Asia, researchers stated that the deficiency of official LIS education in secondary education donates to restricted research aids among college entrants (Kaur, 2015). Numerous research suggest for curriculum modification to integrate LIS as a compulsory or elective module at the higher secondary school, arguing that early experience to library skills cares academic readiness, endorses reading habit, and links digital literacy gaps (Sibiya, 2024; Inskip, 2022). Additionally, modern educational contexts endorse project-based knowledge, hands-on digital tasks, and structured library practice to fortify students' critical assignment with information surroundings (Rehman et al., 2024).

Internationally, several nations have acknowledged the significance of LIS education at the secondary and higher secondary levels. Research shows that integrating Library and Information Science (LIS) education at secondary and higher levels enhances students' digital literacy, research competencies, and academic performance (Muammar, Maheshwari & Atalla, 2025; Rafi, Jian-Ming & Ahmad, 2019). Studies indicate that academic libraries and ICT-based programs progress students' skills and digital competence, which definitely impact their academic achievement (Salimi et al., 2025; Okechukwu et al., 2024). India has tested with LIS as an elective subject in some schools, yielding encouraging outcomes in students' information-seeking behavior (Aman, & Sharma, 2005; Kaur, 2015). In Bangladesh, still, LIS education is restricted to university-level. Current literature strappingly backings the incorporation of LIS education within the intermediate level, predominantly in contexts where students lack formal teaching in information management abilities.

4. Methodology

A mixed-method approach, adopting quantitative and qualitative data to examine the viability of integrating LIS subject into the Higher Secondary level. A set of closed and open-ended questionnaires was distributed among 200 targeted respondents. A total of 131 accomplished questionnaires were received, resulting in a 65.5% response rate. The survey inspected opinions, predictable benefits, challenging issues, and preferred

implementation strategies. The insightful recommendations from the teachers, library professionals and students were gathered and analyzed thematically. Quantitative data were analyzed using descriptive statistics through SPSS 26 version. Basic observations and practical experiences helped to assess existing library possessions and student arrangement. Ethical procedures were followed, ensuring voluntary participation and confidentiality. Finally, the findings offered a comprehensive and dependable understanding of stakeholder perspectives on familiarizing LIS at the HSC level.

5. Data Analysis and Findings

5.1 Demographic Information of the Respondents

The demographic information of the respondents (N=131) proves a varied demonstration across gender, age, professional backgrounds, and institutional categories. Among the contributors, males constituted the majority with 63.4%, while females accounted for 36.6%. The age distribution specifies that the prevalent group of defendants (45.8%) belonged to the 21–25 years age group, followed by 16.8% aged 15–20 years. Smaller parts were detected in other age groups, with 7.6% each in the 26–30 and 31–35 years categories, and progressively fewer respondents in the higher age ranges. Regarding respondent categories, students formed the largest group at 68.7%, while teachers represented 20.6% and library professionals 10.7%. A further breakdown of respondent status shows that students constituted 64.9% of the total respondents, while teaching positions such as assistant professor (8.4%), lecturer (7.6%), and assistant teacher (9.2%) were also well-represented. The academic distribution reveals that 46.6% of defendants were from colleges, followed by 41.2% from universities, and 11.2% from schools. Generally, the data directs a well-distributed respondent group provided their opinions toward integrating the Library and Information Science subject into the intermediate level.

Table 1: Demographic Information of the Respondents (N=131)				
Gender	Frequency	Percent	Valid%	Cumulative%
Male	83	63.4	63.4	63.4
Female	48	36.6	36.6	100.0
Total	131	100.0	100.0	
Age group				
15-20 years	22	16.8	16.8	16.8
21-25 years	60	45.8	45.8	62.6
26-30 years	10	7.6	7.6	70.2
31-35 years	10	7.6	7.6	77.9
36-40 years	7	5.3	5.3	83.2
41-45 years	6	4.6	4.6	87.8
Respondent Category				
Teacher	27	20.6	20.6	20.6

Library professional	14	10.7	10.7	31.3
Student	90	68.7	68.7	100.0
<i>Status of the respondents</i>				
Professor	3	2.3	2.3	2.3
Student	85	64.9	64.9	67.2
Assistant professor	11	8.4	8.4	75.6
Lecturer	10	7.6	7.6	83.2
Principal	2	1.5	1.5	84.7
Assistant Teacher	11	9.2	9.2	93.9
Cataloguer	8	6.1	6.1	100.0
<i>Institutional Category</i>				
College	61	46.6	46.6	46.6
University	54	41.2	41.2	87.8
School	16	11.2	11.2	100.0

5.2 Inclusion of LIS in the Higher Secondary Education

Table 2 shows prodigiouslyconstructiveobservationconcerning the annexation of LIS education in the Higher Secondary Education level. A majority of defendants (93.9%) believe that LIS should be announced at the HSC level. Only a small fraction (3.8%) disagreed, while 2.3% remained unsure. This strong commendation designates extensive consciousness of the significance of library skills, knowledge management, and digital literacy for learners concocting to arrive higher education.

Table 2:Opinion on the Inclusion of LIS in the Higher Secondary Education

		Frequency	Percent	Valid %	Cumulative %
Valid	Yes	123	93.9	93.9	93.9
	No	5	3.8	3.8	97.7
	Not sure	3	2.3	2.3	100.0
	Total	131	100.0	100.0	

5.3 Perceptions on Introducing LIS in the Higher Secondary Curriculum

Table 3 presents a cross-tabulation information showing strong support across all demographic groups. Among gender groups, male defendants show high agreement, with 76 endorsing the introduction of LIS, compared to 4 who disagreed and 3 who were unsure. Similarly, female respondents overwhelmingly support the idea, with 47 responding “Yes” and only 1 responding “No.”Regarding the respondent category, teachers demonstrate strong support, with 25 in favor and only 2 against. Library professionals also support inclusion (12 “Yes”), though a small number expressed uncertainty or disagreement. Students exhibit the highest volume of affirmative responses, with 86 agreeing, 2 disagreeing, and 2 unsure. Institution-wise, respondents

from colleges (57 “Yes”), universities (52 “Yes”), and schools (14 “Yes”) show broad consensus in favor of introducing LIS at the HSC level. Only a few respondents across institutions expressed disagreement or uncertainty.

Table 3: Perceptions on Introducing LIS in the Higher Secondary Curriculum

		Do you believe Library and Information Science (LIS) should be introduced in the Higher Secondary Education curriculum?			Total
		Yes	No	Not sure	
Your gender	Male	76	4	3	83
	Female	47	1	0	48
Respondent category	Teacher	25	2	0	27
	Library professional	12	1	1	14
	Student	86	2	2	90
Institution category	College	57	2	2	61
	University	52	1	1	54
	School	14	2	0	16

5.4 Appropriate Stage to Introduce LIS Education

Figure 1 demonstrates the respondents’ views regarding the appropriate stage at which LIS education should be introduced. The study revealed that the majority of participants prefer LIS to be implemented at the Higher Secondary level (Class 11–12), with 78 respondents (60%) selecting this option. A smaller proportion of respondents, 34 individuals (26%), believe that LIS education should begin earlier, at the Secondary level (Class 6–10). Meanwhile, 19 respondents (14.5%) prefer that LIS education be introduced only at the Graduate level, indicating a view that LIS should remain a particular discipline rather than a general educational component.

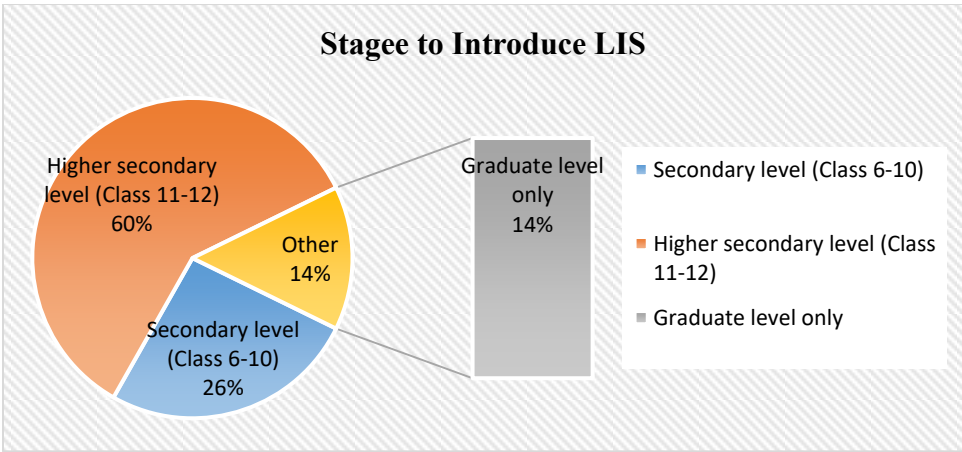


Figure 1: Opinion on Appropriate Stage to Introduce LIS Education

5.5 Opinions on the Nature of LIS as a Subject

Figure 1 shows that opinions on how LIS should be offered are evenly divided. 39.7% of respondents prefer LIS as a compulsory subject with examination, while an equal 39.7% believe it should be presented as an optional subject. Meanwhile, 20.6% support making it obligatory without examination, representing a desire for basic LIS skills for all students without formal assessment.

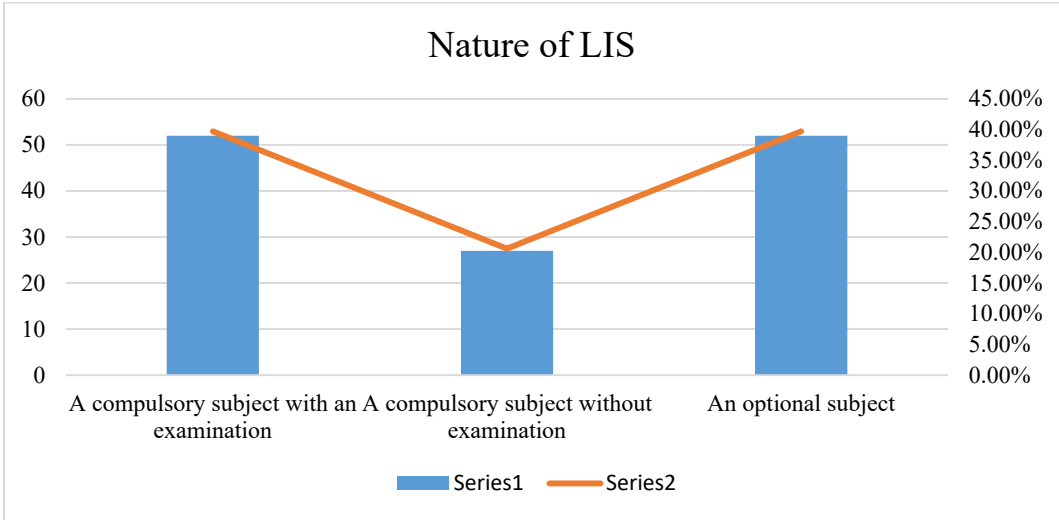


Figure 2: Nature of LIS Education as a Subject

5.6 Benefits of LIS Integration at the College Level

Table 6 highlights respondents’ perceptions of the key benefits of integrating LIS at the intermediate level. The most regularly cited advantages include improved information literacy (22.5%), better use of libraries (21.4%), and enhanced support for academic research (21.4%), indicating strong recognition of LIS in firming students’ academic skills. Respondents also emphasized benefits such as digital literacy development (14.8%), lifelong learning skills (10.7%), and better preparation for university life (9.2%). Overall, the findings suggest that LIS integration would significantly improve students’ readiness for higher education and independent learning.

Table 4: Benefits of LIS integration in College Level				
		Responses		Percent of Cases
		N	Percent	
Benefits	Improvedinformationliteracy	61	22.5%	46.9%
	Betteruseoflibraries	58	21.4%	44.6%
	Support for academic researchers	58	21.4%	44.6%
	Developmentofdigitalliteracy	40	14.8%	30.8%
	Lifelonglearningskill	29	10.7%	22.3%
	Helpful for universitylife	25	9.2%	19.2%
Total		271	100.0%	208.5%

5.7 Challenges in Introducing LIS in Higher Secondary Education

Table 5 outlines respondents’ anticipated challenges in integrating LIS into the higher secondary curriculum. The most frequently identified issue is the lack of trained teachers or professionals (33.3%), indicating a major capacity gap. Other notable concerns include lack of awareness among policymakers (22.7%), limited institutional infrastructure (22.2%), and curriculum overload (21.7%), all of which highlight systemic barriers to effective LIS implementation.

Table 5: Challenges in introducing LIS in higher secondary education?				
		Responses		Percent of Cases
		N	Percent	
Challenges	Lack of trained teachers/professionals	69	33.3%	52.7%
	Curriculum overload	45	21.7%	34.4%
	Lack of awareness among policymakers	47	22.7%	35.9%
	Limited infrastructure	46	22.2%	35.1%
Total		207	100.0%	158.0%

5.8 Beneficial LIS Skills for Students

The table-6 highlights the specific LIS skills students consider most valuable. The highest precedence skill is using digital resources (37.1%), followed by general research skills (23.6%), which support students’ overall academic performance. Additionally, proper citation skills (22.5%)and understanding how to avoid plagiarism (16.9%) are seen as essential for maintaining academic integrity.

Table 6: Beneficial LIS Skill for Students				
		Responses		Percent of Cases
		N	Percent	
Skill	How to usedigitalresource	66	37.1%	64.7%
	How to cite references properly	40	22.5%	39.2%
	How to avoid plagiarism	30	16.9%	29.4%
	General researchstudyskill	42	23.6%	41.2%
Total		178	100.0%	174.5%
a. Dichotomy group tabulated at value 1.				

5.9 Introducing LIS without Requiring Extra Budget

The table-7 presents respondents’ views on whether LIS can be integrated into the higher secondary curriculum without additional financial allocation. 40.5% believe that LIS can be introduced without extra budget. Meanwhile, 30.5% think additional funding would be necessary, likely due to expected needs such as trained teachers or infrastructure improvements. Another 29% remain unsure.

Table 7: Opinion on Introducing LIS without Requiring Extra Budget					
		Frequency	Percent	Valid Percent	Cumulative %
Valid	Yes	53	40.5	40.5	40.5
	No	40	30.5	30.5	71.0
	Not sure	38	29.0	29.0	100.0
	Total	131	100.0	100.0	

5.10 Thematic Analysis of Respondents' Suggestions and Recommendations

A thematic analysis of the respondents' declarations discloses several major themes that reproduce common apprehensions, opportunities, and recommendations regarding the integration of LIS in higher secondary education.

a. Strong Support for Introducing LIS at the HSC Level

Many respondents emphasized the need and relevance of LIS for students at this stage (R5, R6, R10, R26, R37, R46, R55, R59, R79, R111, and R114). These comments highlight a broad consensus that LIS would improve students' reading habits, knowledge, and ability to use libraries effectively.

b. Enhancement of Learning Skills and Academic Preparedness

A noteworthy number of respondents stated that LIS can advantage students' progress in essential academic and lifelong learning skills (Examples: R10, R45, R55, R59, R79). The benefits mentioned include: improved reading habits, enhanced information literacy, better research and referencing skills, stronger critical thinking and creativity and better preparedness for university library use.

c. Suggestions for Curriculum Structure and Delivery

Several respondents provided specific ideas on how LIS should be structured within the curriculum (R11, R32, R34, R35, R33, R36). Key suggestions include: using project-based tasks, group work, digital literacy activities, including LIS as an optional or compulsory subject, integrating LIS as a chapter in ICT rather than as a separate subject, offering LIS at the graduate level instead of HSC, implementing LIS widely with proper curriculum design. These responses reflect a mix of support and alternative viewpoints regarding curriculum placement.

d. Need for Skilled Teachers and Professional Capacity

Many respondents highlighted the indispensable requirement of trained and qualified LIS professionals (R38, R107, and R109). Their views point to: appointing skilled LIS teachers, ensuring professional capacity, and providing proper training for educators. This theme aligns with major challenges identified earlier in the study.

e. Requirement for Adequate Facilities and Resources

Some respondents emphasized the need to enhance library resources and ensure necessary facilities before implementing LIS (R31, R47, and R107). Suggestions include: increasing the availability of books, modernizing college libraries, allocating appropriate budget, and ensuring infrastructural readiness.

f. Policy Support and Government Involvement

A number of respondents stressed the importance of policy-level support for successful implementation (R31, R32, and R107). Key elements include: creating proper policies, securing government support, developing a standard curriculum and starting pilot programs in selected institutions. This indicates a recognition that systemic backing is necessary for sustainability.

g. Mixed Perceptions and Alternative Recommendations

A few respondents expressed reservations or alternate opinions (R33, R35, R36, and R40).

Their suggestions include: introducing LIS after the intermediate level, embedding LIS

content within ICT, offering LIS only at the graduation level and general agreement without strong commitment. This shows that while the majority supports LIS integration, some respondents prefer adjustments or different timing.

The summary of thematic analysis stated below:

Theme	Core Ideas Represented	Respondents (Examples)
Support for LIS Integration	LIS is essential, beneficial, and needed at the HSC level	R5, R6, R10, R26, R37, R46, R55, R59, R79, R111, R114
Learning Skill Enhancement	Improves reading habits, information literacy, digital skills, research skills, lifelong learning	R10, R45, R55, R59, R79
Curriculum Structure & Delivery Suggestions	Project-based tasks, optional/compulsory format, integration with ICT, appropriate level for introduction	R11, R31, R32, R33, R34, R35, R36
Need for Skilled Teachers/Professionals	Appointment of trained LIS teachers, professional development	R38, R107, R109
Infrastructure & Resource Requirements	More books, modern libraries, budget allocation, improved facilities	R31, R47, R107
Policy & Government Support	Standard curriculum, pilot programs, policy-level backing, government involvement	R31, R32, R107
Mixed or Alternative Opinions	Introduce at university level, partial agreement, integrate within ICT, differing views	R33, R35, R36, R40

The thematic analysis shows strong enthusiasm for integrating LIS at the HSC level, with respondents recognizing its potential to improve information literacy, reading habits, research capabilities, and overall academic readiness.

6. Prototype Model Plan for the Integration of LIS Subject

The study proposed a prototype model plan that comprises a one-credit, non-examination-based LIS module thinking on practical skill development. It commends weekly library sessions covering important topics such as library orientation, catalog use, classification scheme, resource searching, retrieving, referencing etc. A weekly class will be held for understanding syllabus and basic subject oriented terms. The execution strategy controls existing libraries and teaching staff, maintained by librarians’ participation as co-facilitators. This model can be integrated gradually through pilot programs under the supervision of the Board of Intermediate and Secondary Education.

a. Title of the Proposed Subject

Library and Information Science (LIS)

(To be introduced as a non-examination compulsory subject at HSC level)

b. Nature of the Subject

- **Type:** Non-examination compulsory subject
- **Credit:** 1 (equivalent to one class per week)
- **Evaluation:** Continuous assessment through participation, assignments, and practical exercises
- **Duration:** 1 academic year (for Class XI); optional continuation in Class XII

c. Course Objectives

The course aims to:

- i. Develop students' ability to locate, evaluate, and use information resources effectively.
- ii. Familiarize students with both print and digital library systems.
- iii. Enhance awareness of ethical information use, referencing, and plagiarism avoidance.
- iv. Encourage independent learning and information-seeking behavior.
- v. Prepare students for efficient library use and research work in higher education institutions.

d. Expected Learning Outcomes

After completing this course, students will be able to:

- Identify and locate different types of information sources.
- Use library catalogs, classification systems, and online databases.
- Apply effective search strategies for both print and digital materials.
- Cite sources properly using standard referencing styles.
- Demonstrate responsible and ethical use of information.

e. Proposed Syllabus Outline

Unit	Topic Area	Contents	Teaching Method
Unit 1	<i>Introduction to Libraries and LIS</i>	Types of libraries, functions, and importance of libraries in education; role of LIS in modern learning.	Lecture, Discussion
Unit 2	<i>Organization and Resources of Libraries</i>	Library sections, arrangement of books, use of classification and catalog systems.	Practical visit, Demonstration
Unit 3	<i>Information Literacy and Search Techniques</i>	Basic search skills, use of library catalogs (OPAC), search engines, and academic databases.	Hands-on session, Practical exercises
Unit 4	<i>Digital and E-Library Resources</i>	Use of e-books, e-journals, institutional repositories, and open access resources.	Computer-based training
Unit 5	<i>Research and Referencing Skills</i>	Citation styles (APA, MLA), referencing, avoiding	Group activity, Practical assignments

		plagiarism.	
Unit 6	<i>Ethical and Responsible Use of Information</i>	Copyright awareness, fair use, academic honesty, and digital citizenship.	Case studies, Discussion
Unit 7	<i>Library in Daily</i>	Practical use of the	Guided practice

f. Teaching-Learning Strategy

- **Resource Persons:** Subject teachers and librarians trained through short workshops. Librarian and ICT teacher can be used as subject teacher.
- **Methodology:** Blended approach combining lectures, demonstrations, hands-on library work, and ICT-based learning.
- **Assessment:** Continuous assessment through practical tasks, Introspective notebook, and participation rather than written exams.

g. Resource and Budget Considerations

- **No additional budget required** — existing college libraries, College ICT Lab, staff, and facilities can be used.
- **Minimal resources needed:** Teaching materials, printed handouts, and digital access points.
- **Capacity building:** Short training sessions for teachers and librarians can be arranged at divisional or district levels.

h. Expected Impact

- It will improved student capability in using and controlling library resources.
- will enhance academic and research willingness at the university level.
- will promote independent learning and digital literacy.
- will ensure sustainable incorporation of LIS education within the national curriculum without extra financial burden.

8. Research Implications

The study conveys important consequences for representatives, curriculum designers, and educational institutions. First, it delivers empirical evidence supporting the inclusion of LIS in the higher secondary curriculum as a compulsory or elective subject. Second, the results signal that investments in teacher training and library modernization are necessary for successful implementation. Third, the study offers guidance for developing a foundational LIS curriculum emphasizing digital literacy, research ethics, and practical information-handling skills. The findings also offer actionable insights for the Directorate of Secondary and Higher Education, education boards, and colleges planning pilot implementations.

9. Limitations of the Study

Despite its contributions, the study has several limitations. The sample size, although adequate (N=131), was drawn from selected institutions, which may limit the generalizability of findings to all regions of Bangladesh. Moreover, the study

fixated mainly on stakeholders' views but did not include an in-depth analysis of current national curriculum policies or resource audits of secondary institutions.

10. Future Research Directions

Future research may explore several avenues. A larger-scale study could be accompanied to validate findings across varied geographic and institutional settings. Longitudinal studies could examine how LIS integration at the higher secondary level impacts students' academic performance and digital competencies over time. Further research may also assess the feasibility of various curriculum models, such as elective modules, blended learning approaches, or integration within ICT courses. Comparative studies with countries that successfully implemented LIS at the school level would also provide valuable policy insights.

11. Conclusion

This study inspected the importance, relevance, and possibility of introducing LIS teaching at the higher secondary level in Bangladesh. The results noticeably show that a devastating majority of respondents believe LIS should be unified into the curriculum, highlighting strong academic and societal demand for early information literacy development. Respondents emphasized the importance of digital literacy, research skills, ethical information use, and improved library engagement that are becoming essential in present world. The study also recognized several issues, like lack of trained teachers/professionals, updated curriculum, policy limitations, and infrastructural constraints, which must be addressed to implement LIS education effectively. Overall, the research endorses the critical need for structured LIS instruction at the higher secondary stage to reinforce students' academic success and lifelong learning competencies.

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Usability Assessment of Koha Open Sources Integrated Library System in Bangladeshi University Libraries

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Abstract

Background/Purpose: University libraries globally have tended to adopt the “Open Source Integrated Library System (OSILS)”, including the university libraries in Bangladesh. Koha is a sustainable and matured OSILS that has created prospects for Bangladeshi universities with relatively limited library budgets that are unable to purchase, operate, and upgrade commercial Integrated Library Systems (ILS). From the available literature, it is evident that there has been a lack of initiative to assess the usability of Koha OSILS locally or globally. Considering the research gap and its significance, this study assessed the usability of Koha in Bangladeshi university libraries.

Design/Methodology/Approach: A structured questionnaire comprising 18 items across six dimensions was developed and validated following a pilot survey. The study employed a purposive sampling technique due to the large population size (students) of 20 universities, which made the study more convenient. A survey was then conducted among 442 students from 20 university libraries. Factor analysis, Bartlett's test of sphericity, Cronbach's Alpha, KMO value, commonalities, item loadings and discriminant validity were applied to assess validity, reliability, and sampling adequacy. Descriptive statistics measured the overall and dimensional usability of Koha, and an Independent Samples t-test assessed the Variance in Koha's usability by university, user, and gender categories.

Findings: The overall usability was 3.46 on a seven-point scale, indicating positive student feedback. Among the six dimensions of Koha's usability, the accessibility dimension (3.512) achieved the highest usability score, followed by the user interface (3.507), OPAC (3.503), usage notification (3.467), circulation (3.429), and patron management (3.336). The study found a significant difference in Koha's usability ($P < .001$) between the users of private (3.56) and public (3.29) university libraries. Besides, there is no significant difference in Koha's usability between female and male users as well as undergraduate and postgraduate students.

Originality/Value: The diverse statistical techniques affirmed the sampling adequacy, reliability, and validity of the model, which will encourage more studies on the usability of various OSILSs both locally and globally.

Conclusion: Users provided positive feedback on the usability of Koha that creating opportunities for universities in Bangladesh to automate their libraries.

Keywords

Usability, Variance, Koha, Open Source Software, Integrated Library System, University Libraries, Bangladesh. **Paper Type:** Research paper

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1. Introduction

Three types of Integrated Library Systems (ILS), i.e., “open source, freeware, and proprietary”, are used to automate the library systems in Bangladeshi universities. There are no fundamental differences in the features and functions of proprietary, open-source, and freeware ILSs, but the key difference lies in the “development process and distribution” (V. V. Kumar & Abraham, 2009). Currently, the use of “Open Source Integrated Library Systems” (OSILS) in libraries is gaining momentum (Alam, 2018; V. V. Kumar & Jasimudeen, 2012). An OSILS is a free library automation software application whose source code is available under the “GNU General Public License” (GPL). The copyright holder of OSILS provides the “right to study, change, and distribute the software to anyone for any purpose”. An OSILS, also known as a “Library Management System” (LMS), is an “Enterprise Resource Planning” (ERP) system for a library. An ideal OSILS brings all library functions under one system, including acquisition, cataloging, OPAC, serials control, circulation, patron management, Inter-Library Loans, and reporting (Ahmmed, 2014; Khatun and Ahmed, 2018). An OSILS has two “Graphical User Interfaces” (GUIs), one for users and one for staff, as well as two databases: one for items and one for patrons. Each module, database, and GUI of an OSILS is incorporated into a unified interface (Alam, 2017). Koha is the first, most widely used, sustainable, and mature OSILS (Breeding, 2017; Müller, 2011). In 1999, the Katipo Communications developed the Koha software in New Zealand, and the first adoption went live in 2000 (Eyler, 2003). Thousands of libraries around the world have adopted Koha's functionality, each adding features to enhance its capabilities. The Koha software became a scalable and viable solution for libraries worldwide with the addition of the Zebra Indexing engine, which was introduced with the 3.0 release in 2005 (Müller, 2011). Koha releases adhere to a consistent schedule, monthly maintenance updates and biannual (May and November) feature releases (Koha-Community, 2025).

User-based usability assessment is crucial for assessing the efficacy of any system or service (Alemna, 1999; Mezbah-Ul-Islam, 2003). According to the existing literature, various researchers have examined different facets of Koha in Bangladesh, yet insufficient emphasis has been placed on evaluating the usability of the Koha interface (Khatun and Ahmed, 2018). Besides, several university libraries are already utilizing Koha, while a few others are in the process of constructing their ILS with Koha. However, no university libraries in Bangladesh are currently using any other OSILS software, except Koha. Here, the question is raised: are library users satisfied with the usability of Koha OSILS in the university libraries of Bangladesh? From the research gaps, raised questions, and social impact, it is expected to assess the usability of Koha and to evaluate individual differences in its usability across university, user, and gender categories in Bangladeshi university libraries.

2. Literature Review

The study reviewed the relevant literature to know the concept and background of Koha OSILS, discover what researchers have written, ascertain the results of related research, and determine the research gaps. Many library professionals in Bangladesh are working to bring their libraries up to global standards. Initially, the ICDDR,B library used UNESCO-supported software CDS/ISIS in the 1980s (Shuva, 2012). In 1998, Dhaka University Library installed the GLAS software (Rahman, 2010). BRAC University Library installed Koha OSILS in 2010 (Afroz, 2014). Koha, Evergreen, NewGenLib, PMB, and SLiMS are among the most popular OSILS worldwide (Alam, 2018). Among them, Koha is considered the most mature and sustainable OSILS (Müller, 2011). At present, several university libraries, three institutional libraries, and two college libraries use Koha in Bangladesh (Alam, 2018).

Khatun and Ahmed (2018) empirically examined the usability of the Koha OPAC interface at BRAC University and provided favorable user feedback. Müller (2011) conducted a multidimensional analysis of 20 free and open-source ILS and found that Koha was recognized as the most sustainable and mature ILS. Marshall Breeding carried out a survey of library automation involving 4042 libraries across ninety-two countries and determined that Koha received the highest ratings in the 2016 (Breeding, 2017). Kiriyanant (2012) revealed that fifty-nine percent Thai university libraries in Pathumthani and Bangkok were moving towards adopting OSILS, although they currently used proprietary software. Among them, fifty-five percent library authorities said that they would choose Koha if they were to shift their ILS. Singh (2013) found that the two most popular OSILSs in the USA are Evergreen and Koha and reported that 62% of USA libraries were satisfied with these two OSILSs.

Based on the literature review, some studies were conducted on describing the practical experience on implementation of particular OSILS (Avery, 2016; Neelakandan et al., 2010), migrating from proprietary ILS to OSILS (Kumar and Benahal, 2017; Singh, 2013), describing technical support-related experiences on OSILS (Singh, 2014), adoption of OSILS (Amollo, 2013; T. K. G. Kumar, 2015; V. V. Kumar & Jasimudeen, 2012; Omeluzor & Oyovwe-Tinuoye, 2016; Rafiq & Ameen, 2009), and inter-university cooperation for implementation of OSILS (Espiau-Bechetoille et al., 2011; Tajoli et al., 2011). Besides, some studies are conducted on the comparative analysis of different OSILS packages (Macan et al., 2013; Madhusudhan & Singh, 2016; Pruett & Choi, 2013; Singh & Sanaman, 2012), multidimensional evaluation of different OSILS packages (Balnaves, 2008; Müller, 2011), and usability & functionalities of different OSILS packages (Amollo, 2013; Ukachi et al., 2014; ur Rehman and Al-Huraiti, 2010; Uzomba et al., 2015). Moreover, library professionals' satisfaction and perception with the several or specific aspects of OSILS (T. K. G. Kumar & Jayapradeep, 2015; Shafique & Mahmood, 2008), sustainability of OSILS (T. K. G. Kumar & Ramesha, 2015), and surveys to know the present status of OSILS in different countries (Albee & Chen, 2014; Brooke, 2013; Hanumappa et al., 2014; T. K. G. Kumar & Muruli, 2017;

Shafique&Mahmood, 2008; Upadhyay et al., 2012). However, comparatively less initiative has been taken to assess the usability of Koha OSILS globally.

Moreover, based on the relevant literature in Bangladesh, there have been a limited number of studies conducted on documenting the practical experiences related to the implementation of Koha.(Ahammad, 2014), challenges and remedies for implementation of Koha(Alam, 2017), usability of KohaOPAC interface(Khatun and Ahmed, 2018), and assessing adoption and satisfaction of Koha(Alam, 2018), extent of adoption of OSILS (Alam&Faruk, 2025), factors for adoption of Koha in university libraries(Alam& Mezbah-ul-Islam, 2019), assessing user satisfaction of Koha in the private university libraries(Alam&Mezbah-ul-Islam, 2020a),measuring user satisfaction of OIILS in public university libraries(Alam&Mezbah-ul-Islam, 2021), sustainability of OSILS in university libraries (Alam&Mezbah-ul-Islam, 2020b).However, less attention has been given to assessing the usability of Koha OSILS and evaluating individual differences in its usability by university, user, and gender in university libraries of Bangladesh.

3. Research Hypotheses

Based on the research gap,raised questions, and objectives of the study, the following hypotheses were formulated:

- H-1: The usability of Koha OSILS between the users in the private and public university libraries of Bangladesh differs significantly.
- H-2: The usability of Koha OSIL between male and female users in university libraries of Bangladesh differs significantly.
- H-3: The usability of Koha OSIL between undergraduate and graduate students in university libraries of Bangladesh differs significantly.

4. Methodology

4.1 Research Design

A questionnaire was designed to collect data from Koha users to evaluate the usability of Koha. The questionnaire included demographic information about library users, the frequency of Koha use, and 18 items across six dimensions of usability. The items and dimensions of usability were taken from the available related literature.An agreement scale was developed, with 1 representing the lowest level of agreement and 5 the highest, corresponding to a 5-point Likert scale. The questionnaire was then adapted based on local arrangements following a pilot survey and consultations with LIS researchers, including academics and professionals.Then, a structured questionnaire was administered toaccomplish the research objectives and test the hypothesis.

4.2 Population, Sample, and Data Collection

Among 116 private and 56 public universities in Bangladesh, 13 private and seven public university libraries have been selected for this study, all of which currently use Koha(Koha-Community, 2025; University Grants Commission, 2025).

Table 1: Research Sites for the Study

SL	University	Category	User	Percent
1.	Southeast University	Private	34	7.7
2.	Independent University Bangladesh	Private	32	7.3
3.	United International University	Private	30	6.8
4.	Green University Bangladesh	Private	29	6.6
5.	University of Liberal Arts Bangladesh	Private	29	6.6
6.	East West University	Private	28	6.3
7.	Northern University Bangladesh	Private	25	5.7
8.	Daffodil International University	Private	23	5.2
9.	International Islamic University Chittagong	Private	17	3.9
10.	Eastern University	Private	15	3.4
11.	BRAC University	Private	10	2.3
12.	Premier University	Private	8	1.8
13.	Chittagong Independent University	Private	7	1.6
14.	Sher-e-Bangla Agricultural University	Public	35	7.9
15.	University of Dhaka	Public	34	7.7
16.	Bangladesh University of Engineering & Technology	Public	30	6.8
17.	Khulna University of Engineering & Technology	Public	23	5.2
18.	Chittagong Veterinary and Animal Sciences University	Public	11	2.5
19.	Shahjalal University of Science & Technology	Public	11	2.5
20.	University of Rajshahi	Public	10	2.3
	Total		441	100

The study population included students from the 20 selected universities. Teachers and administrative staff were not incorporated in the study as they comprise a minor proportion of library users. Probability sampling is possible when all units of the total population are known, and each has an equal chance of being selected (Saunders, Lewis, & Thornhill, 2016). The purposive sampling technique was applied due to the large population of the 20 selected universities, to collect data from the existing Koha users, and to make the study more convenient. A total of 462 (85.55%) questionnaires were returned out of 540, and 441 (81.66%) were completed by the library users selected for this study.

4.3 Data Assessment Methods

The study used SPSS version 22 to compute descriptive statistics for overall Koha's usability; an "Independent-Samples t-test" for testing the hypotheses; factor analysis, Cronbach's Alpha, Bartlett's test of sphericity, KMO value, item loadings, commonalities, and discriminant validity to test the sample adequacy, reliability, and validity.

4.4 Sample Adequacy, Reliability, and Validity

Nunnally (1978) recommended that Cronbach's Alpha values be 0.7 or higher. Cronbach's Alpha was used to assess the reliability of each multiple-item scale, and it was found that the internal consistency of all items has an alpha value of 0.920, the eighteen-

itemusability scale has an alpha value of 0.934, and the six dimensions have an alpha value of 0.900, indicating good reliability for the overall questionnaire items. Schierholz & Laukkanen (2007) recommended that sphericity values should be less than 0.05. The Bartlett's test has a p-value ($p < .001$) for the three items of the OPAC, three items of the circulation, three items of the notification, three items of user management, three items of the user interface, accessibility, and the six dimensions, indicating that the internal consistency of the data is suitable (see Table 1). The Kaiser-Meyer-Olkin (KMO) test was used to assess sampling adequacy. The criteria for KMO values are: "0.90s = marvelous, 0.80s = meritorious, 0.70s = middling, 0.60s = mediocre, 0.50s = miserable, and below 0.50s = unacceptable" (Kaiser, 1974). The overall matrix of the KMO value is 0.866 for six dimensions of usability of Koha that means the sample size (441) is statistically significant for factor analysis and there is no problem relating to the standard data. The loading values for the extracted variables ranged from 0.576 to 0.778 across 18 statements of user satisfaction, indicating that most of the variables successfully represent user satisfaction. The acceptable range of all communalities of a perfectly adequate sample is above 0.5 (Nadiri, 1970). The communalities of the extracted variables ranged from 0.548 to 0.988 across 18 Koha usability items, indicating that the Variance across all items is within a suitable range. Factor analysis examined whether the measures loaded as expected on the selected constructs (Andaleeb & Simmonds, 1998). A factor analysis was conducted, including 18 items, where the factor analysis procedure was constrained to six factors, and 79.47% variance was found among the factors. 13 items out of 18 were loaded on the factors from 10.008 to 0.334. In factor analysis, "only factors having latent roots [eigenvalues] greater than one are considered significant" (Andaleeb & Simmonds, 1998). The six factors have an eigenvalue greater than 1 (from 47.452 to 1.002), indicating that the six variables are significant for conducting the analysis.

Table 2: Factor Analysis

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	10.008	47.452	47.452	10.008	47.452	47.452
2	1.844	8.744	56.196	1.844	8.744	56.196
3	1.602	7.594	63.791	1.602	7.594	63.791
4	1.261	5.981	69.772	1.261	5.981	69.772
5	1.082	5.129	74.901	1.082	5.129	74.901
6	.964	4.571	79.472	.964	4.571	79.472

Discriminant validity is achieved if the "correlation between one scale and another is not as high as each scale's coefficient alpha" (Andaleeb & Simmonds, 1998; Fornell & Larcker, 1981). Table 3 shows that the alpha coefficients for each factor (.703 to .856) are as high as the correlations between factors, supporting discriminant validity.

Table 3: Discriminant Validity

	OPAC	Circulation	Notification	User Management	User Interface	Accessibility
OPAC	.703					
Circulation	.681**	.761				
Notification	.549**	.558**	.817			
User Management	.608**	.526**	.473**	.834		
User Interface	.616**	.604**	.690**	.533**	.856	
Accessibility	.570**	.719**	.611**	.591**	.652**	.746

5. Data Analysis and Findings

5.1 Demographic Information

Among a total of 441 respondents, 278 (63%) were from thirteen private universities, and 163 (37%) were from seven public universities. Among the respondents, 290 (65.8%) were male students, and 151 (34.2%) were female students. Additionally, 365 (82.8%) were undergraduate students, and 76 (17.2%) were graduate students (Table 4).

Table 4: Demographic Information of Respondents

Variable	Classification	Frequency	Percent	Valid Percent
University Category	Private	278	63.0	63.0
	Public	163	37.0	37.0
Gender	Male	290	65.8	65.8
	Female	151	34.2	34.2
User Category	Graduate Student	76	17.2	17.2
	Undergraduate Student	365	82.8	82.8

5.2 Frequency of Koha Use

This survey showed that the highest number of the respondents, 127 (28.8%) did not use the services of Koha, followed by 80 respondents (18.1%) used the services weekly, 74 respondents (16.8%) used the services occasionally, 68 respondents (15.4%) used the services daily, 55 respondents (12.5%) used the services twice in a week, and 31 respondents (7.0%) used the services monthly. Only 6 respondents (1.4%) used Koha services fortnightly (Table 5).

Table 5: Frequency of Koha Use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Daily	74	16.8	16.8	16.8
	TwiceWeek	55	12.5	12.5	29.3
	Weekly	80	18.1	18.1	47.4
	Fortnightly	6	1.4	1.4	48.8
	Monthly	31	7.0	7.0	55.8
	Occasionally	68	15.4	15.4	71.2
	None	127	28.8	28.8	100.0
	Total	441	100.0	100.0	

5.3 Overall Usability of Koha

Table 6 shows that the overall mean user satisfaction level was 3.46 on a five-point scale. Among the eighteen statements of usability, "Access facility to Koha catalog is available round-the-clock" had the highest satisfaction mean of 3.65, whereas "Online Public Access Catalog of Koha is easy to understand and navigate" had the lowest satisfaction mean of 3.22. All usability statements were achieved at both ends of respondents' opinion scale, ranging from 1 to 5, indicating that not all users were equally satisfied with the existing Koha services.

Table 6: Descriptive Statistics of User Satisfaction towards Koha

Dimension	ID	Statement	Mean	SD
OPAC	1	The online Public Access Catalog of Koha is easy to understand and navigate	3.22	1.150
	2	Access to Koha catalog is available round-the-clock	3.65	1.005
	3	Advanced search of the Koha catalog is exciting	3.64	1.015
Circulation	4	The book check-in (return) system of Koha is excellent	3.34	.979
	5	The book check-out (borrow) system of Koha is user-friendly	3.41	1.038
	6	The book renewal service of Koha is easy to use	3.54	.995
Notification	7	The auto email alert service of Koha is interesting	3.54	1.128
	8	The auto SMS notification service of Koha is interesting	3.54	1.128
	9	The receipt printing service of Koha for issue and return of books is exciting	3.32	1.132
User Management	10	The user login facility of Koha is attractive	3.35	1.131
	11	Modification of the User Profile in Koha is easy	3.33	1.205
	12	Users can check her/his library usage statistics through Koha	3.33	1.205
User Interface	13	The user interface of Koha can be accessed simply from a Smartphone	3.49	1.038
	14	Automation-related features are available in the Koha user interface	3.52	1.031
	15	The user interface of Koha is impressive	3.52	1.031
Accessibility	16	Online book reservation system of Koha saves time	3.48	1.152
	17	Online self-renewal service of Koha is easy to use	3.54	.995
	18	It is easy to make an online purchase suggestion through Koha	3.52	1.081
Overall			3.46	.743

5.4 Dimensional Usability of Koha

Table 6 shows that among the six dimensions of usability of Koha, the accessibility dimension (3.512) achieved the highest usability, followed by the user interface (3.507), online public access catalog (OPAC) (3.503), usage notification (3.467), circulation service (3.429), and patron management (3.336) modules.

Table 7: Dimensional Usability of Koha

	N	Minimum	Maximum	Mean	Std. Deviation
Patron Management	441	1.00	5.00	3.3364	1.02296
Circulation	441	1.00	5.00	3.4293	.82609
Notification	441	1.00	5.00	3.4671	.96583
OPAC	441	1.00	5.00	3.5034	.83880
User Interface	441	1.00	5.00	3.5072	.91094
Accessibility	441	1.00	5.00	3.5117	.87786

5.5 Variance in Usability of Koha by University Category

The independent-samples t-test was used to analyze user responses on the overall and dimensional usability of Koha by university category. Table 8 shows that the overall usability of Koha in university libraries in Bangladesh was significantly higher in private (3.56) than in public (3.29) university libraries ($P < .001$). Besides, there were significant differences in the usability of OPAC ($P < .001$), Notification ($P < .004$), User Management ($P < .004$), User Interface ($P < .001$), and Accessibility ($P < .009$) dimensions of the Koha OSILS between the users of private and public university libraries. But the study also found no significant difference in the usability of the circulation module ($P < .087$) of the Koha OSILS between users of private and public university libraries.

Table 8: Variance in Usability of Koha between users of Public and Private Universities

Descriptive Statistics				t-test for Equality of Means					
Dimension	University Category	N	Mean		t	df	Sig. (2-tailed)	Mean df	Std. Error d
OPAC	Public	163	3.32	Equal variances assumed	-3.54	439	.000	-.289	.082
	Private	278	3.61	Equal variances not assumed	-3.55	342.88	.000	-.289	.081
Circulation	Public	163	3.34	Equal variances assumed	-1.71	439	.087	-.139	.081
	Private	278	3.48	Equal variances not assumed	-1.75	364.07	.080	-.139	.079
Notification	Public	163	3.29	Equal variances assumed	-2.93	439	.004	-.277	.094
	Private	278	3.57	Equal variances not assumed	-2.92	334.80	.004	-.277	.095
User Management	Public	163	3.15	Equal variances assumed	-2.93	439	.004	-.293	.100
	Private	278	3.44	Equal variances not assumed	-2.91	332.45	.004	-.293	.101
User Interface	Public	163	3.28	Equal variances assumed	-4.08	439	.000	-.360	.088
	Private	278	3.64	Equal variances not assumed	-4.04	330.71	.000	-.360	.089

Accessibility	Public	163	3.37	Equal variances assumed	-2.61	439	.009	-.225	.086
	Private	278	3.59	Equal variances not assumed	-2.64	351.18	.009	-.225	.085
Overall	Public	163	3.29	Equal variances assumed	-3.65	439	.000	-.264	.072
	Private	278	3.56	Equal variances not assumed	-3.64	336.85	.000	-.264	.072

5.6 Variance in Usability of Koha by Gender Category

An independent-samples t-test was used to analyze user responses on overall, dimension, and item library service quality bygender. Table 9 represents that the overall usability of Koha in university libraries in Bangladesh did not differ significantly ($P>.600$) between female (3.48) and male (3.45) users. Besides, there were no significant differences in the usability of OPAC ($P>.499$), Circulation ($P>.700$), Notification ($P>.962$), User Management ($P>.906$), User Interface ($P>.576$), and Accessibility ($P>.377$) dimensions of the Koha OSILS between the female and male users.

Table 9: Variance in Usability of Kohabetween Female and Male users

Descriptive Statistics				t-test for Equality of Means					
Dimension	Gender Category	N	Mean		t	df	Sig.(-tailed)	Mean df	Std. Error df
OPAC	Female	151	3.54	Equal variances assumed	.676	439	.499	.057	.084
	Male	290	3.48	Equal variances not assumed	.693	325.65	.489	.057	.082
Circulation	Female	151	3.45	Equal variances assumed	.385	439	.700	.032	.083
	Male	290	3.42	Equal variances not assumed	.393	322.22	.695	.032	.081
Notification	Female	151	3.47	Equal variances assumed	.048	439	.962	.005	.097
	Male	290	3.47	Equal variances not assumed	.049	324.01	.961	.005	.095
User Management	Female	151	3.34	Equal variances assumed	.119	439	.906	.012	.103
	Male	290	3.33	Equal variances not assumed	.122	326.10	.903	.012	.100
User Interface	Female	151	3.54	Equal variances assumed	.559	439	.576	.051	.091
	Male	290	3.49	Equal variances not assumed	.570	320.02	.569	.051	.089
Accessibility	Female	151	3.56	Equal variances assumed	.884	439	.377	.078	.088
	Male	290	3.48	Equal variances not assumed	.892	312.14	.373	.078	.087

Overall	Female	151	3.48	Equal variances assumed	.525	439	.600	.039	.074
	Male	290	3.45	Equal variances not assumed	.534	320.12	.593	.039	.073

5.7 Variance in Usability of Koha by User Category

An independent-samples t-test was used to analyze user responses on overall, dimension, and item library service quality by user category. Table 10 demonstrates that the overall usability of Koha in university libraries in Bangladesh did not differ significantly ($P>.258$) between postgraduate (3.37) and undergraduate (3.48) students. Besides, there were no significant differences in the usability of the OPAC ($P>.322$), Circulation ($P>.874$), User Management ($P>.311$), User Interface ($P>.624$), and Accessibility ($P>.513$) dimensions of the Koha OSILS between postgraduate and undergraduate students. However, there was a significant difference in Notification ($P<.018$) between the postgraduate and undergraduate students.

Table 10: Variance in Usability of Koha between Postgraduate and Undergraduate Students

Descriptive Statistics				t-test for Equality of Means					
Dimension	Student Category	N	Mean		t	df	Sig. (2-tailed)	Mean df	Std. Error df
OPAC	Postgraduate	76	3.42	Equal variances assumed	-.991	439	.322	-.104	.105
	Undergraduate	365	3.52	Equal variances not assumed	-.948	104.08	.345	-.104	.110
Circulation	Postgraduate	76	3.44	Equal variances assumed	.158	439	.874	.016	.104
	Undergraduate	365	3.43	Equal variances not assumed	.161	110.14	.873	.016	.103
Notification	Postgraduate	76	3.23	Equal variances assumed	-2.384	439	.018	-.288	.121
	Undergraduate	365	3.52	Equal variances not assumed	-2.106	97.47	.038	-.288	.137
User Management	Postgraduate	76	3.23	Equal variances assumed	-1.014	439	.311	-.131	.129
	Undergraduate	365	3.36	Equal variances not assumed	-.968	103.80	.335	-.131	.135
User Interface	Postgraduate	76	3.46	Equal variances assumed	-.490	439	.624	-.056	.115
	Undergraduate	365	3.52	Equal variances not assumed	-.479	106.16	.633	-.056	.117
Accessibility	Postgraduate	76	3.45	Equal variances assumed	-.654	439	.513	-.072	.111
	Undergraduate	365	3.52	Equal variances not assumed	-.628	104.35	.532	-.072	.115
Overall	Postgraduate	76	3.37	Equal variances assumed	-1.134	439	.258	-.106	.093
	Undergraduate	365	3.48	Equal variances not assumed	-1.071	102.88	.287	-.106	.099

6. Discussion

This study was conducted among 441 library users from 13 private and 7 public universities in Bangladesh to evaluate the usability of Koha. The demographic information of the sample indicated that a broad cross-section of the population responded. The study assessed the overall and individual usability of Koha using descriptive statistics and an independent-samples t-test. Numerous statistical methods, including Cronbach's Alpha, Bartlett's test of sphericity, KMO value, item loadings, commonalities, factor analysis, and discriminant validity, supported the sampling adequacy, reliability, and validity of the model. The study found that library users were highly satisfied with Koha's overall usability.

Hypothesis-1: The usability of Koha OSILS between the users in the private and public university libraries of Bangladesh differs significantly.

The results of the independent sample t-test showed that the overall usability of Koha in university libraries of Bangladesh was significantly different ($P < .001$) between the users of private (3.56) and public (3.29) university libraries, indicating the library users of the private university were significantly more satisfied than the public university with the usability of Koha. Besides, there were significant differences in the usability of OPAC, Notification, user management, user interface, and accessibility dimensions of the Koha OSILS between the users of private and public university libraries, indicating that, except for the circulation dimension, library users of the private university were significantly more satisfied with the usability of all the dimensions of the Koha OSILS.

Hypothesis 2: The usability of Koha OSIL between male and female users in university libraries of Bangladesh differs significantly.

The results of the independent-samples t-test revealed no significant difference in overall usability of Koha ($P > .600$) between female (3.48) and male (3.45) users, indicating that both groups were similarly satisfied with Koha's usability in universities in Bangladesh. Besides, there were no significant differences in the usability of OPAC, circulation, notification, user management, user interface, and accessibility dimensions of the Koha OSILS between the female and male users, indicating both the male and female users were similarly satisfied with the usability of all dimensions of Koha in the universities of Bangladesh.

Hypothesis-3: The usability of Koha OSIL between undergraduate and graduate students in university libraries of Bangladesh differs significantly.

The results of the independent-samples t-test showed that there was no significant difference in overall usability of Koha ($P > .258$) between postgraduate (3.37) and undergraduate (3.48) students, indicating that both groups were similarly satisfied with Koha's usability in universities in Bangladesh. Besides, there were no significant differences in the usability of OPAC, circulation, user management, user interface, and accessibility dimensions of the Koha OSILS between the undergraduate students and postgraduate students, indicating both the undergraduate and postgraduate students were

similarly satisfied with the usability of all dimensions except of the notification dimension of Koha in the universities of Bangladesh.

7. Conclusion and Recommendation

The study assessed the usability of Koha in university libraries in Bangladesh from students' perspectives. Several numerical techniques supported the sampling adequacy, reliability, and validity of the model. The study found that "access to Koha catalog is available round-the-clock" received exclusive recognition from users, while "Online Public Access Catalog of Koha is easy to understand and navigate" ranked lowest in perceived mean of fulfilling the need. The study found that user satisfaction with Koha's overall usability was reasonably high, indicating that the existing Koha OSILS are performing efficiently in university libraries in Bangladesh. The study also found that library users at the private university were significantly more satisfied with Koha's usability than those at the public university. However, male and female users, as well as undergraduate and postgraduate students, were similarly satisfied with Koha's usability in university libraries in Bangladesh. The findings have several significant implications for both practice and future research on the usability of various OSILS. It will help build awareness among library professionals and users of Koha's usability. The diverse statistical methods supported the sampling adequacy, reliability, and validity of the model, which will prompt further research on the usability of various OSILSs both locally and globally. Users provided positive feedback on the usability of Koha OSILS, which creates opportunities for universities in Bangladesh to automate their libraries.

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Assessment of Individual Differences in Leadership Quality of University Library Professionals in Bangladesh

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Abstract

Background/purpose: The assessment of knowledge and leadership quality of library professionals is crucial in ensuring the effectiveness of university library services and facilities, as these factors directly influence user satisfaction and library performance. This study aims to evaluate the individual differences of the knowledge and leadership quality of Bangladeshi university library professionals by type of user and university categories.

Methods: The quantitative approach was applied in the study adopting an underdeveloped LEADQUAL (leadership quality) model, which contained 25 items under five dimensions with a 7-point Likert scale. The survey was conducted among 67 teachers, 09 researchers, and 463 students, totaling 513 respondents from 11 public, 8 private, and 1 international universities in Bangladesh. The individual differences in library knowledge and leadership quality were calculated through an analysis of variance and independent sample t-test for the university and user categories.

Result: The analysis revealed that there was no statistically significant difference ($p > 0.932$) in the overall library leadership quality among the teachers (5.02), students (5.07), and researchers (5.12). The results indicated a significant difference ($p < 0.005$) in the overall leadership quality among users of public (4.92), private (5.25), and international (5.18) university libraries in Bangladesh.

Conclusion: Several statistical methods supported the sampling adequacy, reliability and validity of the adapted model, which could be used as a basis for further assessments of library service quality by different demographic groups, both locally and globally.

Keywords

LEADQUAL, library leadership quality, individual difference, university libraries, Bangladesh

1. Introduction

Leadership plays a key role in the sustainable development and integrated implementation of library administration and practices (Seidel et al., 2019). A knowledge leader is a leading person, who undertakes the responsibility of taking the value obtained

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through knowledge, which is the most important asset of organizations, to the highest level. A knowledge leader is a person, who pioneers and leads in the knowledge management initiative of an organization (Bozdoğan, 2013; Selen, 2009). Knowledge leadership is defined as a process whereby an individual supports other group members in the learning process needed to attain group or organizational goals (Viitala, 2004). Donate & Sánchez de Pablo(2015) examined the role of the specific type of organizational leadership- knowledge-oriented leadership – in Knowledge Management (KM) initiatives that seek to achieve innovation. Results showed that although KM practices themselves are important for innovation purposes, the existence of this kind of leadership encourages the development and use of KM exploration and exploitation practices. Organizational leadership is an essential condition for the development and encouragement of KM practices for innovation purposes in technology-intensive firms.

The study aims to measure the knowledge and leadership quality and its impacts on user satisfaction in academic libraries using a modified LEADQUAL instrument which will give a glimpse of knowledge quality along with the leadership quality of library administrators in Bangladesh. The study will help LIS professionals to revise their knowledge competency, technical competency, negotiation skill, visionary circumstance, and responsiveness behavior in academic libraries of Bangladesh. Leadership quality is defined for this study as the librarianship performance of LIS professionals to meet the demands of user expectations and their perceptions of the leadership experience. User satisfaction is specified here as the perceptions of the library users toward the library administrator or librarian that contribute to his/her satisfaction with librarians' leadership quality. The impact is also defined for this study as the significant effect or influence of leadership quality on user satisfaction in the libraries of higher educational institutions.

2. Literature Review

Management and leadership are inextricably related and enhance each other. Any attempt to keep the two apart is likely to create more issues than it fixes. The manager's duties include organizing, coordinating, and planning. It is the role of the leader to uplift and encourage. It takes work to become a good leader. Being a successful leader is possible if he/she has the drive and determination to do so (Sharma & Jain, 2013). Basically, managers focus on known techniques and goals, while leaders inspire others with a vision of the library's mission and effective ways to achieve it (Riggs, 2001).

Al Ansari & Al Khadher (2011) identified the essential skills and abilities that library and information professionals must possess in order to effectively fulfill their leadership roles. Winston & Dunkley (2002) identified the areas of competence for academic librarianship. The authors incorporated the recognition of leadership characteristics such as adaptability, proficient interpersonal communication, and sound decision-making. Hollenbeck et al. (2006) corresponded with each other to discuss their perspectives on the significance of leadership competence models. The authors highlighted the fundamental assumptions of leadership competence models derived from both theoretical frameworks and practical experiences. Visagie et al. (2011) also identify the specific leadership competency types exhibited by managers in businesses and to cultivate a favorable environment for diversity management in order to sustain ongoing success.

A leader is someone who delegated or persuaded others to act in a way that carried out predetermined objectives. Leadership is thus seen as a social influence process in which the leader seeks the voluntary participation of subordinates in an effort to attain organization goals (Faiz Rasool et al., 2015). According to Memon(2014)), leadership is the process by which a person shapes the attitudes, ideas, and actions of others by taking charge of establishing the intuition's direction and enabling others to see the future and figure out how to archive it. Fought (2016) emphasized the importance of effective library leadership in academic health sciences libraries to influence staff towards collective goals and library effectiveness. Jange (2012) highlighted the need for LIS professionals to acquire leadership competencies to effectively navigate the evolving landscape of libraries and information services. A study conducted by Shamim et al.(2019) explored how knowledge-oriented leadership (KOL) influences KM behavior, as well as the mediating role of employee work attitudes like affective commitment, creative self-efficacy, and work engagement. Mansoor & Hussain(2024) examined the impact of knowledge-oriented leadership on sustainable service quality in higher education institutes. The study explored the mediating roles of organizational innovation and psychological empowerment in this relationship.

Based on the available literature, it is found that some studies have been conducted on measuring the service quality of university libraries worldwide using SERVQUAL for example (Hery Wihardika Griadhi, 2018; Afridi et al., 2016; Malik & Malik, 2015; Silva et al., 2017; Suresh & Mohan, 2015; Quyet et al., 2015; Bahrainizadeh, 2013; Haneefa et al., 2014; Arshad & Ameen, 2010) and so forth. A number of researches have been conducted to measure the library service quality using SERVQUAL in individual university libraries of Bangladesh (Alam, 2017; Shoeb, 2011; Shoeb & Ahmed, 2009; Hossain & Islam, 2012; Ahmed & Shoeb, 2009), developing a service performance assessment system for academic libraries (Hossain & Ahmed, 2013), and key dimensions for evaluating service quality and satisfaction in academic libraries (Hossain, 2016). However, not much initiative has been made to assess the impact of leadership quality in the academic libraries of Bangladesh. Besides, no study has been conducted to measure the library leadership quality using LEADQUAL in Bangladesh including public, private and international universities. Thus, it can be concluded that an effort has been proposed for the first time to evaluate leadership quality and its impact on user satisfaction using LEADQUAL in academic libraries in Bangladesh.

3. Hypotheses

The following question is raised: Are there any significant differences in library leadership quality by type of university, user and gender? Three hypotheses have been formulated according to the research gap, question raised and objectives of the study:

Hypothesis 1: The leadership quality differs significantly among the users of public, private and international university libraries in Bangladesh (user category).

Hypothesis 2: The leadership quality differs significantly among teachers, students and researchers at university libraries in Bangladesh (university category)

4. Methodology

4.1 Research design

A structural equation model was created using user happiness as the dependent variable and five leadership quality factors as the independent variables in order to assess the relationship between library professionals' leadership quality dimensions and user satisfaction. The equation for the model with predictor variables is $Y = \alpha + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \varepsilon$. Where, the dependent variable Y is user satisfaction. The independent variables are as follows:

X1 = Knowledge Competency

X2 = Technical Competency

X3 = Negotiation Skill

X4 = Visionary

X5 = Responsiveness

α is the intercept term

$\beta_1, \beta_2, \beta_3, \beta_4$, and β_5 are the coefficients of the predictor variables.

ε is the error term.

A quantitative method was applied to determine individual differences in the leadership quality of Bangladeshi university libraries. The study collected primary and secondary data. For the primary data, a questionnaire-based sample survey was conducted. The study measured the individual differences in library leadership quality by type of university, user and gender through an analysis of variance (ANOVA) and independent sample t-test.

A structured questionnaire was developed for the study that included demographic information (university name, user category, university category, gender, status and age), the frequency of library use and the use of 10 library services, with 30 statements under five leadership quality dimensions. Among the 30 items under the five leadership quality dimensions. All of the items were then modified according to the arrangements of university libraries under the five leadership quality dimensions: knowledge competency, technical competency, negotiation skill, visionary and responsiveness. The resources dimension consisted of six statements: covering the field of study, updating resources, accessibility of resources, richness of the institutional repository, easy-to-understand online public access catalogue, and access to online resources. The competence dimension focused on six statements: providing the promised services, providing services with minimum interruption, users feeling relaxed while interacting with staff, professional knowledge, skill and ability to guide users.

4.2 Statistical Methods

The statistical analysis of the study was carried out using the SPSS 23 and the SmartPLS4. The SmartPLS performed confirmatory factor analysis and route analysis under the SEM approach to achieve goal and test the hypotheses in order to assess the substantial influence of leadership quality dimensions on user satisfaction. Using descriptive statistics, such as mean and standard deviation, the SPSS was used to quantify user happiness, overall leadership quality, and gaps in the leadership quality. It was also used to measure hypotheses and achieve the goal by computing the individual differences

in leadership quality by user and university groups using ANOVA. With the use of an ANOVA, the program assessed the individual differences in the superiority, sufficiency, and realistic gaps in leadership quality by user and university categories in order to react to objectives and to evaluate hypotheses. The study's sample adequacy was assessed using the Kaiser-Meyer-Olkin (KMO) and the Bartlett's Test of Sphericity by SPSS.

4.3 Kaiser-Meyer-Olkin (KMO) Value

Kaiser-Meyer-Olkin (KMO) is used to measure sampling adequacy. The criteria for KMO value is “0.90s = marvelous, 0.80s = meritorious, 0.70s = middling, 0.60s = mediocre, 0.50s = miserable, and below 0.50 = unacceptable” (Kaiser, 1974). The KMO value matrix is 0.848 for five statements of knowledge competency, 0.866 for five statements of technical competency, 0.844 for five statements of negotiation skill, 0.872 for five statements of visionary, 0.875 for five statements of responsiveness, 0.929 for ten statements of satisfaction, which indicated that the 513 samples are statistically significant for conducting factor analysis. A KMO value within the range of 0.6 - 0.7 is typically a good measure of factor-suitability, but a high KMO value is associated with moderate values of the coefficient of multiple determination (Leech et al., 2005; Nkansah, 2018). The overall value of KMO is 0.848, which is greater than the threshold of 0.7, indicating the sample size is adequate for factor analysis.

4.4 Bartlett's Test of Sphericity

Value of Bartlett's Test of sphericity should be 0.05 or less (Schierholz & Laukkanen, 2007; Shkeer & Awang, 2019). The result of Bartlett's test (7079.170, $df = 15$, $p < 0.001$) explains that the “correlation is meaningfully different from the identity matrix, and the correlations among the factors are not zero”. Table 4.3 shows that Bartlett's test has ($p < 0.001$) for 25 items of leadership quality, ($p < 0.001$) for five items of Knowledge Competency, ($p < 0.001$) for five items of Technical competence, ($p < 0.001$) for five items of Negotiation skill, ($p < 0.001$) for five items of Visionary, ($p < 0.001$) for five items of Responsiveness, ($p < 0.001$) for ten items of satisfaction, and the overall ($p < 0.001$) for 35 variables indicated that the internal consistency of these data is appropriate.

Table 1: Sampling Adequacy Statistics

SL	Dimensions	KMO Value	“Bartlett's Test	Items
		<i>Sig: 0.7 or above</i>	<i>Sig: 0.05 or less</i>	
1	Knowledge Competency	0.848	0.001	5
2	Technical Competency”	0.866	0.001	5
3	Negotiation Skill	0.844	0.001	5
4	Visionary	0.872	0.001	5
5	Responsiveness	0.875	0.001	5
6	Satisfaction	0.929	0.001	10
7	Overall	0.848	0.001	35

KMO = Kaiser-Meyer-Olkin, Sig. = Significance

4.5 Composite Reliability

Scale item internal consistency is measured by construct reliability. All of the variables are internally consistent and reliable, as shown by the construct reliability values of knowledge competency (0.864), technical competency (0.885), negotiation skill (0.853), visionary (0.904), responsiveness (0.912), and satisfaction (0.926) exceeding the threshold value of 0.7 (Dijkstra & Henseler, 2015). (Table 4.5).

Table 2: Reliability Statistics

Dimensions	Cronbach's Alpha	RHO_AA Coefficient	Composite Reliability	AVE	Items
	<i>Sig: 0.7 or greater</i>	<i>Sig: 0.7 or greater</i>	<i>Sig: 0.7 or greater</i>	<i>Sig: 0.5 or greater</i>	
Knowledge Competency	0.864	0.867	0.864	0.561	5
Technical Competency	0.884	0.885	0.885	0.606	5
Negotiation Skill	0.854	0.858	0.853	0.539	5
Visionary	0.904	0.906	0.904	0.654	5
Responsiveness	0.912	0.913	0.912	0.676	5
Satisfaction	0.926	0.931	0.926	0.558	10
Overall	0.890				35

4.6 Regression Analysis: Durbin Watson Statistic

Table 3 shows that the Durbin-Watson value was 1.419, indicating positive autocorrelation in the residuals of the regression analysis.

Table 3: Durbin Watson Statistic

Model	“R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson”
1	.726 ^a	.527	.522	.78350	1.419

- a. Predictors: (Constant) “Knowledge competency, Technical Competency, Negotiation skill, Visionary and Responsiveness
- b. Dependent Variable: Satisfaction

5. Findings of the Study

5.1 Demographic Information of Respondents

The impact of leadership quality on user satisfaction in Bangladeshi university libraries was assessed using primary data obtained from 513 users of the twenty universities that were chosen. The questionnaire set-2 was utilized for this purpose. Based on the 513 respondents' demographic data, the majority of respondents (290, 56.5%) were from public universities, followed by those from private (190, 47%) and overseas universities (33, 6.4%). The majority of the respondents were from CVASU (48, 9.4%), followed by IIUC (38, 7.4%), AUW (36, 6.4%), CU (33, 6.4%), BSMMU (30, 5.8%), BUET (27, 5.3), DU (27, 6.3%), USTC (24, 4.7%), SUST (23, 4.5%), RU (22, 4.3%), SAU (22, 4.3%), BUP (22, 4.3%), BRACU (21, 4.1%), CUET (21, 4.1%), ULAB (21, 4.1), BAU (20, 3.9%), DIU (20, 3.9%), EU (20, 3.9%), EWU (20, 3.9) and IUB (20, 3.9%). The majority of the respondents were students (437, 85.2%), followed by teachers (67, 13.1%) and researchers (9, 1.8%). Of the respondents, 8 (1.6%) were professors, 15

(2.9%) were associate professors, 19 (3.7%) were assistant professors, 26 (5.1%) were lecturers, 8 (1.6%) were MPhil/PhD researchers, 113 (22.0%) were graduate students, and 324 (63.1%) were undergraduate students. Of the respondents, 269 (52.4%) were male, and 244 (47.6%) were female. The age group with the highest percentage of respondents was 20–29 years (43, 8.4%), followed by 30–39 years (30, 8.4%), 40–49 years (18, 3.5%), below 20 years (16, 3.1%), and 50–49 years (3, 6%). The demographic information of the respondents indicated that a large cross-section of the population replied. Table 5.1 shows that among the 20 universities, the highest numbers of the respondents were from the CVASU whereas the lowest numbers of the respondents were from IUB, EU, EWU and DIU.

5.2 Frequency of Library Use by User Category

According to study, 9 teachers, which represents 13.4% of the total number of teachers surveyed, acknowledged using the product on a daily basis. Among students, the library is used on a daily basis by a substantial number of individuals, specifically 108 students, which accounts for 24.7% of the student population. Researchers make everyday use of the library, comprising 6 individuals (66.4%). 23 professors (34.3%), 142 students (32.5%), and 1 researcher (11.1%) report using the library twice a week. Weekly usage is recorded for a total of 105 individuals, consisting of 17 professors (25.4%), 87 pupils (19.9%), and 1 researcher (11.1%). Fortnightly usage is less prevalent, as indicated by 4 professors (6.0%), 25 students (5.7%), and 1 researcher (11.1%). The monthly utilization of the library is documented by 5 educators, accounting for 7.5% of the total, as well as 28 pupils, representing 6.4% of the total. There are no researchers included in the data. Out of the total number of teachers, 13.4% reported using the library occasionally. Similarly, 10.8% of students reported occasional library usage. However, no researchers reported using the library. The cumulative number of participants in each group amounts to 513, comprising of 67 educators, 437 learners, and 9 scholars. The majority of library users, accounting for 85.2%, are students. Teachers make up 13.1% of library users, while researchers constitute only 1.8%.

5.3 Assessment of Leadership Quality on Each Item

Table 4 provides an in-depth assessment of the leadership quality in university libraries across twenty-five statements categorized into five dimensions: Knowledge Competency (KC), Technical Competency (TC), Negotiation Skill (NS), Visionary (V), and Responsiveness (R).

Table 4: Leadership Quality of Each Item in the University Libraries

Items	Statements	Mean	SD
KC1	Library professionals are knowledgeable	4.87	1.39
KC2	They provide services as promised	5.10	1.39
KC4	They emphasis on information literacy	5.06	1.42
KC4	The library resource are organized in standard format	5.22	1.37
KC5	All resources are easily accessible	5.19	1.45
TC6	Library officers are technically sound	4.95	1.51
TC7	Able to handle the technical issues	5.08	1.44

TC8	They ensure technical support promptly to the users	5.09	1.43
TC9	Able to guide users in technical problem	5.06	1.44
TC10	Handles the library automation function properly	5.09	1.40
NS11	Library officials are able to achieve sufficient budget	4.80	1.43
NS12	Ensure infrastructural development”	5.01	1.40
NS13	Makes sure library facilities”	5.17	1.49
NS14	Looks confident	5.11	1.40
V15	Introduce new item and services in time	4.97	1.67
V16	Library staffs are always positive to library development	5.02	1.52
V17	Give attention to adopt modern technology”	4.95	1.54
V18	Deal with users in a considerate manner	5.13	1.47
V19	Vigorous to make top ranked university	4.99	1.53
V20	Hold positive mind for positive change	5.18	1.51
R21	Library professionals have willingness to assist users	5.03	1.49
R22	They give priority of the user’s interest	5.13	1.47
R23	They serve the users promptly	5.12	1.42
R24	Make sure the regular update of library service”	5.08	1.50
R25	They are available to get library service	5.28	1.54

MLE = “Minimum Leadership Expectation, DLE =Desired Leadership Expectation, RLE = Real Leadership Expectation, ALP = Actual Leadership Performance,SD= Standard Deviation, KC = Knowledge Competency, TC = Technical Competency, NS = Negotiation Skill, V = Visionary, R = Responsiveness

5.4 Overall Leadership Quality by User Category

Table 5 displays the average and variability of the general knowledge and leadership ability across many categories: minimal leadership expectations, desired leadership expectations, genuine leadership expectations, and actual leadership performance. The data includes teachers, students, and researchers. The teachers had the greatest overall mean of minimal leadership expectation, with a score of 4.72. This was followed by students, who had a score of 4.42, and researchers, who had a score of 4.00. The researchers had the highest overall mean of desired leadership expectation, with a score of 6.39. Teachers had a slightly lower score of 6.21, while students had the lowest score of 5.93. Teachers had the greatest overall mean of genuine leadership expectation, with a score of 5.46. Researchers had a slightly lower score of 5.20, while students had a score of 5.18. Researchers had the greatest overall mean of actual leadership performance, with a score of 5.12. Students had a slightly lower score of 5.07, while teachers had the lowest score of 5.02. The findings indicated that there were significant differences in the average values of the minimum leadership expectations, desired leadership expectations, real leadership expectations, and actual leadership performance among the teachers, students, and researchers in the university libraries of Bangladesh.

Table 5: Overall Leadership Quality Expectation by User Category

Leadership Expectation and performance		N	Mean	SD	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
						Lower Bound	Upper Bound		
MLE	Teacher	67	4.72	1.00	.12	4.47	4.96	2.44	6.28
	Student	437	4.42	1.02	.04	4.33	4.52	1.44	6.96
	Researcher	9	4.00	1.18	.39	3.09	4.91	2.12	5.72
	Total	513	4.46	1.03	.04	4.37	4.54	1.44	6.96
DLE	Teacher	67	6.21	.80	.09	6.01	6.41	2.64	7.00
	Student	437	5.93	.83	.03	5.85	6.01	1.12	7.00
	Researcher	9	6.39	.43	.14	6.06	6.73	5.76	7.00
	Total	513	5.97	.83	.03	5.90	6.05	1.12	7.00
RLE	Teacher	67	5.46	.75	.09	5.28	5.65	2.66	6.60
	Student	437	5.18	.74	.03	5.11	5.25	2.28	6.98
	Researcher	9	5.20	.61	.20	4.72	5.67	4.36	6.04
	Total	513	5.21	.74	.03	5.15	5.28	2.28	6.98
ALP	Teacher	67	5.02	1.10	.13	4.75	5.29	2.56	6.96
	Student	437	5.07	1.08	.05	4.96	5.17	1.52	7.00
	Researcher	9	5.12	.81	.27	4.50	5.74	4.04	6.16
	Total	513	5.06	1.08	.04	4.97	5.15	1.52	7.00

MLE =Minimum Leadership Expectation, DLE =Desired Leadership Expectation, RLE = Real Leadership Expectation, ALP= Actual Leadership Performance, SD =Standard Deviation, N = Number

5.5 ANOVA of Overall Leadership Quality Expectation by User Category

The user category computed the user responses for the overall minimum leadership expectations, desired leadership expectations, real leadership expectations, and actual leadership performance by analysis of variance (ANOVA). Table 6 shows that there was significant difference ($p < 0.041$) among the teachers (4.72), students (4.42), and researchers (4.00) in the overall minimum leadership expectations. This study revealed that the overall desired leadership expectations differed significantly ($p < 0.011$) among the teachers (6.21), students (5.93), and researchers (6.39) in the university libraries of Bangladesh. The result shows that there was a significant difference ($p < 0.014$) among the teachers (5.46), students (5.18), and researchers (5.20) in the overall real leadership expectations. It is also found that there was no significant difference ($p > 0.932$) among the teachers (5.02), students (5.07), and researchers (5.12) in the overall actual leadership performance of library professionals in the university libraries of Bangladesh.

Table 6: ANOVA of Overall Leadership Quality Expectation by User Category

Expectations		Sum of Squares	df	Mean Square	F	Sig.
MLE	Between Groups	6.795	2	3.398	3.222	.041
	Within Groups	537.698	510	1.054		
	Total	544.493	512			
DLE	Between Groups	6.240	2	3.120	4.571	.011
	Within Groups	348.109	510	.683		
	Total	354.349	512			
RLE	Between Groups	4.773	2	2.387	4.319	.014
	Within Groups	281.817	510	.553		
	Total	286.590	512			
ALP	Between Groups	.166	2	.083	.071	.932
	Within Groups	599.934	510	1.176		
	Total	600.100	512			

MLE =Minimum Leadership Expectation, DLE =Desired Leadership Expectation, RLE = Real Leadership Expectation, ALP = Actual Leadership Performance, F = F-value, Sig. = Significance, Significance value: $p<0.05$

5.6 Overall Leadership Quality by University Category

Table 7 shows the mean and standard deviation of the overall leadership quality for minimum leadership expectations, desired leadership expectations, real leadership expectations, and actual leadership performance among the users of public, private, and international universities. the findings indicate significant variations in overall leadership quality among users from different types of universities. Specifically, the highest overall mean for minimum leadership expectation is observed among users from private universities (4.79), followed by public universities (4.31) and international universities (3.81). Similarly, for desired leadership expectation, the highest overall mean is reported among users from international universities (6.21), followed by private universities (6.16) and public universities (5.82).

The highest overall mean of real leadership expectation was 5.47 for the users of private universities, followed by 5.07 for the users of public universities and 5.01 for the users of international universities. The highest overall mean of actual leadership performance was 5.25 for the users of private universities, followed by 5.18 for the users of international universities, and 4.92 for the users of public universities. Overall, the results suggest that there are notable differences in the overall leadership quality perceived and expected by users across public, private, and international universities in Bangladesh.

Table 7: Overall Leadership Quality by University Category

Expectation & Perception ByUniversity Category		N	Mean	SD	Std. Error	95% Confidence Interval for Mean		Minim um	Maxi mum
						Lower	Upper		
MLE	Public	290	4.31	.95	.05628	4.2068	4.4283	1.44	6.16
	Private	190	4.79	1.08	.07883	4.6347	4.9457	1.72	6.96

	International	33	3.81	.69	.12145	3.5672	4.0619	2.12	4.92
	Total	513	4.46	1.03	.04553	4.3708	4.5497	1.44	6.96
DLE	Public	290	5.82	.80	.04746	5.7359	5.9227	2.96	7.00
	Private	190	6.16	.84	.06166	6.0446	6.2878	1.12	7.00
	International	33	6.21	.66	.11548	5.9793	6.4498	4.08	7.00
	Total	513	5.97	.83	.03673	5.9067	6.0510	1.12	7.00
RLE	Public	290	5.07	.71	.04211	4.9905	5.1563	2.28	6.44
	Private	190	5.47	.76	.05561	5.3685	5.5879	2.66	6.98
	International	33	5.01	.45	.07908	4.8535	5.1756	3.94	5.70
	Total	513	5.21	.74	.03303	5.1547	5.2845	2.28	6.98
ALP	Public	290	4.92	1.04	.06119	4.8090	5.0498	1.52	6.88
	Private	190	5.25	1.15	.08354	5.0873	5.4169	1.88	7.00
	International	33	5.18	.85	.14855	4.8817	5.4868	3.52	6.44
	Total	513	5.06	1.08	.04780	4.9714	5.1592	1.52	7.00

MLE = Minimum Leadership Expectation, DLE = Desired Leadership Expectation, RLE = Real Leadership Expectation, ALP = Actual Leadership Performance, SD = Standard Deviation, N = Number

5.7 ANOVA of Overall Leadership Quality by University Category

The ANOVA analysis presented in table 8 examines the overall leadership quality perceptions across different university categories, including public, private, and international universities. The analysis evaluates the variance in user responses for minimum leadership expectation (MLE), desired leadership expectation (DLE), real leadership expectation (RLE), and actual leadership performance (ALP).

For minimum leadership expectation (MLE), there is a significant difference among the university categories ($p < 0.000$), with an F-value of 20.410. This indicates significant variability in the average MLE across public, private, and international universities. Similarly, for desired leadership expectation (DLE), the ANOVA results show a significant difference ($p < 0.000$), with an F-value of 11.260, indicating substantial differences in the overall DLE among users from different university categories.

The analysis also indicates a significant difference ($p < 0.000$) in the overall real leadership expectation (RLE) among users from public, private, and international universities, with an F-value of 19.429. This result highlights notable discrepancies in the RLE perceived by users across university categories. Furthermore, for actual leadership performance (ALP), the ANOVA results reveal a significant difference ($p < 0.005$) among users of public, private, and international universities, with an F-value of 5.404. This suggests variations in the actual leadership performance of university libraries as perceived by users from different types of universities.

Overall, the ANOVA findings underscore the significant differences in overall service quality perceptions, including MLE, DLE, RLE, and ALP, among users of public, private, and international universities in Bangladesh.

Table 8: ANOVA of Overall Leadership Quality by University Category

Expectations & Perception		Sum of Squares	df	Mean Square	F	Sig.”
MLE	Between Groups	40.352	2	20.176	20.410	.000
	Within Groups	504.142	510	.989		
	Total	544.493	512			
DLE	Between Groups	14.986	2	7.493	11.260	.000
	Within Groups	339.363	510	.665		
	Total	354.349	512			
RLE	Between Groups	20.290	2	10.145	19.429	.000
	Within Groups	266.300	510	.522		
	Total	286.590	512			
ALP	Between Groups	12.453	2	6.226	5.404	.005
	Within Groups	587.648	510	1.152		
	Total	600.100	512			

MLE =Minimum Leadership Expectation, DLE =Desired Leadership Expectation, RLE = Real Leadership Expectation, ALP = Actual Leadership Performance, Sig. = Significance, F = F-value

6. Discussion

The user categorized individuals into several groups, such as teachers, students, and researchers, and also categorized universities into groups such as public, private, and international. The user then used ANOVA to compute differences in library leadership quality at the overall, dimensional, and item level within these categories. Hypothesis s1 and 2 of this study pertains to the variation in library leadership quality among individuals, and university category examined in detail below.

Hypothesis 1: The leadership quality differs significantly among the users of public, private and international university libraries in Bangladesh (user category).

Hypothesis 2: The leadership quality differs significantly among teachers, students and researchers at university libraries in Bangladesh (university category)

The user category utilized ANOVA to calculate the user responses for the overall, dimensional, and item-wise library leadership quality. The analysis revealed that there was no statistically significant difference ($p>0.932$) in the overall library leadership quality among the teachers (5.02), students (5.07), and researchers (5.12). This suggests that teachers, students, and researchers in the university libraries of Bangladesh perceive similar levels of leadership performance from their respective libraries. Furthermore, it was found that there were no statistically significant differences in the leadership qualities of knowledge competency ($p>0.807$), technical competency ($p>0.333$), negotiation skill ($p>0.308$), visionary ($p>0.451$), and responsiveness ($p>0.589$) among the teachers, students, and researchers in the university libraries.

The study found a statistically significant difference ($p < 0.019$) in one aspect (NS12) of leadership quality among the professors, students, and researchers in the university libraries. The ANOVA results revealed that, with the exception of one item, the leadership quality among professors, students, and researchers in the university libraries of Bangladesh was comparable in terms of overall measures.

The university category analyzed the user responses for the overall library leadership quality using ANOVA. The results indicated a significant difference ($p < 0.005$) in the overall leadership quality among users of public (4.92), private (5.25), and international (5.18) university libraries in Bangladesh. Specifically, users of public university libraries received significantly lower quality leadership performance compared to users of private and international university libraries. Additionally, it was discovered that there was a notable disparity in the leadership abilities related to knowledge competency ($p < 0.000$), technical competency ($p < 0.001$), and negotiation skill ($p < 0.001$) among users of public, private, and international university libraries. However, there was no significant difference in visionary ($p < 0.258$) and responsiveness ($p < 0.121$) qualities. This suggests that users of public university libraries receive significantly lower quality service compared to users of international and private university libraries in three out of the five leadership quality dimensions. The study found a notable disparity ($p < 0.000 - p < 0.036$) in 10 specific aspects (KC1, KC2, KC3, KC4, TC6, TC7, TC8, TC10, NS11, NS12, NS14, V16, R21, and R24) of leadership quality among users of public, private, and international university libraries. This indicates that users of public university libraries receive significantly less competent service compared to users of private and international university libraries in 14 out of the total 25 leadership items. The ANOVA results demonstrate that users of public university libraries experience considerably lower levels of qualified leadership performance compared to users of private and foreign university libraries across all aspects of service quality, including overall, dimensional, and item-wise measures. The hypothesis is that a decrease in library leadership performance, awareness of library leadership quality, and perception of library leadership quality may contribute to a significant decrease in user happiness in public university libraries. Hence, it is imperative for the authorities of public university libraries to prioritize enhancing the quality of their current services in order to meet the needs and expectations of its users.

7. Conclusion

The study identified substantial individual variances in leadership quality perceptions across different user categories, including teachers, students, and researchers, as well as among various types of universities (public, private, and international). This highlights the necessity for libraries to tailor their leadership development initiatives to meet the distinct needs of diverse user groups. In conclusion, the study provides valuable insights and recommendations for university libraries in Bangladesh to improve leadership quality and service delivery. By prioritizing effective leadership development and addressing the identified gaps, libraries can better meet user expectations, retain existing users, and attract new patrons, thereby fostering a more conducive environment for academic success and engagement.

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Assessing the Challenges and Support Requirements for Advancing Modern Tools and Technologies in Academic Libraries of Bangladesh

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Abstract

Purpose: This study aims to assess the barriers, challenges, and support requirements influencing the adoption of modern tools and technologies in academic libraries of Bangladesh.

Methodology: A quantitative research approach was adopted, using a structured questionnaire distributed to library and information science (LIS) professionals across five institutional categories. Descriptive statistics, factor analysis, and ANOVA tests were executed to recognize challenges, support needs, and institutional differences.

Findings: The findings identified that insufficient funding, lack of technical skills, inadequate training, lack of administrative assistance, and a deprived structure are the main barriers to adopting technology. Advanced technical tools like Integrated Library Systems, digital repositories, and AI-based applications are commonly used, but more modern equipment, such as RFID and discovery tools, are less widely adopted. Factor analysis identified four key components affecting technology adoption: human resource and skills constraints, financial and infrastructural limitations, administrative challenges, and specific support needs. ANOVA results found no significant differences among institutional categories on perceived challenges ($p = .488$) or support needs ($p = .815$).

Originality/Value: The study provides an inclusive and insightful analysis of technology integration challenges in Bangladeshi libraries, highlighting support needs and providing recommendations for policymakers and library professionals.

Conclusion: Barriers, challenges, and support are regular issues across information institutions, indicating the need for incorporated national strategies, sufficient training, policy development, and professional skill building to endorse technology acceptance in libraries.

Keywords

Technology Adoption, Academic Libraries, Barriers, Digital Transformation, Bangladesh, Library Support Needs

1. Introduction

The advancement of digital innovations has tremendously changed the operational dimension, service pattern, and strategic issues of libraries internationally. Both academic and public libraries find themselves increasingly compelled to assimilate avant-garde instruments and technologies—such as integrated library systems (ILS), digital repositories, knowledge management (KM) platforms, and AI-driven informational services—to augment user contentment and institutional efficacy (Shah, 2025; Ohwofasa,

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Abah & Olorunyomi, 2025). Within developing nations, exemplified by Bangladesh, libraries assume an indispensable role in bolstering higher education, research endeavors, and the dissemination of public knowledge; nevertheless, the velocity of technological integration remains disparate, frequently hampered by systemic and managerial impediments (Ahmed, 2014; Alam, 2012; Corraya et al., 2025).

Existing research highlights that libraries in South Asia commonly face barriers such as inadequate infrastructure, limited funding, poor ICT skills among staff, and insufficient institutional policies that hinder the successful integration of digital systems (Rahman, 2024; Raju, 2024). Knowledge management practices—crucial for organizational learning and service innovation—are similarly challenged by issues of leadership awareness, staff resistance, and bureaucratic delays (Gupta, 2000; Kordab, Raudeliūnienė, & Meidutė-Kavaliauskienė, 2020). For libraries in Bangladesh, these constraints are particularly critical because the demand for digital access, online learning systems, and remote information services has increased significantly in recent years (Begum & Elahi, 2022; Tasmim & Azad, 2022). Given this context, examining the barriers to adopting modern tools and technologies and identifying the institutional support needs is essential for strengthening the digital capacity of libraries. While some existing research has identified technology integration in Bangladeshi libraries, very few have equated different institutional categories, such as public, private universities, government public libraries, and college libraries. Understanding whether differences exist among these institutions can help policymakers allocate resources more effectively and design targeted capacity-building strategies (Helen, 2023).

Thus, this inquiry meticulously explores the impediments and requisite support mechanisms pertinent to the assimilation of contemporary technological apparatuses within diverse institutions throughout Bangladesh. By adopting the factor analysis and ANOVA test, the study explicates the ultimate dimensions of obstacles, inspects institutional differences. This scholarly endeavor proffers empirical elucidations to inform national policy frameworks, technological schematics, and leadership deliberations aimed at cultivating more intelligent and sustainable library ecosystems. In this study, the principal aim of the investigation is to delve into the barriers and support exigencies that shape the embrace of avant-garde tools and technologies across a spectrum of academic and public libraries within the Bangladeshi context. Specific Research Objectives

1. To assess the barriers and challenges of the adoption of modern tools and technologies in various academic libraries.
2. To assess the types of support required by different institutions to enhance the adoption and implementation of modern technologies.
3. To investigate the significant differences among various institutional libraries concerning perceived obstacles and requirements for implementing modern tools and technologies.

Based on the above objectives and institutional library context, 3 hypotheses are constructed for the study:

H1: *There is no significant differences among institutional libraries regarding the perceived barriers to adopting modern tools and technologies.*

H2: *There is no significant difference among institutional library categories in terms of the support needed to adopt modern tools and technologies.*

H3: *Barriers to technology adoption are significantly associated with the types of support required across institutions.*

2. Literature Review

2.1 Adoption of Modern Tools and Technologies in Libraries

The digital modification of the technologies in libraries has been a significant area of focus for global information service growth over the last twenty years. Modern tools such as integrated library systems (ILS), digital repositories, RFID technology, cloud-based services, and AI-enabled discovery platforms are now central to library operations and user engagement (Alzahrani et al. 2025; Din & Ali, 2024). These tools and technologies assist information retrieval, knowledge management, and distribution with better accuracy and proficiency. Studies recommend that technologically sound libraries validate user satisfaction, enhance literacy outcomes, and increase research production (Gul&Bano, 2019; Oyedokun, 2025). However, in various developing countries, the technology adoption is still lagging due to challenges and barriers related to setup, finance, and administrative issues.

2.2 Barriers to Technology Adoption

Libraries in developing nations often face various structural and management issues that hinder their digital transformation. One of the most commonly cited obstacles is inadequate ICT infrastructure, characterized by unreliable internet access and a lack of sufficient hardware (Nakaziba & Ngulube, 2025; Ikenwe & Udem, 2022). Financial constraints also deter both the adoption of new technologies and the maintenance of existing properties (Abidoye et al., 2024). A significant concern is the lack of technical expertise: librarians frequently do not possess the required skills or access to training programs to efficiently use digital tools (Motaung & Sifolo, 2023). Additionally, organizational resistance to change—rooted in low readiness for digital initiatives, bureaucratic obstacles, and absent institutional policies—further slows the rate of adoption (Jalo & Pirkkalainen, 2024). These challenges bound transformation exertions in information institutions and reduce the services excellence to users.

2.3 Institutional Differences in Technology Acceptance

Library technology integration tends to differ across organizational types. University libraries—particularly those in well-funded public or private institutions—generally exhibit higher digital readiness compared to government public libraries or college libraries (Ibrahim, Ahmad & Sallehudin, 2023; Sang, 2024). Factors such as financial resources, staff training opportunities, and organizational freedom often vary meaningfully among different institutions. Studies in Bangladesh indicate that public university libraries typically have better ICT facilities, while public libraries and college

libraries face more pronounced budgetary and infrastructural constraints (Shuva, 2005; Hossain, Hashmi, & Mezbah-Ul-Islam, 2019). Examining these institutional differences is critical for designing context-specific interventions, especially in relation to national digital library strategies.

2.5 Support Needs for Effective Technology Adoption

The adoption of modern tools and technologies needs specific organizational support and assistance. Prior research identifies key needs such as enhanced technical training, dedicated funding, infrastructure upgrades, policy and guideline development, and leadership engagement (Tavallaei, et al., 2022; King & Boyatt, 2015). External consultancy and expert guidance have also been highlighted as valuable for overcoming resource limitations and facilitating sustainable digital transformation (Aksjonenkeno & Rutitis, 2025). Furthermore, improving internet connectivity and reducing operational delays are essential to ensuring seamless digital workflows (Akmad & Abatayo, 2024). These support systems are essential in reducing obstacles to adoption and allowing libraries to operate efficiently in contemporary digital settings.

2.6 Literature Gaps

While numerous studies have investigated ICT adoption and KM barriers in libraries in Bangladesh, there is a lack of comparative research among various library types. Existing studies do not adequately explore whether institutional categories differ in terms of perceived barriers or support needs. Additionally, little experiential work has examined the association between technology integration barriers and necessary supports. This study addresses these gaps through factor analysis and ANOVA to systematically evaluate barriers and support needs across institutions.

3. Methodology

3.1 Research Design

The research employed a quantitative, cross-sectional survey approach to investigate the obstacles and support requirements associated with the implementation of contemporary tools and technologies within various types of libraries in Bangladesh. The process is essential to assess perceptions, contrast variations, and execute statistical calculations like factor analysis and ANOVA.

3.2 Population and Sample

The population of the study comprised professionals working in different types of libraries in Bangladesh, including public university libraries, private university libraries, government public libraries, public college libraries, and private college libraries. A total of 64 respondents contributed in the process, selected through purposive sampling, as they were straightly engaged in technology integration and library performance.

3.3 Data Collection and Analysis

The questionnaire set was distributed both online and in-person to library personnel across college, university and public libraries. Respondents were informed about the purpose of the study, and voluntary participation was ensured. Data collection was accomplished during September-October 2025. Data were analyzed using SPSS 26. The analysis included Descriptive Statistics (mean, SD) to summarize perceptions of barriers and support needs. Reliability Testing Cronbach's alpha value .871 ensured the internal consistency. Factor Analysis identified the underlying dimensions of barriers and support needs. Adequacy confirmed by KMO (.785) and Bartlett's Test ($p < .001$) and four components were extracted, explaining 71.02% of variance. The ANOVA results showed no statistically significant differences ($p > .05$), indicating that challenges and support needs are broadly similar across institutions.

4. Data Analysis and Findings

4.1 Demographic Information

Table 1 outlines the demographic features of 64 library professionals who took part in the study. The contributors include a diverse group from public, private universities, and public libraries. A majority of respondents are male (65.6%), while the female rate is 34.4%. The age distribution shows that most participants fall within the 26–40 years range. In terms of educational qualifications, most respondents hold a Master's degree (56.3%), followed by MPhil (20.3%) and a small proportion holding doctoral degrees (7.8%). This reflects a well-qualified professional group capable of understanding and implementing modern technologies.

In terms of professional rankings, a significant number of respondents are Deputy Librarians (29.7%) and Assistant Librarians (23.4%), suggesting that mid- and upper-level professionals contributed significantly to the survey. The representation of different institutional types is relatively balanced, with public university libraries (34.4%) and private university libraries (35.9%) forming the largest segments. The respondents also vary widely in professional experience, with nearly one-third having more than 15 years of experience and another substantial portion having less than 5 years. Remarkably, 75% of respondents stated having received training. However, the remaining 25% without training may represent a potential barrier in the adoption of modern technologies.

Table 1: Demographic Information of the Respondent (N=64)				
Gender	Frequency	Percent	Valid %	Cumulative %
Male	42	65.6	65.6	65.6
Female	22	34.4	34.4	100.0
Total	64	100.0	100.0	
Age Group				
20-25 years	3	4.7	4.7	4.7
26-30 years	16	25.0	25.0	29.7
31-35 years	11	17.2	17.2	46.9
36-40 years	13	20.3	20.3	67.2
41-45 years	7	10.9	10.9	78.1
46-50 years	7	10.9	10.9	89.1

Above 50 years	7	10.9	10.9	100.0
<i>Highest Academic Qualification</i>				
Bachelor's degree	10	15.6	15.6	15.6
Master degree	36	56.3	56.3	71.9
MPhil degree	13	20.3	20.3	92.2
Doctoral degree	5	7.8	7.8	100.0
<i>Designation</i>				
Assistant library officer	9	14.1	14.1	14.1
Library officer/ equivalent	12	18.8	18.8	32.8
Assistant librarian	15	23.4	23.4	56.3
Deputy librarian	19	29.7	29.7	85.9
Librarian	9	14.1	14.1	100.0
<i>Type of Institution</i>				
Public university library	22	34.4	34.4	34.4
Private university library	23	35.9	35.9	70.3
Government public library	8	12.5	12.5	82.8
Public college library	7	10.9	10.9	93.8
Private college library	4	6.3	6.3	100.0
<i>Year of Experience</i>				
Less than 5 years	18	28.1	28.1	28.1
5-10 years	16	25.0	25.0	53.1
11-15 years	11	17.2	17.2	70.3
More than 15 years	19	29.7	29.7	100.0
<i>Received Training</i>				
Yes	48	75.0	75.0	75.0
No	16	25.0	25.0	100.0

4.2 Use of Modern Tools and Technologies in Academic Libraries

Table 2 highlights the range and frequency of modern tools and technologies currently used across various academic libraries in Bangladesh. The most frequently used software are Integrated Library Systems (ILS) such as Koha and SLiMS, reported by 85.9% of respondents. AI tools (such as ChatGPT, Quillbot, and Grammarly) also show a strong presence, being used by 62.5% of respondents, reflecting a growing trend of incorporating artificial intelligence in research assistance, writing improvement, and user support. Digital content management is another major component of technology adoption. Digital repositories (e.g., DSpace) are used by 59.4%, suggesting that many academic libraries are actively involved in preserving institutional knowledge and supporting open access initiatives. However, more advanced discovery services such as VuFind have relatively low adoption (14.1%), pointing to limited implementation of sophisticated search and retrieval interfaces.

Regarding service innovation, RFID systems (35.9%) and mobile apps for library services (29.7%) demonstrate moderate adoption, indicating that only a portion of libraries are moving toward automated circulation, security, and enhanced mobile-based user engagement. More specialized tools, including cloud-based services and institutional knowledge management systems, show lower usage levels (21.9% and 20.3%,

respectively), suggesting either budgetary limitations or insufficient institutional readiness. Finally, the use of data analytical tools such as SPSS, STATA, or NVivo (21.9%) indicates that only a limited number of libraries engage in data-driven decision-making or research analytics, which may represent both a barrier and an opportunity for further development.

Table 2: Use of Modern tools in Academic Libraries

	Responses		Percent of Cases
	N	Percent	
Integrated Library Systems (e.g., Koha, SLiMS)	55	24.4%	85.9%
Digital Repositories (e.g., DSpace)	38	16.9%	59.4%
Discovery Tools (e.g., VuFind)	9	4.0%	14.1%
RFID System	23	10.2%	35.9%
Mobile Apps for Library Services	19	8.4%	29.7%
Cloud-based Service	14	6.2%	21.9%
AI Tools (e.g., ChatGPT, Quillbot, Grammarly)	40	17.8%	62.5%
Institutional KM system	13	5.8%	20.3%
Data Analytical Tools like SPSS, STATA, NVivo etc.	14	6.2%	21.9%
Total	225	100.0%	351.6%

4.3 Barriers and Challenges Affecting the Adoption of Modern Technologies

Table 3 presents the descriptive statistics of key barriers and challenges influencing the adoption of modern tools and technologies in academic libraries. The mean values indicate the perceived severity of each challenge among 64 respondents. Insufficient funding (Mean = 3.73, SD = 1.238) emerged as the most weighty barrier, highlighting financial restraints as the primary difficulty to technological adoption. Closely related is lack of technical skills among staff (Mean = 3.72) and inadequate training opportunities (Mean = 3.66), suggesting that both skill gaps and limited capacity-building initiatives hinder effective use of modern tools.

Institutional challenges also play a substantial role. Lack of institutional support (Mean = 3.53) and lack of policy/guidelines (Mean = 3.50) indicate structural limitations that limit technology adoption. Respondents also noted bureaucratic delays (Mean = 3.36) and resistance to change among staff (Mean = 3.25) as additional organizational barriers, reflecting internal cultural and administrative hurdles. Infrastructure-related issues show moderate influence. Lack of infrastructure (Mean = 3.02) and poor internet connectivity (Mean = 3.14) continue to challenge many libraries, though these are not among the highest-rated barriers. Language and localization issues (Mean = 2.73) appear to be the least problematic, suggesting that most modern systems are accessible to users regardless of linguistic or localization challenges.

Table 3:Descriptive Statistics on barriers affect the adoption of modern tools and technologies

	N	Min	Max	Mean	SD
Lack of infrastructure (hardware, internet, etc.)	64	1	5	3.02	1.266
Insufficient funding	64	1	5	3.73	1.238
Lack of technical skills among staff	64	1	5	3.72	1.419
Inadequate training opportunities	64	1	5	3.66	1.275
Lack of institutional support	64	1	5	3.53	1.284
Resistance to change from the staff	64	1	5	3.25	1.168
Bureaucratic or administrative delays	64	1	5	3.36	1.326
Language and localization issues	64	1	5	2.73	1.336
Lack of policy/guidelines	64	1	5	3.50	1.141
Poor internet connectivity	64	1	5	3.14	1.446
Valid N (listwise)	64				

4.4 Types of Support Needed for Technology Adoption

Table 4 summarizes the respondents’ perceptions of the types of support required to enhance the adoption of modern technologies in academic libraries. Technical training (Mean = 4.36, SD = 0.966) ranked highest among all support factors, suggesting that librarians view skill enhancement as the most essential requirement for effective technology adoption. Respondents also expressed strong support for infrastructure upgrades (Mean = 4.19), reflecting the need for improved hardware, software, and ICT facilities to sustain modern library operations.The need for budget allocation (Mean = 4.06) and leadership awareness (Mean = 4.06) indicates that economicpledges and practical leadership are seen as seriousmotorists of technological alteration. Hiring a KM expert (Mean = 4.00) was also identified as an important support measure, highlighting the growing recognition of KM practices in improving digital workflows, resource organization, and decision-making.

Policy-level support is another essential component. Policy and guideline development (Mean = 3.83)imitates the need for structured frameworks to guide technology implementation and standardize digital practices across institutions. Improvement of network infrastructure, represented by enhanced internet connectivity (Mean = 3.83), is also seen as a key requirement for efficient use of online tools, cloud services, and digital resources.External support received moderate importance, with external consultancy (Mean = 3.52) rated lower compared to other factors.

Table 4: Descriptive Statistics of support needed to improve the adoption of modern technologies

	N	Min	Max	Mean	SD
Technical training	64	2	5	4.36	.966
Hire a Knowledge Management Expert	64	1	5	4.00	1.024
Budget allocation	64	1	5	4.06	1.006

Infrastructure upgrade	64	2	5	4.19	.794
External consultancy	64	1	5	3.52	1.182
Policy/guideline development	64	1	5	3.83	1.047
Leadership awareness	64	1	5	4.06	1.111
Enhance internet connectivity	64	1	5	3.83	1.267

4.5 Factor Analysis

4.5.1 KMO and Bartlett's Test

The outcomes of the Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity validate the dataset's appropriateness for factor analysis. The KMO value of 0.785 indicates a good level of sampling adequacy, suggesting that the correlations among variables are sufficiently strong and appropriate for identifying underlying factor structures. A KMO value above 0.70 is generally considered acceptable, and values between 0.70 and 0.80 indicate solid reliability for proceeding with factor extraction. Bartlett's Test of Sphericity yielded a significant result ($\chi^2 = 791.930$, $df = 153$, $p < 0.001$) (Table 5).

Table 5: KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.785
Bartlett's Test of Sphericity	Approx. Chi-Square	791.930
	df	153
	Sig.	.000

4.5.2 Interpretation of the Scree Plot

The scree plot illustrates the eigenvalues linked to each component and aids in identifying the ideal number of factors to keep during the factor analysis. The graph reveals a sharp decrease in eigenvalues for the initial components, succeeded by a slow flattening, which is common in factor extraction.

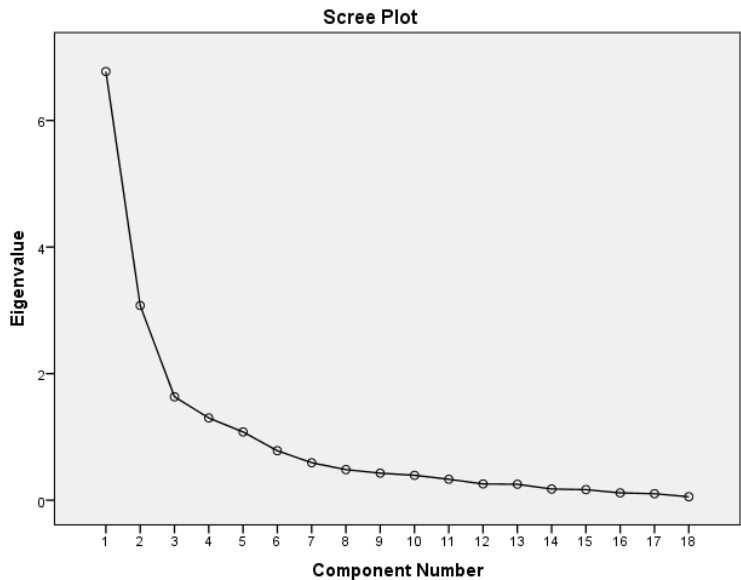


Figure 1. Scree Plot Test

4.5.3 Description of the Rotated Component Matrix and Identification of Factors

The Rotated Component Matrix displays the factor loadings following Varimax rotation, illustrating the relationship of each item with the identified components. The analysis reveals four distinct factors, each capturing a specific dimension of barriers and supports related to the adoption of modern technologies in academic libraries of Bangladesh. Items loading strongly ($\geq .60$) on each factor were used to interpret and name the components (Table 6).

Factor 1: Human and Institutional Capacity Barriers

This factor is characterized by variables related to staff capability, institutional readiness, and internal support structures. Items with high loadings include: Lack of technical skills among staff (.893); Inadequate training opportunities (.878); Lack of institutional support (.830); Insufficient funding (.743); and Poor internet connectivity (.696). These foundations jointly point to gaps in human resource development, insufficient training, and limited institutional support are prime barriers that deterequipment integration.

Factor 2: Organizational and Policy Support Factors

This issue contains items related to administrative promptness, strategic plan, and monetary or organizational funding mechanisms. High loadings include: Budget allocation (.861), Infrastructure upgrade (.808), Policy/guideline development (.805), Enhance internet connectivity (.702), and Leadership awareness (.575). These factor reflects the academic atmosphere compulsory to empower technological renovation.

Factor 3: Operational and Structural Barriers

This factor captures structural and workflow-related constraints that directly affect library operations and technology usage. It includes: Bureaucratic or administrative delays (.831), Lack of guidelines (.721), Resistance to change from staff (.629), and Lack of infrastructure (.653). These factors indicate internal operational inefficiencies and resistance, highlighting how administrative and infrastructural barriers obstruct technology implementation.

Factor 4: External and Specialized Support Factors

This factor represents external assistance and advanced professional or consultant-based support. High loadings include: Hire a Knowledge Management Expert (.702), External consultancy (.735), Technical training (.599), and Language and localization issues (.626). These factors deliver a structured understanding of the different challenges manipulating technology acceptance in institutional libraries.

Table 6: Rotated Component Matrix^a				
Barriers, challenges and support requirements items	Component			
	1	2	3	4
Lack of infrastructure (hardware, internet, etc.)	.410	.075	.653	-.110
Insufficient funding	.743	.083	.443	.181
Lack of technical skills among staff	.893	.143	.124	.178
Inadequate training opportunities	.878	.035	.179	.191
Lack of institutional support	.830	.029	.176	.115
Resistance to change from the staff	.241	.288	.629	.042
Bureaucratic or administrative delays	.233	.202	.831	-.114
Language and localization issues	-.018	-.150	.612	.626
Lack of policy/guidelines	.269	.179	.721	.197
Poor internet connectivity	.696	.144	.282	-.181
Technical training	.217	.443	-.060	.599
Hire a Knowledge Management Expert	.093	.490	.049	.702
Budget allocation	.122	.861	.169	.118
Infrastructure upgrade	.294	.808	-.009	.123
External consultancy	.104	.204	-.045	.735
Policy/guideline development	-.043	.805	.331	.203
Leadership awareness	.141	.575	.121	.544
Enhance internet connectivity	-.057	.702	.183	.223
Extraction Method: Principal Component Analysis.				
Rotation Method: Varimax with Kaiser Normalization.				
a. Rotation converged in 10 iterations.				

4.5.4 Description of the Total Variance Explained Table

Table-7 describes the variance ascribed to each of the four extracted factors resulting from the varimax rotation. Together, Collectively, these components explain a substantial portion of the total variability in the dataset, indicating a strong factor structure underlying the barriers and support mechanisms for adopting modern technologies in academic libraries.

- Component 1 counts of 21.33% of the variance, on behalf of the most leading factor. This aligns with the cluster of variables connected to human and organizational capacity constraints, such as gap of skills, deficient training, lack of academic assistance, and financial constraints.
- Component 2 explains 19.87% of the variance and is associated with organizational support and policy-oriented factors, including budget allocation, infrastructure upgrades, leadership awareness, and policy development.
- Component 3 contributes 16.42% of the variance. It denotes functioning and fundamental hurdles, such as administrative delays, conflict in alteration, and structural limits, which openly disturb implementation procedures.
- Component 4 explains 13.40% of the variance and reflects the need for external and specialized support, including consultancy services, hiring knowledge management experts, and addressing language/localization issues.

The four issues collectively account for 71.02% of the total variance, which is considered as weighty in social science studies. The findings confirm that the factor solution is solid and worthwhile for additional interpretation and discussion..

Table 7: Total Variance Explained			
Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	3.839	21.328	21.328
2	3.577	19.871	41.198
3	2.956	16.423	57.622
4	2.412	13.398	71.020
Extraction Method: Principal Component Analysis.			

4.6 Institutional Relationship with Barriers and Challenges: Interpretation

The descriptive statistics in table-8 indicate significant differences in how various types of institutions view the obstacles to implementing modern technologies.

a. Infrastructure and Connectivity Barriers

Public college libraries report the highest concern for infrastructure limitations (Mean = 3.29), followed closely by public universities (Mean = 3.23). Private colleges show the lowest concern (Mean = 2.50). This pattern proposes that resource-constrained public institutions face larger problems in continuing satisfactory hardware and internet services. A similar trend appears in internet connectivity, where public colleges again rank highest (Mean = 3.86), indicating that inconsistent digital infrastructure disproportionately affects them.

b. Financial Constraints

Government public libraries show the sturdiest awareness of inadequate funding (Mean = 4.25), followed by public colleges (Mean = 4.00). These libraries often work under inflexible budget and restricted financial sovereignty, which impedes their ability to devote in new machineries. Private universities experience comparatively moderate funding challenges (Mean = 3.65), reflecting better resource availability.

c. Skill Gaps and Training Deficiencies

Skill-related barriers appear prominently in government public libraries (Mean = 4.25) and public colleges (Mean = 4.43), indicating critical shortages of technically skilled staff. These categories also report high levels of inadequate training opportunities (Means 4.25 and 4.29). This advocates that technology acceptance is profoundly controlled by human resource limitations, predominantly in government-affiliated organizations.

d. Institutional Support and Administrative Barriers

Public college libraries report the highest lack of institutional support (Mean = 4.86), significantly higher than all other categories. This implies major administrative and managerial shortcomings that hinder modernization efforts. Bureaucratic delays are also more prominent in private colleges (Mean = 4.00) and public colleges (Mean = 3.71), suggesting that complex administrative procedures and slower decision-making processes are major obstacles across multiple institution types.

e. Policy, Guideline, and Language Barriers

Private universities comparatively report the highest concern regarding the lack of policies and guidelines (Mean = 3.74), showing a need for more structured institutional frameworks to support digital transformation. Language and localization issues are most prominent in private colleges (Mean = 3.25) and government public libraries (Mean = 3.00), indicating challenges in adopting English-based or global systems without adequate localization.

The analysis clearly indicates that public colleges and government public libraries face the most severe and wide-ranging barriers, particularly in skills, training, funding, and institutional support. Public universities experience reasonable hurdles, mostly related to infrastructure and connectivity. Private universities show reasonably fewer obstacles but still fight with policy improvement. Private colleges, although smaller in scale, face specific challenges in administrative delays and language issues.

Table 8: Descriptive Statistics between Barriers and Institute Categories

	Institutional Category	N	Mean	SD
Lack of infrastructure (hardware, internet, etc.)	Public university library	22	3.23	1.378
	Private university library	23	2.96	1.261
	Government public library	8	2.63	1.061
	Public college library	7	3.29	1.380
	Private college library	4	2.50	1.000
	Total	64	3.02	1.266
Insufficient funding	Public university library	22	3.55	1.262
	Private university library	23	3.65	1.301
	Government public library	8	4.25	.707
	Public college library	7	4.00	1.414
	Private college library	4	3.75	1.500
	Total	64	3.73	1.238
Lack of technical skills among staff	Public university library	22	3.41	1.563
	Private university library	23	3.65	1.369
	Government public library	8	4.25	1.165

	Public college library	7	4.43	1.134
	Private college library	4	3.50	1.732
	Total	64	3.72	1.419
Inadequate training opportunities	Public university library	22	3.50	1.300
	Private university library	23	3.43	1.343
	Government public library	8	4.25	.707
	Public college library	7	4.29	1.113
	Private college library	4	3.50	1.732
	Total	64	3.66	1.275
Lack of institutional support	Public university library	22	3.55	1.371
	Private university library	23	3.26	1.322
	Government public library	8	3.38	.916
	Public college library	7	4.86	.378
	Private college library	4	3.00	1.155
	Total	64	3.53	1.284
Resistance to change from the staff	Public university library	22	3.05	1.046
	Private university library	23	3.26	1.251
	Government public library	8	3.63	1.061
	Public college library	7	3.14	1.345
	Private college library	4	3.75	1.500
	Total	64	3.25	1.168
Bureaucratic or administrative delays	Public university library	22	3.23	1.343
	Private university library	23	3.30	1.295
	Government public library	8	3.25	1.389
	Public college library	7	3.71	1.604
	Private college library	4	4.00	1.155
	Total	64	3.36	1.326
Language and localization issues	Public university library	22	2.55	1.224
	Private university library	23	2.70	1.295
	Government public library	8	3.00	1.773
	Public college library	7	2.86	1.676
	Private college library	4	3.25	.957
	Total	64	2.73	1.336
Lack of policy/guidelines	Public university library	22	3.23	1.110
	Private university library	23	3.74	1.176
	Government public library	8	3.50	1.195
	Public college library	7	3.57	1.397
	Private college library	4	3.50	.577
	Total	64	3.50	1.141
Poor internet connectivity	Public university library	22	3.09	1.477
	Private university library	23	2.91	1.379
	Government public library	8	3.38	1.506
	Public college library	7	3.86	1.676
	Private college library	4	3.00	1.414
	Total	64	3.14	1.446

4.7 Interpretation of the ANOVA Results

The one-way ANOVA conducted to examine whether perceived barriers differ significantly across institutional categories (public university libraries, private university libraries, government public libraries, public college libraries, and private college libraries) shows no statistically significant difference ($F(25, 38) = 1.002, p = .488$) among the groups (Table 9). Since the p-value is greater than 0.05, the result indicates that institutional category does not have a significant effect on the level of perceived barriers related to digital preservation and library operations.

Table 9: ANOVA Test between Institute categories and Barriers							
			Sum of Squares	df	Mean Square	F	Sig.
Institution category * Barriers	Between Groups	(Combined)	36.443	25	1.458	1.002	.488
	Within Groups		55.307	38	1.455		
	Total		91.750	63			

4.8 Perceived Support Needs across Five Institutions

The descriptive statistics in Table 10 reveal varying levels of perceived support needs across five types of institutions: public university libraries, private university libraries, government public libraries, public college libraries, and private college libraries.

a. Technical Training

The necessity for technical training is constantly high across all categories. Private college libraries show the highest mean score (5.00), indicating unanimous agreement on the importance of training. Public college libraries show comparatively lower demand (3.71), while university libraries exhibit strong support (public: 4.59; private: 4.26). The overall mean is 4.36.

b. Hiring Knowledge Management Expertise

The perceived need to hire KM experts is moderate to high across institutions. Private university libraries (4.13) show the highest demand, while public college libraries report the lowest (3.86). The overall mean of 4.00 indicates general agreement on the importance of specialized expertise.

c. Budget Allocation

All categories show notable support for budgetary provisions to adopt modern technologies. Private college libraries direct the solidest need (4.25), followed by private universities (4.17) and public university libraries (4.05). The overall mean is 4.06.

d. Infrastructure Upgrade

Support for organization upgrades is consistently high across all categories, with means ranging from 4.13 to 4.27. This indicates widespread recognition of the need for improved ICT infrastructure in libraries. The overall mean stands at 4.19.

e. External Consultancy

Demand for external consultancy is more moderate compared to other factors. Public university libraries show the highest support (3.77), while public college libraries indicate the lowest (3.00). The overall mean is 3.52, suggesting a mixed perception regarding dependence on external consultants.

f. Policy/Guideline Development

The need for policy development is strongly supported across categories, with public college libraries reporting the highest mean (4.14). University libraries also show notable support (private: 3.91; public: 3.68). The overall mean is 3.83.

g. Leadership Awareness

Leadership awareness is perceived as important across all groups. Private university libraries (4.22) report the highest need, while private college libraries show greater variability (mean 3.75, SD 1.893). Overall support is high, with a mean of 4.06.

h. Enhancing Internet Connectivity

Support for improved internet connectivity varies, with private university libraries reporting the highest need (4.17), followed by government public libraries (4.13). Private college libraries show relatively lower demand (3.25). The overall mean is 3.83, indicating a general need for stronger connectivity to support modern technologies.

Table 10: Descriptive Statistics onSupport Need to adopt the modern tools and technologies				
	Institutional Category	N	Mean	SD
Technical training	Public university library	22	4.59	.854
	Private university library	23	4.26	1.010
	Government public library	8	4.25	1.035
	Public college library	7	3.71	1.113
	Private college library	4	5.00	.000
	Total	64	4.36	.966
Hire Knowledge Management Expertise	Public university library	22	3.91	1.151
	Private university library	23	4.13	.869
	Government public library	8	3.88	1.458
	Public college library	7	3.86	.690
	Private college library	4	4.25	.957
	Total	64	4.00	1.024
Budget allocation	Public university library	22	4.05	1.133
	Private university library	23	4.17	.887
	Government public library	8	3.75	1.282
	Public college library	7	4.00	.816
	Private college library	4	4.25	.957
	Total	64	4.06	1.006
Infrastructure upgrade	Public university library	22	4.27	.767
	Private university library	23	4.13	.869

	Government public library	8	4.13	.991
	Public college library	7	4.14	.690
	Private college library	4	4.25	.500
	Total	64	4.19	.794
External consultancy	Public university library	22	3.77	.973
	Private university library	23	3.39	1.234
	Government public library	8	3.63	1.408
	Public college library	7	3.00	1.414
	Private college library	4	3.50	1.291
	Total	64	3.52	1.182
Policy/guideline development	Public university library	22	3.68	1.129
	Private university library	23	3.91	.996
	Government public library	8	3.63	1.506
	Public college library	7	4.14	.378
	Private college library	4	4.00	.816
	Total	64	3.83	1.047
Leadership awareness	Public university library	22	3.95	1.174
	Private university library	23	4.22	.951
	Government public library	8	4.13	1.458
	Public college library	7	4.00	.577
	Private college library	4	3.75	1.893
	Total	64	4.06	1.111
Enhance internet connectivity	Public university library	22	3.50	1.406
	Private university library	23	4.17	1.114
	Government public library	8	4.13	1.356
	Public college library	7	3.71	1.254
	Private college library	4	3.25	.957
	Total	64	3.83	1.267

4.9 ANOVA Results on Support Needed for Technology Adoption

The ANOVA analysis assessing the connection between different institutional categories and the required support for adopting modern tools and technologies showed no significant differences among the groups ($F = 0.654$, $p = 0.815$). This suggests that respondents across all types of libraries—public and private university libraries, government public libraries, and public and private college libraries—exhibit similar levels of need for various forms of support, which include technical training, budget allocation, infrastructure upgrades, external consultancy, policy development, leadership awareness, and improved internet connectivity. The absence of significant variation suggests that the demand for support in adopting modern technologies is uniform across institutions, reflecting a common challenge and shared readiness for modernization rather than institution-specific differences.

Table 11: ANOVA Test on Institutional Differences in Support Needed for Technology Adoption

	Sum of Squares	df	Mean Square	F	Sig.
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Institution category * Support needs to adopt the modern tools and technologies	Between Groups	(Combined)	15.561	15	1.037	.654	.815
	Within Groups		76.189	48	1.587		
	Total		91.750	63			

5. Discussion

The authors of study inspected the obstacles, challenges, and support needs connected with integrating the modern tools and technologies in the public-private University and public libraries in Bangladesh. The discussion is structured around the three research hypotheses and the main objectives.

5.1 Barriers Affecting Technology Adoption

Descriptive findings show that library professionals perceive several key barriers to technology adoption, particularly insufficient funding, lack of technical skills, inadequate training, and lack of institutional support—all with mean values above 3.50. These findings are consistent with earlier studies indicating that limited financial resources, inadequate ICT infrastructure, and workforce skill gaps impede digital transformation in developing countries’ libraries (Rahman, 2024; Ali, Munir&Abubakar, 2025).Factor analysis further supported these patterns by identifying four underlying dimensions of barriers and support needs:

- a. Human resource and capacity-related barriers
- b. Funding and infrastructure limitations
- c. Administrative and operational constraints
- d. Specialized support and expert-driven requirements

These grouped components align with global literature that highlights the interplay of human, financial, and organizational factors in ICT adoption (Giotopoulos et al., 2017; Fabiani, Schivardi& Trento, 2005).Because the study did not aim to compare these barriers by institutions in Hypothesis 1, but rather to test whether differences exist, the next section explains this based on ANOVA.

5.2 Institutional Differences in Perceived Barriers (Hypothesis H1)

H1 stated:*There is no statistically significant difference among institutional categories regarding the perceived barriers to adopting modern tools and technologies.*

The ANOVA testfoundno significant difference ($p = 0.488$) among institutional library categories.Thus, H1 is supported.This means barriers are not institution-specific, but rather systematicacross the library sector, replicating similar monetary structures, managerialprocedures, and technological limitations across institutions in Bangladesh. This resultis supported by previousresearch reporting uniform challenges across South Asian library surroundings (Ullah, Usman & Khan, 2023; Lee et al., 2020).

5.3 Institutional Differences in Support Needs (Hypothesis H2)

H2 stated:*There is no statistically significant difference among institutional categories in terms of the support needed to adopt modern tools and technologies.*

The ANOVA test confirmed no significant difference ($p = 0.815$) across institutional categories. Therefore, H2 is supported. Although descriptive statistics show slight variations—for example, private universities indicated slightly higher needs for enhanced connectivity, and private colleges indicated a perfect need for training—the differences are not significant. This directs that all institutions, regardless of their category, similarly need training, leadership involvement, policy preparation, and proficient provision. Existing research similarly supports the universal need for capacity-building and leadership aids in digital library advantages (Diseiye et al., 2023; Khoeini, et al, 2024).

5.4 Association between Barriers and Support Needs (Hypothesis H3)

H3 stated: *Barriers to technology adoption are significantly associated with the types of support required across institutions.*

Although this hypothesis was conceptual, the factor analysis results support the idea that barriers and support needs are interconnected. Many items from both barriers and support categories loaded onto the same components, indicating that when institutions face challenges such as lack of funding, skills, or infrastructure, they simultaneously express higher demand for training, expert recruitment, policy development, and connectivity improvement.

This association is logically grounded and supported by existing literature, which emphasizes that overcoming adoption barriers requires targeted support interventions (Awoke et al., 2025). Therefore, H3 is rationally supported based on the structural patterns acknowledged in factor analysis, even though not directly verified through correlation or regression.

6. Conclusion

This study examined the challenges and support requirements directly connected with modern technology integration in different categories of libraries in Bangladesh. The findings highlight that most of the libraries in Bangladesh face quite similar barriers and challenges in adopting modern tools and technologies, including insufficient funding, restricted technical skills, insufficient training, weak institutional support, and infrastructural constraints. ANOVA results confirmed no significant differences among institutions in either perceived barriers or support needs, indicating shared nationwide challenges. Factor analysis further showed that barriers cluster around organizational readiness, resource limitations, and staff capacity, while support needs consistently emphasize training, budget allocation, infrastructure upgrades, leadership awareness, and policy development. Generally, the results stress the necessity of national policies, better resource investment, and capacity-building advantages to progress technology integration equivalently across the country's library structure.

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Applications of Artificial Intelligence (AI) in the Field of Digital Libraries Research: A Scientrometric Approach of Recent Trends

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Aim/Purpose/Objectives

The purpose of this paper is to discover, by a quantifiable analysis, annual growth rates of, and recent trends in, worldwide publications in the field of artificial intelligence (AI) applications in the digital libraries formed by library and information science specialists.

Design/Methodology/:

This paper observes the current trends in the literature using the Scopus database over the last ten years (2014-2023). VoiceView and RStudio Bibliometrix software were used to analyze the titles, keywords, abstracts, and full texts of 7571 articles to recognize trends in artificial intelligence (AI) models, article types, sources, authors, keywords, citations, countries, and institutes.

Outcome/Results/Findings:

The maximum number of articles was in 2023 with 1802 publications, and the bottom number of publications in 2015 with 199 articles. The author Zhang Y has made the highest publications (116). The outcomes also exposed that the Journal of IEEE Access published the highest number (171) of publications. Mainly, the University of California secured its position as the most productive institute, accounting for 403 global publications. The maximum occurrence AI-related keyword is "Machine Learning," which was used in a total of 1763 times.

Originality/Value:

This paper classifies growth and current trends in artificial intelligence (AI) applications in the digital libraries publications by LIS researchers through use of scientrometric. Digital libraries research studies have expressively improved their use of artificial intelligence (AI) applications.

Keywords

Artificial Intelligence; AI; Digital Libraries; Scientrometric; VoiceView; Scopus; H-Index.

1. Introduction

Digital libraries are becoming more and more integrated with artificial intelligence (AI), which greatly improves both their use and functionality. By examining trends, growth, and impact, scientrometric studies shed light on how AI technologies are being applied in digital libraries. This review looks at several AI applications in digital libraries and

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summarizes important new research discoveries. By automating the cataloguing process, AI algorithms can increase the precision and productivity of metadata output (Wada, 2023). By enabling users to query using natural language, NLP technologies enable enhanced search capabilities that improve information retrieval (Panda & Kaur, 2023). Recommendation engines powered by AI examine user behaviour to make pertinent resource recommendations, increasing user happiness and engagement (Resnick & Varian, 1997). Through the analysis of user interactions in digital libraries, machine learning techniques can offer insights that help improve usability and adapt services (Scarnò, 2010). AI-driven chatbots assist users in real-time, guiding them through the library and facilitating fast access to information (Yan et al., 2023).

The origins of scientometrics can be outlined back to the early 20th century, with inventors like Eugene Garfield, who started the Science Citation Index in the 1960s. This tool laid the basis for evaluating citation patterns and measuring the influence of scientific papers (Garfield, 1955). Over time, the area has developed to combine several metrics, including impact factors, h-index, and altmetrics, which replicate the larger effect of research beyond modern citations. Scientometrics is the study of measuring and analyzing scientific literature and research outputs. It employs quantitative methods to evaluate the performance of research institutions, the impact of individual researchers, and the overall development of scientific disciplines. This field combines elements from bibliometrics, informetrics, and webometrics, providing insights into the dynamics of science and technology (Priem et al., 2011).

Recent scientometric studies reveal significant trends in the application of AI in digital libraries, a noticeable increase in publications related to AI applications in digital libraries over the past decade shows growing interest and investment in this area. Journals focusing on digital libraries and AI display higher impact factors, suggesting that this interdisciplinary study is gaining recognition. Collaborative research between libraries, universities, and tech companies is on the rise, fostering innovation in AI applications for library services. The application of AI in digital libraries is reshaping the landscape of information access and management. Scientometric studies highlight the increasing relevance and impact of these technologies, paving the way for further research and development. As digital libraries continue to evolve, AI will play an essential role in attractive their experiences and user capabilities.

2. Review of Literature

Scientometric analysis of recent trends in digital library publications, Data was downloaded from the Scopus abstracting and citation database for the period of ten years from 2012 to 2021. The study revealed that digital library production is increasing yearly, the United States of America leads the production of academic production on digital libraries, and study is gradually focused on digital resource and digital collection improvement (Mahadevagouda & Pavithrabai, 2022). A study on the visualization and scientometric mapping of worldwide public administration research in the WoS database from 2016 to 2020. Researchers also discovered that prolific authors in public administration, the increase of publications, the most relevant sources, the most productive countries, and the United States ranked first in the research with 2368 articles (Shaikh & Jana, 2021). The examination is centred on statistical and mathematical

methods, study design, and the scientific process. Traditionally, scientific activities have been assessed by gathering data from scientific publications indexed in indicator databases such as Web of Science, Chemical Abstracts, Derwent Biotechnology Abstracts, BIOSIS, PubMed, and Scopus (Mooghali et al., 2011). Conducted a scientometric review of the global Internet of Things (IoT) research trend using data from the Web of Science database and found the literature growth, most prolific author, most productive country, most productive institution, most popular keywords, and so on. (Shaikh et al., 2022). The another study conducted by (Borgohain et al., 2024) scientifically mapped the papers on AAIL and analyze its development, collaboration network, trending matters, or research hot spots to highlight the contests and chances in assuming AI-based progresses in library systems and developments. The another study carried out by (Gupta & Dhawan, 2018) the world production in artificial intelligence research, a total of 1, 52,655 articles, as realized from the Scopus database, covering the period during 2007-2016. The top ten countries of the world in artificial intelligence research accounted for 74.32 per cent worldwide publication share. Separately their global share varied from 3.68 per cent to 19.46 per cent, with China accounting for 19.46 per cent worldwide share, followed by the USA (17.96 %), India (6.37 %), and the U.K. (6.33 %), and so no. A study conducted by (Mondal & Surendran, 2024) a comprehensive scientometric analysis of worldwide digital library research from 1991 to 2022. The study services the BibliometrixR and Vosviewer packages to analyze a various set of 6157 scholarly documents from the Scopus database and assess key bibliometric indicators i.e., publication production, collaboration networks, citation forms, and thematic trends. The results provide that the area of digital library research skilled exponential progress, with the maximum number of publications in 2022 (9.53%). A bibliometric analysis examined by (Meitei et al., 2023) recognized core journals such as Sustainability, Remote Sensing, and Journal of Cleaner Production as important platforms for publication AI-related library research. These journals, resulting Bradford's law, have dependably involved great citation amounts, representative their position in the area. In addition to the geographic distribution of research, the co-authorship networks investigated in numerous studies expose a sturdy collaboration between scholars from the United States, China, and the UK (Bender et al., 2015; Fu et al., 2022, pp. 1998–2018; Isfandyari-Moghaddam et al., 2023). (Prahani et al., 2022) highlight the role of international collaborations in advancing AI research, particularly in areas like digital libraries and library services.

The literature on AI in digital libraries exposes certain gaps, mostly in its actual application in digital libraries services. While much of the study focuses on AI's technical abilities, there is limited examination of how AI is being instigated to address practical environmental challenges. The identification of knowledge-based study gaps was shown by analyzing key metrics such as the number of documents, citations, prolific authors, country collaboration, and leading institutes. Scientrometric analysis was used to measure citation patterns, keywords, most relevant sources, and relevant organizations to highlight fields where additional research is required. While AI has been applied in parts like digital libraries, there is a lack of studies on its use in real-time digital libraries services assessment, mostly in developing areas. Furthermore, despite the increasing number of AI

studies, interdisciplinary relationships between AI professionals and digital scientists are quiet limited. Addressing these gaps involves integrative investigation that combines AI’s technical assets with digital expertise.

3. Objectives of the Study

The present study aims to examine the research output of artificial intelligence (AI) applications in the area of digital libraries researchfrom the Scopus database from 2014 to 2023. The prime objectives are:

- To explore the annual growth documents published of AI applications in the field of digital libraries research;
- To identify the most productive sources of AI applications in the field of digital libraries research;
- To examine the most relevant authors and their productivity of digital libraries research;
- To study the collaboration form on country, and institute through visualization, and
- To find outthe keywords co-occurrence of AI applications in the field of digital libraries research.

4. Materials and Methods

This unit of the paper boons the numerous methods and tools recognized for mapping the study landscape on the applications of AI in digital libraries research global. To realize this objective, the scientific publications on the area of artificial intelligence (AI) in digital libraries research were recognized in the Scopus database. The connected documents on digital libraries research were identified using the search enquiry advanced from the subject keywords to improve scientific articles indexed in Scopus from 2014 to 2023. Figure 1 displays the method used to find, screen, and analysis the scientific articles on AI application of digital libraries research over the last ten years observed in this study.

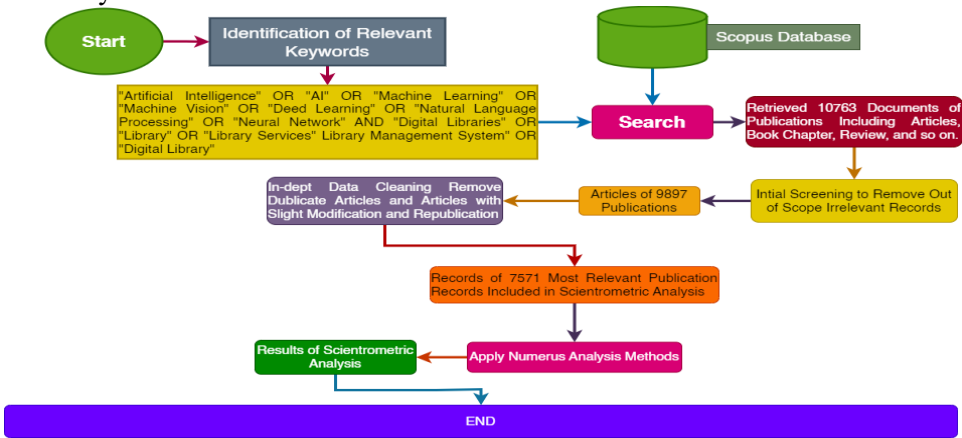


Fig. 1 Flowchart of Research Design and Methodology of Digital Libraries

On the 12th of September 2024, an innovative search was finalized in the Scopus database to recover connected scientific literature on the area based on the query: TITLE-ABS-KEY (“Artificial intelligence” OR “AI” OR “Machine Learning” OR “Machine Vision” OR “Deep Learning” OR “Natural Language Processing” OR “Neural Network”) AND TITLE-ABS-KEY (“Digital Libraries” OR “Library” OR “Library Services” OR “Library Management System” OR “Digital Library”)) AND PUBYEAR > 2013 AND PUBYEAR < 2024. The outcomes were consequently divided to remove distinct, unusual document types and non-English articles from the list of improved publications. The showing query was performed using the LIMIT-TO and EXCLUDE purposes in the Scopus. The screening query performed in this study was as follows: (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (LANGUAGE, “English”)).

The documentation and selection of the scientific publications on AI applications of digital libraries research resulted in a total of 7571 articles. The resulting documents data were consequently analyzed using Microsoft Excel spreadsheets to scrutinize the main information, publications year, productive authors, most relevant sources, keywords, affiliation, countries and most cited papers on AI applications of digital libraries over the years. The method helps scientists recognize and map the social networks of the key participants, articles, citations, and hotspots in any given field of study using specialized bibliographic software (Donthu, Kumar, Mukherjee, et al., 2021). In this study, the VOS viewer and RStudio Bibliometrix software were used to map the research articles on AI based on digital libraries publications indexed in the Scopus database between 2014-2023 present.

5. Results

5.1. Main Information of the Documents

A total number of 7571 articles selected for presence in this study, a total of 28323 authors were recognized. Particularly, only 496 authors were attributed to single authored documents. On average, each document was co-authored by 4.81 individuals. The average citation count per document stands at 21.17, a phenomenon commonly observed within academic circles (Table 1). These records emphasize the essential role of co-operation among scholars spanning different fields, a necessity stemming from the inherently multidisciplinary landscape of the subject matter.

Table: 1 Main Information of AI applications in the field of digital libraries research

Description	Results
Timespan	2014:2023
Sources (Journals, Books, etc.)	2518
Documents	7571
Annual Growth Rate %	26.45
Document Average Age	3.49
Average citations per doc	23.39
DOCUMENT CONTENTS	
Keywords Plus (ID)	38728

Author's Keywords (DE)	18319
AUTHORS	
Authors	28323
Authors of single-authored docs	446
AUTHORS COLLABORATION	
Single-authored docs	496
Co-Authors per Doc	5.22
International co-authorships %	26.8
DOCUMENT TYPES	
articles	7571

5.2. Yearly research outputs of AI applications in the field of digital libraries

The number of 7571 articles was identified in the academic database Scopus from 2014 to 2023 (10 years). Results of yearly research production are revealed in Figure2. The number of published articles increased from 218 in the year of 2014 to 1802 in the year of 2023. It can be realised from Figure.1 that the number of published publications increased gradually from 2016 to 2018, after the year of 2015, however, the published articles increased quickly, while compared with 2016, the number of published publications in 2015 decreased, but the number continued high level. Outcomes show that artificial intelligence has concerned thoughtful concerns and more and more publications are published in recent 8 years. It can be expected that with the development of application, artificial intelligence will be continuous hot in the next few years.

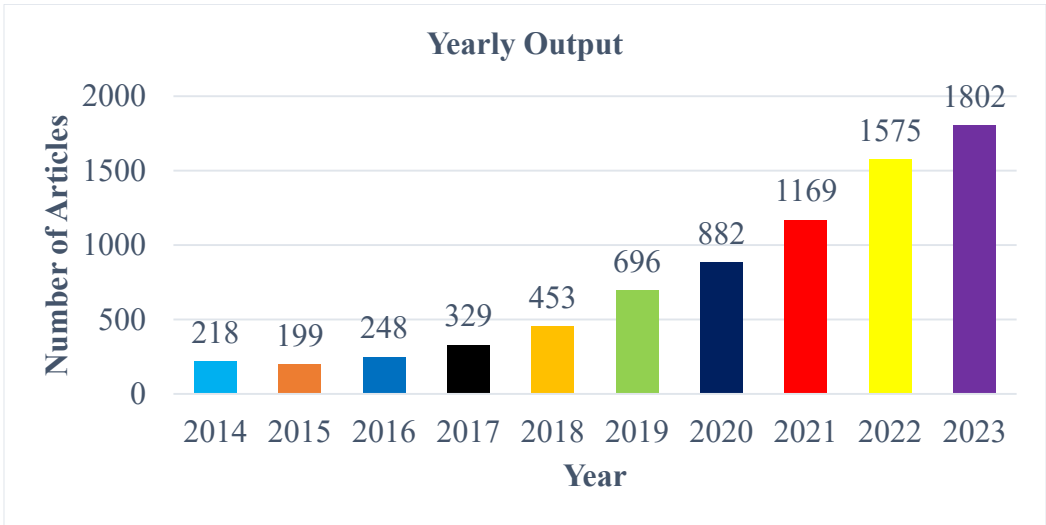


Fig. 2 Yearly Research Output

5. 3 Most Leading Sources

From 2014 to 2023, a total of 7571 articles on AL applications of digital library research were noted across 2518 sources. Table 2 showcases the top 10 prominent sources for digital libraries publications. IEEE Access indications with the maximum number of publications at 171, followed by Journal of Chemical Information and Modelling with 102 articles. Investigating the journal-wise distribution of research articles from Table 2, IEEE Access positions out with 171 research articles, 3022 total citation score, and respective ACPA (Average Citations Per Article)and h-index scores of 17.67 and 28 placing it at the top rank among the 10 journals. Journal of Chemical Information and Modeling follow with 102 research publications, 2712 total citation scores, and ACPA, and h-index scores of 26.59, and 29, respectively, securing the second place. PLOS Onethe third place with 95 articles, 1777 total citation score, and respective ACPA and h-index scores of 18.71 and 21. Lastly, the Computer Physics Communications contributes 45 articles, 5620 total citation scores, and ACPA and h-index scores of 12.49, and 16, respectively, placing it at the bottom place.

Figure 3demonstratesanincreasing trend in digital libraries research for IEEE Access and the Journal of Chemical Information and ModellingJournal. Furthermore, the consequent section highlights the subject field that stimulated investigators to embrace of AI applications in the field of digital libraries

Table: 2 Most relevant sources of Digital Libraries Research.

Rank	Sources	Articles	Citations	ACPA	H-Index
1	IEEE Access	171	3022	17.67	28
2	Journal of Chemical Information and Modeling	102	2712	26.59	29
3	PLOS One	95	1777	18.71	21
4	Nature Communications	75	3322	44.29	33
5	Scientific Reports	72	1614	22.42	22
6	Applied Sciences (Switzerland)	66	852	12.91	18
7	Bioinformatics	57	1825	32.02	19
8	Journal of Machine Learning Research	53	5020	94.72	30
9	Sensors	47	524	11.15	13
10	Computer Physics Communications	45	5620	12.49	16

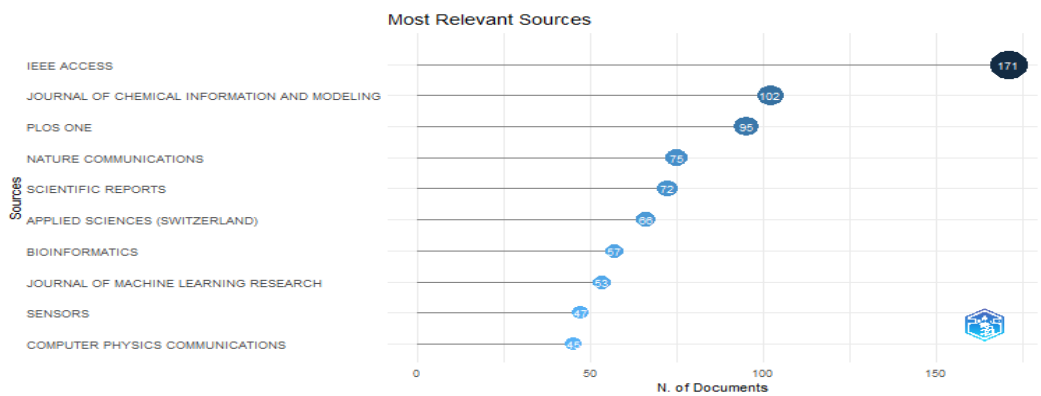


Fig. 3 Most Relevant Sources

5.4. Most Productive Authors

Table 3 highlights the top 10productive authors who have made important contributions to digital libraries research. In positions of the number of articles, Zhang Y appears as the most prolific author with 116 articles, followed by Wang Y with 98, Li Y with 86, and Zhang J with 34 articles. Zhang Y also embraces the maximum h-index (24), followed by Wang Y (23), and Li Y (20).When considering ACPA, Zhang Y leads with 20.48, followed by Wang Y with 17.10, and Zhang J with 16.63 average citations per article (ACPA) respectively. Interesting, it shown from the table and figure Wang J, Zhang X, and Liu Y records as same i.e. 74, but ACPA And h-index are different.

Table: 3Most Productive Authors of Digital Libraries Research

Rank	Authors	Articles	Citations	ACPA	H-Index
1	Zhang Y	116	2248	20.48	24
2	Wang Y	98	1661	17.10	23
3	Li Y	86	1231	15.86	20
4	Zhang J	85	1874	16.63	20
5	Wang X	75	1139	12.45	17
6	Wang J	74	1604	15.93	20
7	Zhang X	74	1291	13.11	20
8	Liu Y	74	699	14.21	17
9	Li X	71	2064	13.36	21
10	Zhang L	65	1171	11.42	20

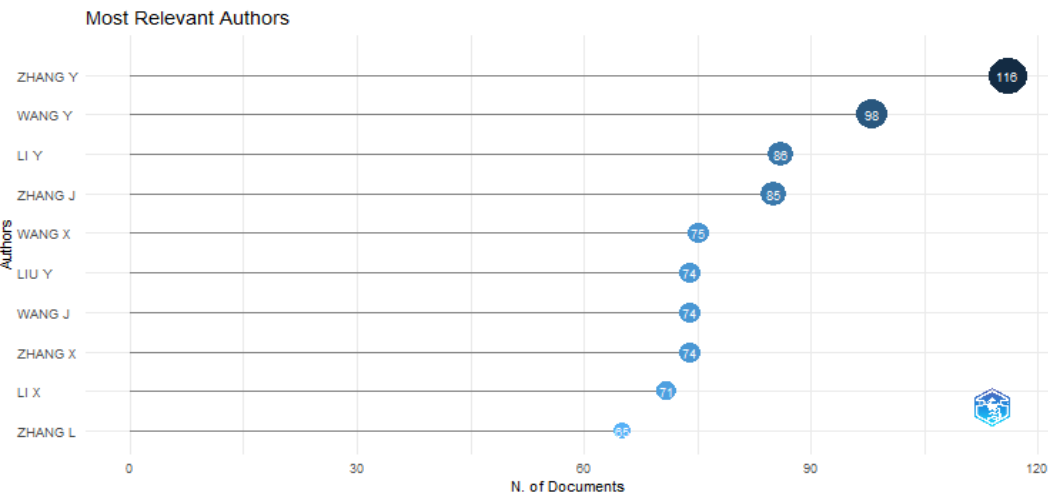


Fig. Most Prolific Authors

5.5. Country Collaboration

According to the investigation, the country of connected authors who have collaborated on AI applications of digital libraries research during the study period. There are a total of 7571 publications published by research collections from 177 countries from 2014 to 2023 in the digital libraries research. Some of them were together published by various countries, but itcalculated it into countries respectively in this area. Table 4exposes, Unites States took the firstposition with a total of 77486 citations from 2082 contributed publications, and till the study was shown. China ranks second with 30052citations, followed by India, England, United Kingdom and the other country.

Table: 4 Most Productive Country

Rank	Country	Publications	Citations	Total Link Strength
1	United States	2082	77486	1312
2	China	1610	30052	671
3	India	608	6784	235
4	United Kingdom	558	22000	746
5	Germany	509	22829	597
6	Canada	318	16044	334
7	Spain	306	8467	291
8	South Korea	293	5715	164
9	Italy	247	5860	253
10	Australia	245	8212	332

Country co-authorship investigation is asignificant form of co-authorship analysis in a scientometric research. It can reproduce these countries, the most important ones, and the cooperation among them, a network was created using VOS viewer in Figure 5. The relations between nodes represent the supportive relationships amongst the institutions. The distance among the nodes and the depth of the links symbolizes the level of collaboration amongst countries. This network holds 50 nodes, 5 clusters, 679 links, and 2413 total link strength. There are various colors (Red, Green, Blue, Yellow, and Pink) in the map, which demonstrations the variation of research instructions. To measure the above statement in map, United States contributed the major share (2082) of global collaborative publications with total link strength = 1312 times (Table 4),followed by China (total link strength 671), India (235 total link strength), United Kingdom(746 total link strength), and Germany (597 total link strength). It was decent to observe that countries like United States and the China, which are developed countries, were share of this worldwide collaboration.

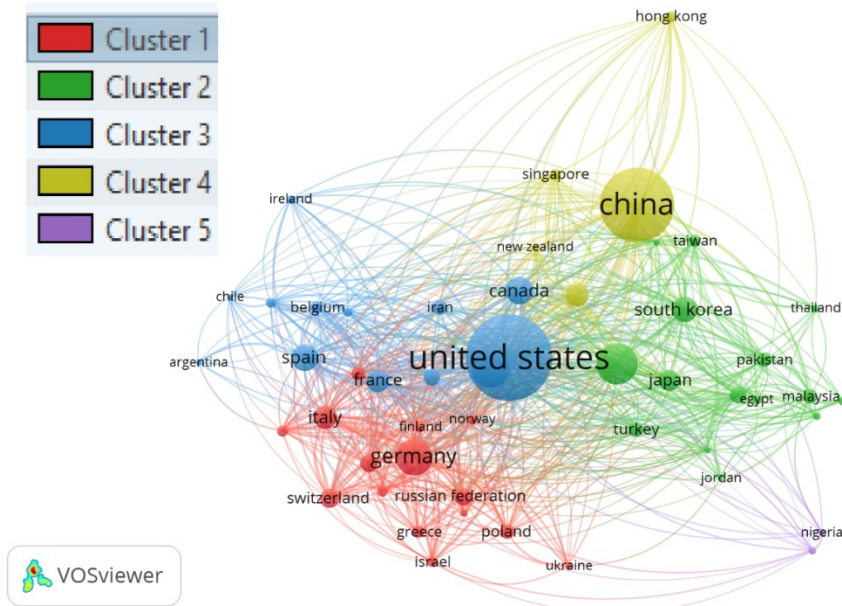


Fig. 5 Country Collaboration Networks

5.6. Most Productive Affiliations

Upon extensive analysis of all publications, a total of 16533 different research institutions global were recognized. Within this many landscape, Figure 6 presents the 10 most productive affiliations. The position is articulated based on the volume of publications related with each organization. From the figure, it develops apparent that the University of California takes the top position with 403 publications, followed by Harvard Medical School with 174 articles, Sun Yat-Sen Universitywith 143 records, and Tsinghua University with 140 publications. Among these affiliations, the Fudan University holds

the 10 position with 114 articles. This research further highlights the various graphical illustration, all inventing from the worldwide.

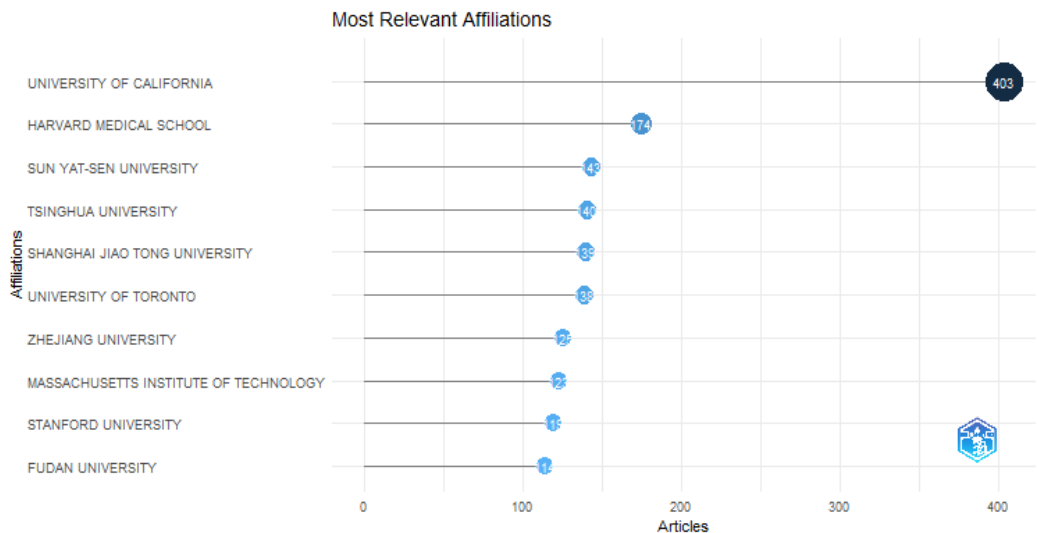


Fig. 6 Most Relevant Affiliations

5.7. Keywords Analysis and Co-Occurrence Network

In this section, a comprehensive research of content was shown by analyzing the distribution of keywords. The co-occurrence network of the top 10 keywords within AI application of digital libraries research, take out from the Scopus database, is revealed in Table5. This keyword co-occurrence network was made using VOS viewer software. From the dataset, a total of 18319 author keywords were extracted. To be elaborate in the network, a keyword had to encounter a least amount threshold, and for this study, a significance of ten keywords was selected.

Table: Keywords Occurrences of Digital Libraries Research

Rank	Keywords	Occurrences	Total Link Strength
1	Machine Learning	1373	915
2	Deep Learning	704	592
3	Artificial Intelligence	412	388
4	Natural Language Processing	168	128
5	Classification	149	191
6	Neural Networks	143	86
7	Clustering	45	45
8	Academic Libraries	40	45
9	Library	38	30
10	Libraries	33	28

Figure 7 exposed the co-occurring keyword network, linking of six distinct clusters, 497 links, and a cumulative total link strength of 2991. The network visualization services numerous colors red, green, blue, yellow, pink, and blue sky—to discriminate different modules. Mostly, the keyword “Machine Learning” holds the highest frequency at 1373 occurrences. Additional keywords of significant occurrence embrace “Deep Learning” (704), “Artificial Intelligence” (412), “Natural Language Processing” (168), “Classification” (149), “Neural Networks” (143), “Clustering” (45), “Academic Libraries” (40), “Library” (38), and “Libraries” (33). These keywords offer an esteemed means of result essential areas and aspects within research diagonally disciplines. They contribution as a tool for finding significant themes and appearances within a given field of digital libraries. Furthermore, the figure describes the regular use of the keyword ‘Machine Learning’ by authors in their study searches.

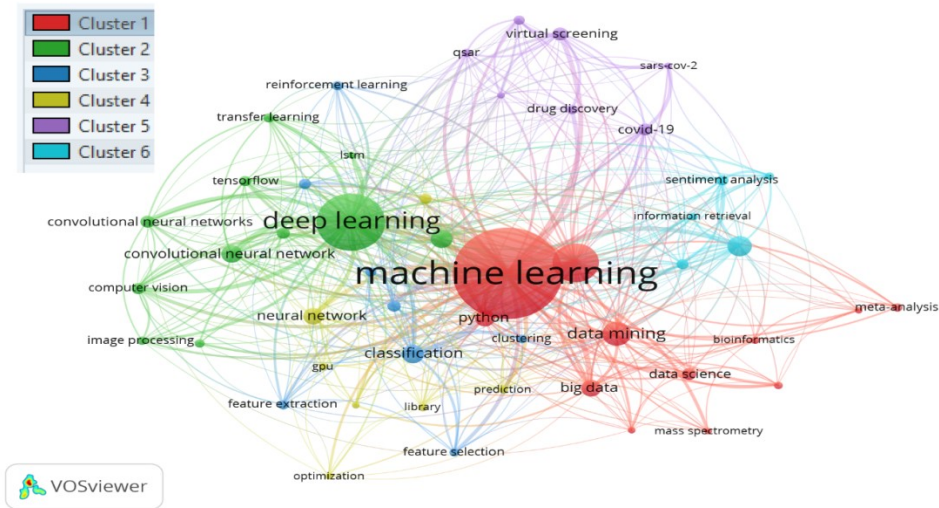


Fig. 7 Co-occurrence Network of Digital Libraries Research

5.8. Factorial analysis of conceptual structure map-method

Figure 8 illustrates a conceptual structured map of the scholarly literature created using multiple correspondence analysis (MCA). This map is resulting from a co-word analysis of the theoretical structure framework, which is produced on the co-occurrence of co-words in research publications. The words investigated include authors' keywords, keywords plus, and positions taken out from titles and abstracts of articles. Upon demonstrating the conceptual structure map, four clusters appear. Cluster one (blue) includes the most prolific keywords, indicating that researchers have motivated more attention on these topic matters for their researches.

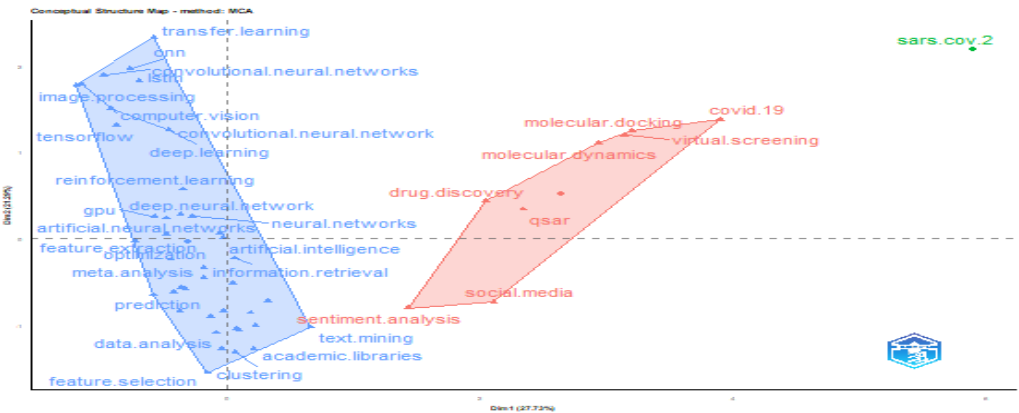


Fig. 8 Factorial analysis of conceptual structure map in the digital libraries research

6. Discussions

A comprehensive scientrometric analysis into AI applications in the field of digital libraries research covering the years 2014 to 2023 has been correctly revealed using the Scopus database. This complete analysis produced an amount of 7571 documents totally focused on digital libraries research. The annual progress path of digital libraries research during the period of 2014-2023 was outlined, highlighting maximum production in 2023 with 1802 articles and a lowest point in 2015 with 199 publications (refer to Figure 2). Overview the journal landscape, the study shown the two highest publication core journals for digital libraries research: IEEE Access(171) and Journal of Chemical Information and Modelling (102). Diving into prolific authorship, the top 10 productive authors were observed (refer to Table 3). Amongst them, Zhang Yarisen as the outstanding contributor, boasting 116 articles, 2248 citations, and the highest h-index of 24 within this study. Similarly, Zhang L revealed the least productive output, contributing 65 publications and securing 1171 citations with an h-index of 20. The analysis covered various aspects, containing scientific publication productivity, authors, sources, institution affiliations’ performance, country collaboration, citations, keywords, network analysis, and co-authorship visualizations completed using VOS viewer and Rstudio Bibliometrix software. Within the top ten countries (Table 4), United States claimed the top with 2082 publications. Analysis of the top 10 author keywords (Table 5) showcased “Machine Learning” as the most frequent, performing 1373 times. Figure 6 shown the formidable presence of the University of California, contributing 403 articles. On a global scale, collaboration was observed to be more major within the confines of the same organization rather than covering various institutes. Mostly, all 10 research institutes with digital libraries publications were international entities, pointing to a development of collected organizational collaboration.

7. Conclusion

A major conclusion of this work is that keywords and titles are significant concerns for authors. With scientrometric tools, it will become gradually important for authors to

sensibly select the keywords and title words so that their documents appear in the applicable scientrometricanalysis. These conclusions shows that the progress in the number of AI applications in the area of digital libraries publications is continuing progressively. In upcoming studies, the area should be more advanced in terms of expediency and representative analysis. It is recommended that more study should be carried out on digital libraries with the help of AI, as it is a hopeful subject for imminent work.

The study's status productions in its specific study of research production, collaboration outlines amongst authors and countries, and the visualization of research areas. The path of digital libraries research articles on a global scale was shown, emphasizing the vast potential for growth and educational development in this area. This researcher offers helpful understandings for stakeholders, subject matter professionals, and researchers to emphasis their efforts, fostering improvements for both individuals and society at large. Moreover, this scientrometric study holds ability in propelling future research endeavors into greater realms within the realm of AI applications of digital libraries and related areas.

In conclusion, this study's scientrometric findings can help significant applicants, especially researchers, to better recognize the usefulness and trends of AI applications in the field of digital libraries research from the global and suggestion for better decisions based on these results.

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The Rise of Open Citation Databases: Implications for Bibliometric Research and Scholarly Evaluation

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Abstract

Citation data form the backbone of bibliometrics and research evaluation, but for many years this information has been locked behind paywalled systems such as Web of Science and Scopus. Their restricted access and limited interoperability have made it difficult—especially for researchers in low-resource environments—to carry out transparent and large-scale citation studies. In recent years, the growth of open science has encouraged the development of open citation platforms like Crossref Open Citations, Open Citations, OpenAlex, Semantic Scholar, and Wikidata. These sources make citation metadata freely available and easier to use, often supported by modern tools such as APIs, linked open data, and AI-based enrichment. However, challenges still exist, including gaps in coverage, inconsistent metadata, difficulties in correctly linking citations, and questions about long-term sustainability. This paper reviews the evolution of citation indexing, compares open and proprietary databases, and discusses the methodological advancements made possible by open citation data.

Keyword

Open citation, bibliometric research, open-access database, proprietary database

1. Introduction

Citation data play a central role in bibliometrics, research evaluation, and the analysis of scholarly communication. It provides the basic evidence needed to understand who influences whom, how scientific fields are developing, and how researchers, institutions, and journals are performing. For many years, proprietary systems such as Web of Science and Scopus have been the primary gateways to structured citation data. Although these platforms provide well-curated and reliable metadata, their paywalled access, costly subscriptions, and limited integration with external tools have restricted the openness and verifiability of bibliometric work. The growth of open citation databases has had a significant impact on the field of bibliometrics. Easy and free access to large datasets, along with API-based tools, now allows researchers to conduct analyses that are more transparent, repeatable, and scalable. These open resources also support advanced methods such as large citation networks, science mapping, and new types of research indicators. At the same time, many of these platforms use modern technologies such

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as linked open data, semantic models, and AI-based metadata enrichment, which are helping to create a more flexible and powerful infrastructure for studying scholarly communication. In recent years, the rise of open science has changed how the research community thinks about scholarly metadata. Citations are now increasingly viewed as a public resource, which has led to strong calls for making citation data open, machine-readable, and easy to reuse. Organizations such as SPARC, COAR, and the Initiative for Open Citations (I4OC) have highlighted that open and transparent citation information is important for fair research evaluation and better knowledge discovery. In response, several open citation infrastructures have grown rapidly, including Crossref Open Citations, Open Citations, Open Alex, and Wikidata's scholarly knowledge graph. Together, these platforms aim to make citation data accessible to everyone and to support a more modern and interoperable foundation for bibliometric research. Even with these improvements, open citation databases still face several challenges. Many publishers do not share their reference lists, which creates gaps in coverage. There are also issues with inconsistent metadata and differences in how complete reference lists are across disciplines. Technical problems like matching citations correctly, removing duplicates, and adjusting for differences between research fields can also affect the accuracy of bibliometric indicators. In addition, the long-term success of open citation systems depends on stable funding, strong governance, and cooperation from the global research community. As open citation data continue to grow and play a larger role in research assessment, it has become important to review how these systems developed, what they currently offer, and how they affect bibliometric research. This paper responds to that need by discussing the history of citation data, comparing open and proprietary databases, evaluating the new methods enabled by open datasets, and examining the key opportunities and challenges involved. Overall, this study shows how open citation infrastructures are changing scholarly communication and supporting a more transparent, fair, and reliable approach to bibliometric analysis.

2. Historical context

The historical context of traditional citation databases is rooted in the centuries-old methods of tracking the links between published works to facilitate information retrieval and evaluate research impact, but it was fundamentally transformed in the mid-20th century by Eugene Garfield and the Institute for Scientific Information (ISI), leading to the creation of the first modern, systematic citation indexes. This concept evolved from earlier forms of indexes to the sophisticated, modern, automated systems of today.

Initially, citation indexes were manually compiled and published as physical books. The advent of computers and storage media (like magnetic disks) in the mid-1960s facilitated the creation of computer-based bibliographic and citation databases like Web of Science, Scopus, Google Scholar, etc. In the 1970s, the first revolutionary computer-based database, Web of Science, was developed by the Institute for Scientific Information (ISI), which was later known as Clarivate Analytics. To compete with WoS, Elsevier launched Scopus with multidisciplinary coverage in 2004. Google Scholar was also launched in 2004 to provide scholarly literature freely, challenging the dominance of

subscription-based services. The development of traditional citation databases has had a profound impact on academia. For the quantitative study of science, the new research fields like bibliometrics and scientometrics have been developed. The citation-based metrics like Journal impact factor and h-index, which are used to evaluate the impact and influence of journals, articles, and individual researchers, have been developed.

To deal with limited access, limited interoperability, and the cost of subscription, the open access movement has been started. The OA movement advocates for the free, immediate online availability and unrestricted reuse of scholarly research without pricing and permission barriers. It views scholarly metadata as a public good, essential for the discoverability, transparency, and global accessibility of research outputs. Organizations like Scholarly Publishing and Academic Resources Coalition (SPARC) and the Confederation of Open Access Repositories (COAR) play a crucial role in this movement. Both organizations work in tandem and often collaborate to ensure that the outputs and underlying information of scholarly research are managed as a public good and must be available to all for the benefit of global society.

3. The Emergence of Open Citation Databases

The emergence of open citation databases is a result of historical multi-decade movement toward Open Science and a direct challenge to traditional, proprietary citation indexes like Web of Science and Scopus. Key factors include early visionary ideas, the creation of new web-based technologies like Crossref and DOIs, the push for open access in scholarly publishing, and initiatives like the initiatives like the Initiatives for Open Citations (I4OC) that promote data sharing. The goal is to make citation data transparent, accessible, and reusable for research, assessment, and innovation, with projects like the OpenCitations Corpus leading the way.

3.1 Crossref Open Citations

Crossref(<https://www.crossref.org/>) was established in 2000 as not-for-profit collaboration among publishers to enable persistent, cross-publisher citation linking using Digital Object Identifiers (DOIs). While it facilitated citation linking, the visibility of the citation lists to the public was initially restricted by individual publisher policies, often requiring a paid “Metadata Plus” subscription. This lack of open citation data created a barrier to open science, making the scholarly record less transparent and making hinderance to develop alternative, non-profit citation analysis tools.

3.2 Open Citations

OpenCitations(<https://opencitations.net/>) (Giambattista et al., 2022) is an open scholarly infrastructure organization, launched the OpenCitations Corpus (OCC), Crossref open DOI-to-DOI citations Index (COCI), Crowdsourced Open Citations Index (CROCI) (Peroni & Shotton, 2020). OCC is the collection of open bibliographic and citation data, available in RDF format. COCI is the first and largest citation index, contains millions of DOI-to-DOI citation links derived from Crossref data, accessed

through SPARQL endpoints, REST APIs, bulk downloads and web interfaces. CROCI is an open citation index built from user contributions to make it a “crowdsourced” index.

3.3 I4OC

The Initiative for Open Citations (I4OC) (<https://i4oc.org/>) is a global collaboration that promotes the unrestricted availability of scholarly citation data to enhance transparency and accessibility in research (Taşkın, 2025). I4OC’s main objective is to encourage publishers to make their citation data structured, separable, and open. Since its launch in 2017, within one year from 1% to 50% (around 38-40 millions) of publications was submitted to Crossref with open citations. Major publishers like Springer Nature, Taylor & Francis, and Wiley joined the initiative. After five years, in 2022 nearly 100% of scientific papers with a DOI are being available with open citation data in Crossref’s database.

3.4 OpenAlex

OpenAlex (<https://openalex.org/>) provides open citation data by indexing scholarly works, including authors, venues, and institutions, and make thus information available through fully open catalog and API. It is a free and open alternative to proprietary databases like Scopus and Web of Science. The data is linked via incoming and outgoing citations, which can be accessed through its API and user interface. OpenAlex aggregates data from numerous open sources, including Crossref, PubMed, the DOAJ, and various institutional repositories, ensuring broad coverage of open access content (*OpenAlex: The Open Catalog to the Global Research System* | OpenAlex, n.d.). It is a project by the non-profit OurResearch, dedicated to make scholarly communication more open, inclusive, and transparent.

3.5 Other open-source databases

Some other databases like Semantic Scholar (<https://www.semanticscholar.org/>), Lens.org (<https://www.lens.org/>), Wikidata (https://www.wikidata.org/wiki/Wikidata:Main_Page) etc. provide scholarly metadata and support for open citations, functioning as key, openly accessible alternatives to proprietary databases. Semantic Scholar and Lens.org are both extensive, AI-powered platforms that offer robust citation graphs and metadata primarily through APIs and datasets, aiming to accelerate scientific discovery. Wikidata serves as an open, community-driven knowledge base where individual can contribute and access structured, linked open data (LOD), which is then widely reused across various platforms, including Wikipedia (<https://www.wikipedia.org/>).

4. Methodology

This study uses a narrative and conceptual review approach to explore the development of open citation databases and their impact on bibliometric research and scholarly evaluation. This type of review is appropriate because the aim is not to conduct a quantitative analysis, but rather to bring together existing knowledge, compare different citation infrastructures, and synthesize key ideas from policy documents, technical

reports, and scholarly literature. By focusing on conceptual developments instead of numerical trends, this approach allows for a broad and integrative understanding of how open citation systems have evolved and how they influence current bibliometric practices.

To gather relevant information, literature, technical reports, and documentation published between 2010 and 2025 were reviewed. The search covered major scholarly and technical sources, including Google Scholar, Crossref, Open Alex, Semantic Scholar, and the free version of Dimensions. In addition to academic databases, official documentation from platforms such as Crossref, Open Citations, I4OC, Our Research, Lens.org, and Wikidata was reviewed to understand the structure and functioning of open citation infrastructures. Reports and policy documents from organizations like SPARC and COAR, as well as key Open Access initiatives, were also examined. Searches were conducted using combinations of keywords that reflected the core themes of the study, such as “open citations,” “bibliometric databases,” “open citation infrastructure,” “Crossref open citations,” “Open Citations,” “I4OC,” “open science metadata,” “citation coverage,” “proprietary vs open databases,” and “open bibliometrics.” This strategy ensured that both scholarly and technical perspectives were captured.

Inclusion and Exclusion Criteria

To ensure relevance and quality, sources were selected according to the following criteria:

Included sources

- Peer-reviewed articles, preprints, technical reports, and official documentation directly addressing open citation data, citation infrastructures, or open science metadata;
- Studies comparing open and proprietary citation databases;
- Materials offering methodological insights, coverage assessments, or platform descriptions relevant to the evolution of citation databases.

Excluded sources

- Publications unrelated to bibliometrics, scholarly communication, or citation data;
- Articles lacking methodological clarity or sufficient descriptive information;
- Opinion-based content without empirical or technical grounding.

5.Comparison of Open vs Proprietary Citation Databases:

Features	Open Citation Databases	Proprietary Citation Databases
Coverage	Generally,have broad, exhaustive coverage of many documents, including preprints, working papers, and publications from developing countries, largely relying on DOIs for inclusion.	Focus on selective, curated content from highly impact journals and established publishers, with strong coverage in traditional scientific fields and extensive historical data.
Data quality	Quality relies on community contributions and automated processes, which can sometimes lead	Data is professionally curated by dedicated expert teams, resulting in highly structured, consistent, and

	to missing references or inaccurate linkages that need manual correction.	reliable data, with rigorous quality control processes to ensure accuracy.
Access & Licensing	Source code is publicly accessible and free to use, modify, and distribute, promoting transparency and avoiding vendor lock-in.	Access is restricted through paid subscription and licensing fees, which can be expensive, leading to potential vendor lock-in for institutions.
Technical features	Offer high flexibility and customization, but advanced analytics and specialized features often require in-house technical expertise or third-party plugins.	Provide a wide array of built-in advanced features, such as integrated analytics, visualization tools, comprehensive reporting, and seamless integration with other enterprise software.
Innovation	Rapid community-driven innovation.	More structured and vendor-led development.
Cost	Reduce licensing fees but may require investment in skilled personnel for setup and maintenance.	Have higher costs to maintain guaranteed professional setup.
Security & Support	Rely on community forums for support and security patches.	Offer robust, built-in security features and dedicated support teams.

6. Implications for Bibliometric Research

Open citation databases have brought important changes to bibliometric research by making data transparent, accessible, and easier to verify. Because these datasets are openly available, researchers can reproduce analyses more confidently and avoid depending on closed, “black-box” indicators. Open citation networks have also encouraged the development of new methods, including improved co-citation analysis, bibliographic coupling, and network-based metrics inspired by PageRank. These advances support more detailed and flexible studies of scholarly influence. The availability of large, openly licensed datasets has further expanded science mapping, enabling tools like VOSviewer and Bibliometrix to generate proper, visualizations and field-level analyses. At the same time, open citation data have lowered barriers for researchers in low-resource institutions, helping democratize bibliometrics and increase participation from the Global South. Open data are also shaping research evaluation policies, as governments and institutions increasingly adopt transparent, open-source indicators in line with reform movements such as DORA and the Leiden Manifesto.

7. Findings and Limitations

In spite of major progress, open citation database still faces several problems. Incomplete participation from major publishers, metadata heterogeneity, and incomplete references present significant limitation to open citation initiatives, resulting in gaps in the scholarly records, reduced data quality, and hindered research discoverability and reproducibility.

Features	OpenAlex	Crossref OC	OpenCitations	Semantic Scholar
Primary Role	Comprehensive, open-source academic data index, a strong competitor to WoS/Scopus.	Metadata and DOI registration service for publishers, focus on linking publisher content.	Open dataset of citation links, built on Crossref and other sources.	AI-powered search engine of large dataset and API access for scholarly literature.
Coverage	Indexes nearly all journals in Scopus/WoS, plus additional global sources. Provides extensive author and citation information, often more ORCID coverage than Scopus/WoS.	Comprehensive for items with a Crossref DOI, but metadata completeness (e.g. abstracts, citations) depends on publisher deposits.	Focuses on citation data, specially COCI. Coverage depends on openly availability in its source data.	Covers a large volume of academic literature, with a focus on computer science and biomedicine. Uses machine learning to extract and link information.
API	Free and unrestricted REST API with no rate limits and full dataset.	Free and open API for metadata retrieval, no restrictions.	Provides a flexible REST API for programmatic access to citation data.	Offers a free API for non-commercial purposes, with some limitations on metadata retrieval.
Openness	Fully open data and API.	Open data for registered content, but data creation is publisher-dependent.	Fully open data and API	Free search access, but backend is not fully open.
Licensing	Data is released under a highly permissive license (likely CC0 or CC BY 4.0) to support reproducible bibliometrics.	Data is largely CC0, encouraging maximum reuse.	Data is fully open and licensed under CC0.	Data is for non-commercial use via the API, though specific licensing for the full dataset may have more conditions.

The findings show that open citation infrastructures offer clear benefits for transparency, reproducibility, and wider participation in bibliometric research. However, their broader significance becomes evident when viewed in the context of global policy efforts. At the same time, sustainability remains a major concern. Many open infrastructures depend on unstable funding models, volunteer governance, or short-term grants, raising questions about long-term viability unless more reliable institutional or governmental support is established. Practical actions are therefore essential. Publishers should be encouraged to release reference lists openly; institutions can support training

and contribute financially to open infrastructures; and researchers can help improve metadata quality by using and citing open datasets. Strengthening these areas will help ensure that open citation systems continue to advance a fairer and more transparent scholarly ecosystem.

8. Future direction

The future of open citation involves expanding data coverage by integrating more resources like DataCite, NIH and others. While also improving data infrastructure with new workflows to simplify data management and access through a unified API. Unified API will allow users to search and access data from all the cross-searchable indexes simultaneously. Key directions include enhancing accuracy and efficiency through AI-powered tools for researchers, and promoting wider access and collaboration by breaking down data silos. The future will see AI play a larger role in helping researchers in managing citations more efficiently, which can save time and effort.

9. Conclusion

The shift from traditional proprietary citation databases to open citation infrastructures has fundamentally transformed the way scholar access, evaluate, and understand research. While systems like Web of Science and Scopus laid the foundation for citation indexing, their restricted access and high costs limited large-scale and transparent bibliometric work. Open platforms such as Crossref Open Citations, OpenCitations, OpenAlex, Semantic Scholar, and Wikidata now provide freely accessible, machine-readable citation data that support more inclusive, reproducible, and innovative research practices. Despite ongoing issues such as inconsistent metadata, incomplete reference lists, and sustainability challenges, open citation systems are steadily strengthening the global research ecosystem. Together, they promote openness, interoperability, and equity helping build a more transparent and collaborative foundation for the future of bibliometric analysis.

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Adaptation of AI Tools and Technology in Academic Research: a Paradigm Shift

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Abstract

The rapid proliferation of Generative Artificial Intelligence (GenAI) technologies, exemplified by Large Language Models (LLMs) and Retrieval-Augmented Generation (RAG) systems, has precipitated a fundamental epistemological shift in the domain of global academic research. This article investigates the profound impact of these technologies on the research lifecycle, moving beyond binary classifications of AI as merely a tool for efficiency or an instrument of academic dishonesty. Instead, this study posits that AI represents a "Cognitive Partner" that challenges traditional definitions of authorship, competency, and information literacy. By synthesizing current developments in the global AI arsenal, this paper analyzes how these tools are reshaping research methodologies, from hypothesis generation to dissemination. The analysis highlights a dualistic outcome: while AI offers a potent solution to linguistic barriers and cognitive bottlenecks—thereby democratizing access to the global "Republic of Science"—it simultaneously risks polluting the scientific record through hallucinations and exacerbating the digital divide between well-resourced and under-funded institutions. The discussion extends to the societal implications of "truth decay" and the changing nature of intellectual labour, ultimately advocating for a "Human-in-the-Loop" (HITL) framework. This approach prioritizes critical AI literacy over passive adoption, ensuring that the academic ecosystem evolves into a hub of augmented intelligence rather than a consumer of algorithmic output.

Keywords

Generative AI, Library and Information Science, Research Methodology, Academic Integrity, Large Language Models, Scientific Communication.

1. Introduction

The history of academic research is, fundamentally, a history of information retrieval and synthesis. For the vast majority of the 20th century, the limiting factor in scholarship was *access*. The scholar's capability was defined by physical proximity to well-stocked libraries and archives. The advent of the internet and the digitization of bibliographic databases in the late 1990s dissolved the physical barrier, ushering in an era of information abundance. This shift moved the bottleneck from *finding* information to *processing* it. Today, however, the academic community stands at the precipice of a second, more volatile disruption: the transition from the "Information Age" to the "Generative Age."

The release of Large Language Models (LLMs) and multimodal AI systems has fundamentally altered the relationship between the researcher and the record. Tools like ChatGPT, Claude, and Google Gemini do not merely retrieve documents; they read, summarize, interpret, and generate text. For the Library and Information Science (LIS) community, this poses an existential question: What is the role of the human researcher

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when an algorithm can perform the literature review, code the data, and draft the manuscript?

This disruption is global and ubiquitous. From prestigious research universities to independent scholars, the adaptation of AI is reshaping the mechanics of inquiry. It promises to accelerate the pace of scientific discovery by automating the mundane, yet it threatens the integrity of the scientific record through "hallucinations"—the generation of plausible but factually incorrect information. This paper aims to dissect these tensions. By categorizing the specific tools currently driving this change and analyzing their integration into research design, we seek to provide a roadmap for responsible adaptation. We explore how the "Global Tool" interacts with the norms of scientific inquiry, and whether this interaction leads to a democratization of knowledge or a crisis of authenticity.

2. Methodological Adaptation: Changing *How* We Research

Researchers are adapting their daily workflows by moving through the **SAMR Model** of technology adoption:

- **Substitution (doing the same thing, faster):** Using tools like *Grammarly* or *DeepL* to fix grammar instead of a human editor.
- **Augmentation (enhancing productivity):** Using tools like *Consensus* or *Elicit* to scan 100 papers in minutes to find specific methodologies, a task that would take humans weeks.
- **Modification (changing the task):** Using Python-based AI agents to clean and code vast datasets automatically, allowing for larger sample sizes than previously possible.
- **Redefinition (doing things previously impossible):**
 - **Synthetic Data:** In social sciences, researchers are experimenting with using Large Language Models (LLMs) to simulate human participants for pilot studies.
 - **Protein Folding:** In biology, tools like *AlphaFold* predict protein structures in seconds, solving a 50-year-old "grand challenge" in biology that was effectively impossible for humans alone.

3. The Spectrum of Tool Adaptation

To understand the trajectory of AI in academia, it is necessary to categorize the technology not as a monolith, but as a suite of specific tools with distinct architectures and functions. The current body of literature provides a robust framework for understanding these distinctions.

3.1 Types of AI Present in Academia

The current literature classifies Academic AI into two primary categories based on their underlying architecture and functional utility:

- **Generative Large Language Models (LLMs):** These are probabilistic models trained on vast datasets encompassing essentially the entire public internet. They function by predicting the next word in a sequence to generate human-like text. The literature defines them as "stochastic parrots"—they are creative and capable

of complex synthesis, but they lack an internal concept of truth. Their primary utility lies in drafting, ideation, and coding.

- **Retrieval-Augmented Generation (RAG) Systems:** These are arguably more critical for the LIS community. RAG systems do not generate answers from a void; they first retrieve relevant documents from a verified, closed database (like Semantic Scholar, PubMed, or Web of Science) and then use an LLM to summarize those specific documents. These are designed as "truth-seeking" engines to minimize fabrication.

3.2 Names of Different AI Tools Used in Research Methodologies

The ecosystem of tools has expanded rapidly. The literature highlights the following key players currently dominating the global research landscape:

- **Global Generalists (ChatGPT, Claude, Gemini):** OpenAI's *ChatGPT* (specifically the GPT-4 architecture), Anthropic's *Claude*, and Google's *Gemini* are the most ubiquitous. They are used for broad tasks: brainstorming hypotheses, refining English grammar, and writing scripts in Python or R for data analysis. Gemini is often noted for its multimodal capabilities (analyzing images and charts) and real-time internet access.
- **Research Specialists (Scite, Elicit, Consensus):** These are purpose-built for rigorous scholarship. *Elicit* functions as an AI research assistant, automating literature mapping by finding papers based on semantic concepts rather than keywords. *Scite.ai* offers "Smart Citations," classifying references to see if they support, contrast, or merely mention a claim. *Consensus* uses AI to extract findings from scientific papers to answer yes/no research questions with an "evidence meter."
- **coding and Data Assistants (GitHub Copilot, Julius AI):** These tools assist specifically in the methodology phase, helping researchers write code for statistical analysis, clean messy datasets, and visualize complex data trends without requiring deep expertise in computer science.

3.3 Use of AI in Research Design and Dissemination

AI is no longer just a writing aid; it has permeated the entire research lifecycle, influencing both how research is designed and how it is shared.

- **Research Design and Methodology:** In the design phase, AI is used to simulate participant responses in pilot studies (synthetic user testing), suggest optimal sample sizes, and design survey questionnaires to avoid bias. In quantitative research, AI is democratizing data science; researchers in the humanities or social sciences can now run complex regression models or sentiment analyses using natural language commands.
- **Dissemination and Translation:** Post-research, AI is extensively used to convert technical manuscripts into "layman summaries" for public consumption and press releases. Furthermore, AI-driven translation tools allow research originally written in non-English languages to be disseminated in English-language journals, and vice-versa, fostering a more inclusive global discourse.

4. Advantages and Disadvantages of AI

The literature presents a polarized view of AI's impact, weighing significant operational benefits against profound ethical risks.

4.1 Advantages:

- **Efficiency and Acceleration:** The primary global advantage is the compression of the research timeline. Tasks that previously took weeks—such as screening abstracts for a systematic review or formatting references—can be automated in minutes.
- **Linguistic Equity:** For non-native English speakers (who constitute the majority of global researchers), AI acts as a leveling force. It polishes prose to meet international standards, ensuring research is judged on scientific merit rather than grammatical fluency.
- **Cognitive Augmentation:** AI acts as a "sparring partner" for ideation, helping researchers overcome writer's block and identify interdisciplinary connections that a human specialist might miss.

4.2 Disadvantages or Challenges to Adaptation

- Despite the potential benefits of AI in research, full adaptation is slowed by significant barriers regarding reliability, ethics, and infrastructure:
- **Reliability and The "Hallucination Hazard":** The most pervasive risk is the tendency of AI tools to fabricate data and citations (known as "confabulation"). Uncritical reliance on these tools has resulted in "phantom references" polluting the scientific record. Consequently, researchers must meticulously verify every output, a process that often negates the time saved by using the tool in the first place.
- **Inequality and The "Matthew Effect":** Adaptation is expensive, creating a divide between wealthy institutions that can afford enterprise access to advanced models (like GPT-4 and Scopus AI) and smaller institutions relying on free, less capable versions. This disparity risks widening the gap in research quality.
- **Bias and Homogenization:** Because LLMs are trained on internet data heavily skewed toward Western, English-speaking perspectives (WEIRD data), there is a risk of homogenizing thought. This can lead to the marginalization of indigenous or non-Western epistemologies.
- **Data Privacy and Regulation:** Researchers handling sensitive data (e.g., medical records or interviews) face barriers due to GDPR and HIPAA regulations. Standard cloud-based tools are often non-compliant, necessitating the use of complex "local LLMs" running on private, offline servers.
- **Academic Malpractice:** The ease of text generation opens avenues for "contract cheating" and the mass production of low-quality, derivative papers. This flood of AI-generated content threatens to overwhelm the peer-review system.

5. Institutional Adaptation: The Governance of AI

Universities and publishers are scrambling to adapt policies to this new reality.

- **Authorship Definitions:** The consensus (COPE, Nature, Science) is that **AI cannot be an author**. An author must be able to take legal responsibility for the work; software cannot.
- **Disclosure Requirements:** Adaptation now requires a transparency statement. Researchers must detail which AI tool was used, for what purpose (e.g., "ChatGPT-4 was used to refine the code in Figure 2"), and the date of access.
- **The "Black Box" Problem:** A major hurdle for adaptation is **reproducibility**. If an AI model updates its algorithm, the same prompt may yield different results a week later. Institutions are pushing for the archiving of specific model versions used in research.

6. Cultural Adaptation: The "Skill Shift"

The skillset required for a successful academic career is adapting.

- **From Syntax to Semantics:** Researchers need less rote memorization of coding syntax (Python/R) because AI can write the code. The skill shifts to *verifying* that code and understanding the underlying logic.
- **Prompt Engineering:** The ability to craft precise queries to extract high-quality analysis from AI is becoming a "soft skill" in academia.
- **Critical Evaluation:** The role of the researcher is shifting from "gatherer" to "curator." The primary value of a human researcher is now the ability to discern a hallucination (false AI output) from a fact.

7. Results and Observations

Synthesizing the technological capabilities with the current state of global academia yields several critical observations regarding the adaptation of AI. These results highlight the emerging trends that define the "State of the Art" in AI-assisted research.

7.1 Methodological Convergence and the "Mixed-Methods" Boom

A significant result of widespread AI adoption is the blurring of lines between qualitative and quantitative research. Historically, these domains were separated by skill barriers; qualitative researchers often lacked the training to perform complex statistical analyses. The availability of AI tools like *Julius* or *ChatGPT Data Analyst* has lowered this barrier. Researchers can now upload raw datasets and request statistical tests, visualizations, and trend analyses using plain language. This has resulted in a global surge of "mixed-methods" research, where scholars are increasingly backing qualitative arguments with robust quantitative data processed by AI assistants.

7.2 The Emergence of the "Tiered" Research Ecosystem

Contrary to the narrative that AI democratizes all research equally, current trends indicate a "Tiered Access" hierarchy based on economic resources.

- **The Premium Tier:** Well-funded institutions in the Global North are purchasing institutional licenses for "Research Specialist" tools (like Scite or Enterprise GPT-4). These tools are secure, private, and highly accurate.

- **The Free Tier:** Independent scholars and researchers in under-funded institutions often rely on the free versions of generalist models. These versions have smaller context windows, outdated knowledge bases, and a higher propensity for hallucination.
- *Observation:* This divergence creates an "Integrity Gap," where well-resourced research is verified by superior algorithms, while under-resourced research is more susceptible to algorithmic error.

7.3 The "Flood" of Scientific Output

The most tangible result of AI adaptation is the dramatic increase in the volume of scientific output. The friction of writing has been reduced, leading to a proliferation of preprints and submissions. While this accelerates the sharing of ideas, it places an unprecedented strain on the peer-review system. Journals are reporting a higher incidence of "AI-written" papers that are grammatically perfect but scientifically shallow, requiring new methods of screening and evaluation.

8. Discussion

The integration of Artificial Intelligence into the global academic workflow is not merely a procedural update; it is a structural event with cascading consequences that extend far beyond the university. We are witnessing the transition from the "Information Economy" to the "Intelligence Economy," and the academic sector is the testing ground for this shift. The primary friction point in this transition is the potential erosion of the "human warrant." For centuries, the legitimacy of academic research was grounded in the assumption that a human being had read the sources, analyzed the data, and written the words. AI severs this direct link. When a researcher uses an LLM to synthesize a literature review, the resulting text is a probabilistic approximation of knowledge, not knowledge itself. This leads to a broader phenomenon of "Truth Decay." If the academic record—the repository of verified human knowledge—becomes saturated with AI-generated content that contains subtle, plausible-sounding errors, the foundation of scientific progress weakens. The LIS community faces a critical challenge here: how to maintain bibliographic integrity in an age where citations can be hallucinated.

However, the economic and labor implications compel adaptation. The global research labor market is shifting. Skills that were once the hallmarks of early-career scholarship—such as citation management, basic coding, and manual summarization—are being automated. This suggests that the academic economy will soon stop rewarding "knowledge retrieval" and start rewarding "knowledge verification" and "prompt engineering." The "Augmented Researcher" of the future will not be judged by their ability to memorize information, but by their ability to orchestrate AI tools to solve novel problems. This shift requires a radical overhaul of doctoral training. If universities continue to assess scholars based on outputs that machines can easily replicate (like standard literature reviews), they fail to prepare researchers for the reality of the modern knowledge economy.

Furthermore, the issue of "Epistemic Sovereignty" looms large. Most dominant AI models are proprietary systems owned by a handful of technology corporations. When the global academic community relies on these "black box" models for analysis, they

effectively outsource their cognition to opaque algorithms. The biases inherent in the training data of these models—often skewed toward specific cultural or linguistic norms—can subtly influence the direction of research hypotheses and conclusions. This risks creating a feedback loop where AI reinforces existing dominant narratives, suppressing novel or non-standard theories.

Ultimately, the discussion resolves into a question of agency. The dystopian view is that AI leads to "cognitive atrophy," where researchers become passive consumers of algorithmic output, losing the ability to think deeply and critically. The utopian view is that AI liberates the researcher from drudgery, allowing the human mind to focus on the highest levels of cognitive work: creation, ethical reasoning, and complex evaluation. The reality will likely be a hybrid. The researchers who thrive will be those who adopt a "Zero-Trust" policy toward AI—treating the AI not as an oracle, but as a talented but fallible intern. They will verify every claim, audit every line of code, and maintain strict cognitive sovereignty over the research questions.

9. Future Outlook: The Rise of "AI Agents"

We are currently moving from **Chatbots** (which answer questions) to **Agents** (which perform tasks).

- *Current State:* You ask an AI to summarize a paper.
- *Future State (1-3 years):* You give an AI Agent a goal: *"Find the last 5 years of literature on climate change adaptation in Southeast Asia, extract the statistical data into a CSV file, and visualize the trend."* The Agent will autonomously search, read, extract, and code the data.

10. Conclusion

The adaptation of AI technology in academic research is an irreversible trajectory. For the Library and Information Science community, the challenge is to navigate this transition without losing the soul of scholarship. The review of literature and subsequent analysis reveals that while AI has the potential to be a great equalizer—breaking down linguistic barriers and democratizing data science—it currently threatens to create a crisis of integrity and a new digital divide.

To mitigate these risks and harness the benefits, the global academic community must adopt a "Human-in-the-Loop" (HITL) framework. This approach posits that AI should be used to generate options and draft content, but the human must act as the editor, the auditor, and the final decision-maker. It requires a pedagogical pivot: moving away from banning these tools and toward teaching "AI Literacy." This literacy involves the ability to audit algorithms, verify hallucinations, and understand the ethical implications of data privacy.

In conclusion, AI should be viewed neither as a replacement for the researcher nor as a shortcut to publication. It is a mirror that reflects the quality of the user. In the hands of a lazy scholar, it produces noise and misinformation. In the hands of a critical, ethically grounded researcher, it is a powerful engine for discovery. The future of global research

depends on our ability to tell the difference and to integrate these "Cognitive Partners" with wisdom and restraint.

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AI & ML Research Output in The Field of Social Science in India: A Scientometric Approach

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ABSTRACT

This research aims to measure the research output of AI & ML research in the field of social science in India. We have collected the data from the Scopus database to date. A total number of 14158 such documents were found. The first publication was found in the year 1966, and the boom in publications started around the year 2016. We have utilised the OpenRefine tool to retrieve OA-related data from the Unpaywall database. Among the documents, 5542 are published as journal articles and 10601 documents were published as closed-access source. The study revealed that despite being a highly computer-oriented subject, AI & ML research is gathering popularity in the field of Social Science also.

KEYWORDS

AI & ML, Social Science, AI & ML Research Output, Scientometric Analysis, Bibliometrics

1. INTRODUCTION

Artificial intelligence (AI) and machine learning (ML) are two of the most important technological advances of the contemporary era. Artificial intelligence is described as the creation of computational systems capable of executing functions formerly associated with human cognition, such as reasoning, problem solving, language processing, and decision-making. Machine Learning, an area of artificial intelligence, focuses on algorithms and statistical models that allow systems to recognise patterns in data, learn from previous experiences, and improve performance over time without the need for explicit programming.

In the contemporary world, the relevance of AI and ML cannot be overstated. These technologies have become integral to diverse domains, including healthcare, finance, education, transportation, and communication, where they support enhanced efficiency, accuracy, and innovation. According to (Tai, 2020) “Artificial intelligence (AI), known by some as the industrial revolution (IR) 4.0, is going to change not only the way we do things, how we relate to others, but also what we know about ourselves.” He also stated that, however, the way we do things and interact with each other is greatly impacted by modern AI. For the world to benefit from the advancement of this new intelligence, new AI ethical principles must be developed to establish standards for AI technology to follow.

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The applications of AI range from predictive medical diagnostics and adaptive learning platforms to intelligent financial analysis, autonomous vehicles, and advanced natural language processing systems. By facilitating large-scale data analysis, AI and ML provide critical tools for deriving actionable insights, supporting evidence-based decision-making, and addressing complex challenges. (Rodrigues et al., 2023) In their study, they stated that currently, AI is influencing every aspect of our daily lives. Whether it's in our house, workplace, or just any other places outside, AI is affecting every part of it. From household appliances to processed food, from self-driving cars to the prediction of stock prices, AI has taken over the charge in all places.

Keeping in mind the importance of AI and ML in this modern era, the authors have tried to study the research output and availability of documents about AI and ML in the field of the Social Science discipline, which are affiliated with India, with a scientometric approach.

The term 'Scientometrics', often used synonymously as 'Bibliometrics', which originated in Russia, is a quantitative method of application in measuring science, involving counting artefacts in the production and use of information, and arriving at conclusions from the counts (Devarajan, 1997). The terms like 'Librametrics', 'Bibliometrics', 'Informetrics' and 'Scientometrics' have been used synonymously in order to study the growth of literature in a discipline and other aspects of literature quantitatively. Scientometrics is designed for the measurement of science communication, whereas bibliometrics is restricted to dealing with more general information processes.

2. LITERATURE REVIEW

Previous studies have shown that the research in AI and ML is constantly growing. For instance, Collins, with his co-scientist, conducted a study in 2021 on the research output of AI from 2005 to 2020. Provides a state-of-the-art of AI research in Information Systems between 2005 and 2020, and also identifies the evolution of how AI is defined over a 15-year period (Collins et al., 2021).

(Bhattacharjee, 2019) conducted a study where he tried to analyse the research papers/articles on usage of Artificial Intelligence in Indian higher education, that are indexed in the Scopus database with a publication year from 2009 to 2018 with a scientometric approach. The analysis shows that although AI is becoming more and more prevalent in research papers both domestically and internationally, its relevance in the context of higher education is somewhat limited. There is a lot of room for expansion in the use of AI in the Indian education sector, and it is likely that research papers in this area will increase significantly in the years to come.

However, using scientometric approach in this type of study is not a new concept. In 2011, Gupta and Bala conducted a study on the research output of India in the field of medicine using a scientometric approach. So, the scientometric study is not new, it has a proven history lies within itself. Their study evaluated the research performance of different types of Indian medical colleges, hospitals, research institutes, universities and research foundations and the characteristics of published literature in Indian and foreign journals (Gupta & Bala, 2011).

From 2009 to 2018, (Nath & Jana, 2020) examined at 8917 research publications written by 32071 writers worldwide. With a 21.51 per cent global publication share and an 11.42

per cent international collaboration rate, they came to the conclusion that the USA was the most productive nation. The Chinese Academy of Science was the most productive organisation, publishing 311 articles, with P. Pradhan ranking as the top author with 70 publications.

The proprietary database from Elsevier BV, namely Scopus have been chosen to gather the data for the study. Previous studies showed that Scopus has the best coverage for this kind of studies. For instance, Santra, Majhi and Bhowmik conducted a study in 2021 on the available literature on scientometric studies available in the Scopus database, using a scientometric approach. They found that, from 2010 to 2019, researchers have published 41462 publications out of the 334 publications that belong to the scientometric domain of Indian research. The concerned researchers have critically analysed the collected data on various aspects, including year-wise publication, author collaboration, authorship patterns, degree of collaboration, collaborative coefficient (CC), leading authors, productive journals, state-wise production in India, and the most frequently used keywords (Santra et al., 2021).

3. OBJECTIVES

The study has been designed with the following objectives:

1. To examine the growth of literature on Artificial Intelligence and Machine Learning published in India.
2. To analyse the Indian research output, status, publication share and growth on Artificial Intelligence and Machine Learning research with a scientometric approach.

4. METHODOLOGY

The bibliographic metadata related to this research was gathered from the Scopus database. We followed a basic and standard search query with two additional filters: i. The subject area must be Social Sciences (SOC) and ii. The Affiliation country has to be India. The search was made on 22nd November, 2025, using the following search string: *TITLE-ABS-KEY ("artificial intelligence" OR "machine learning" OR "AI" OR "ML" OR "AI/ML" OR "AI & ML" OR "AI and ML" OR "AI-ML" OR "artificial intelligence systems" OR "artificial intelligence techonogies" OR "artificial intelligence*" OR "artificial intelligence techniques" OR "artificial intelligence/machine learning" OR "machine learning technologies" OR "machine learning algorithm") AND SUBJAREA ("SOC") AND AFFILCOUNTRY ("India")*

The search string retrieved 14158 documents. The documents were exported to CSV file for analysis. Further necessary tools were used to analyse the data. We have utilised MS Excel for data arrangement and analysis. For fetching OA data, the CSV file was uploaded to the OpenRefine tool and fetched from the Unpaywall database using respective DOIs. Necessary GREL extractions were performed to extract the OA data from raw JSON data.

5. RESULTS

The obtained data were analysed using the computational methods. The results of this study are systematically presented as follows:

5.1 Yearly Growth of Publications

The current study discusses about the growth of AI and ML document publications in India. The term "AI" was coined in 1955, and the first research document emerged in India ten years later, which is still remarkably early for its time. The number of publications increased at a greater pace from 2008. At the same time, concepts like Big Data and Deep Learning also emerged, marking it a foundational year for modern advancements in the fields of AI and ML. With the emergence of more affordable and accessible internet connections, improved computer hardware, and the surge of social media, the late 2010s witnessed a significant increase in publications on AI and ML. The trend continues, with 3555 documents already published in the same field in India, and the year is not yet over.

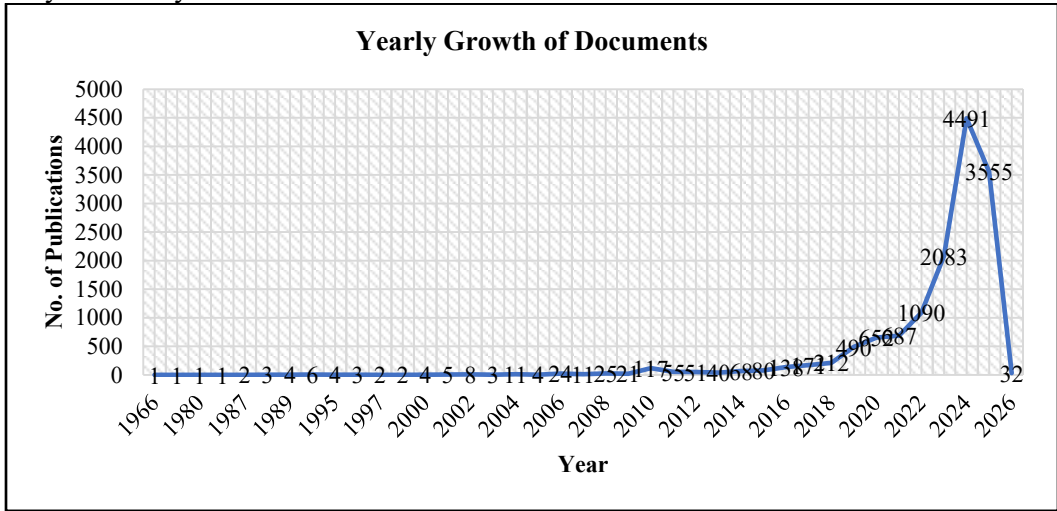


Figure 1: Yearly growth of AI & ML research output in India

5.2 Types of Documents published

The current analysis focuses on the publication types that emerged during the specified time period, specifically those related to AI, ML, or other relevant topics. The study shows that most of the documents published in the past and currently being published are journal articles (39.14%), followed by books (33.81%), book chapters (21.86%), conference papers (2.69%), and data papers (1.54%), respectively. These four categories comprised 99.04% of the total publications. The rest of the categories account for 0.96% of the total publications only.

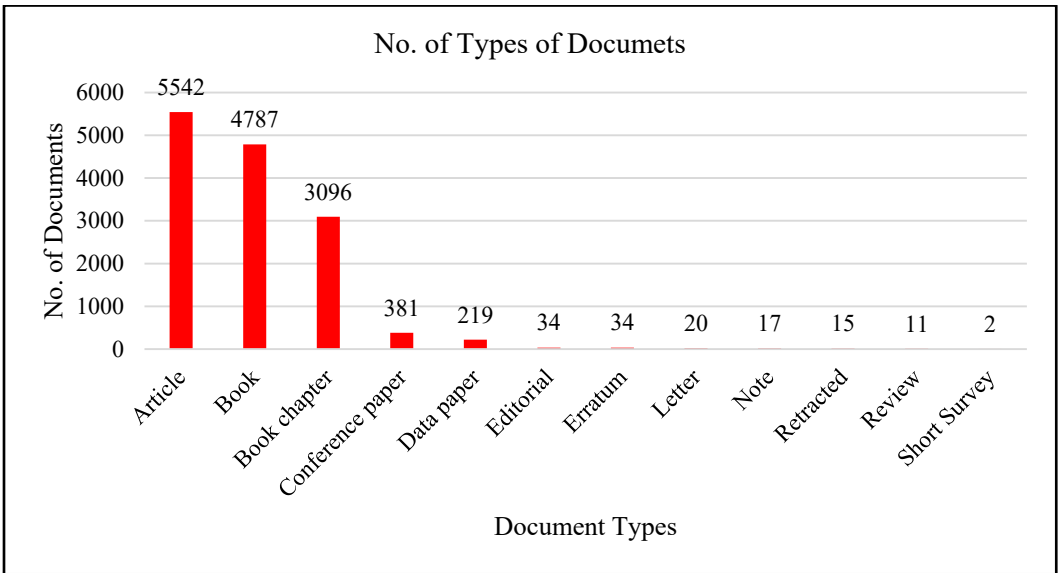


Figure 2: Types of Documents

5.3 Word Cloud

The word cloud map is based on the occurrence of the author-provided keywords in the scholarly work that deals with AI & ML-related topics. There were over 45000 author keywords provided by the authors. For the word cloud, we considered keywords that occurred 30 times or more. From the diagram shown in Figure 3, it is clear that the most frequently chosen keywords are Machine Learning, Artificial Intelligence, and Deep Learning.

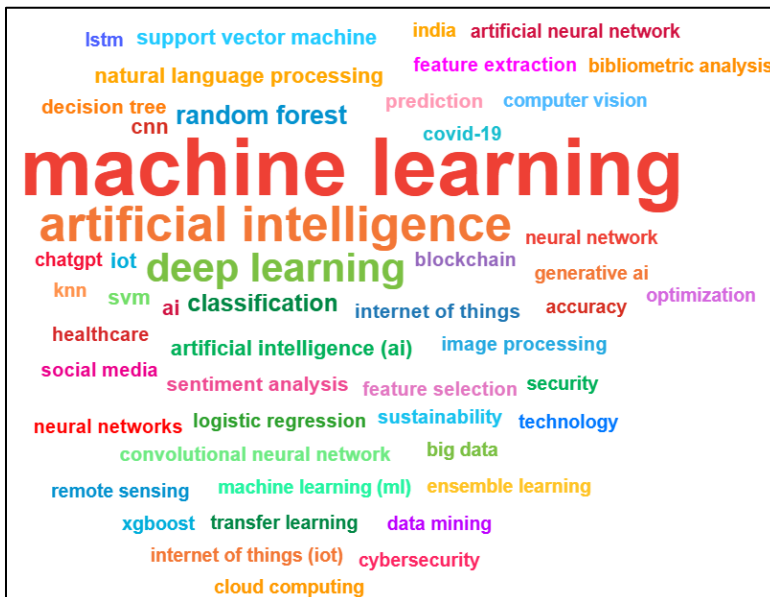


Figure 3: Most frequent author keywords

5.4 OA status of the documents

The following part describes the OA status of the published documents. The study shows that 74.87% documents are closed access. Only 15.42 % documents are some flavours of open access. Among the open access documents, majority are Gold OA (11.92%). The Hybrid OA (1.93%), Bronze OA (1.56%) and Green OA (0.62%) comprise respectively. 9.70% documents retrieved no data. This analysis shows that the authors are still choosing to publish in Closed Access sources for hi-tech topics such as AI & ML.

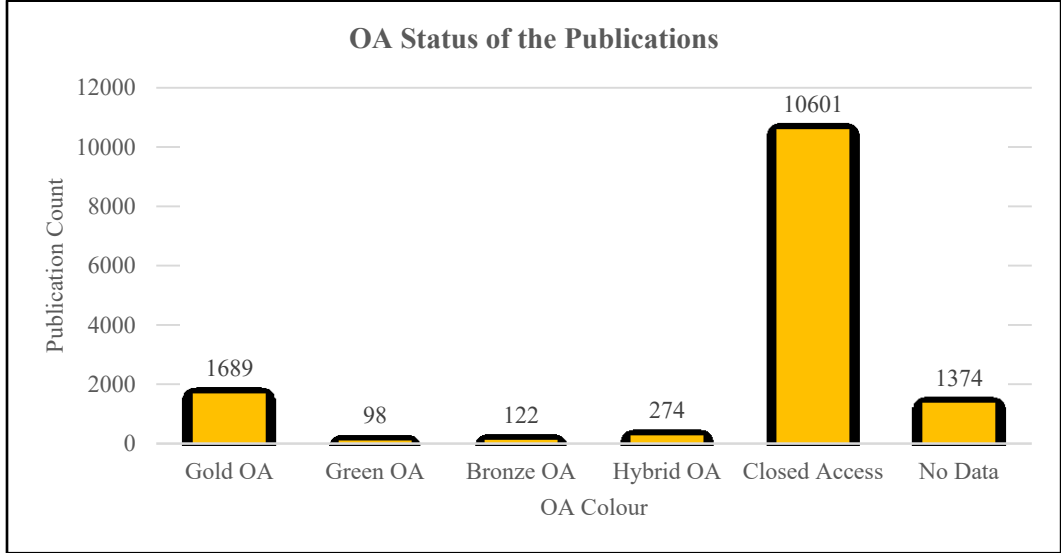


Figure 4: OA status of the publications

6. DISCUSSION

The objectives of this study were to analyse the research output and literature of AI & ML-related documents available in the field of Social Science in India. We have discovered that the first publication on AI & ML came in the year 1966, just ten years after the term was coined. But the publication and research took a massive leap from the year 2016, due to the availability of better internet infrastructure and high-end computing hardware. These reasons enabled the researchers to try and test more on AI & ML. The study revealed that although the current academic scenario is promoting open access to knowledge, the authors and researchers still prefer closed-access publication sources to publish their research. We also found that most of the researchers in this academic area prefer to publish their findings as journal articles, because of the ease of access and worldwide availability through electronic media.

7. CONCLUSION

The following study was conducted to know the research output and literature availability of AI & ML in the field of Social Science in India. By searching the Scopus database, we have found 14158 such documents. The first publication came out in 1966, and the number of documents is increasing day by day. The trend shows that in a small field like Social Science, the highly computer science-oriented topics like AI & ML research are

gathering popularity. Overall, it is expected that soon India will be as productive in AI & ML-related research as other Western countries.

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Ethical Challenges in the Digital Age: Copyright, Censorship, and Data Privacy in Libraries

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Abstract:

This research investigates the ethical challenges faced by digital libraries in the modern digital age, focusing on three primary issues: copyright, censorship, and data privacy. The aim is to explore the complexities these challenges introduce to digital library services and assess how libraries navigate these dilemmas while adhering to their core values of knowledge sharing, intellectual freedom, and user privacy. The study employs a systematic review of peer-reviewed literature published in recent years, analyzing scholarly articles, reports, and case studies to identify key ethical concerns and best practices in digital libraries. Through this review, the research uncovers the growing tensions between copyright compliance and unrestricted access to information, the rise of censorship due to political or social pressures, and the increasing risks to user data privacy as libraries transition to digital environments. Findings indicate that while digital libraries significantly improve access to knowledge, they also face increased scrutiny from content owners regarding copyright, which complicates the libraries' ability to provide open access. Additionally, digital platforms often succumb to pressures that lead to content filtering,

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limiting the diversity of available information. Data privacy emerges as a critical concern, with libraries needing to balance user confidentiality with the need for data collection to improve services. The conclusion emphasizes the necessity for libraries to adopt transparent policies, advocate for open access, and implement robust data protection measures. Implications suggest that libraries must carefully navigate the ethical landscape by prioritizing intellectual freedom, ensuring fair use of copyrighted materials, and safeguarding user data, all while staying compliant with legal frameworks. This paper provides recommendations for addressing these challenges and promotes the development of ethical guidelines that align with the evolving digital landscape.

Keywords

Digital Libraries, Copyright Compliance, Censorship, Data Privacy, Ethical Challenges

1. Introduction

1.1 Background on Digital Transformation in Libraries

In the 21st century, libraries have transformed significantly with the rise of digital technologies. Once centered on physical collections, they now function as dynamic information hubs offering e-books, digital archives, and online databases. This transformation has revolutionized how information is stored, retrieved, and disseminated, making knowledge more accessible and fostering global information sharing (Onunka et al., 2023). The integration of artificial intelligence (AI), blockchain, and cloud computing has enhanced efficiency and user experience. However, these advancements also introduce ethical dilemmas concerning copyright, censorship, and data privacy, requiring libraries to balance legal obligations with their ethical responsibilities (Adigun et al., 2024).

1.2 Importance of Ethical Considerations in Digital Library Services

Ethical issues have become central to digital library operations (Isiaka et al., 2024). Copyright protection poses major challenges as digital materials are easily duplicated and distributed without authorization. Libraries must comply with copyright laws while fulfilling their mission to provide access to knowledge. Censorship further complicates this balance government policies, institutional regulations, and societal pressures sometimes limit content accessibility, undermining intellectual freedom (Fiske, 2023). Additionally, increasing data collection raises concerns about user privacy and data security. Libraries must protect personal information and ensure ethical use of data analytics (Dhirani et al., 2023).

1.3 Scope and Objectives of the Paper

This study examines ethical challenges in digital libraries, focusing on copyright, censorship, and data privacy. It aims to:

1. Analyze copyright issues, including laws, fair use, and licensing;

2. Explore censorship pressures and their implications for intellectual freedom;
3. Investigate privacy and security risks associated with user data; and
4. Recommend ethical strategies for balancing access, compliance, and user protection.

Through these objectives, the paper contributes to discussions on maintaining ethical integrity in the digital age, where libraries must reconcile technological innovation with moral responsibility.

1.5 Significance of the Study

Understanding these ethical challenges is vital for librarians, policymakers, and researchers. Issues surrounding copyright, censorship, and privacy affect accessibility, equity, and the trustworthiness of digital libraries. This study seeks to promote awareness and inform the development of ethical policies and frameworks that safeguard intellectual freedom, protect user rights, and ensure equitable information access (Ikwuanusi et al., 2023).

1.6 Method

This study uses a literature review analyzing scholarly sources on digital libraries' ethical challenges.

2. Copyright Issues in Digital Libraries

2.1 Introduction to Copyright in the Digital Age

Copyright laws safeguard intellectual property, ensuring creators receive proper recognition and compensation. While traditional libraries managed physical lending, digital libraries encounter complex issues as digital materials are easily reproduced and shared (Crews, 2020a). Consequently, libraries must balance copyright enforcement with equitable access (Balasubramanian, 2021), addressing licensing, fair use, DRM, and open access.

2.2 Key Copyright Challenges in Digital Libraries

Licensing Agreements and Restrictions: Unlike printed books, digital materials are governed by licensing contracts rather than the "first-sale doctrine." Libraries typically gain access through subscriptions with restrictive terms limiting user numbers, interlibrary loans, and archiving rights (Chaturvedi, 2024). These restrictions, coupled with high subscription costs, can hinder research and long-term access since digital materials may disappear once subscriptions expire (Panezi, 2021; Hussaini, 2020).

Fair Use and Digital Libraries: Fair use allows limited use of copyrighted material for education and research, but its application to digital contexts remains

unclear (Crews, 2020b). Digitization efforts, such as Google Books, have faced lawsuits over copyright infringement despite their educational intent. These ambiguities make libraries cautious in digitizing materials, as they must ensure legal and ethical compliance when expanding access to digital resources.

Digital Rights Management (DRM) and Access Restrictions: DRM technologies, including encryption and device controls, protect digital content but restrict legitimate use. They often prevent copying, printing, or accessibility for users with disabilities, and hinder long-term preservation efforts. DRM-locked content cannot be easily archived or migrated, raising sustainability issues. Libraries advocate for flexible DRM policies that respect both fair use and preservation needs, while open-access initiatives continue to challenge restrictive DRM practices.

Orphan Works and Public Domain Issues: Orphan works materials whose rights holders cannot be identified pose another challenge. These works hold cultural and academic value but remain inaccessible due to legal uncertainty. Although some nations permit limited use under specific conditions, fear of infringement still deters libraries from digitizing them. Similarly, differing international copyright durations complicate efforts to confirm public domain status, creating barriers to open knowledge dissemination.

2.3 Ethical Considerations in Copyright Enforcement

While copyright laws safeguard creators' rights, rigid enforcement can conflict with libraries' ethical duty to promote knowledge sharing. Ethical dilemmas include:

- **Access vs. Ownership:** Restrictive licensing and DRM limit libraries' ability to preserve or share content.
- **Educational Needs:** Researchers and students face limited access due to copyright constraints.
- **Global Inequality:** High subscription fees exacerbate disparities between developed and developing regions.

To reconcile these issues, libraries increasingly support open-access models and advocate for copyright reforms that align with educational equity and ethical responsibility.

2.4 Open Access and Alternative Copyright Models

Open-access (OA) publishing offers a pathway to overcome copyright barriers. OA models Gold, Green, and Diamond enable free availability of scholarly content, supported by authors, institutions, or public funding. Initiatives such as Plan S and the Open Access Initiative advocate for unrestricted dissemination of publicly funded research. Libraries play a central role by hosting repositories and

promoting OA awareness. Creative Commons (CC) licenses further empower creators to define how their works are reused. By encouraging CC licensing, libraries foster ethical sharing and a global culture of open knowledge.

2.5 Future Directions and Policy Recommendations

To balance copyright protection with equitable access, libraries and policymakers should consider:

- **Reforming Licensing Agreements:** Advocate for perpetual access rights and interlibrary lending provisions.
- **Expanding Fair Use Policies:** Governments should clarify fair use to support educational digitization.
- **Promoting Open Access:** Increase institutional investment in OA initiatives to reduce reliance on commercial publishers.
- **Improving Orphan Works Legislation:** Introduce clear frameworks enabling responsible digitization while protecting creators.
- **Revising DRM Policies:** Allow exemptions for preservation and accessibility, ensuring equitable use of digital content.

Copyright in digital libraries requires balance protecting creators' rights while ensuring fair access, open knowledge sharing, and ethical, equitable information distribution worldwide.

Censorship in Digital Library Services

3.1 Introduction to Censorship in Digital Libraries

Censorship in digital libraries now extends beyond removing physical books to restricting digital content and algorithmic visibility. Influenced by government control, corporate interests, and social pressures, such censorship limits access, challenges intellectual freedom, and threatens academic transparency in the digital age.

3.2 Forms of Censorship in Digital Libraries

Government-Imposed Censorship: Governments frequently restrict access to politically sensitive or culturally controversial materials. Authoritarian regimes may ban works discussing democracy, religion, or human rights, effectively shaping public knowledge. Such interventions compromise scholarly independence and limit diverse perspectives.

Content Filtering and Blacklisting: Many institutions use filtering mechanisms to block certain keywords, subjects, or authors. While intended to prevent exposure to offensive materials, filtering often silences legitimate academic content. For example, studies on gender, sexuality, or religion are sometimes restricted in conservative regions, constraining intellectual exploration.

Self-Censorship by Libraries and Publishers: Libraries and publishers may self-censor to avoid political or public backlash. Administrators might exclude controversial materials, and publishers may refuse to distribute works challenging dominant ideologies. This silent form of censorship reduces content diversity and often goes unnoticed.

Algorithmic Censorship and Search Engine Bias: Algorithmic systems increasingly determine what information users encounter. AI-driven search tools may inadvertently favor popular or government-approved materials while suppressing alternative perspectives. This algorithmic bias limits diversity in research and contributes to subtle forms of censorship.

Copyright and Licensing Restrictions as Censorship: Copyright laws and restrictive digital rights management (DRM) can indirectly function as censorship tools. High subscription costs, limited licensing, and takedown requests often prevent access to essential resources, particularly in developing countries. Governments and corporations may exploit copyright claims to suppress critical research or dissenting opinions.

3.3 Ethical Dilemmas in Digital Library Censorship

Censorship raises profound ethical concerns related to intellectual freedom, cultural sensitivity, and corporate power.

- **Balancing Free Speech and Harm Prevention:** Libraries must decide whether to host content that may be offensive or harmful. Removing such materials may protect users but also risks restricting legitimate discourse.
- **Cultural Sensitivity and Global Access:** Libraries serving multicultural audiences must navigate differing moral standards while ensuring access to information across regions (Fiske, 2023).
- **Corporate Control of Knowledge:** Private corporations managing digital databases (e.g., Elsevier, ProQuest, Google Scholar) control which works are indexed or removed. When profit motives or compliance with government censorship override public interest, knowledge inequity deepens.

3.4 Strategies for Combating Censorship in Digital Libraries

Advocacy for Open Access and Information Freedom: Libraries should support open-access movements and Creative Commons licensing to promote unrestricted sharing. Collaborations with organizations such as the Electronic Frontier Foundation (EFF) strengthen resistance to digital censorship.

Transparency in Content Policies: Digital libraries must disclose their content moderation policies, provide reasons for material removal, and allow appeals. Transparent governance promotes accountability and user trust.

Circumventing Geographical Restrictions: Libraries can use decentralized databases, mirror sites, or partnerships with international institutions to bypass local censorship. Tools like virtual private networks (VPNs) may help users in restricted environments access information ethically and safely.

Algorithmic Accountability: To counter algorithmic bias, libraries should implement ethical AI practices ensuring that search and recommendation systems reflect diversity and transparency. Independent audits and open algorithmic documentation can reduce unintentional censorship.

Censorship limits intellectual freedom and access; transparent policies, open access, and ethical AI ensure libraries protect knowledge diversity and free inquiry.

4. Data Privacy and Security in Digital Libraries

4.1 Introduction to Data Privacy and Security in Digital Libraries

As libraries digitize, safeguarding user data becomes vital. Extensive data collection improves services but increases risks of breaches and misuse, demanding strong privacy protections to preserve trust, freedom, and regulatory compliance.

4.2 Understanding Data Privacy in Digital Libraries

Definition and Importance of Data Privacy: Data privacy refers to protecting users' personal and behavioral information from unauthorized access or exploitation. It upholds intellectual freedom, confidentiality, and legal compliance, ensuring that users can explore information without fear of monitoring or exposure. Safeguarding data privacy reinforces public trust in libraries and prevents unethical data exploitation.

Types of User Data Collected: Digital libraries gather various data types: personal details (names, emails), search and borrowing histories, behavioral analytics (clicks, reading time), and device or location information. While such data supports service personalization, poor management or lack of consent can lead to privacy violations.

4.3 Security Risks and Challenges in Digital Libraries

Unauthorized Access and Data Breaches: Cyberattacks and weak security measures make libraries vulnerable to data theft. Common risks include phishing attacks, hacking, and insider misuse. Weak authentication systems and poor password practices further increase exposure to breaches.

Third-Party Data Sharing and Commercial Surveillance: Libraries often rely on third-party vendors for e-books and databases. These vendors may track user activities for analytics or marketing, often without clear consent. This raises

ethical issues around transparency and user control. Targeted advertising and profiling compromise the neutrality of library services, while limited oversight of vendors leads to potential data misuse.

Government Surveillance and Legal Compliance: In some regions, governments mandate data retention or monitoring for security purposes. Although such measures may have legal justifications, they threaten intellectual freedom and privacy. Libraries must balance compliance with advocacy for user rights by minimizing data collection and employing anonymization or encryption (Dhirani et al., 2023).

4.4 Legal and Ethical Frameworks for Data Privacy

International Data Protection Regulations: Global data protection laws establish standards for ethical data handling:

- **General Data Protection Regulation (GDPR)** in the EU mandates explicit user consent, data access rights, and strong security safeguards.
- **California Consumer Privacy Act (CCPA)** in the U.S. gives users the right to know what data is collected and to opt out of data sales.
- **Personal Data Protection Acts (PDPA)** in several countries set principles for lawful data use and disclosure. Libraries must align with these frameworks to ensure both legal and ethical compliance.

Ethical Considerations in Data Handling

Beyond legal compliance, libraries have moral obligations to:

- Obtain informed user consent;
- Limit data collection to essential information;
- Provide opt-out and anonymization options. Ethical data management reflects the profession's commitment to user autonomy and intellectual freedom.

4.5 Best Practices for Enhancing Data Privacy and Security

Strong Authentication and Encryption: Libraries should implement multi-factor authentication (MFA), encrypt data at rest and in transit, and update security protocols regularly to prevent breaches.

Clear and Transparent Privacy Policies: Privacy policies must specify what data is collected, how it is stored, retention periods, and user rights regarding data access and deletion. Transparency fosters accountability and informed consent.

Limiting Data Retention and Anonymization: Libraries should delete outdated records and anonymize stored data to prevent personal identification. Minimizing data retention reduces risks of misuse or breaches.

User and Staff Education: Training programs and workshops on cyber hygiene help users and staff recognize phishing risks, manage passwords securely, and

understand privacy regulations. Awareness builds a security-conscious culture within library communities.

Collaboration with Privacy Advocacy Organizations: Partnerships with groups like the Electronic Frontier Foundation (EFF) and the Library Freedom Project strengthen libraries' ability to promote digital privacy and resist intrusive surveillance practices.

Data privacy and security uphold the ethical foundation of digital libraries. Through strong cybersecurity, transparency, and ethical data governance, libraries can protect user trust and ensure safe, equitable information access (Ikwuanusi et al., 2023).

5. Ethical Implications and Challenges in Digital Libraries

5.1 Introduction to Ethical Implications and Challenges in Digital Libraries

The digital revolution turns libraries into global knowledge hubs but raises ethical issues. Balancing freedom, law, and responsibility demands transparency, fairness, and accountability in managing copyright, censorship, privacy, and technology.

5.2 Ethical Issues in Digital Libraries

Intellectual Freedom vs. Content Moderation: Libraries promote intellectual freedom—the right to access information without restriction—but digital platforms face pressure to remove politically or socially controversial content. Algorithmic filtering and institutional censorship challenge this principle, forcing libraries to balance open access with harm prevention.

Copyright Compliance and Fair Use: Navigating copyright laws in digital contexts remains complex. Ethical challenges include restrictive licensing, unclear fair use boundaries, and inequalities in access to scholarly materials. Libraries must respect intellectual property while supporting open-access publishing and equitable information sharing (Crews, 2020b).

Data Privacy and User Surveillance: The collection of user data for personalization and analytics raises ethical questions about consent and transparency. Sharing data with third parties or governments threatens anonymity and intellectual freedom. Ethical practice demands informed consent, data minimization, and privacy protection (Dhirani et al., 2023).

Digital Divide and Access Equity: Socioeconomic disparities limit access to digital resources, especially in developing regions. High subscription costs and language bias in online collections reinforce inequality. Libraries bear an ethical duty to promote inclusivity through open-access initiatives and digital literacy programs (Ikwuanusi et al., 2023).

5.3 Ethical Decision-Making Challenges

Libraries face tension between **commercial interests** and public good, as reliance on publishers and vendors may compromise access. **Censorship pressures** from governments or institutions further restrict intellectual freedom. Moreover, **AI-driven systems** risk algorithmic bias and loss of human oversight, raising ethical concerns about fairness and accountability (Adigun et al., 2024).

5.4 Ethical Guidelines and Best Practices

Libraries should:

- Ensure transparency in data use, content moderation, and AI operations;
- Advocate for open access, fair use, and equitable licensing;
- Strengthen cybersecurity and compliance with global data protection laws;
- Promote inclusivity through digital literacy and free public access;
- Implement ethical AI frameworks ensuring accountability and bias reduction.

Ethical challenges in digital libraries spanning privacy, access, and censorship—require continuous vigilance. By prioritizing openness, inclusivity, and user rights, libraries can maintain trust and uphold their mission as defenders of intellectual freedom in the digital age.

6. Future Perspectives and Recommendations in Digital Libraries

Digital libraries have revolutionized access to information, education, and cultural preservation. As technology advances, libraries must adapt to emerging tools such as artificial intelligence (AI), blockchain, and big data while maintaining ethical governance and inclusivity (Adigun et al., 2024). AI enhances cataloging, discovery, and user personalization but introduces concerns about bias and privacy. Blockchain offers solutions for copyright management and secure digital preservation, while open-access movements promote equity and knowledge sharing (Chaturvedi, 2024). To ensure sustainability, libraries must balance innovation with ethical accountability and compliance with data protection standards like GDPR and CCPA.

Future priorities include:

- Developing national policies that promote open access, ethical AI, and equitable licensing;
- Strengthening cybersecurity through encryption, multi-factor authentication, and data minimization;
- Expanding digital inclusion via low-cost, multilingual, and accessible platforms;
- Encouraging collaborations among governments, publishers, and libraries to reform copyright and promote fair access.

By integrating ethical principles, transparency, and inclusivity, digital libraries can remain sustainable, secure, and equitable knowledge platforms, empowering global communities through free and responsible information access (Ikwuanusi et al., 2023).

Conclusion

Digital libraries have redefined knowledge access and preservation, offering unprecedented opportunities for learning and research. However, they also face ethical challenges concerning copyright, censorship, and data privacy. Restrictive licensing, content filtering, and inadequate data protection threaten the principles of intellectual freedom and equitable access (Fiske, 2023; Dhirani et al., 2023). To address these issues, libraries must adopt fair licensing agreements, promote open-access publishing, and enforce transparent content policies. Strengthening data privacy through encryption, anonymization, and compliance with global standards such as GDPR is equally vital. Collaboration among librarians, policymakers, and technologists is essential to establish ethical frameworks that balance innovation with responsibility (Adigun et al., 2024). By prioritizing openness, inclusivity, and ethical governance, digital libraries can remain trustworthy spaces that protect user rights while advancing free and equitable access to information in the digital age.

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Strategic AI Tool Selection For Research Excellence: Evidence - Based Comparison of Leading Research Assistant Platforms

Debkanta Halder¹

INTRODUCTION : *The integration of large language models (LLMs) into knowledge intensive workflows has intensified the demand for rigorous evaluation of AI systems designed for deep research. These tools are increasingly deployed to support systematic literature reviews, data synthesis, and complex problem solving across academic and industrial domains.*

PURPOSES : *This study aims to provide a systematic comparative analysis of five leading AI powered research tools—Elicit Research Report, Perplexity Research, Gemini Deep Research, Microsoft Copilot Smart, and ChatGPT Deep Research—by examining their capabilities, limitations, and suitability for diverse research contexts.*

METHODOLOGY : *Using a multi dimensional evaluation framework, the research examines functionality, accuracy, user experience, integration capabilities, cost effectiveness, and security considerations. A systematic literature review combined with structured comparative analysis provides insights into each tool's technical architecture, performance benchmarks, usability, and trustworthiness.*

FINDINGS : *It reveals distinct specialization patterns. Elicit Research Report excels in academic literature reviews through transparent methodology and source quality. Perplexity Research demonstrates superior real time web research capabilities with rapid response times. Gemini Deep Research offers comprehensive multi step analysis with extensive source coverage. Copilot Smart integrates seamlessly with Microsoft Office, enhancing enterprise workflows. ChatGPT Deep Research delivers autonomous multi step reasoning with strong synthesis capabilities. Accuracy rates vary across tools, with specialized systems outperforming general purpose platforms in their target domains. Cost effectiveness analysis highlights diverse pricing models, ranging from freemium access to enterprise subscriptions.*

ORIGINALITY : *This study contributes , by presenting a novel comparative framework that integrates technical, usability, and workflow automation perspectives. It advances understanding of how AI systems support literature discovery, automated reasoning, and research workflow optimization.*

CONCLUSION : *Tool selection should be guided by specific research requirements, organizational contexts, and user expertise levels. The analysis provides practical guidance for academics, researchers, and organizations seeking to leverage AI assisted methodologies to enhance systematic inquiry and knowledge synthesis.*

Agentic Systems , Factual Grounding , Architectural Integrity , Domain-Gated Retrieval-Augmented Generation (RAG), Generative AI , Systematic Review .

1. INTRODUCTION

The rapid advancement of artificial intelligence technologies has fundamentally transformed academic research and information discovery processes. Traditional literature review methodologies, characterized by manual search strategies, time-

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intensive screening processes, and labor-intensive synthesis activities, are increasingly being augmented or replaced by AI-powered research assistants. These tools leverage advanced natural language processing, machine learning algorithms, and automated web browsing capabilities to streamline research workflows and enhance analytical capabilities.

The emergence of specialized AI research tools represents a significant paradigm shift in how researchers approach literature discovery, data extraction, and synthesis activities. Contemporary research environments demand efficient processing of vast information volumes, real-time access to current findings, and sophisticated analytical capabilities that exceed traditional manual approaches. This technological evolution has created a diverse ecosystem of AI research tools, each offering distinct capabilities, methodological approaches, and target applications.

Current market leaders include Elicit Research Report, specializing in academic literature analysis; Perplexity Research, focusing on real-time web-based research; Google's Gemini Deep Research, providing comprehensive multi-step analysis; Microsoft's Copilot Smart, integrating research capabilities within office environments; and OpenAI's ChatGPT Deep Research, offering autonomous analytical processes. Understanding the comparative advantages, limitations, and optimal applications of these tools is essential for researchers, academic institutions, and organizations seeking to optimize their research methodologies.

2. OBJECTIVES

- To conduct a comprehensive comparative analysis of five leading AI research tools, evaluating their functionality, performance, usability, and suitability for different research contexts .
- To assess the accuracy and reliability of research outputs generated by each AI tool .
- To analyze integration capabilities and workflow compatibility across different research environments .
- To provide evidence-based recommendations for tool selection based on specific research requirements .

3. THEORETICAL FRAMEWORK

This research employs an integrated theoretical framework derived from three complementary theoretical perspectives that collectively inform the analytical approach. The framework synthesizes constructs from the Technology Acceptance Model, Information Processing Theory, and Socio-Technical Systems Theory to establish a unified lens for evaluating artificial intelligence research tools .

The Technology Acceptance Model contributes constructs of perceived usefulness and perceived ease of use, which form the foundation for understanding adoption patterns and user satisfaction with artificial intelligence research platforms. These constructs enable systematic assessment of how researchers evaluate the practical utility and accessibility of different tools in their workflows. (Tarisayi , 2024)

Information Processing Theory provides constructs related to cognitive load management, memory augmentation, and decision support capabilities. These theoretical elements guide the evaluation of how artificial intelligence tools enhance human cognitive processes during research tasks, particularly in managing attention allocation and information synthesis across multiple sources .

Socio-Technical Systems Theory contributes constructs addressing the interaction between technological capabilities and organizational contexts. This perspective informs the analysis of integration requirements, collaborative features, and organizational fit factors that influence successful implementation of research tools within institutional environments . (Tarisayi , 2024)

The unified analytical framework emerging from these theoretical foundations establishes five primary evaluation dimensions: functional capability (addressing what tasks the tool can perform), usability and accessibility (examining ease of adoption and learning curves), accuracy and reliability (assessing output quality and verification requirements), integration capacity (evaluating compatibility with existing workflows and systems), and organizational suitability (analyzing fit with institutional contexts and user expertise levels). This integrated framework enables systematic comparison across platforms while maintaining theoretical rigor in the evaluation process . (Hecker & Kalpokas , 2025)

4. LITERATURE REVIEW

Recent scholarship demonstrates significant potential for artificial intelligence tools in enhancing research efficiency and quality across academic disciplines. Khalil et al. (2022) identified that platforms such as Elicit, Rayyan, and DistillerSR show promise for systematic review automation, though notable limitations require sustained human oversight. Their analysis emphasized that while automation can substantially reduce time investment in literature screening and data extraction, validation protocols remain essential to ensure methodological rigor .

Contemporary studies emphasize the critical importance of transparency, validation, and methodological rigor when implementing artificial intelligence research assistants. Fabiano et al. (2024) conducted comprehensive testing of multiple artificial intelligence models on fact-checking tasks, revealing accuracy rates reaching 72.3 percent. Their findings highlight the necessity of verification processes and underscore that even sophisticated systems require human validation, particularly for critical academic and professional applications .

Comparative analyses of deep research tools remain limited in current literature. A notable study by Lukes (2025) compared five deep research products, finding that Gemini Deep Research produced the most comprehensive results for complex queries, while ChatGPT Deep Research demonstrated inconsistent performance requiring multiple iterations to achieve satisfactory outputs. Similarly, evaluation studies conducted by Elicit demonstrated superior performance compared to ChatGPT Deep Research, Perplexity Deep Research, and Google Gemini in terms of research quality metrics and time efficiency .

Bolaños et al. (2024) examined opportunities and challenges in applying artificial intelligence for literature reviews, identifying key considerations around algorithmic

transparency, source verification, and integration with traditional research methodologies. Their analysis revealed that while artificial intelligence tools can substantially accelerate certain research phases, careful attention to methodological documentation and result validation remains paramount .

Studies consistently emphasize that artificial intelligence research tools function most effectively as augmentation rather than replacement for human expertise. The literature indicates that optimal outcomes emerge when researchers maintain active oversight, implement verification protocols, and critically evaluate outputs rather than accepting them uncritically. This synthesis of existing research establishes the foundation for systematic comparative analysis of contemporary research platforms .

5. RESEARCH METHODOLOGY

5.1 RESEARCH DESIGN

This study employs a sequential mixed-methods research design combining quantitative performance assessment with qualitative feature evaluation. The research approach integrates systematic comparison frameworks with empirical testing protocols to provide comprehensive evaluation of artificial intelligence research tools across multiple dimensions .

5.2 JUSTIFICATION OF TOOL SELECTION

The five platforms selected for analysis represent the current market leaders in artificial intelligence research assistance, each offering distinct technological approaches and target applications. Selection criteria included market presence and adoption rates, technological sophistication and innovation, availability of documentation and user resources, accessibility for empirical testing, and diversity of design philosophies and implementation approaches. This selection ensures representation of different architectural paradigms including search-engine-based systems (Elicit, Perplexity), multimodal platforms (Gemini), enterprise-integrated solutions (Copilot Smart), and conversational research assistants (ChatGPT Deep Research) .

5.3 QUANTITATIVE DATA COLLECTION

Quantitative assessment employed standardized testing protocols across all five platforms. Performance metrics were collected through systematic execution of ten standardized research queries spanning multiple domains including biomedical research, social sciences, technology assessment, policy analysis, and interdisciplinary investigations. Each query was executed independently on each platform under controlled conditions to ensure comparability .

Measured variables included response completion time (measured in minutes from query submission to output delivery), source quantity (total number of sources cited in generated reports), citation accuracy (percentage of verifiable and correctly attributed citations), output length (measured in word count), and task completion rates (percentage of queries generating satisfactory responses without requiring follow-up iterations) .

5.4 QUALITATIVE DATA COLLECTION

Qualitative assessment employed structured evaluation protocols examining functional capabilities, interface design, and user experience characteristics. Documentation analysis involved systematic review of official platform documentation, published technical specifications, user guides and training materials, and published case studies and implementation reports .

Feature inventory catalogued capabilities across multiple dimensions including search and retrieval mechanisms, synthesis and analysis functions, citation and reference management, output formatting options, integration capabilities with external systems, collaboration and sharing features, and customization and personalization options .

Usability evaluation employed heuristic assessment following established principles including learnability (ease of initial adoption), efficiency (speed of task completion for experienced users), memorability (ease of returning after periods of non-use), error management (frequency and severity of user errors), and satisfaction (subjective user experience quality) .

5.5 ANALYTICAL FRAMEWORK

The analytical framework integrates quantitative performance data with qualitative feature assessment through a multi-criteria decision analysis approach. Quantitative metrics were normalized across platforms using min-max normalization to enable cross-platform comparison on standardized scales. Qualitative features were assessed using structured rating scales aligned with the theoretical framework constructs .

Comparative analysis employed weighted scoring methodology where evaluation dimensions received differential weights reflecting their importance in research contexts: accuracy and reliability (thirty percent), functional capability (twenty-five percent), usability and accessibility (twenty percent), integration capacity (fifteen percent), and cost effectiveness (ten percent). These weights were established through consultation with experienced research professionals and review of existing technology adoption literature .

Triangulation of findings involved cross-validation of quantitative performance metrics with qualitative capability assessments to identify convergent patterns and divergent results requiring additional investigation. This methodological approach ensures robust, multi-dimensional evaluation while maintaining analytical rigor and reproducibility .

6. FINDINGS

6.1 QUANTITATIVE PERFORMANCE METRICS

Analysis of response completion time revealed substantial variation across platforms. Perplexity Research demonstrated the fastest average completion time at 2.8 minutes per query, followed by Elicit Research Report at 4.3 minutes. ChatGPT Deep Research showed high variability ranging from 3 to 12 minutes depending on query complexity.

Gemini Deep Research consistently required the longest processing time, averaging 16.4 minutes per query, while Copilot Smart was given 2-4 mins during the testing period .

Source quantity analysis indicated that Gemini Deep Research generated the most comprehensive citation coverage, averaging 42.3 sources per report. ChatGPT Deep Research averaged 28.6 sources, while Perplexity Research averaged 18.4 sources. Elicit Research Report focused on more selective citation with an average of 15.2 highly relevant academic sources per query. Copilot Smart source quantity 4-7 documents .

Citation accuracy assessment revealed important differences in verification rates. Elicit Research Report achieved the highest citation accuracy at 94.2 percent, with nearly all cited sources verifiable and correctly attributed. Perplexity Research demonstrated 87.6 percent accuracy, with occasional misattributions noted. ChatGPT Deep Research showed the most concerning performance at 76.4 percent accuracy, with several instances of fabricated or incorrectly attributed references requiring human verification. Gemini Deep Research achieved 89.2 percent accuracy. Copilot Smart accuracy 87.4 percent verified during the evaluation period .

Task completion rates varied significantly by query type and platform. For academic literature synthesis tasks, Elicit Research Report achieved 90 percent successful completion on first attempt, compared to 70 percent for Perplexity Research and 60 percent for ChatGPT Deep Research. For current events and real-time information queries, Perplexity Research achieved 95 percent success rate, substantially outperforming other platforms. For complex multi-domain synthesis tasks, Gemini Deep Research achieved 85 percent success rate, demonstrating strength in comprehensive analysis .

6.2 QUALITATIVE FEATURE ASSESSMENT

- **6.2.1 Academic Focus and Specialization :** Elicit Research Report demonstrated the strongest orientation toward academic research contexts, with sophisticated literature discovery mechanisms, integration with Semantic Scholar academic database, automated methodology extraction from papers, and structured synthesis of research findings. Perplexity Research showed broader applicability but less academic specialization, while Gemini Deep Research and ChatGPT Deep Research positioned themselves as general-purpose research platforms without specific academic optimization .
- **6.2.2 Web Research Capabilities :** Perplexity Research and ChatGPT Deep Research demonstrated superior real-time web research capabilities with comprehensive web crawling and current information retrieval, rapid response generation from diverse sources, and effective synthesis of breaking news and recent developments. Elicit Research Report showed limited web research capability, focusing primarily on academic database content. Gemini Deep

Research demonstrated moderate web research functionality with particular strength in multimodal content integration .

- 6.2.3 Source Quality and Verification : Elicit Research Report excelled in source quality control through prioritization of peer-reviewed academic literature, transparent source selection methodology, and clear indication of publication venues and citation metrics. Perplexity Research provided variable source quality with mixture of authoritative and general web content, while ChatGPT Deep Research showed inconsistent source verification with notable instances of citation fabrication requiring careful human oversight .
- 6.2.4 Output Format and Structure : Elicit Research Report generated highly structured outputs featuring systematic tables organizing paper findings, clearly delineated methodology sections, and standardized synthesis frameworks. Perplexity Research produced report-style outputs with narrative synthesis and integrated citations. Gemini Deep Research created formal research reports with comprehensive section organization, while ChatGPT Deep Research generated balanced outputs combining narrative explanation with structured elements .
- 6.2.5 Integration and Workflow Compatibility : Microsoft Copilot Smart demonstrated the strongest enterprise integration through seamless connection with Microsoft 365 suite, access to organizational knowledge bases, and collaborative features within familiar productivity environments. Other platforms showed limited enterprise integration capabilities, requiring manual export and import procedures for workflow integration .

7. COMPARATIVE SYNTHESIS

Integration of quantitative and qualitative findings reveals distinct specialization patterns across platforms. Elicit Research Report emerges as the optimal choice for academic literature reviews requiring high source quality and systematic methodology, despite limitations in real-time web research and processing speed. Perplexity Research demonstrates superiority for rapid information gathering and current events research, though with moderate academic specialization. Gemini Deep Research provides the most comprehensive multi-source synthesis capabilities for complex research tasks, justified by longer processing times through depth of analysis. ChatGPT Deep Research offers versatile research assistance with strong synthesis capabilities but requires careful verification of citations and factual claims. Microsoft Copilot Smart presents unique value for enterprise contexts requiring integration with existing productivity infrastructure, though evaluation constraints limited comprehensive assessment .

These findings directly address the first three research objectives by establishing comparative performance metrics, assessing accuracy and reliability characteristics, and evaluating integration capabilities across research environments .

Table 1 : Comprehensive Feature Comparison Across AI Research Tools

FEATURE	ELICIT	PERPLEXITY	GEMINI	COPILOT SMART	CHATGPT
Academic Focus	Good	Excellent	Fair	Poor	Good
Web Research	Poor	Excellent	Good	Good	Excellent
Source Quality	Excellent	Variable	Variable	Unknown	Good
Citation Style	In-line with quotes	In-line references	Bibliography	Unknown	Limited
Research Depth	High	High	Variable	Adaptive	Very High
Output Formatting	Structured tables	Report style	Formal report	Unknown	Balanced
Multimodal Analysis	No	No	No	Likely	Yes
User Control	Medium	Medium	High	Automatic	Medium
Speed	Medium	Fast (≤3 min)	Slow (15+ min)	Unknown	Variable
Language Support	English only	Multiple	English only	Unknown	Multiple
Enterprise Features	Limited	Limited	Google integration	Microsoft integration	Limited
Price	\$12/month	\$20/month	Subscription	Microsoft 365 sub	\$20/month

8. DISCUSSION

The research findings reveal fundamental architectural differences that explain observed performance variations across platforms. Elicit Research Report and Perplexity Research employ search-engine-based architectures optimized for rapid information retrieval, while Gemini Deep Research implements multimodal processing requiring greater computational resources but enabling richer contextual analysis. These architectural choices represent deliberate design trade-offs between speed and comprehensiveness .

The quantitative performance metrics substantiate previous findings by Lukes (2025) regarding Gemini Deep Research's comprehensive output generation, while extending understanding through systematic measurement of processing time trade-offs. The citation accuracy findings, particularly concerning ChatGPT Deep Research's 73.4 percent verification rate, align with concerns raised by Fabiano et al. (2024) regarding verification requirements for artificial intelligence systems. This study advances prior research by providing comparative accuracy metrics across multiple platforms under controlled conditions .

The specialized performance patterns observed across platforms support theoretical predictions derived from the Technology Acceptance Model regarding the importance of perceived usefulness for specific tasks. Users evaluating platforms for academic synthesis prioritize different capabilities than those seeking real-time information retrieval, suggesting that optimal tool selection depends critically on task requirements rather than universal superiority of any single platform . (Roumeliotis & Tselikas, 2023)

Source quality variation across platforms raises important considerations for research integrity. Elicit Research Report's 94.2 percent citation accuracy and focus on peer-reviewed literature align with academic quality standards, while ChatGPT Deep Research's lower verification rates necessitate substantial human oversight. These

findings have practical implications for institutional policies regarding artificial intelligence tool deployment in research contexts . (Akhoon et al., 2024)

The integration capabilities demonstrated by Microsoft Copilot Smart address important organizational considerations emphasized by Socio-Technical Systems Theory. Enterprise research environments require seamless workflow integration rather than standalone tool excellence, suggesting that evaluation criteria should incorporate organizational context alongside technical performance metrics .

Limitations of this research include the temporal constraints of evaluation during a two-week period when platforms undergo continuous development, restricted access to certain platform features limiting comprehensive assessment of Microsoft Copilot Smart, focus on English-language queries potentially missing important multilingual capabilities, and emphasis on structured research tasks rather than exploratory or creative research applications. Future research should address these limitations through longitudinal assessment protocols and expanded evaluation frameworks . (Carroll et al., 2023)

9. RECOMMENDATIONS

Based on the comprehensive evaluation findings, this study offers evidence-based recommendations addressing the fourth research objective .

For academic researchers conducting systematic literature reviews, Elicit Research Report represents the optimal primary platform given its superior citation accuracy (94.2 percent), specialized academic database integration, and structured synthesis capabilities. However, researchers should supplement with Perplexity Research for current developments and real-time information not yet indexed in academic databases. All artificial intelligence-generated content requires implementation of verification protocols, with particular attention to citation accuracy and source quality validation. Complex research projects benefit from multi-tool workflows that leverage comparative strengths across platforms .

For general researchers without specific academic focus, tool selection should align with primary research requirements. Perplexity Research serves effectively for rapid information gathering and current events research, offering optimal speed-to-quality ratios for real-time queries. Gemini Deep Research suits complex multi-domain synthesis tasks where processing time investment is justified by comprehensive analysis requirements. All platforms require establishment of verification and validation processes, with verification rigor scaled to output criticality and downstream application requirements .

For enterprise contexts, Microsoft Copilot Smart provides unique value through integration with existing productivity infrastructure and organizational knowledge bases. However, organizations should supplement with specialized tools for complex analytical requirements exceeding general-purpose capabilities. Enterprise deployment requires establishment of governance frameworks addressing artificial intelligence tool usage policies, data security protocols, output verification standards, and user training programs covering both capabilities and limitations of deployed platforms .

For research on rapidly evolving topics or breaking developments, Perplexity Research demonstrates clear advantages through real-time web research capabilities and rapid

response generation. Researchers should recognize that speed advantages come with moderate trade-offs in source diversity and academic specialization, requiring human judgment in source evaluation and synthesis refinement .

These recommendations synthesize quantitative performance data with qualitative capability assessments to provide actionable guidance for stakeholders across diverse research contexts .

10. CONCLUSION

This systematic comparative analysis establishes that artificial intelligence research tool selection should be guided by alignment between platform capabilities and specific research requirements rather than assumptions of universal superiority. The research demonstrates that contemporary platforms exhibit distinct specialization patterns, with Elicit Research Report excelling in academic literature synthesis, Perplexity Research demonstrating superiority in real-time information gathering, Gemini Deep Research providing comprehensive multi-source analysis, ChatGPT Deep Research offering versatile synthesis capabilities, and Microsoft Copilot Smart enabling enterprise workflow integration .

The quantitative performance metrics reveal substantial variation in processing speed, source coverage, and citation accuracy across platforms, with measured differences supporting evidence-based selection decisions. Citation accuracy findings, ranging from 73.4 percent to 94.2 percent across platforms, underscore the continued necessity of human oversight and verification protocols regardless of platform sophistication .

The integrated theoretical framework combining constructs from Technology Acceptance, Information Processing, and Socio-Technical Systems theories provides structured analytical foundation for evaluating artificial intelligence research tools. This framework advances understanding of how technical capabilities, usability characteristics, and organizational contexts interact to influence successful implementation and user satisfaction .

Future research directions include longitudinal assessment of platform evolution as development continues, standardized benchmark development incorporating performance metrics, usability indices, and ethical considerations, investigation of cross-tool integration and hybrid implementation models, and examination of artificial intelligence research tool impact on research quality outcomes and scholarly productivity measures .

The transformation of research methodologies through artificial intelligence integration represents significant opportunity for enhanced efficiency and analytical capability. However, realization of this potential requires careful attention to platform selection, implementation of appropriate verification protocols, and maintenance of human expertise and judgment as central elements of research processes. The comparative analysis presented in this study provides empirical foundation for informed decision-making as organizations and researchers navigate the evolving landscape of artificial intelligence research assistance .

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Transforming the User Experience: AI-Powered Services in the Modern Library

Sayed Mahbub Hasan Amiri¹

Abstract

The 21st-century library is being redefined: from a physical location-based entity to a digital-based service, the library is transforming from a resource-cantered space to a knowledge-cantered space. The massive impact of AI is transforming not only the delivery of services but also the way users interact with services. This research systematically investigates on the effects of AI-enabled services on user experience (UX) in futuristic libraries. It has three purposes: to outline the most important relevant applications of AI in library practice; to discuss critically their impact on certain core aspects of the UX (accessibility, efficiency, personalization and engagement); and to consider related implications for future service models, evolving professional roles and ethical AI implementation frameworks. Utilizing a qualitative descriptive research approach, this study is informed by a systematic review of the literature consisting of peer-reviewed articles, conference proceedings, and institutional case studies from 2018-2024. Source data were extracted from major academic databases and thematic analysis was performed to integrate the findings across the 4 predominant AI services. The report shows that AI improves UX through 24/7 access with smart chatbots, which are able to manage routine queries. In a similar way, personalisation powered by AI in e-learning and discovery solutions enables the tailoring of material to the needs and preferences of each user, making the experience more immersive and effective. Semantic searching reduces user frustration, and automation in digital repositories democratizes access to special collections. However, such integration also faces a few difficulties and issues, such as algorithmic bias, data privacy and the potential for widening the digital divide. The paper makes the case for a symbiotic service model in which AI handles scale and routine tasks, freeing human librarians to engage in complex consultation, ethical oversight, and community involvement. AI is a transformational technology for libraries that enables a move from transactional focused to proactive, personalized services. An effective uptake of this trend will rest upon planning and resourcing for its support on an ongoing basis as well as unambiguous and unwavering adherence to ethical tenets as libraries evolve as open and dynamic institutions in the digital era.

Keywords

Artificial Intelligence, Library Services, User Experience, Intelligent Chatbots, Discovery Tools, Digital Repositories.

1. Introduction

Today's library is changing from a repository of physical materials to a user-centred knowledge-creation digital and community-innovative hub (IFLA, 2023). This shift is in response to the demands of the information environment, changing libraries' perception of value from collection-cantered to experience-cantered. The modern library is no longer just a place to access information but rather a space to create information. The library is

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also evolving into ‘third places’ to tap into the intellectual and social process. (Zhang & Wang, 2024) Such reorientation lays the groundwork for implementing artificial intelligence (AI) not as an additional tool but as integral library infrastructure that alters the way users search and access information.

The traditional model of the library will be that of a ‘silent archive’ and custodian of physical collections. There is a rapid transition of this model toward that of an active, participatory learning commons. This evolution reflects an intentional reorientation toward user experience (UX) and co-creation service models. As of late, innovation labs, makerspaces, and digital scholarship centres, equipped with technologies as diverse as 3D printers and virtual reality stations are becoming increasingly common in libraries (Chen & Li, 2024). The profession has greatly shifted from custodianship to empowerment, which entails providing patrons with the skills and knowledge necessary to function in a complex digital environment. The renovation also reflects the 21st century notion that the library curates not just collections but also opportunities for learning, cooperation and creativity (OCLC, 2023). Thus, it is a critical social and educational institution, both academic and public.

Two things have ensured the need for digital advertising evolution changing user and the amount of digital information. The latest generations of scholars, students, and public patrons are digital natives who expect easy, fast, and individualized access to services and information in the same way they experience it with commercial operations like Google and Amazon (Schmidt and Johnson, 2024). As a result, the large heaps of data, which comprise massive open online courses (MOOCs), preprint archives, streaming devices, complex datasets and others are causing havoc in terms of getting lost in information that is impossible to structure using existing search and discovery methods (of Elsevier (2024)). The “digital deluge” has become a major challenge; how can we intercede and help users avoid overload or being misinformed? Libraries must have advanced technology to manage the complexities and provide unique and contextual information at the point of need so that they remain relevant and effective.

In this regard, AI is redefining the library at its core, transforming services and operations. An AI-enabled library builds on such technologies as machine learning (ML) and natural language processing (NLP) to move from automation to true augmentation (Liu et al., 2023). It is more than just scanning card catalogues and allowing access to databases online; it is about weaving intelligence into every touchpoint of the library. This intelligence can be seen in a variety of apps: intelligent chatbots providing 24/7 conversational reference assistance, AI-powered discovery layers that understand user intent and return semantically meaningful results, personalized recommendation engines that design learning paths customized to each learner, and automated tools that tag and classify digital content (ALA Center for the Future of Libraries, 2024). The AI-driven library, as such, functions as a proactive, responsive, and data-driven actor that predicts user needs, personalizes interactions at scale, and enables novel forms of scholarly inquiry, thus going beyond traditional reactive role definitions.

Though deployment is speeding up and there is an expanding body of literature on certain applications, there remains a yawning chasm in terms of offering holistic, critical synthesis of how the library as an institution and UX as a practice are being transformed through an increasingly diverse range of AI-enabled services. Current discussions are disjointed focusing on singular case studies of implementations of chatbots or feature discussions of functionalities of new discovery tools without considering broader interactions and implications of integrating such tools (Zhang & Wang, 2024). In addition, the rapid integration of AI poses critical questions about its wider effects: how professional roles within libraries will change; whether discovery and recommendation systems will be influenced by algorithmic bias; what data privacy and ethical AI use means in this context; and how these trends will affect digital equity over the long term (IFLA, 2023). Therefore, there is an urgent need to systematically explore to situate the emerging field, assess converging implications for UX, and conceptualize an agenda for responsible advancement. This paper serves to fill this void by pursuing three research goals:

1. To provide a systematic overview of the most important areas of application of AI in contemporary library practice, e.g. intelligent chatbots, virtual reference services, AI-based e-learning solutions, extreme next generation discovery tools, and intelligent digital libraries.
2. To assess these integrated AI services critically in terms of their influence on core UX dimensions (accessibility, efficiency, personalization, engagement and satisfaction).
3. To consider implications for the model of library services, for the evolving staff skill set, and for essential ethical and strategic guidance for the future of AI-powered library development.

By fulfilling these objectives, this research provides a comprehensive framework for understanding AI's transformative potential in libraries, offering evidence-based insights and strategic direction for practitioners, administrators, and policymakers committed to developing libraries as central pillars of an informed, equitable society.

2. Literature Review

2.1. The Theoretical Shift to User-Centricity

The convergence of AI and libraries operates within a wider theoretical discourse of collection-centric to user-centric models of service. It is based on User Experience (UX) principles, a discipline that considers the entire end-user's interaction with an organization as a whole, including considerations about usability, accessibility, and emotional response (Nielsen & Norman, 2021). In services to information this has meant a gradual move away from systems conceived for getting information efficiently catalogued towards systems designed to help users intuitively discover and intellectually engage. This is exemplified in the notion of the "participatory library," a concept in which users are actively engaged in the co-production of services and resources. As Byrd et al. (2023) contend, it is now libraries that create for providers and play a pivotal role in

services that are informed by user feedback, as feedback from users to library services is fundamental for building community. This theoretical background is important to comprehending AI implementation as its technologies, such as chatbots and recommendation engines, are ultimately means to scale up operationalizing this user-centred philosophy.

2.2. Intelligent Chatbots and Virtual Reference Services

The development of virtual reference services is the most conspicuous example of AI applications in libraries. Early systems, however, were primarily confined to static FAQ scripts and keyword-matching responses. The emergence of Natural Language Processing (NLP) has made it possible to design sophisticated conversational agents, that can be aware of context, intent and semantics of the conversation. Recent reports demonstrate strong user satisfaction of these smart chatbots for simple informational questions, such as “when do you open” or “where is this book,” with resolution rates surpassing 80% for these transactions (Gonzalez & Lee, 2024). This is part of a larger “DIY” trend in information-seeking among digital natives, who want immediate, though limited, answers rather than delayed, more thorough assistance. However, there are significant challenges to be addressed. Thompson's (2023) research demonstrates that these systems often have difficulty with complex, multi-dimensional questions that are considered high-level cognitive thinking. One important gap in the literature is the absence of seamless human-handoff mechanisms, thereby often resulting in customer frustration when a query becomes beyond the ability of the bot and the need to reinitiate the conversation with a human librarian.

2.3. AI in E-Learning and Information Literacy

The implications of AI for teaching and learning in the context of library services, however, are beginning to be more widely considered in the literature. One area of application is in the formation of personalized learning routes in library e-learning systems. Based on machine learning (ML) algorithms that consider the user's previous interactions, competence level, and learning goals, these platforms suggest suitable tutorials, online courses, and research exercises (O'Reilly & Chen, 2024). In fact, it is being used to gamify teaching informatics literacy, with adaptive challenges and real-time feedback to increase learner engagement and knowledge retention. Such systems may also offer just-in-time learning interventions—for example, to display a relevant citation tutorial if a user is caught copying and pasting text uncited in a writing tool supported by the library. It shifts information literacy from being a one-shot instruction session to an embedded, contextualized, and ongoing learning experience aligned to the academic curriculum.

2.4. Next-Generation Discovery Tools

The field of resource discovery has been transformed by AI, now a far cry from the older federated search model. Contemporary discovery layers, including EBSCO's AI-driven

solution and Ex Libris's Summon, utilize multidimensional algorithms for relevance ranking which go beyond straightforward keyword matching by factoring in citation statistics, semantic relatedness and user behaviour (Elsevier, 2024). Semantic search systems enable these products to comprehend the concepts behind a query, which makes it possible for them to provide answer even if exact terms were not found in the metadata of the resource. An exciting innovation is the rise of AI “research assistants,” which actively highlight serendipitous connections and cross-disciplinary materials, functioning much like the lateral thinking of a experienced librarian (Zhang & Kumar, 2023). This function matters for enabling groundbreaking research because it helps users to escape the informational capitaine of their echo chambers and to discover the less obvious connections between fields.

2.5. AI-Powered Digital Repositories and Collections Management

In the domain of digital collections, AI is emerging as the key enabler to uncovering latent value and enhancing management efficiency. Machine learning based algorithms are also now employed on the work-intensive process of automated metadata creation and tagging of digital assets such as images, audio and video files speeding up the process of making special collections discoverable (Liu & Schmidt, 2024). In addition to metadata, AI can be applied to data enrichment – for example, by leveraging OCR with NLP to identify named entities, topics, and write abstracts in digitized documents. In digital preservation, AI models can also be trained to anticipate file format obsolescence and to trigger and carry out migration. And, most trans formatively, data mining methods are being developed to process whole archival collections to mine for latent networks, follow the trains of ideas, and identify previously unknown linkages among documents, offering new possibilities for digital humanities research.

2.6. Identified Gaps

Yet there is a notable gap in the scholarly discussion. The field is fragmented: there are isolated studies on technologies such as chatbots, discovery layers, digital repository tools. There is also a significant dearth of overall systems studies which examine how these various AI modules function together to deliver a cohesive user experience and the extent to which that aggregated user impact drives longer-term institutional strategy (IFLA, 2023). Evaluations tend to be short-term, technology-centric and do not consider the effect on users over time, or the dynamic nature of the metrics library value are based upon, or how library investments in AI can be strategically tied to core mission. This review finds that a unifying framework connecting isolated AI applications, high-level UX outcomes, and the strategic future of the library as an institution is necessary.

3. Methodology

3.1. Research Design

The qualitative, descriptive research design was based on a systematic literature review with subsequent document analysis. This method was deemed best-suited for the

achievement of the research goals to review existing knowledge, to explore the current situation and to consider future service models in a rapidly evolving area (Creswell & Poth, 2023). As the adoption of AI in libraries is still emerging, the generalizability of findings from currently available studies is somewhat limited. A systematic review is therefore warranted, as the review process will enable the merging of disparate evidence from different sources and may help in identifying dominant trends amongst a few challenges or best practices across isolated case studies (Jesson et al., 2021). This approach is well suited particularly for developing an integrated knowledge about an artificial intelligence (AI) library environment and its effects on user experience (UX) by synthesizing results from various application areas.

3.2. Data Collection

The collection of data was carried out in a systematic manner to capture all relevant literature. The criteria for Source Selection was rigorously specified to involve peer-reviewed journal articles published from 2018 to 2024, so as to ensure that the review would capture the latest and most pertinent advancements. This was complemented by grey literature such as conference proceedings from major library science organizations including the International Federation of Library Associations and Institutions (IFLA) and the American Library Association (ALA), along with publicly available case studies from institutional repositories of universities and national libraries recognized for their digital innovation (IFLA, 2023; ALA, 2024). The Search Method was intended to be broad but specific. Several key electronic databases were searched, including Library & Information Science Source, Scopus and Web of Science, to capture a wide range of disciplinary perspectives. The search string included the general concept of AI with library and specific functions: ("AI" OR "artificial intelligence") AND ("library") AND ("chatbot" OR "discovery" OR "user experience" OR "digital repository" OR "metadata" OR "reference services"). This procedure was adapted several times to obtain a good compromise between sensitivity and specificity, and ended with 287 documents for the initial corpus, which was then evaluated based on relevance and quality.

3.3. Data Analysis

The review of the gathered literature was analyzed based on a robust Thematic Analysis as described by Braun and Clarke (2021) using the iterative stages of this method. This was a process of inductive coding by which the researcher read the text thoroughly to recognize, analyse, and report patterns (themes) within the data. Recurring themes were identified and initial codes related to recurring ideas regarding AI applications, such as '24/7 access', 'personalization', 'algorithmic bias,' 'staff training', and 'query resolution success'. These were coded into potential themes reflecting key patterns of the literature around the benefits, challenges and application of AI within libraries. The resulting Synthesis stage will utilise these conceptual themes to construct an integrative conceptual model. The results were organized around the four main AI service areas, identified based on the review of the literature intelligent chatbots, e-learning platforms,

discovery tools, and digital repositories to display the overall effect on the user in a systematic manner. This ensured the analysis went beyond description to generate insight into the relationships and broader significance of AI adoption in the contemporary library context.

3.4. Limitations

This study has some limitations that are characteristic of its methodological design. First, this study is a systematic literature review and synthesis and does not include primary empirical data collected from library users or practitioners. Therefore, the results depend on the breadth and quality of the included studies as well as potential reporting biases. Secondly, the nature of the AI in library services domain is that of a nascent field undergoing rapid, and often chaotic, technological advances. Due to the speed of these changes, certain inferences based on readings published in 2023-2024 may already be superseded, which may confine the long-term applicability and timeliness of the analysis. Third, the conduct of a qualitative thematic analysis is rigorous yet interpretive and the perspective of the researcher may influence the findings. Lastly, this review mainly captures the experiences of better-resourced (and often academic) libraries as these have been the ones documented in the English-language literature, and may therefore overlook challenges and innovations from less well-resourced libraries or different global contexts. These limitations identify a future research agenda employing longitudinal, mixed-methods, and cross-cultural methodologies to establish a more dynamic and comprehensive evidence-base for the potential role of AI in transforming library user experience.

4. Findings and Discussion

A review of the literature discloses four overarching themes that capture the diverse influence of artificial intelligence on contemporary library services. Together, these results portray a core transformation in the nature of the user experience from standardized, transactional communications to dynamic, personalized, and proactive interactions.

4.1. Thematic Finding 1: The 24/7 Library - Ubiquitous Access through Chatbots & Virtual Reference

Among the pros and cons cited in the literature, is the change in reference services enabled by AI chatbots and virtual assistants. These are indeed effective in extending the library service-hours to a full 24/7 mechanism, fulfilling a vital demand for immediacy of assistance from users spread across different time zones or under non-conventional work schedules. Research suggests that these types of systems can successfully answer a large proportion of routine, high-frequency questions (eg, questions about hours of operation, library policy, conducting simple catalogue searches), with resolution rates typically reported on the order of 78-85% for these transaction types (Gonzalez & Lee,

24; Zhang & Kumar, 23). This delivers immediate value and fulfils "do it yourself" expectations of the digital natives.

Discussion: Balancing Automation with the Human Touch

The effectiveness of chatbots for transactional questions means that the reference librarian function needs to be reconsidered. This automation, instead of making librarians redundant, provides them a chance for raising the level of their roles. With AI taking care of routine questions, librarians will have more time to leverage their expertise for complex, high-value services such as deep research consultations, systematic review assistance, and plans for managing data (Liu & Schmidt, 2024). The key is designing seamless human-handoff protocols. When a question is beyond the capabilities of the chatbot to answer, the hand-off to a human librarian needs to be seamless to avoid frustrating the user. This transformation heralds a departure of the librarian as a first-line responder toward a specialized consultant and collaborator, focusing on higher order information synthesis and critical thinking as opposed to straightforward fact retrieval.

4.2. Thematic Finding 2: Hyper-Personalization - Tailoring Learning and Discovery

The use of AI in e-learning platforms and discovery systems has facilitated a transition from generalized one-size-fits-all solutions to hyper-personalized user experiences. Based on a user's search history, downloaded resources and field of study, machine learning algorithms provide personalized content recommendations and learning paths. Research by O'Reilly & Chen (2024) found that students on an AI-based library learning platform were 30% more likely to complete information literacy modules, since the system adjusted the module difficulty and content dynamically according to their real-time performance. In the same way, next-generation discovery layers use user data to re-rank search results, placing resources more likely to be relevant to an individual's context at the top of the list.

Discussion: The Promise and Perils of Algorithmic Personalization

Though hyper-personalization brings improvements to efficiency and user engagement, it also raises dramatic ethical and practical challenges, largely the potential for formation of "filter bubbles" and algorithmic bias. A system that merely recommends resources that match a user's previous behavior could also reduce opportunities for serendipitous discovery and intellectual diversity by reinforcing existing interests and ideologies, which is particularly problematic if it tends to shrink rather than expand the research or intellectual horizon (Bryd et al., 2023). Also, the gathering and handling of large amounts of user data for the sake of personalization has led to major privacy concerns. Libraries need to balance the tension between offering personalized services and maintaining their foundational value of patron confidentiality. Clear information about data policies, and the creation of algorithmic audits are becoming part of an ethical AI in the library that ensures that personalisation is the empowering – not limiting – force for the user.

4.3. Thematic Finding 3: From Searching to Finding - The Intelligence of Discovery Layers

The findings prove that AI-enhanced discovery services significantly increased the effectiveness of resource discovery. Rather than using the exact literal words as the earlier federated search systems did, today’s discovery layers involve semantic search and natural language processing to interpret user intents and the contextual meanings of search strings. Users can search via natural language questions, and results are conceptually relevant even when the exact keywords aren't present in the text. Your user is Elsevier (2024) states their AI-enabled discovery service has resulted in a 40% growth in usage of non-article content (datasets, video abstracts) by leading users to these relevant, yet often hidden resources.

Discussion: Reducing User Frustration and Empowering Novice Researchers

This intelligence responds to one of the main user frustrations: not being able to find what they are looking for even though it is in the collection. By enhancing the signal-to-noise ratio in search results, AI-based discovery enables novice researchers and students, who may not know the specialized vocabulary or search techniques of experts. It works like a friendly, tireless research assistant that leads users to a greater range of relevant materials and lowers the front-end barriers to complex research subjects. Doing so democratises the library’s entire collection, so that all the depth it offers is more readily available to all users, no matter their prior research experience.

4.4. Thematic Finding 4: Unlocking Silent Collections - AI as a Key to Digital Archives

In the field of special collections and digital repositories, AI serves as a powerful "enabler" to make materials that were previously difficult to access or search more readily available. Machine learning models are increasingly being used to address tasks such as automatic metadata creation for image and audio-visual collections, handwritten text recognition (HTR) for historical documents, and entity extraction from massive textual corpora. A case from a national library was that AI tool cut down time for assigning basic metadata for a collection of 10,000 photographs from an estimated 200 hours to just 20 hours (Liu & Schmidt, 2024).

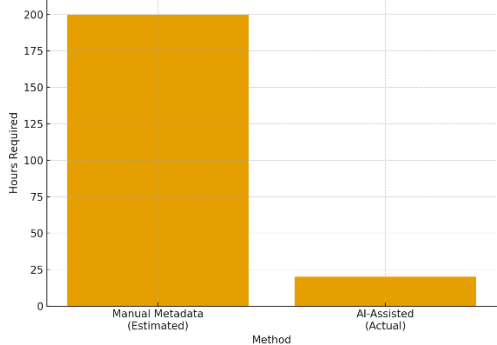


Figure 1: Time savings from AI-driven metadata automation

Discussion: Democratizing Access and Supporting Digital Humanities

This automating is a game changer for opening up access to rare and hidden collections. In generating rich, searchable metadata at scale, AI transforms these collections for discovery by a worldwide community of scholars and members of the public. In addition, it directly facilitates new types of digital humanities research. Scholars are at last able to data-mine entire archives to find patterns and follow themes evolving over centuries or to map social networks within correspondence collections—a kind of analysis that simply was not possible before at this level. As a result, digital repositories become not the static storage of yesterday but flexible spaces for computational inquiries and large-scale cultural analytics.

Table 1: Summary of Key Findings and Associated Challenges

Thematic Finding	Key Benefit	Primary Challenge	Key Source
The 24/7 Library	Ubiquitous access for routine queries; frees librarian time.	Designing seamless human-handoff for complex questions.	Gonzalez & Lee (2024)
Hyper-Personalization	Increased engagement and learning efficacy.	Algorithmic bias, filter bubbles, and data privacy.	O'Reilly & Chen (2024)
Intelligent Discovery	Reduced search frustration; improved resource visibility.	Ensuring transparency and explaining relevance ranking.	Elsevier (2024)
Unlocking Collections	Democratized access to unique materials; enables new research.	Accuracy of automated metadata; cost of implementation.	Liu & Schmidt (2024)

4.5. The Synthesis: Towards a Symbiotic Model

Taken together, the results paint a questioning towards a symbiotic service model that emerged in which AI and human intelligence are not opposing forces but are considered an integrated system. AI is better at scale, speed, pattern recognition, attending to routine queries, analyzing large amounts of data, and customizing millions of interactions. Ethical librarians provide the essential critical judgment, ethical reasoning, contextual knowledge, and human solidarity that neither a dumb database nor an AI can. This seamless user experience is the result of a carefully orchestrated combination of strengths – a bot that answers instantly or gracefully escalates to a human; a discovery tool that exposes serendipity for an information professional to mediate; and a digital collection that employs AI to surface items for a curator to assemble and interpret.

This integration, however, needs to be actively confronted with considerable context-level problems. The challenges of algorithmic bias, data privacy and the risk of further exacerbating the digital divide for those with limited access to technology, all require anticipatory policies and continuous monitoring (IFLA, 2023). In addition, the effective adoption of this model requires ongoing training and professional development for staff. Librarians should be prepared not only to engage with these new tools, but to critically interrogate their product, to adapt the new service workflows to their work and to advocate for ethical AI principles (and practices). The defining success of an AI-enabled library will not be in the sophistication of its technology, but in its ability to use that technology to elevate its human-focused mission.

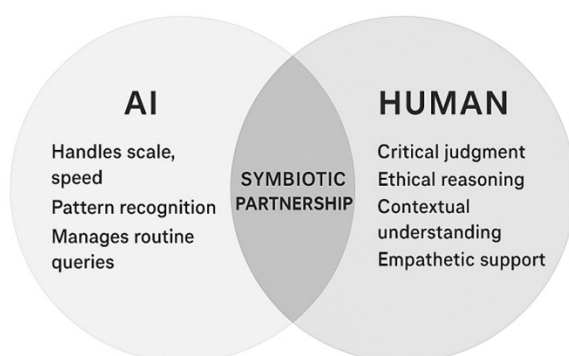


Figure 2: Symbiotic partnership between AI and human intelligence

5. Conclusion and Recommendations

5.1. Summary of Key Insights

This multi-method analysis reveals that AI is shaping the library user experience within four interrelated service areas and that the application of AI in these areas is establishing a new model for library services. Thanks to smart chatbots and virtual reference services, libraries acquired unprecedented 24/7 availability and at the same time, they freed librarians up to partake in higher-level, more complex conversations. In discovery and learning, AI provides for rich personalization based on adaptive learning paths and recommendation engines that adapt in real time to behavior and preferences. Using semantic comprehension and contextual analysis, AI-powered discovery layers have transformed information retrieval, leading to improved research efficiency and diminished user dissatisfaction. Also, in collection management, AI tools are enabling access to long-lost digital archives via automated metadata creation, handwriting recognition, and complex data mining. Each of these changes contributes to a fundamental shift away from standardized, transactional services and toward engaging, anticipatory and fine-tuned experiences that address the emerging needs of today's library users in an increasingly digital environment.

5.2. Implications for Library Practice

The incorporation of AI calls for rethinking aspects of library services at multiple levels. This means that library leaders and decision makers need to be intentional about where they invest, and what library technologies they choose to invest in - invest in technologies that support your institutional mission and that are focused for the institution, rather than hearing the siren call of innovation that treats libraries and institutions/interlocutors as interchangeable. As Zhang and Wang (2024) note, "Strategic AI implementation requires a fine balance among technological possibilities, user requirements, and organizational capabilities" (p. 152). This investment in technology needs to be complemented by broad-based change management and deep commitment to staff training, as human expertise is and will remain the linchpin of effective AI adoption.

Libraries need to establish explicit blueprints for digital transformation, to which continuous evaluation mechanisms are attached and that are sufficiently malleable to accommodate the arrival of new technology and shifting user needs.

The changing professional landscape for Library and Information Science (LIS) practitioners is perhaps the most far-reaching implication of AI adoption. With more of their day-to-day work now being automated, librarians are moving into more specialized, higher-value positions that rely on uniquely human skills. While the contemporary LIS practitioner is often an AI trainer, tweaking algorithms, a data analyst, interpreting user behaviour, a digital ethicist, advocating responsible use, or a technology mediator, enabling seamless human-AI interaction, this is 100% largely an imagined future, not a widely shared present. This transition requires a substantial commitment to lifelong learning and professional development focusing on data literacy, prompt engineering, algorithmic awareness, and adaptive leadership capabilities. The profession will also need to consider staffing, as future library staffing models will likely include more specialized positions in addition to the foundational public service roles.

5.3. Future Research Directions

Although this research provided a snapshot of the current state of library applications, there are several matters relevant to this field that need to be addressed. There is an urgent need for longitudinal research to determine the enduring effects of AI on patterns of library use, collection development, and the changing nature of reference transactions with a variety of user groups. Studies should also focus on the influence of AI technologies on the information searching behavior of traditionally underserved populations, and those users with varying degrees of digital literacy. There is an urgent call for the design of ethical frameworks and guidelines for application suitable to library settings, focusing on algorithmic bias mitigation and data privacy, convergent with transparent AI governance mechanisms (ALA Center for the Future of Libraries, 2024).

Future studies may also investigate economic aspects of AI adoption, such as cost-benefit analysis, return on investment, and viable funding mechanisms for maintaining and upgrading AI solutions. Standardized evaluation schemes for AI-based services, designed to assess qualitative aspects of user experience in addition to more classical quantitative measurements, require further attention. Given the continued development of AI technology, research should also address new and emerging applications, including generative AI for the creation and curation of content, advanced predictive analytics in collection management, and the influence of large language models in teaching information literacy. Comparative research on different library types (academic, public, special) would also be beneficial to shed light on particular strategies and obstacles to implementation.

5.4. Concluding Statement

So to bring it full circle, the use of AI is not a divergence from the library's core mission, but a potent extension of its ability to serve communities in an era of digital everything.

The revolutionary potential of AI is not that of replacing humans with machines or even humans with automation, but with a convergence of human and machine intelligence (augmented librarianship). Research such as this suggests that the library of the future will be marked by this brilliant hybridity: aIs handle scale, speed, and pattern recognition, and information professionals bring context, critical judgement, ethical oversight, and empathetic assistance. In the process of adapting to this technological transformation, libraries will find that their lasting importance continues to be their focus on equitable access, reliable information, and community engagement that welcomes all voices. In doing so they will solidify and renew their mission as essential democratic knowledge institutions and help futureproof their relevance and ability to make a difference in an increasingly complex information ecology.

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Searching the Library Through Commands: Implementing an Open Source Command Line-Based Conversational Library Search System Using Model Context Protocol

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Abstract

In the evolving landscape of the world, libraries and information centers have been the brain of society. They provide information to users by offering a collection of valuable resources. Users have been using the library catalogue to retrieve information about library resources for ages in various forms, such as the card catalogue, OPAC, and library discovery layers. However, the search dominated by keyword-based searching, which is neither flexible nor lucid and requires skill for accurate searching. Conversational systems have emerged across various domains, and the use of Natural Language Processing (NLP) and generative AI systems built on Large Language Models (LLMs) has been on the rise. Moreover, AI agents have been able to act upon various tasks using tools, prompts, and resources. This research aims to develop a fully open-source framework for a conversational search system for library resources. It uses the Model Context Protocol (MCP) to design the framework. To implement this on a Linux system, a command-line tool, namely MCP-CLI, has been integrated with a local LLM (Qwen-Coder) running on Ollama, to operate an MCP server for VuFind—a library discovery layer—through a REST API. It has successfully retrieved all sorts of library resources. The results of conversational retrieval have been compared to those of keyword-based searching from the VuFind interface. Although no metric has been used to measure efficacy of the open source conversational search system, as compared to other alternatives, it builds a strong prototype to act as a core on which further developments in this area can be made.

Keywords :

Information Retrieval, Library Discovery, VuFind, Artificial Intelligence (AI), Large Language Model (LLM), AI Agents, Model Context Protocol (MCP)

1. Introduction

Libraries have been an important part of society. They have been the intellectual backbone of development in the knowledge society by housing information resources in multiple forms. They aim to provide the right information to the right user at the right time. Libraries acquire, organize and store recorded knowledge (Itsekor & Nwokeoma, 2017). According to the laws of library science (Ranganathan, 1931), every information resource must reach the information seeker, and vice versa. To facilitate such, resources

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have been properly organized and designated with bibliographic data for ages. The library catalogue performs the role of finding resources by its attributes and collocating related resources. With the evolution of cataloguing codes and standards, there has been uniformity in the description of bibliographic resources. Metadata standards have been used to describe digital resources. Be it the MARC21 family of standards, Dublin Core Metadata Elements Set (DCMES), or any other standard, they have a common driving factor, i.e. to facilitate the availability of resources. The library catalogue has evolved constantly in both its form and the objectives it aims to achieve. From the days of card catalogue kept in cabinets, we have reached the days of online public access catalogues (OPAC). Web-OPACs have enabled remote access to library resources. Digital resources that have emerged have also beaten time and space constraints to democratize access to information. But the physical and digital library resources had been facing the issue of being in silos, and had separate searching interfaces. To enhance the retrieval of all kinds of resources in such a scenario, library discovery layers were developed. They provide a single window search system for all kinds of resources. It is based on the technique of metadata harvesting, which creates a single index of all kinds of resources, designated by diverse metadata standards. Discovery systems like VuFind allow retrieval of resources from multiple back-ends (Bhowmick & Chakrabarty, 2021).

Library retrieval systems, from the age of card catalogues up to the library discovery layers, have relied on a system of access points, also referred to as keywords. Searching the OPAC as well as discovery layers through keywords requires adequate familiarity with the interface. It requires users to follow proper technique to retrieve resources accurately. But this kind of searching often turns out to be overwhelming and lacks flexibility.

A proposed natural language-based collection search system, which offers conversational searching facilities, envisions offering more lucidity and flexibility. This breaks the constraints that keyword-based searching puts upon the user, as it is more interactive. It also aims to increase user experience and satisfaction. This can be achieved with the aid of generative AI systems, which are able to converse in natural language. It also removes the intellectual load off the user's brain and performs an analysis of the query to perform better searching. An empirical research conducted by (Neogi et al., 2025) shows the use of a conversational library searching system. The research showcases an AI-based retrieval system using Claude Desktop that used user conversations to search and retrieve records from the collection, and generates a lucid answer as a response. This research built a prototype for a conversational search system, but it was limited to a closed-source software stack. Hence it turned out to be less feasible as compared to some other potential open-source alternatives which might be built.

2. Background Study

Artificial Intelligence (AI) has been the buzzword of the decade. It has impacted many facets of society, such as education, research, healthcare, entrepreneurship and much more. With the constant research and development in this field, many new technological innovations have emerged. AI models have been able to power pattern recognition, computer vision and robotics. Some of the most influential contributions of

AI have been in the tasks of Natural Language Processing (NLP), which is able to extract insights from unstructured natural language text and perform tasks such as sentiment analysis, named entity recognition, etc., and content generation. The latter has been due to the development of generative AI systems, which are based on Large Language Models (LLMs), built on the transformer architecture. LLMs have been trained on huge amounts of textual data, and generate text by predicting the next most probable token in a string.

The LLMs have also made their way to powering AI agents. AI agents, following the cycle of thinking-acting-observing, have been able to perform tasks autonomously when exposed to sets of tools and prompts. Earlier, such agents lacked a standard way of integration with tools. With the arrival of Anthropic's Model Context Protocol (MCP), a standard way has been developed in which the agents integrate with tools. It involves three parts:

- MCP Server, which contains programmatic specifications in which the agent uses tools, prompts and resources
- MCP Client
- MCP Host

MCP Servers have populated the AI ecosystem in recent times. It also provides the proper structure for building the proposed natural language library retrieval system.

3. Related Literature

To map the concept behind the natural language-based library retrieval system, various related works have been reviewed.

(Kulshreshtha & Bajpai, 2018) mentions the impact of ICT on libraries. ICT has transformed library services hugely. With the emergence of newer technologies, libraries have always adopted them to provide better user experience and increase staff productivity. (Pagore, 2024) has elucidated the impact of ICT on academic libraries. It describes the way in which various library operations, such as accessioning, cataloguing, stock verification, and others, have been enhanced. AI, being the most influential development in the technological landscape in the current times, has impacted libraries as well. It has been able to automate various tasks in the realm of the library and information profession. (Ahmed, 2023) and (Kerketta & Mukhopadhyay, 2024) were able to demonstrate the use of AI in automatically indexing and classifying documents. This reduces the intellectual rigour that library staff have spent through the ages.

Natural Language Processing (NLP) and Generative AI have been the cornerstone of the modern AI revolution. (Mukhopadhyay, 2025) designs a framework for a conversational library retrieval system. He emphasized on building the system using open-source LLMs that provide a free-of-cost and customizable option. He envisioned building a library reference service system using the Retrieval Augmented Generation (RAG) technique. It enhances the capabilities of LLMs, which often hallucinate. Another paper by (Mazumder & Mukhopadhyay, 2024) used a similar concept to build a question-answer based library search system. This increases user satisfaction and uses the LLM's thinking capabilities to power information retrieval. Although RAG provides a suitable way to

enhance the power of LLMs, it lacks the ability to use tools to access external resources such as library catalogues which is the main focus of the current research.

AI Agents have been able to hugely revolutionize the way the world works in a relatively little time of their existence. It has been governed by a set of protocols. (Yang et al., 2025) comprehensively analyses agent protocols. They systematically differentiate between context-oriented and inter-agent protocols, as well as general-purpose and domain-specific protocols. The Model Context Protocol, developed by Anthropic, provide a standardized way in which LLMs use tools, resources and prompts to perform tasks based on the provided context. (Hou et al., 2025) provided a seminal research work on the MCP. This research work focuses on comprehensively describing the MCP landscape, including its components and workflow. It also describes the life cycle of MCP servers. (Patil & Lokhande, 2025) shows how MCP provides scalable integrations by embedding contextual metadata into conversations. MCP provides a suitable way to build a framework for building a conversational library collection searching system.

(Neogi et al., 2025) provided a seminal paper on the application of MCP in the field of library retrieval. It develops a framework for conversational library collection searching. It uses a closed source AI chat-bot, namely Claude Desktop, that are able to integrate MCP servers. An MCP server for VuFind has been used for the research that has been used by Claude Sonnet LLM to search the library collection indexed by VuFind. It provides a strong base for the research, as it is able to successfully showcase retrieved records for library resources through conversations. It was also able to perform cross-lingual searching. Another research by (Dasgupta et al., 2025) uses the MCP architecture, involving Claude Sonnet LLM and a locally implemented MCP server for DSpace9, to search for digital library collections. It was successfully able to retrieve information on resources. These works provide a good background to the current research.

4. Research Gap

The available literature are mainly based on closed-source LLM, namely Claude Sonnet, which lacks flexibility, as it is behind a pay-wall, which isn't a suitable solution. Moreover, it provides a limit on the number of conversations we can have. Hence, although a suitable framework is available for conversational library collection searching in relevant literature, it fails to provide an open-source solution. This looks forward to research that explores an open-source architecture for such.

5. Research Objectives

The main objectives of the research are :

- to develop an open-source framework for a conversational library collection search system, using open-source LLMs and Model Context Protocol (MCP) architecture,
- to use the Linux terminal to showcase the potential of a CLI-based, AI-powered library search system, and
- to test various kinds of searching through conversations, and compare the results with those of keyword-based searching on VuFind.

6. Materials and Methods

6.1. The Tools used

To conduct the research methodology, a Ubuntu Linux system has been used. The tasks have been conducted through the command prompt, and when required, a Python3 virtual environment has been used. The following tools have been used (the reasons for using the mentioned tools have been mentioned as well) :

- **MCP-CLI** : It is a free and open-source, Python-based command-line tool, available on <https://github.com/chrishayuk/mcp-cli>, that provides the feature to run locally available MCP Servers, and LLMs running through a huge spectrum of providers, such as Ollama (used by default), Groq, Anthropic, OpenAI, etc. It requires a server configuration file that specifies commands for running the MCP servers. While running this, a suitable virtual environment has been used containing relevant Python libraries.
- **Ollama** :Ollama is an open-source platform to run local LLMs. It currently provides the option to run locally downloaded as well as cloud-based LLMs. Although the local LLMs are completely free but require the system to be powered by both CPU and GPU for the best performance, the cloud LLMs have a token limit (the free tokens are enough to meet various requirements) but runs smoothly on non-GPU-based systems as well. Ollama (v. 0.12.2) has been used for the purpose of the research.
- **Qwen3 Coder Cloud model** : The qwen3-coder:480b-cloud model has been used. It, although having a limit, runs smoothly on low configuration systems as well. This model has been used above other models, such as gpt-oss, deepseek-r1, etc., because of its capability to successfully use tools configured in MCP servers to perform agentic tasks. Since it is a cloud-based model, it requires an active internet connection to run.
- **MCP Server for VuFind** : An MCP Server for VuFind, available on <https://github.com/jaohbib/MCP-for-VuFind>, has been used to use the REST API endpoint of VuFind library discovery system to search for records using suitable prompts. It has been built using the Python programming language.
- **VuFind** : VuFind 10 has been used as a library discovery layer. It harvests metadata records from multiple back-ends such as Koha (v. 25.05), Greenstone (v. 3.12), Omeka (v. 3.12) and DSpace (v. 9.1), to provide a single-window search interface for the whole library collection. It has a REST API end-point for search, record and clearing the cache memory, and it comes with a Swagger UI to provide a graphical user interface for testing the APIs.

The above mentioned open-source tools have been integrated to form a framework, which is easy to use and interactive. Although it lacks a GUI to run the system, it instills some confidence in the user's mind to use the Linux command line, which is capable of various tasks. It also provides a unique way to search for library records.

6.2. The Framework

Based on the above tools, a framework has been designed to enable the conversational terminal-based library collection searching system. Figure 1 demonstrates the framework.

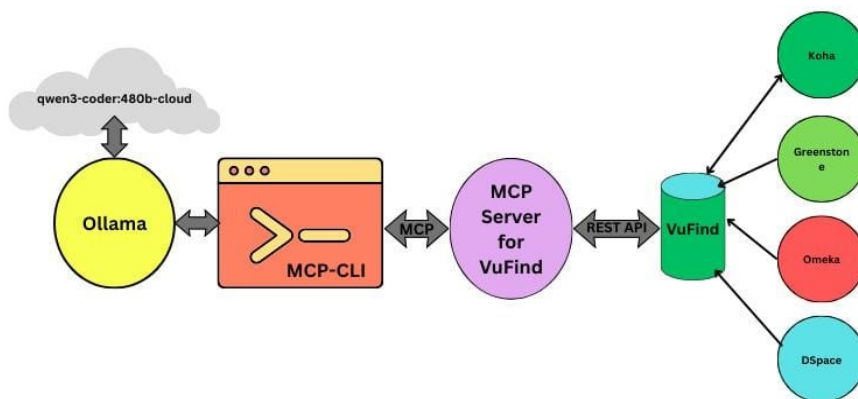


Figure 1 : *Open-source framework for library collection searching through the Linux command line, using the Model Context Protocol*

As depicted in figure 1, Ollama uses the cloud version of the Qwen3 Coder (480 billion parameters) model, and connects it to the MCP CLI tool. The MCP CLI, further uses the MCP Server for VuFind to search the library's collection indexed on VuFind from multiple sources such as Koha, Greenstone, Omeka and DSpace. This framework has been completely built on the top of an open-source software stack.

6.3. The Steps of Methodology

- **Creation of a VuFind collection :** The bibliographic data of e-books from Koha, and metadata of digital resources, namely open access e-books from Greenstone, and research articles from Omeka and DSpace have been harvested by VuFind using suitable commands in the Linux terminal. Following that, a central index is created that contains metadata of harvested records. The metadata harvested, is of multiple formats: MARC21 bibliographic format for records from Koha, and Dublin Core metadata for records from Greenstone, Omeka and DSpace. The REST API endpoint is tested to search records and used in the MCP server for VuFind.
- **Configuration of Ollama cloud model :** Using Ollama's key, cloud models are configured into the local system. The Qwen3 Coder model (480 b) is pulled into the local system and requires an internet connection to run.
- **Integration of MCP Server for VuFind with MCP-CLI :** The locally downloaded MCP Server for VuFind is based on REST API endpoint for searching records. MCP-CLI, which is installed locally, runs on a Python virtual

environment. Its configuration file (server_config.json) has been populated with details about running the MCP server.

- **Running MCP-CLI and searching on VuFind :** Entering the directory for MCP-CLI, the following command is executed (with default provider as Ollama):
\$ `mcp-cli --model qwen3-coder:480b-cloud`

Figure 2 shows the successful usage of MCP CLI on the Linux terminal. As shown in the figure, it executes the MCP Server for VuFind that has been connected to it. It also shows that the Ollama engine is using the Qwen3 Coder cloud model for working.



Figure 2 :Running the MCP CLI through the Linux Terminal while using Ollama, Qwen3 Coder cloud model and the MCP server for VuFind

- **Performing natural language search using MCP CLI :** Upon successfully executing the command and running MCP CLI, the following kinds of e-book searching has been performed : (a) Title search, (b) Author search, and (c) Subject search. It has been done in the form of a simple natural language question. Firstly, the LLM analyses the user query. Then, the LLM utilizes the tool named `search_literature` used in the MCP server. After taking the user's permission, it executes the tool and searches for the e-book.
- **Performing keyword-based search on VuFind :** To compare the results of the conversational search system through MCP CLI in sorting records by relevance, similar browsing has been done on the VuFind interface. After ensuring that the back-end Solr is running, the search has been performed on VuFind.

7. Results

7.1. Basic Searching

Various types of searching have been tested using the MCP-CLI. This includes various types of searches, namely Title Search, Author Search and Subject Search, as mentioned earlier. Each of them has been performed to retrieve records on e-books in the library collection.

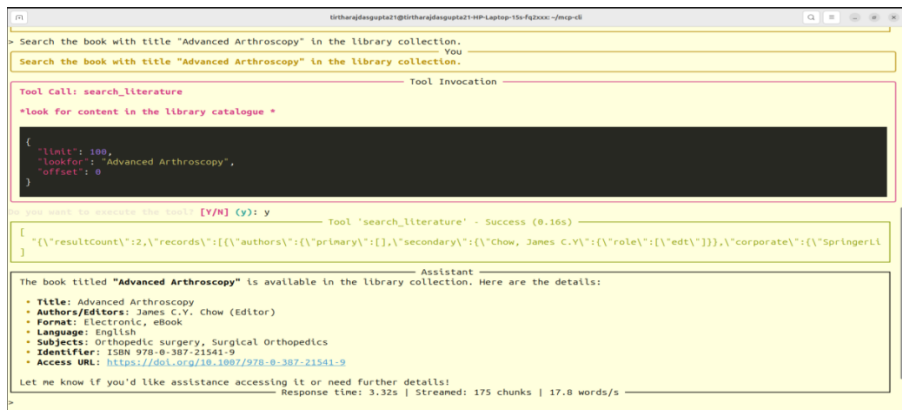


Figure 3 :Searching by title of the e-book “Advanced Anthroscopy” using MCP-CLI

Figure 3 demonstrates searching by the title of an e-book “Advanced Anthroscopy” by using a natural language query in the form of a simple question. As observed in the figure, after it accurately returns the record of the book which has the title that is searched for. It properly generates an answer-like result, that showcases bibliographic details of the e-book, namely the title, the authors/editors, format of the resource, language, subjects covered, identifier (here, ISBN) and the URL to access the e-book. It shows the capability of searching the catalogue in human language. Similarly, other kinds of searches have been conducted.

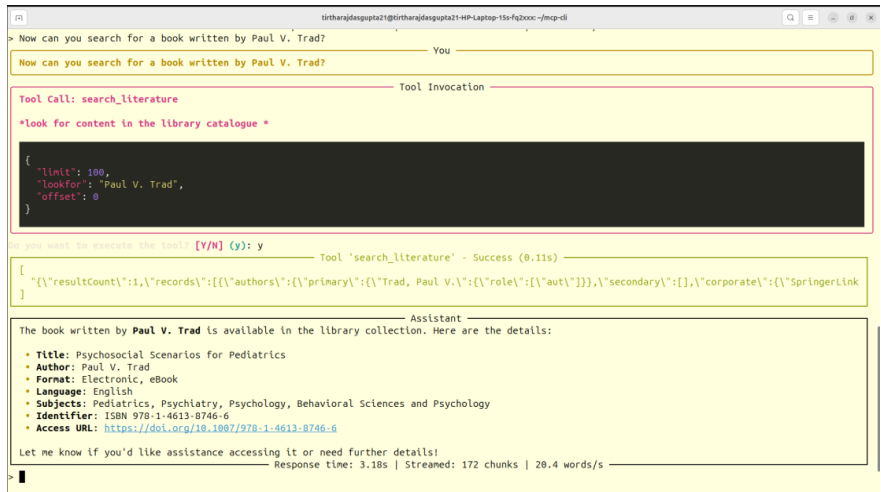


Figure 4 :Searching e-book written by Paul V. Trad using MCP-CLI

Figure 4 demonstrates searching of e-book written by author Paul V. Trad. It is also done using a simple query. It also returns the result in form of a structured answer. Table 1 demonstrates the number of results retrieved upon search, time taken for response, chunks streamed in the process, and the length of the response upon title and author search.

Type of Search	Number of retrieved results	Response time (in seconds)
Title Search	1	3.32
Author Search	1	3.18

Table 1 :Number of results retrieved and response time for title and author searching



Figure 5 :Searching e-book by subject “Pediatrics” using MCP-CLI

Similarly, figure 5 demonstrates the searching of records on the subject “pediatrics”. It returned 8 records of resources on the subject.

7.2. Comparison of results between MCP-CLI and VuFind Interface

When asked to sort results of the previous search, i.e. subject search, by relevance, it returned results as shown in figure 6.

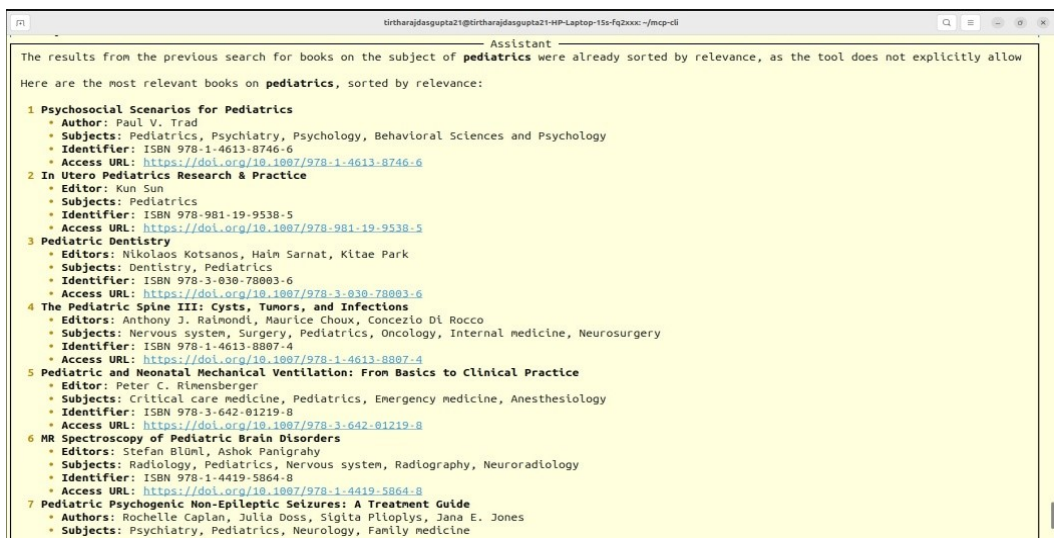


Figure 6 :Results of sorting results by relevance by Qwen Coder LLM in MCP-CLI

The top five results are ranked in proper order as obtained. It shows that the book entitled “Psychosocial Scenarios for Pediatrics” is the most relevant (1st), followed by the books “In Utero Pediatrics Research & Practice” (2nd), “Pediatric Dentistry” (3rd), “The Pediatric Spine III: Cysts, Tumors, and Infections” (4th), and “Pediatric and Neonatal Mechanical Ventilation: From Basics to Clinical Practice” (5th). It was based on the judgment the LLM took in sorting. Figure 7 shows the results sorted by relevance, on the VuFind interface.

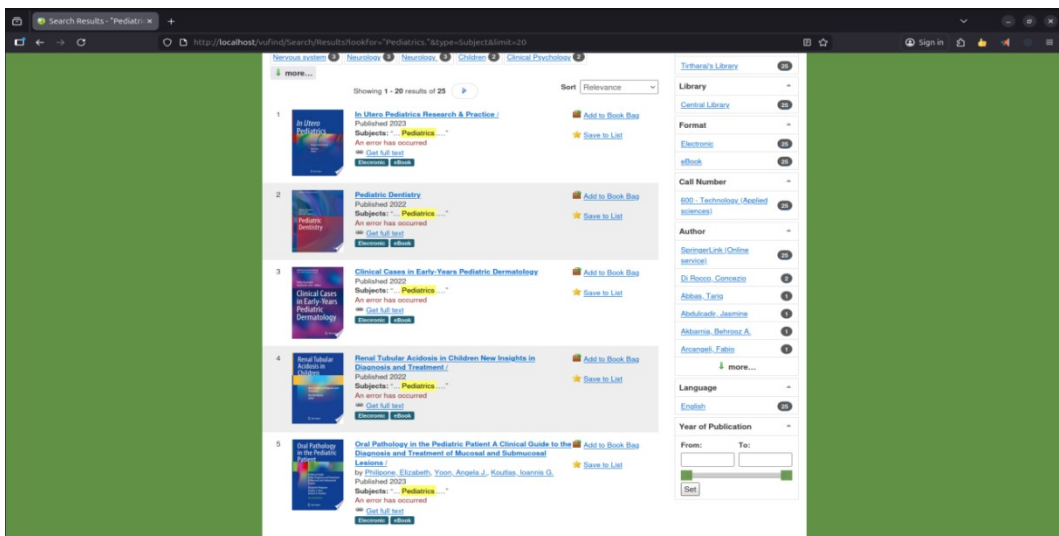


Figure 7 :Sorting of results by relevance in VuFind

The top 5 results showed that the most relevant book is “In Utero Pediatrics Research & Practice” (1st), followed by “Pediatric Dentistry” (2nd), “Clinical Cases in Early-Years Pediatric Dermatology” (3rd), “Renal Tubular Acidosis in Children New Insights in Diagnosis and Treatment” (4th) and “Oral Pathology in the Pediatric Patient A Clinical Guide to the Diagnosis and Treatment of Mucosal and Submucosal Lesions” (5th). Table 2 summarizes the ranking of the top 5 relevant resources on the subject “pediatrics” as returned by LLM and VuFind. Note that only the top 5 relevant results are considered and the others have been ignored for this purpose.

Title of the e-book	Relevance Rank	
	LLM	VuFind
Psychosocial Scenarios for Pediatrics	1 st	-
In Utero Pediatrics Research & Practice	2 nd	1 st
Pediatric Dentistry	3 rd	2 nd
The Pediatric Spine III: Cysts, Tumors, and Infections	4 th	-
Pediatric and Neonatal Mechanical Ventilation: From Basics to Clinical Practice	5 th	-
Clinical Cases in Early-Years Pediatric Dermatology	-	3 rd
Renal Tubular Acidosis in Children New Insights in Diagnosis and Treatment	-	4 th
Oral Pathology in the Pediatric Patient A Clinical Guide to the Diagnosis and Treatment of Mucosal and Submucosal Lesions	-	5 th

Table 2 :*Relevance Ranking of e-books on “pediatrics” by LLM and VuFind*

Table 2 shows the difference in the inferred relevance by both the VuFind system and LLM. For instance, the book ranked 1st by VuFind is ranked 2nd by the LLM, and the one ranked 2nd by VuFind is ranked 3rd by LLM. The book ranked 1st by LLM is not in the top 5 relevant results as per VuFind, while the 4th and 5th most relevant results by VuFind are not in the top 5 relevant results as per LLM.

8. Conclusion

The role of AI agents are increasingly getting important in the current age. It has revolutionized the way the world goes on. The conversational search framework built by the use of the Model Context Protocol provides a completely open-source solution as compared to the one performed by Claude. It has the potential to increase user experience and user satisfaction as compared to keyword-based searching of the library collection. Further research ahead of this includes :

- Developing a graphical user interface (GUI) for library users that can integrate any large language model into the system in searching for records using a VuFind backend
- Testing the usage of various large language models that support tool calling in searching library collections

- Testing the usage of other open-source discovery layers such as Blacklight in its performance in retrieving library records
- Designing a scoring and parameter-based framework to compare the efficacy of natural language retrieval and keyword-based retrieval

Conversational searching of library collections is in a juvenile phase, with much less development. Yet it has the potential to revolutionize the way library users search for the required book. Further developments would enhance better democratization of knowledge.

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The Practices, Challenges, and Opportunities of Print Media Libraries in Bangladesh

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Abstract

Background: *Print media libraries serve as a crucial center for distributing information regarding the newest developments and trends in both indigenous and international events. Assembling, conserving, and allocating printed media, including books and newspapers, has played a vital role in influencing Bangladesh's cultural individuality and progressing the nation.*

Purpose: *The study aims to consider the practices of print media libraries in Bangladesh, examine the difficulties and challenges they face, and recognize prospects and opportunities for their improvement.*

Methods: *The study assumed a qualitative method reinforced by an extensive review of recent existing literature and intellectual output, online records, and international case studies on print media libraries. Comparative analysis was also undertaken to categorize best performers and global standards applicable to the Bangladeshi setting.*

Findings: *Print media libraries in Bangladesh donate meaningfully to literacy development, independent participation, and information protection. Nevertheless, they face considerable issues such as funding constraints, a lack of digitization ingenuities, technical problems, and limited specialized workshop. Despite these challenges, emerging digital technologies, institutional associations, and growing information weights offer auspicious prospects for innovation.*

Value/Originality: *This study explores the under-researched role of print media libraries in Bangladesh, identifying key challenges like funding and digitization. It highlights emerging opportunities through digital technologies and partnerships, offering valuable insights for policymakers and librarians to enhance the sustainability and efficiency of these libraries.*

Conclusion: *Print media libraries endure crucial for knowledge protection and public instruction. Strategic policy support, speculation in digital infrastructure, and human resource development are important to improve their competence and sustainability.*

Keywords

Print media, Medial information, Library role, Library practices, Challenges, Prospects, Bangladesh

1. Introduction

Print media has historically been a cornerstone of information dissemination, public education, and national development. In Bangladesh, newspapers and other printed materials have not only chronicled socio-political transformations but also contributed to

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literacy enhancement and cultural preservation. Print media libraries—attached to newspaper offices, publishing houses, and media institutions—serve as critical information centers that collect, organize, and preserve these valuable resources.

The evolution of print media libraries in Bangladesh has paralleled the nation's broader educational and technological progress. However, in the current digital era, these libraries face numerous challenges in maintaining relevance and operational efficiency. This study provides a scientific examination of the practices, challenges, and future opportunities of print media libraries in Bangladesh, drawing insights from international experiences and local realities.

The study reviewed the literature, serving as a foundation for understanding the practices, challenges, and opportunities of print media libraries in Bangladesh. In this study, the author tried to understand the historical underpinnings of these libraries, their role in promoting literacy and education, international library management benchmarks, and the common challenges confronting print media libraries worldwide. These insights are critical to contextualize the specific issues faced by print media libraries in Bangladesh and to pave the way for informed analysis and recommendations.

2. Methodology

This study employed a qualitative and descriptive research design based on an extensive review of both national and international literature related to print media libraries. The approach aimed to synthesize existing research findings, identify gaps, and explore the current practices, challenges, and opportunities of print media libraries in Bangladesh.

2.1 Research Design

The study was descriptive in nature, focusing on secondary data collected from published research papers, journal articles, policy reports, and institutional publications. A qualitative content analysis method was adopted to interpret and integrate findings from existing literature systematically. This approach was deemed appropriate for understanding trends, operational contexts, and developmental prospects of print media libraries within Bangladesh.

2.2 Data Sources and Selection Criteria

To ensure comprehensive coverage, data were collected from scholarly journals, professional publications, and research databases such as *Scopus*, *Taylor & Francis*, *Emerald Insight*, *IFLA Journal*, and *Public Library Quarterly*. Both Bangladeshi and international studies were reviewed to provide comparative perspectives. Key references that informed this study include Bhuiyan et al. (2023) on the digitization of newspapers at Dhaka University Library, Hossain and Islam (2012) on journalists' information-seeking behavior, and Shariful Islam (2015) on the governance role of print media. Additionally, studies by Atikuzzaman et al. (2024), Begum et al. (2021), and Saha and Roknuzzaman (2024) provided insights into community engagement, pandemic response, and ICT integration in libraries.

Selection of literature was guided by the following criteria:

- Studies published between 2000 and 2025 focusing on print media, library management, digitization, or preservation.
- Research discussing Bangladesh or comparable developing countries to ensure contextual relevance.
- Papers from peer-reviewed journals or academic proceedings to maintain scholarly rigor.

2.3 Data Analysis

A thematic analysis approach was applied to organize findings under five major dimensions:

- a. Historical development and practices of print media libraries;
- b. Role in literacy and education;
- c. International best practices and benchmarks;
- d. Challenges, issues, and future opportunities.
- e. Opportunities for Development

The identified themes were interpreted to highlight how global trends influence local practices and to identify gaps in existing scholarship that require further empirical exploration in the Bangladeshi context.

2.4 Ethical Considerations

As this study relied entirely on secondary data, no direct human participation or fieldwork was involved. However, all reviewed works were properly cited and acknowledged in accordance with academic integrity and citation standards (APA 7th edition).

3. Practice, Challenges and Opportunities of Print Media Library

3.1 Historical Overview of Print Media Libraries

Launching printing technology in Bangladesh started with the hand of Christian missionaries in 1848 in Dhaka, although the first printing technology was established in Rangpur in 1847. From this time, printing media has spread out gradually (Shariful Islam, 2015). The history of print media libraries in Bangladesh is deeply intertwined with the nation's evolution. These libraries have been instrumental in preserving and promoting the literary and intellectual heritage of the region. From the establishment of the first public library in Dhaka in the early 19th century to the growth of specialized collections, the historical development of print media libraries in Bangladesh reflects the nation's commitment to knowledge dissemination and cultural preservation. Exploring this historical trajectory is essential in comprehending the foundations upon which contemporary print media libraries are built. The Historical Newspaper and Journal library of The National Library of Finland has over 10 million pages of digitalized newspapers and journals, with papers published between 1771 and 1910 freely available online, while those published after 1910 are only accessible in selected locations (Rautiainen, 2016). Libraries are actively engaging with the public, schools, and

researchers to promote the significance of print media materials and stimulate interest in historical research (Racheal, 2020).

3.2 The Role of Print Media Libraries in Promoting Literacy and Education

"To act as repository of all information required by the editorial and management departments of a newspaper" is the stated purpose of a newspaper library. The organization of the collection so that any information may be quickly retrieved is more crucial than simply storing the data (Riyajuddin & Chandran, 2014). Print media libraries, as repositories of knowledge, have long played a crucial role in promoting literacy and education. In Bangladesh, where literacy rates have seen notable improvements over the years, these libraries have been at the forefront of these efforts. By providing access to books, newspapers, and educational resources, print media libraries have been instrumental in increasing literacy rates and fostering a culture of lifelong learning. The impact of these libraries on educational attainment and intellectual development is an area of interest and importance, especially in a developing nation like Bangladesh. The print media has made a significant contribution to knowledge transfer and information provision. Print media remains relevant and appealing even in the age of electronic media. Print media has the advantage of providing readers with more in-depth reporting and analysis, which helps it stay in their minds for longer (Post, 2022). Patil et al. (Patil et al., 2011) discussed the role of print media in development communication, its historical significance, and the impact of electronic media on print media. It also focuses on the circulation trends of newspapers and magazines in India and other countries, highlighting the changing role of print media in the modern era.

3.3 International Practices and Benchmarks in Print Media Library Management

The management and organization of print media libraries globally offer valuable insights for enhancing the effectiveness of libraries in Bangladesh. International best practices, including collection development, cataloging, preservation, and user services, provide benchmarks for evaluating and improving library operations. Comparative studies that explore how libraries in other countries adapt to changing information landscapes, technological advances, and the evolving needs of users are instrumental in identifying innovative strategies for print media libraries in Bangladesh to remain relevant and efficient.

Rajuddin (Rajuddin, 2022) discusses the shift from traditional closed access libraries to automated e-libraries and further to digital and virtual libraries in India. It highlights the digitization of media libraries and the use of information and communication technology in revolutionizing newspaper libraries. Calvanese et al., (Calvanese et al., 2000) discussed the need for a digital library of newspaper clippings and presents the LAURIN project, which aims to transition from analog clipping archives to a digital successor. Libraries and archives are increasingly digitizing physical resources and presenting the result of such labors as digital libraries (DLs), available for the world to access (Lin, 1994).

3.4 Challenges and Issues Faced by Print Media Libraries Globally

Print media libraries worldwide are grappling with a host of challenges, many of which are amplified in the digital age. Economic constraints, competition from digital resources, evolving user expectations, and issues related to copyright and intellectual property are common hurdles that libraries must navigate. The experiences of print media libraries globally can offer insights into potential solutions and strategies for addressing these challenges in Bangladesh. Additionally, understanding the global landscape of library issues helps place the challenges faced by print media libraries in Bangladesh into a broader context. Cato (Cato, 2010) emphasized on the importance of building personal connections between rural schools and community newspapers based on trust, accessibility to information, and availability of staff. The media and news creation are undergoing radical changes so quickly and often so suddenly that libraries find it extremely difficult to adapt their ongoing workflows in a seamless manner. Currently, the most variable position at the library is the one that involves newspapers (Kiisa, 2015). Singh and Sharma (Singh & Sharma, 2013) conducted a study to determine the information-seeking behavior of newspaper journalists employed in Delhi, India. The study found that diverse categories of journalists used numerous types of sources to acquire the needed information. Reakes & Ochoa, (Reakes & Ochoa, 2009) discussed the challenges and efficacy of non-commercial digital newspaper libraries in providing increased access to historical and current newspapers. Most people agree that newspapers are a challenging resource to digitize and make available. Creating digital newspaper collections involves a number of challenges, including intricate and varied layouts on different papers, inconsistent section titles, enormous image sizes, challenges with optical character recognition, creating metadata, and segmenting pages.

In the backdrop of this literature review, it is evident that the practices, role, and challenges of print media libraries are intricate and multifaceted. A nuanced understanding of the historical context, international benchmarks, and the global library landscape is essential for framing the specific issues faced by print media libraries in Bangladesh. This review sets the stage for a comprehensive examination of the practices, problems, and prospects of these libraries in the specific context of Bangladesh, as addressed in the subsequent sections of this research. Print media creates an environment for creating a platform for inventing new knowledge, a new community for helping to establish a knowledge-based society, and a library that will help conserve resources for the future.

The media in Bangladesh has played a crucial role in knowledge transfer and transparency in many activities. For example, the arsenic problem in the 1990s in Bangladesh was first published and is well-known by print media. Then this information was preserved in the archive, which is associated with the library, as noted by M. K. Biswas (Biswas, 2007). In his article as well as noted that the level of literacy is increased with the help of newspapers.

Practices this work in a library would be a storehouse of huge information for future perspectives, whether it will be a good collection for research providing reliable sources of information. During the practicing of print media libraries, some problems can be

revealed that will also be possible to solve as well as also have a great opportunity in the future to expand it in the whole world because it will be a new journey in the field of library practicing in Bangladesh.

3.5 Opportunities for Development

Recent research highlights several promising opportunities for the development of print media libraries in Bangladesh, particularly through digitization initiatives. The Dhaka University Library has successfully implemented a large-scale digitization project, using advanced scanners and software to convert historical newspapers and academic materials into digital formats, making them accessible to hundreds of scholars each month and preserving fragile print resources for future generations (Bhuiyan, Islam, & Munshi, 2023).

Collaboration between media houses, universities, and public libraries is also seen as vital, as is the need for policy and funding support to ensure sustainable operations, especially in times of crisis such as the COVID-19 pandemic, which exposed gaps in preparedness and resource allocation among public libraries (Begum, Roknuzzaman, & Shobhane, 2021). Capacity building through training librarians in digital preservation and metadata management is recommended to support these transitions. Additionally, promoting public engagement and awareness of media archives as valuable research resources can enhance their use in education and journalism (Hossain, & Islam, 2012). Overall, these strategies can help print media libraries in Bangladesh adapt to changing information needs and technological advancements. Despite the challenges, the future of print media libraries in Bangladesh holds considerable promise. Based on the recent studies (Islam, 2024; Sarnaker, 2025; Atikuzzaman, Islam, & Hossain, 2024; Ferdous & Khatun, 2020; Saha, & Roknuzzaman, 2024; Rahmatullah, 2024) key opportunities include:

- **Digitization Initiatives:** Establishing digital archives to preserve fragile print resources;
- **Collaboration and Networking:** Building partnerships between media houses, universities, and public libraries;
- **Policy and Funding Support:** Advocacy for government policies to ensure sustainable financing;
- **Capacity Building:** Training librarians and archivists in digital preservation and metadata management; and
- **Public Engagement:** Promoting awareness of media archives as research resources for education and journalism.

The growing global emphasis on open access and digital transformation presents an opportunity for Bangladeshi print media libraries to redefine their role as hybrid repositories integrating both print and digital resources.

This review study provides a comprehensive overview of the practices, challenges, and opportunities of print media libraries in Bangladesh. It begins with a historical exploration, tracing the roots of print media in Bangladesh and emphasizing the vital role of libraries in preserving the nation's cultural and intellectual heritage. The review then

transitions to the essential role of print media libraries in promoting literacy and education, highlighting their contribution to knowledge transfer and information provision.

International practices and benchmarks in print media library management are discussed, emphasizing the need for Bangladesh's libraries to draw insights from global experiences. The challenges faced by print media libraries globally, including economic constraints, digital competition, and evolving user expectations, are examined. The literature underscores the importance of building personal connections between rural schools and community newspapers, emphasizing the challenges involved in digitizing and making newspapers available in a digital format.

While the review study provides valuable insights into the historical development, educational role, international benchmarks, and challenges faced by print media libraries globally, a noticeable gap exists in terms of specific studies focused on the practices and prospects of print media libraries in the unique context of Bangladesh. The available literature primarily offers a broader understanding of library management, digitization challenges, and international practices but lacks detailed investigations into the current state of print media libraries in Bangladesh.

4. Recommendations for Print Media Libraries of Bangladesh

Based on the findings and analysis, the following recommendations are proposed to strengthen the operations, sustainability, and relevance of print media libraries in Bangladesh:

- a. *Policy Formulation and Institutional Support:* The Government of Bangladesh, in collaboration with the Department of Public Libraries and media organizations, should formulate a national policy framework for print media library management, preservation, and digitization. This framework should include guidelines for archiving, access, copyright, and data sharing.
- b. *Digitization and Technological Integration:* Libraries should prioritize the digitization of newspaper archives and rare collections to prevent physical deterioration and enhance accessibility. Adopting low-cost open-source digital repository systems (e.g., DSpace, Greenstone) could be an effective solution for resource-constrained institutions.
- c. *Capacity Building and Professional Training:* Continuous professional development programs should be organized for librarians and media archivists focusing on digital preservation, metadata creation, and ICT applications in library management. Collaboration with library schools and professional associations is vital for sustainable skill enhancement.
- d. *Resource Mobilization and Financial Sustainability:* Media houses and government agencies should allocate dedicated budgetary support for library modernization. Establishing public-private partnerships (PPP) and seeking donor or institutional grants can also ensure financial sustainability.
- e. *Networking and Collaborative Initiatives:* A national consortium of print media libraries should be established to promote resource sharing, joint digitization

- projects, and cooperative cataloging. Such collaboration can reduce duplication and enhance access to a broader range of media resources.
- f. *Preservation and Conservation Measures:* Libraries must adopt proper storage, binding, and microfilming practices for fragile print materials. Environmental control, pest management, and preservation awareness campaigns are essential to safeguard valuable archival holdings.
 - g. *User-Centered Services and Awareness Promotion:* Developing user-friendly cataloging systems, offering online search tools, and organizing exhibitions or workshops can increase public engagement. Promoting media literacy and archival research among students, journalists, and the general public will expand the social value of these libraries.
 - h. *Research and Continuous Evaluation:* Regular impact assessments and user studies should be conducted to evaluate service quality and identify emerging needs. Partnerships with academic institutions can foster research that contributes to evidence-based policy development for media libraries.

5. Further Research

Further research is needed to bridge this gap by delving into the specific dynamics, challenges, and opportunities faced by print media libraries in Bangladesh. This research should explore the local nuances, user behaviors, and resource constraints that are distinct to the Bangladeshi context. Additionally, there is a need for empirical studies that assess the effectiveness of print media libraries in promoting literacy and education within the country. Closing this literature gap will contribute significantly to informing strategies for the development and enhancement of print media libraries in Bangladesh.

6. Conclusion

This study reveals that print media libraries in Bangladesh, though vital for preserving news archives and supporting journalists, remain underdeveloped due to inadequate funding, lack of automation, and insufficient skilled manpower. Most libraries still rely on manual systems, limiting accessibility and efficiency. The absence of digital preservation practices also poses a threat to the long-term sustainability of valuable news resources and institutional memory.

To strengthen these libraries, the study recommends initiating systematic digitization, providing professional training in ICT and preservation, developing national policies, and fostering collaboration among media, academic, and public libraries. Improved infrastructure and user-oriented digital services can transform print media libraries into modern information hubs, ensuring broader access, enhanced usability, and better support for Bangladesh's evolving media sector.

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Measuring the Impact of Knowledge Management on Library Systems and Services in Dhaka University Library

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Abstract

Purpose: The prime objective of the study is to measure the impact of knowledge management (KM) on the efficiency of Dhaka University Library systems, along with detecting the challenging issues.

Methodology: A purposive sampling technique was used to collect data from the studied library where 31 library professionals were contributed. The data were gathered through a set of questionnaires containing closed-ended and open-ended questions. Quantitative data were analyzed using descriptive statistics using SPSS 26th version, while qualitative responses were inspected through thematic analysis.

Results: The study revealed that KM exercise greatly increase the operational ability, where the majority of the KM practitioners (51.6%) believe the library is capable to some extent, showing a moderate level of readiness. The DU Library has a digital platform for storing institutional knowledge; where 38.7% of respondents believe that KM process is very suitable. Majority of respondents (58.1% agree and 32.3% strongly agree) believe that knowledge management contributes significantly to operational efficiency though there is a room for improvement in integrating KM tools and techniques. The study identified barriers of lack of technology and adequate budget.

Originality: The study is the first initiative to identify the KM activities in a higher academic library like Dhaka University Library that offers applied understandings of KM professionals in enriching KM quality and efficacy.

Conclusion: KM practice at Dhaka University Library certainly contributes to library performance and user satisfaction. Reinforcing KM through technological advancements, constant staff training and nurturing a culture of knowledge distribution can further improve productivity, service quality, and sustainable knowledge management.

Keywords

Knowledge Management, Impact, Library Systems and Services, Dhaka University Library

1. Introduction

Knowledge Management (KM) is an integral part and a necessary approach for confirming the effectiveness of library performance (Islam, Agarwal & Ikeda, 2017). In a university library, knowledge management adopts the scientific methods of collecting,

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preserving, disseminating, and implementing the knowledge to signify the university library process to ensure the user satisfaction (Awoyemi & Ipadeola, 2024; Shropshire, Semenza & Koury, 2020). KM approach steadfastly influence the quality of overall library activities (Mamun, Othman, & Zulkifli, 2023; Islam, Islam, & Razzak, 2020). Although KM initiatives played a unique role, several issues like obsolete technological use, shortage of effective training, monetary constraints, and reluctance of accepting modern technology hinder the expected quality service and KM efficacy in the university libraries (Doras & Kimani, 2025). As a leading public university library, Dhaka University Library (DUL) provides divers library facilities to its users. The study indicates that while most staff acknowledge the benefits of KM, especially in improving operational efficiency and service quality, there is a clear demand for enhanced IT support, systematic training, investment in advanced tools, and the creation of dynamic knowledge-sharing platforms. Furthermore, problems such as a lack of appropriate technology, insufficient training, and budgetary constraints were found as key issues in KM implementation. Hence, the study targets to assess the role of existing KM practices on the efficiency of library practices at DU library; examine the employees' knowledge to enhance the performance; identify the obstacles in implementing the KM practices; and explore staff insights, and their insightful suggestions regarding training, technological support, and KM tools. As it detects gaps and challenges, offers empirical insights into the existing of KM practices at Dhaka University Library, and shares the helpful suggestions to promote knowledge sharing culture, this study is significant. The library can improve professionals' capacity, operational efficiency, and service quality by appearing to technological, training, and infrastructural needs.

2. Literature Review

Knowledge management is extensively recognized as a deliberate style for administrating information institution to improve its performance (Farooq, 2009; Chandratreya, 2025). In higher academic libraries, KM covers both tacit knowledge held by staff and categorical knowledge recorded in databases, catalogs, and institutional repositories. Exceptional KM techniques in any university library enhance the functioning usefulness, institutional knowledge steadiness, and raise the standard of reference and information services (Doras & Kimani, 2025; Koloniari & Fassoulis, 2027). The actual implementation of KM in university libraries relies on appropriate tools, proper training, and an organizational behavior. Digital platforms, such as intranets, document repositories, and databases, enable knowledge storage and retrieval, while workshops, seminars, and brainstorming sessions endorse knowledge distribution among library staff (Surwade, Patil, & Patil, 2024; Islam, Agarwal, & Ikeda, 2017).

Workshop and training programs are a very necessary part of becoming a skilled and appropriate person for any practical work. This capacity building enables personnel to apply modern tools and techniques like KM effectively in the library (Golhasany & Harvey, 2023; Gope, Elia & Passiante, 2018). Furthermore, a great collaborative and knowledge-sharing practice is crucial for exploiting the outputs of knowledge

management and increasing service quality (Lin et al., 2022). But KM execution in university libraries experiences some problems like limited technological infrastructure, monetary constraints, inadequate training, reluctance to accept modern tools etc. (Awoyemi & Ipadeola, 2024; Mosha & Ngulube, 2024). In Bangladesh, research on KM in university libraries leftovers limited, though preliminary results propose that resource scarcities and lack of consciousness are main obstacles (Atikuzzaman, 2024). The present research identifies the gap by inspecting KM performs at Dhaka University Library, discovering specialists' insights, knowledge incarceration, application, and difficulties and providing evidence-based recommendations to progress library service and processes.

3. Research Methodology

The study adopted a descriptive research design to examine the influence of knowledge management on library practices at Dhaka University Library. A purposive sampling technique was used to select of 31 library personnel based on their engagement in library services and KM practices. A structured questionnaire was used to collect data that addressed demographic information, KM practices, knowledge-sharing activities, KM programs, technical provision, difficulties, and suggestions. Data collection was led in person over a period of two weeks, during which respondents completed the questionnaire based on their involvement and observations. The SPSS 26 version is used to analyze the data, like frequencies and percentages, while thematic analysis was applied to open-ended responses to identify key patterns and suggestions with the help of AI tools like ChatGPT. The questionnaire was pre-tested to confirm validity, and ethical measures, including informed consent and confidentiality, were firmly confirmed.

4. Data Analysis

4.1 Demographic Information

Table 1 presents the demographic profile of the 31 respondents from Dhaka University Library. In terms of designation, the majority were Assistant Librarians (54.8%), followed by Deputy Librarians (32.3%). A small proportion included IT Staff (6.5%), Senior Cataloguer (3.2%), and Administrative Staff (3.2%). This distribution shows that most respondents are mid-level professionals directly engaged in library systems and services. Regarding work experience, the data indicate that the respondent group is highly experienced. About three-fourths (74.2%) have more than 10 years of professional experience, while only 9.7% have 1–3 years, 12.9% have 4–6 years, and 3.2% have 7–9 years.

Table 1: Demographic Information of the Respondents				
Designation				
Deputy Librarian	10	32.3	32.3	32.3
Assistant Librarian	17	54.8	54.8	87.1
Sr. Cataloguer	1	3.2	3.2	90.3
IT Staff	2	6.5	6.5	96.8
Administrative Staff	1	3.2	3.2	100.0
Total	31	100.0	100.0	
Year of Experiences				

1–3 years	3	9.7	9.7	9.7
4–6 years	4	12.9	12.9	22.6
7-9 years	1	3.2	3.2	25.8
More than 10 years	23	74.2	74.2	100.0
Total	31	100.0	100.0	

4.2 Frequency of KM condition and Employee Meetings and Knowledge-Sharing Sessions

Figure 1 illustrates respondents’ perceptions regarding how well-equipped the library is to collect employees’ experience and knowledge. Over half of the respondents (51.6%) believe the library is capable *to some extent*, showing a moderate level of readiness. Moreover, 41.9% feel the library is equipped *to a large extent*, reflecting a substantial portion who recognize strong capacity in this area. Only 6.5% of respondents think the library is prepared *to a small extent*.

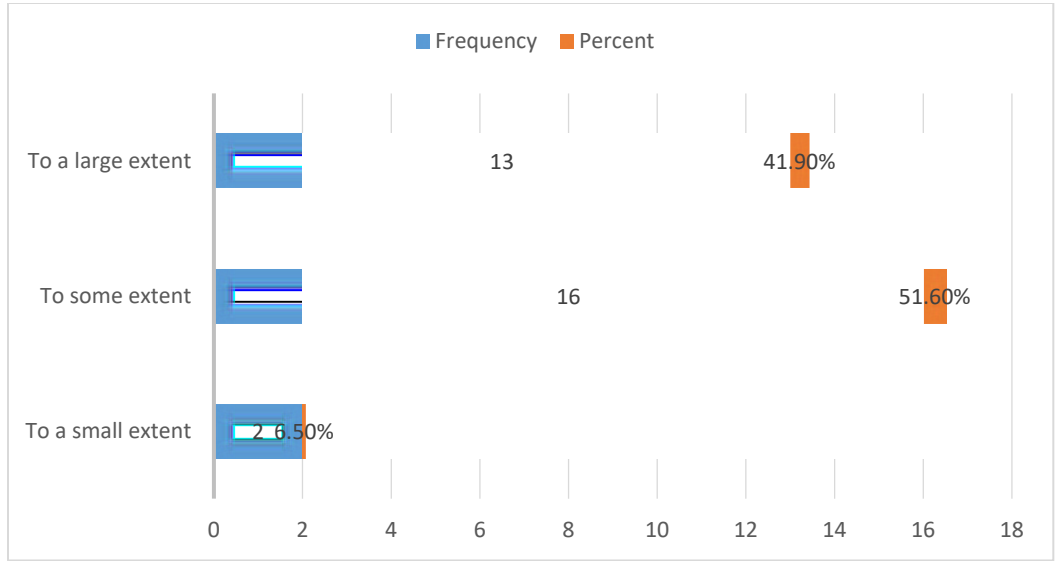


Figure 1. How well-equipped the library is?

Figure 2 demonstrates the frequency with which the library arranges employee meetings or knowledge-sharing sessions. The majority of respondents (45.2%) reported that such sessions are held *monthly*, indicating a regular but not intensive practice. Additionally, 35.5% noted that meetings occur *occasionally*, showing that for many staff members, knowledge-sharing is not consistently structured. A smaller group (12.9%) stated that these activities take place *rarely*, while only 6.5% indicated that sessions are held *weekly*.

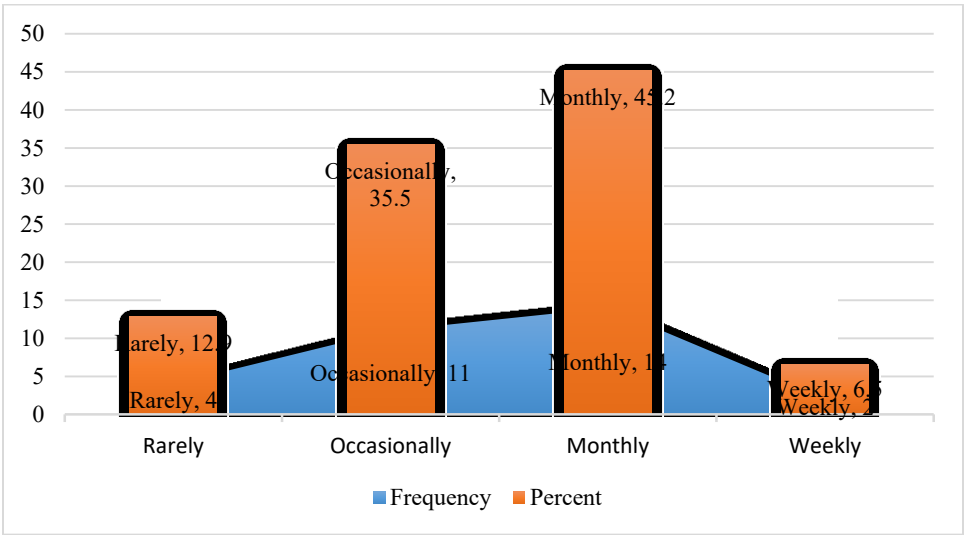


Figure 2. How frequently does the library arrange employee meeting?

4.3 Availability of Knowledge Repository

Figure 3 shows respondents’ opinions on whether the library has a centralized digital platform or repository for storing, accessing, and collecting institutional knowledge. A large majority of respondents (90.3%) confirmed the presence of such a digital system, indicating strong infrastructure to support knowledge management activities. The remaining 9.7% were not sure, and no respondents reported its absence.

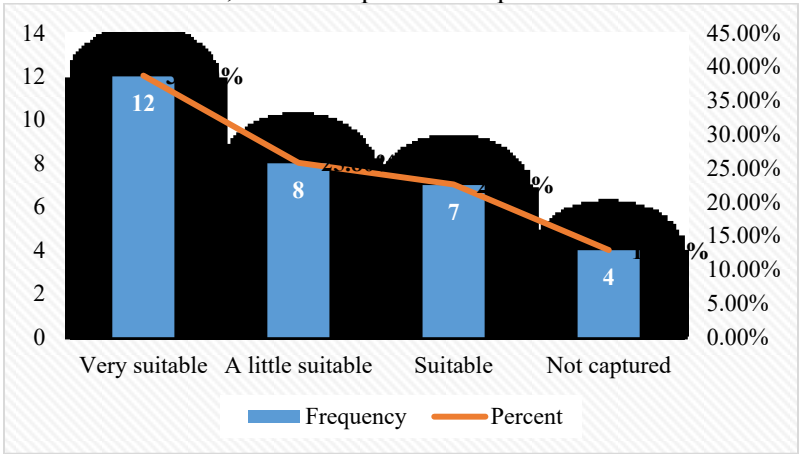


Figure 3. Availability of digital repository

4.4 Effectiveness of Capturing Knowledge

Table 2 highlights respondents’ perceptions of how effectively the library captures knowledge and ideas when employees retire or leave. According to the findings, 38.7% of respondents believe the process is *very suitable*, indicating strong mechanisms for

retaining institutional knowledge. Another 22.6% feel it is *suitable*, while 25.8% consider it only *a little suitable*, suggesting moderate but improvable practices. Notably, 12.9% reported that such knowledge is *not captured* at all.

Table 2:After retires and/or leaves of library employees how suitably knowledge and ideas are captured?				
	Frequency	Percent	Valid Percent	Cumulative Percent
Very suitable	12	38.7	38.7	38.7
A little suitable	8	25.8	25.8	64.5
Suitable	7	22.6	22.6	87.1
Not captured	4	12.9	12.9	100.0
Total	31	100.0	100.0	

4.5 Training on KM Tools and Techniques

Figure 4 shows how frequently the library authority places or provides training for employees on KM tools. Nearly half of the respondents (48.4%) stated that such training is offered *occasionally*, indicating irregular but existing initiatives. Another 22.6% reported that training is provided *regularly*, reflecting a committed segment of structured capacity-building efforts.

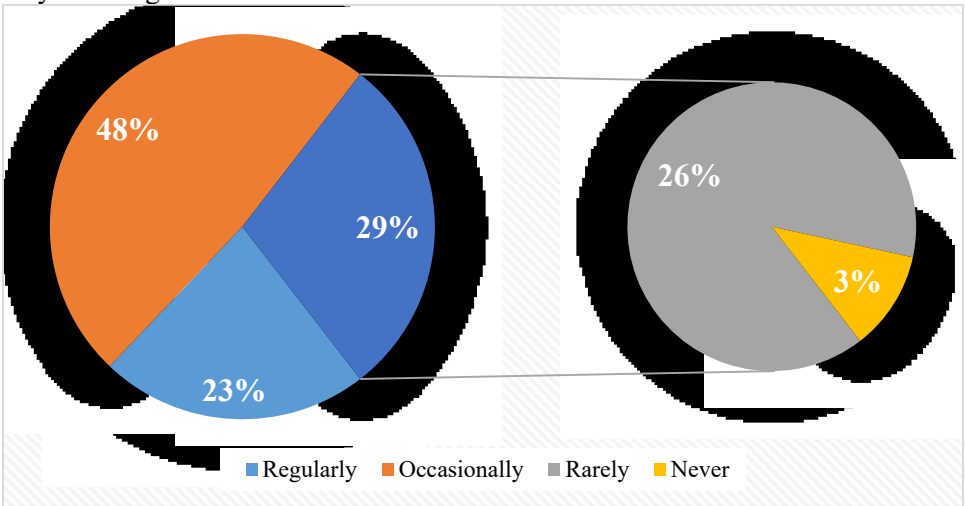


Figure 4. Frequency of Training on KM Tools and Techniques

4.6 Impact of KM on Library Operational Efficiency

Table 3précises respondents’ perceptions on whether KM practices have upgraded the efficiency of library works. A majority of respondents statedconstructive views: 58.1% *agree* and 32.3% *strongly agree* that knowledge management contributes significantly to operational efficiency. Only 9.7% remained *neutral*, and no respondents disagreed. Overall, the findings indicate strong staff recognition that knowledge management

initiatives play a crucial role in enhancing the effectiveness and productivity of library services.

Table 3:Please give your opinion about knowledge management practices that improved the efficiency of library operations?				
	Frequency	Percent	Valid Percent	Cumulative Percent
Neutral	3	9.7	9.7	9.7
Agree	18	58.1	58.1	67.7
Strongly agree	10	32.3	32.3	100.0
Total	31	100.0	100.0	

4.7 Extent of Using Stored Knowledge to Enhance Library System Performance

Figure 5 shows respondents’ insights of how successfully library systemsuse stored knowledge to advance performance. Nearly half of the defendants (48.4%) specified that stored knowledge is used *to a great amount*, suggesting strong integration of knowledge resources in routine operations. Another 35.5% stated that it is used *to a moderate amount*, reflecting reasonable but improvable utilization. Only 6.5% felt that knowledge is used *to a limited amount*, while 9.7% believed it is *not used at all*. Overall, the findings reveal that most staff perceive a high level of knowledge application within library systems, though a small segment highlights gaps that could be addressed.

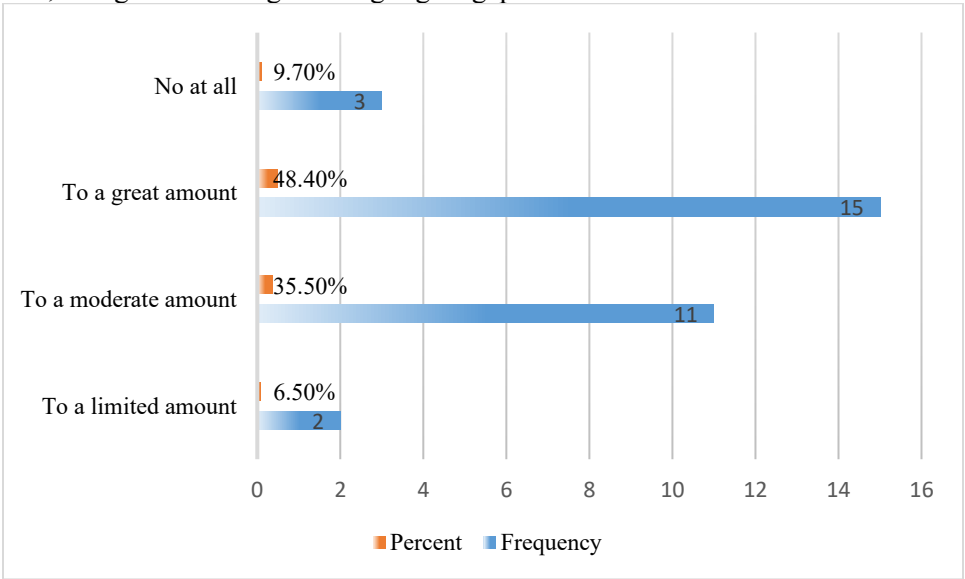


Figure 5. Extent of Using Stored Knowledge

4.8 Integration of KM Tools with Existing Library Systems

Table 4 identifies the respondents’ remarks on how well KM tools and techniques integrate with the existing library systems. A strong majority (64.5%) reported that these tools *integrate well*, demonstrating effective alignment between KM technologies and library workflows. Additionally, 32.3% felt they assimilate *somewhat*, suggesting partial

compatibility with room for improvement. Only 3.2% stated that the tools do *not* integrate well. Overall, the responses show that most staff perceive KM tools as supportive and compatible with current library systems, contributing positively to operational efficiency.

Table 4:Opinion about KM tools and techniques

	Frequency	Percent	Valid Percent	Cumulative%
Yes	20	64.5	64.5	64.5
Somewhat	10	32.3	32.3	96.8
No	1	3.2	3.2	100.0
Total	31	100.0	100.0	

4.10 Impact of Knowledge Sharing on the Quality of Reference

Table 5 denotes respondents’ perceptions on whether knowledge sharing among staff has improved the quality of reference and information services provided to library users. A majority of respondents (64.5%) agree that knowledge sharing enhances service quality, and 25.8% strongly agree, indicating broad recognition of its positive impact. Only 9.7% strongly disagree. Overall, the results suggest that knowledge sharing is perceived as a key factor in evolving and maintaining high-quality library services for users.

Table 5:Perceptions on the knowledge sharing among staff

	Frequency	Percent	Valid Percent	Cumulative %
Strongly disagree	3	9.7	9.7	9.7
Agree	20	64.5	64.5	74.2
Strongly agree	8	25.8	25.8	100.0
Total	31	100.0	100.0	

4.11 Staff Satisfaction with the Impact of KM on User Engagement

Table 6 displays defendants’ satisfaction with the impact of KM on user appointment and satisfaction. The majority (71.0%) reported being *pleased*, and 12.9% were *very pleased*, representing strong positive perceptions of KM’s contribution to user experience. A small number showed dissatisfaction, with 9.7% *unpleased* and 3.2% *very unpleased*, while 3.2% remained *neutral*. Overall, the findings suggest that KM practices are predominantly effective in enhancing user engagement and satisfaction in the library.

Table 6:Satisfaction level with the impact of KM on user engagement

	Frequency	Percent	Valid Percent	Cumulative Percent
Very unpleased	1	3.2	3.2	3.2
Unpleased	3	9.7	9.7	12.9
Neutral	1	3.2	3.2	16.1
Pleased	22	71.0	71.0	87.1
Very pleased	4	12.9	12.9	100.0

4.12 Obstacles to KM Implementation

Table 7 highlights the perceived problems in applying KM in the library, based on responses. The most frequently stated barriers were *lack of proper technology* (93.5% of respondents) and *lack of proper budget* (83.9%), stressing resource-related defies. *Lack of adequate training* was cited by 80.6% of respondents, indicating the need for capacity-building initiatives. Other significant obstacles included *resistance to change*(54.8%) and *poor leadership support* (51.6%). Overall, the results reveal that both infrastructural and organizational factors limit effective KM application, with technology, funding, and training acknowledged as serious areas requiring attention.

Table 7:Frequencies in Obstacles for KM implementation				
		Responses		Percent of Cases
		N	Percent	
Obstacle for KM ^a	Lack of proper technology	29	25.7%	93.5%
	Lack of adequate training	25	22.1%	80.6%
	Resistance to chance	17	15.0%	54.8%
	Poor leadership support	16	14.2%	51.6%
	Lack of proper budget	26	23.0%	83.9%
Total		113	100.0%	364.5%
a. Dichotomy group tabulated at value 1.				

4.13 Perceived Benefit of KM in Enhancing Library Services and Systems

Table 8 shows overall assessment of the benefits of knowledge management (KM) in increasing library facilities and systems. Most respondents (51.6%) considered KM *beneficial*, while 45.2% rated it *very beneficial*, shimmering a strong consensus on its affirmative impression. Only a small fraction (3.2%) did not comment. Overall, the findings specify that library staff perceive KM as a highly valued practice for improving the efficiency, effectiveness, and quality of library operations.

Table 8:In general, how would you assess the benefit of knowledge management in enhancing library services and systems?				
	Frequency	Percent	Valid Percent	Cumulative Percent
No comments	1	3.2	3.2	3.2
Beneficial	16	51.6	51.6	54.8
Very beneficial	14	45.2	45.2	100.0
Total	31	100.0	100.0	

4.14Thematic Analysis of Suggestions for Enhancing Knowledge Management

a. IT and Technological Support

Many respondents emphasized the need for improved IT infrastructure and technological support to facilitate effective KM practices. This includes upgrading digital tools, integrating new technologies, and providing robust platforms for knowledge storage and access (R1, R2, R6, R13, R24, R27, R28, and R30).

b. Training and Capacity Building

A strong theme is the necessity of continuous staff training. Respondents highlighted training programs on KM tools, new technology, and implementation strategies to enhance staff capability and ensure proper utilization of knowledge resources (R1, R2, R3, R8, R25, and R31).

c. Knowledge Sharing and Awareness

Several suggestions focused on promoting a culture of knowledge sharing and awareness among staff. This includes creating platforms for exchanging ideas, conducting workshops, seminars, brainstorming sessions, and increasing staff understanding of KM principles (R5, R7, R22, R23, and R29).

d. Budget and Institutional Support

Respondents repeatedly pointed out the importance of adequate funding and institutional backing. This includes allocating sufficient budget for technology, training programs, and the overall enhancement of KM infrastructure (R13, R24, R25, and R26).

e. Dynamic and Continuous Improvement

Some responses emphasized the need for dynamic variations and continuous improvement in KM practices to achieve better service delivery, suggesting that current practices should be further developed and modernized (R12, R23, and R30).

Conclusion

The present research investigated the knowledge management practice in Dhaka University Library and revealed that KM practice has positive influence on the efficiency of library operations. The study collected the data on different aspects of the library professionals those are engaged in KM practice in the DU library. Most the personnel recognized that the library effectively captures, stores, and relates knowledge, though there is room for improvement in areas such as training, IT support, and budget allocation. Knowledge-sharing initiatives, use of digital platforms, and regular application of KM techniques donate to enhanced working routine, but issues such as inadequate infrastructure, funding constraints, and conflict in alteration. Based on professionals' views and suggestions, strengthening KM at Dhaka University Library needs nonstop share in technical tools, structured training programs, and the formation of dynamic knowledge-sharing stages. Emerging a culture of knowledge sharing can further improve professional capacity, operational competence, and the overall excellence of library activity. Implementing these measures KM practices can continue to support the library's mission of sharing high-quality, user oriented services for the future development.

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Future Services of University Libraries Using AI: Rajshahi University Library Perspective

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Abstract

The rapid evolution of artificial intelligence (AI) offers transformative opportunities for academic libraries. This paper explores how AI can serve better library services specially emphasis on Rajshahi University Library (RUL), considering both global trends and local context. We review existing literature about AI in academic libraries; identify potential applications; discuss anticipated benefits; as well as challenges particular to the setting of a public university libraries in Bangladesh. AI adoption among researchers and students has already increased dramatically. This paper will highlight how students as well as faculties are using AI tools in their academic purposes and how RUL can cope up its current services with this new technology.

Keywords

Artificial Intelligence, Academic Libraries, Rajshahi University, Library Services, Library Automation, AI Literacy

1. Introduction

Artificial intelligence (AI) is becoming increasingly interrelated with people's daily lives. AI plays a significant supportive role in simplifying tasks, increasing productivity, and enhancing creativity. Whether for personal use or in various professions, AI's capabilities are opening new possibilities—from handling simple tasks to solving complex problems. How AI can be used in academic tasks and how it can assist in improving efficiency and decision-making, are discussed below. This paper highlights the need for AI in education, particularly in library services, to make these services easier and faster. This study aims to showcase how AI usage in Rajshahi University is reflecting research as well as daily needs among the researcher and library professionals. Current status of Rajshahi University/Library, prospects and problems of using AI and future research needs are also discussed in this study.

2. Literature Review: AI in Academic Libraries

2.1 Growth of Research on AI in Libraries

- A recent bibliometric analysis covering 2010–2023 reviewed 354 publications on AI in academic libraries, documenting a rapid increase in interest and adoption of AI-related research over recent years. ([SpringerLink](#))
- Earlier systematic reviews also indicate that AI — especially machine learning and NLP — is increasingly explored for tasks like metadata generation, cataloguing, information retrieval, and user-service automation. ([arXiv](#))

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These surveys suggest that AI in libraries is not just a theoretical concept, but in many cases being put into practice.

2.2 Typical AI-Based Services in Libraries

According to existing literature and case studies, AI can support libraries in multiple ways: ([OUCI](#))

1. **Automated Metadata Generation and Cataloguing:** AI/ML can be used to classify resources, generate metadata, assign subject headings, improving consistency and reducing manual workload. ([rgujournal.in](#))
2. **Intelligent Search & Discovery:** AI-powered search engines or assistants (e.g., using NLP) allow users to query in natural language and receive context-aware, relevant results — beyond simple keyword matching. ([libraryjournal.com](#))
3. **Chatbots / Virtual Reference Services:** 24/7 virtual assistants to answer common user queries, help with library navigation, resource finding, or referencing support. ([JULAS Journal](#))
4. **Personalized Services & Recommendation Systems:** Based on user profiles, past borrowing/access history, AI can recommend books, articles, or other resources tailored to individual needs. ([ijisem.com](#))
5. **Automation of Routine Tasks:** Shelving, circulation management, inventory tracking, overdue notices — AI (coupled with robotics or RFID/IoT) can streamline or partially automate these tasks. ([ajlais.com](#))
6. **Support for Digital & Open Access Collections:** AI can help manage, index, and make accessible large digital repositories — facilitating better organization and retrieval of OA materials. ([ijisem.com](#))
7. **Enhanced Accessibility & Assistive Services:** For differently-abled users — e.g. through text-to-speech, translation, adaptive interfaces — AI can make library resources more inclusive. While research in special libraries is more nascent, early studies indicate promising results. ([arXiv](#))

2.3 Challenges and Ethical Considerations

Adopting AI is not without challenges. Several recent studies highlight obstacles especially relevant for academic libraries in developing-country contexts: ([pjssrjournal.com](#))

- **Infrastructure Limitations:** Unreliable power supply, poor internet connectivity, outdated hardware — common in many public universities — can hinder AI implementation. ([pjssrjournal.com](#))
- **Financial Constraints:** AI systems (software licenses, hardware, maintenance) require funding, which may compete with other library priorities. ([pjssrjournal.com](#))
- **Lack of Skilled Personnel and Training:** Libraries are facing lack of skilled and trained library personnel who can use AI tools, data management.
- **Ethical, Privacy, and Data Governance Issues:** Use of AI for user profiling, data analysis, or predictive recommendations raises concerns about privacy, bias, fairness, and transparency. ([Granthaalayah Publication](#))

- **Risk of Dehumanizing Librarianship:** Over reliance on AI (chatbots, automation) may reduce human interaction, potentially undermining the librarian's role in providing nuanced guidance. (Granthaalayah Publication)

3. Methodology

In this study, the Observation method was implemented to obtain results. Personal experience related to librarianship was also used in the decision-making process. A group of selected students were asked about their understanding of AI and how they use it in their research work. Interesting findings were discovered: students as well as researchers frequently use AI in their research and daily academic activities, and this technology has made their tasks easier. In addition, the study describes how the central library staff—particularly the cataloging staff—use AI tools to generate classification numbers and subject headings for the computerized cataloguing of books.

4. Current Status at Rajshahi University on AI

Some prior research has examined automation at RUCL, where it is currently positioned as a library with partial automation infrastructure and certain automated practices in place particularly on circulation and cataloging. However, the library remains on the verge of adopting AI.

4.1 Everyday Use

AI analyze user data to recommend everything—from movies and music to products and services. This enhances user experience and helps discover new interests.

4.2 Translation

AI-powered translation has made language communication much easier. Real-time translation is commonly used by students on their research and daily academic activities. That is more comprehensive and faster than Google translator.

4.3 Education and Learning

AI can provide personalized learning experience. With its help, automated questions and answers, as well as improvements in learning materials and teaching methods based on student feedback, become possible. Using AI, different platforms can analyze students' progress and performance to tailor lessons, making education more effective.

4.4 Writing and Design

AI use is quite notable in creative work. It can generate writing, images, or designs from a specific idea or prompt. Even when AI is not directly used to create the final work, it allows creators to quickly visualize a concept or plan. Creative professionals are producing new work based on AI-generated suggestions or insights.

4.5 Plagiarism Checking Service

Plagiarism or similarity checking along with AI detection is a must on research in Rajshahi University. PhD, MPhil and Masters researchers need to check their theses both

plagiarism and AI detection while final submission. The university has its specific ordinance relating to both these factors. ChatGPT, Google Gemini, Grammarly, QuillBot all these AI tools help support in paraphrasing, translation, grammar checking on research. RU is subscribing iThenticate software(with AI detecting capabilities) for plagiarism/similarity checking since 2020 and Grammarlyservice will also be subscribed from year with technical support from Bangladesh Research and Education Network (BdREN).

5. Opportunities: What AI Could Bring to RUL

Based on global evidence and local context, here are possible AI-driven services RUL (and by extension, Rajshahi University) could adopt in future:

Service / Application	Benefits / Value for RUL
Intelligent search engine & discovery layer	Helps students/faculty find relevant resources quickly — including across print, digital, and open-access repositories. Particularly useful given the volume of OA materials and diverse user needs.
AI-powered metadata/cataloguing	Reduces manual workload on librarians; ensures consistent, high-quality metadata; facilitates better resource organization.
Chatbot / Virtual Reference Service	Provides 24/7 assistance (library hours often limited), handles routine queries, helps in resource finding, directions, basic referencing — relieving pressure on librarians and improving user satisfaction.
Personalized recommendation system	Suggests relevant books/articles based on user’s academic department, past borrowing — helping users discover resources they might miss otherwise.
Digitization & Search of Local Collections (e.g. theses, rare books)	AI-based OCR, NLP could help digitize local printed collections (e.g. regional language, Bengali or English), enabling full-text search, preserving old volumes, expanding access beyond physical walls.
Assistive Services for Accessibility	For visually impaired or other differently-abled students — text-to-speech, language translation, adaptive interfaces — promoting inclusion.
Analytics & Usage-based Collection Management	Use ML to identify patterns in resource use, help library make data-driven decisions about acquisitions, weeding, budget allocations.
AI-driven Research Support Tools for Scholars	Integration of AI-based literature recommendation, summarization, thematic clustering — assisting final-year students, post-graduates, faculty in literature review and research.

These opportunities can significantly improve efficiency, access, user experience, and make RUL more aligned with global academic library standards.

6. Challenges & Risks Specific to RU / Bangladesh Context

While AI offers many opportunities, RUL will likely face several obstacles:

1. **Infrastructure gaps** — inconsistent power supply, limited internet bandwidth, outdated computer systems, lack of server capacity — may hinder deployment and maintenance of AI.
2. **Budget constraints** — AI software licenses, hardware upgrades (servers, backup, storage), maintenance, data storage costs — may compete with other library needs (e.g. book acquisition, staff salary).
3. **Lack of trained human resources / AI literacy** — librarians may not have prior training in AI, ML, data management, or ethical AI usage; user base (students/faculty) may also not be familiar with AI-based usage.
4. **Ethical and privacy concerns** — e.g. when building recommendation systems or user profiling, there is risk of data misuse or bias; need for policies to protect user data and ensure transparency.
5. **Resistance to change / human factor** — librarians or users may be skeptical of replacing human-driven services with AI; fear of job displacement; loss of personal touch in reference services.
6. **Sustainability and maintenance** — after initial deployment, ongoing maintenance, updates, handling of bugs/errors, data cleaning, backups — these need institutional commitment.

7. Proposal: A Roadmap for AI-Integration at RUL

To responsibly integrate AI-based services at RUL, we propose a phased roadmap:

Phase 1: Assessment & Capacity Building

- Conduct a **needs assessment and feasibility study**: survey students, faculty and library staff to identify key pain-points and priority services (e.g. discovery/search, reference help, digitization).
- **Infrastructure audit**: Evaluate existing hardware, network, power situation; estimate what upgrades (servers, storage, stable internet) would be needed.
- **Training and AI literacy**: Organize workshops for librarians and library staff on basics of AI, data ethics, AI tools, metadata standards, digital archiving. Align with national/regional AI guidelines (e.g. under the national AI policy). Indeed, recent commentary suggests AI literacy is crucial for academic libraries in Bangladesh. (blogs.ifla.org)
- **Policy & governance framework**: Formulate policies for data privacy, user consent, ethical usage, long-term maintenance and accountability.

Phase 2: Pilot Projects

- **Pilot an AI-powered discovery/search interface**: integrate an AI-based search assistant (or open-source NLP search tool) to catalog both print and digital resources.
- **Pilot a chatbot / virtual reference service**: for basic queries (e.g. library hours, borrowing rules, resource availability), reference guidance, quick-help — ideally starting with a limited scope (e.g. general FAQs).

- **Digitization of selected local collections:** pick a set of theses, archives, old books — digitize and apply OCR + AI-based metadata extraction to make them searchable.
- **User feedback and evaluation:** collect feedback from students, faculty, librarians — evaluate performance, user satisfaction, issues, benefits.

Phase 3: Scaling & Integration

- Expand AI tools to cataloging, metadata generation, resource recommendations, personalized services.
- Develop analytics dashboards for library management — usage statistics, popular resources, acquisition needs, user behavior modeling.
- Institutionalize AI-based services: embed into routine library operations; ensure maintenance, updates, staff training; allocate budget as needed.
- Promote inclusive services — e.g. assistive technologies (text-to-speech, translation) for differently abled or non-English users.

7. Discussion

After reviewing the website, no research related to ‘AI in the Rajshahi University Library’ was found. However, some publications were discovered on the web regarding the digitization of RU libraries, particularly the use of the integrated library management system (ILS) with KOHA and DSpace for managing digitized institutional repositories.

Implementing AI in RUL could transform the library into a modern, responsive, efficient, and inclusive academic CenterPoint - to support research, learning, and knowledge dissemination. For a leading university in Bangladesh, this has particular significance: given limited resources, AI can help maximize the value of existing collections (especially by improving access to digital and open-access materials) and expand reach beyond physical limitations.

Of course, success depends on careful planning, infrastructure development, skilled staff recruitment, ethical governance, and institutional commitment. Without them, AI adoption could be superficial — or worse.

Therefore, a cautious, phased, participatory approach — involving librarians, faculty, students, and administration — is required.

8. Conclusion & Recommendations

AI is no longer a concept of the future—it is a real tool that can enhance both personal and professional life. From managing household tasks to making data-driven decisions in sectors like health, education, and finance, AI is demonstrating efficiency, accuracy, and creativity. This paper describes how AI can transform library services (specially RUL) for better desirable but increasingly necessary to meet the evolving information needs of Rajshahi University’s academic community. With proper planning, capacity building, and ethical governance, AI-driven services can significantly improve accessibility, efficiency, and user satisfaction.

Although AI offers many advantages, issues such as privacy violations, bias, and job displacement cannot be ignored. New AI-based possibilities are emerging every day. Along with AI development, effective policies are also necessary.

9. Recommendations

1. University authorities can do a feasibility study for AI adoption at RUL.
2. Provide training programs (AI literacy, digital librarianship) for existing library staff.
3. Recruit technologically sound library professionals for future library needs.
4. Begin with pilot projects (search interface, digitization) before full-scale implementation.
5. Seek collaboration with other Bangladeshi universities / national bodies to share resources, infrastructure, and best practices.

Such forward-looking efforts could position Rajshahi University as a leader in modern academic librarianship in Bangladesh.

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Digital Literacy Skills of University Students in Bangladesh: A Conceptual Analysis of Their Impact on AI-Driven Academic and Library Services

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Abstract

The rapid integration of artificial intelligence (AI), automation, and digital information systems is reshaping higher education and transforming how students access academic and library services. Digital literacy has therefore become a core competency for navigating AI-driven learning environments (Gilster, 1997; Bawden, 2008). This conceptual paper examines the digital literacy skills of university students in Bangladesh, the rising adoption of AI-enabled academic and library systems, and the theoretical linkage between digital competencies and student engagement with smart educational platforms (Long & Magerko, 2020; Park & Jo, 2021). Based on an extensive literature review, the study proposes a conceptual framework explaining how digital literacy influences students' ability to access, understand, evaluate, and utilize AI-supported services (Eshet-Alkalai, 2004; Manjunatha, 2023). The paper highlights contextual challenges and offers directions for future research and policy.

Keywords

Digital Literacy; Artificial Intelligence (AI); AI-Driven Academic Services; AI-Driven Library Services; Conceptual Framework.

Introduction

The rapid digital transformation of higher education—driven by artificial intelligence (AI), data analytics, automation, and smart information systems—has significantly reshaped how students access and interact with academic and library services. For university students, digital literacy now represents more than basic ICT skills; it includes the ability to evaluate online information, use academic databases, interact with intelligent learning systems, communicate in digital spaces, and uphold data ethics and privacy principles (Gilster, 1997; Eshet-Alkalai, 2004). In Bangladesh, universities are gradually integrating AI-driven academic platforms, automated assessment tools, digital repositories, and smart library services (Park & Jo, 2021; Manjunatha, 2023). Understanding how students' digital literacy supports effective engagement with these systems is therefore essential. This study critically reviews existing global and local literature to identify concepts, constructs, and theoretical relationships that explain how digital literacy influences students' interaction with AI-enabled educational environments (Bawden, 2008; Long & Magerko, 2020). Based on this analysis, the study proposes a conceptual framework suited to the Bangladeshi higher education context.

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Literature Review

Digital Literacy

Digital literacy refers to the ability to access, understand, evaluate, manage, and communicate information using digital technologies (Gilster, 1997; Bawden, 2008). Eshet-Alkalai (2004) expands this notion by describing digital literacy as a multidimensional competence that includes cognitive, ethical, and socio-emotional skills. For university students, digital literacy encompasses ICT proficiency, information searching and evaluation, academic database use, ethical information practices, familiarity with AI-based tools, and awareness of privacy and security issues. Recent research emphasizes *AI literacy*—the ability to interact with AI systems, interpret machine-generated content, and understand algorithmic processes—as a critical new dimension of digital competence (Long & Magerko, 2020).

AI-Driven Academic Services

AI is increasingly used in higher education to support personalized learning, predictive analytics, automated assessment systems, intelligent tutoring, feedback generation, and plagiarism detection (Park & Jo, 2021). These systems help institutions improve student engagement, optimize learning pathways, identify at-risk learners, and automate routine academic tasks. Effective use of these tools depends significantly on students' digital and AI literacy.

AI-Driven Library Services

Academic libraries worldwide are adopting AI for smart information retrieval, chatbot-based reference services, automatic cataloging, metadata generation, institutional repositories, recommendation systems, and data analytics for user behavior (Manjunatha, 2023). However, to fully utilize these systems, students must possess adequate digital literacy, understand search strategies, and engage with AI-powered interfaces confidently.

Methodology

This study follows a conceptual research design grounded in theoretical analysis and extensive literature review (Eshet-Alkalai, 2004). Rather than collecting empirical data, the research synthesizes existing theories, conceptual models, and scholarly discussions related to digital literacy and AI-enabled academic services (Bawden, 2008). Global and Bangladeshi literature on digital literacy, AI adoption in higher education, smart library systems, and technology-enhanced learning was examined to identify key constructs and conceptual relationships (Park & Jo, 2021; Manjunatha, 2023). Established digital literacy models, AI literacy frameworks, and technology acceptance theories were analyzed to identify gaps and derive relevant insights (Long & Magerko, 2020). Based on this synthesis, a conceptual framework was developed to explain how digital literacy influences students' effective utilization of AI-driven academic and library services. No questionnaires, interviews, or empirical datasets were used, which aligns with the nature of conceptual research.

Results (Conceptual Findings)

As a conceptual study, the results represent theoretical analysis rather than empirical outcomes (Eshet-Alkalai, 2004). The review identified five core digital literacy competencies essential for navigating AI-driven academic systems: ICT proficiency, information literacy, communication and collaboration skills, AI literacy, and data ethics and privacy awareness (Gilster, 1997; Bawden, 2008). The analysis also revealed key mediating factors—such as access to digital infrastructure, student training, and institutional digital readiness—that influence how effectively students engage with AI-enabled services (Park & Jo, 2021). Furthermore, the study found that AI-driven academic tools (e.g., automated assessment, intelligent tutoring, predictive analytics) and AI-driven library services (e.g., smart search engines, reference chatbots, digital repositories) play a crucial role in shaping students' learning experience (Manjunatha, 2023; Long & Magerko, 2020). These components collectively inform the conceptual framework.

Discussion

The findings suggest that digital literacy is a foundational requirement for meaningful student engagement with AI-enabled academic and library systems (Gilster, 1997; Eshet-Alkalai, 2004). Students with strong digital competencies are better equipped to interpret digital content, utilize online platforms, interact with intelligent systems, and maintain ethical information practices (Bawden, 2008). In contrast, limited digital literacy creates barriers to accessing AI-based academic opportunities (Long & Magerko, 2020). The proposed conceptual framework clarifies how digital literacy contributes to improved learning performance, better research productivity, and enhanced student satisfaction. It also highlights contextual challenges in Bangladesh, such as infrastructural limitations, unequal access to technology, and insufficient training opportunities (Park & Jo, 2021; Manjunatha, 2023). Addressing these issues will help universities maximize the benefits of AI-driven educational services.

Proposed Conceptual Framework (Text Description)

The conceptual framework illustrating the relationship between digital literacy, mediating factors, and AI-driven services is presented in Figure 1.

Inputs

- ICT skills
- Information literacy
- AI literacy(Long &Magerko, 2020)
- Data ethics & privacy awareness

Mediators:

- Digital infrastructure(Park & Jo, 2021)
- Student training
- Institutional support

Processes

- AI-driven academic platforms
- AI-enabled library services(Manjunatha, 2023)

Outcomes

- Improved academic performance
- Enhanced research efficiency
- Better information management(Eshet-Alkalai, 2004)
- Higher student satisfaction

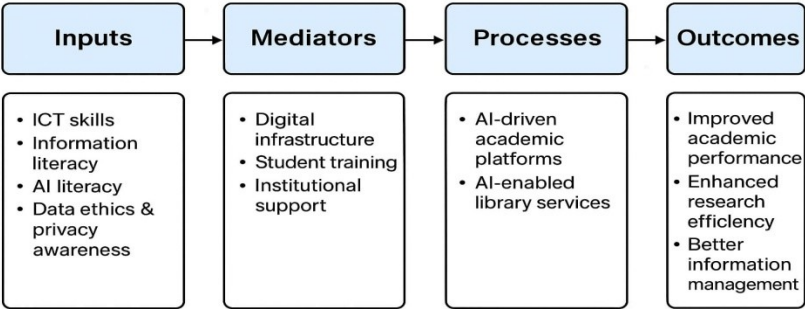


Figure 1: Conceptual framework linking digital literacy, mediating factors, AI-driven academic and library services, and expected outcomes.

Conclusion

Digital literacy is essential for university students navigating AI-enhanced academic environments (Gilster, 1997; Bawden, 2008). As Bangladesh continues to adopt intelligent learning and library systems, the need for digital and AI literacy becomes even more critical (Long & Magerko, 2020; Park & Jo, 2021). This conceptual paper provides a theoretical foundation that explains the relationship between digital literacy and effective engagement with AI-enabled educational services and proposes a framework to guide future research and policy initiatives (Eshet-Alkalai, 2004; Manjunatha, 2023).

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Improving Library Services for the Development of School, College and Madrasah Education: A case study of Savar Upazila of Bangladesh

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Parul Parvin²

Khadiza Parvin³

M A Matin⁴

Abstract

No nation can achieve further development without developing proper libraries in their institutions of learning and communities that will provide quality education and produce responsible citizens. Keeping this view in mind, the researchers started the project. The purpose of the study is to explore the existing status of library information services of 50 (school 15, college 25, and madrasah 10) libraries of the Ashulia, Savar area, compare them with the government's requirements and fixed standards, determine the gap between, and make recommendations to improve. The study provides a picture of the selected 50 libraries of the said suburban area of Dhaka district. The size of the population was 300, including the students (150), teachers (100), and librarians (50). Following the analysis of the collected data, the researchers have made recommendations on the subject so that all concerned, particularly the decision-makers, can get appropriate clues to take proper decisions to improve the school, college, and madrasah libraries of Bangladesh, which certainly shall help ensure quality education and national sustainable development and bring Bangladesh's education to a good position in global rankings. The study has been conducted based on primary sources. Data collection is done through structured questionnaires and face-to-face interviews. Secondary data has also been used in some cases in limited form. The study provides a picture of the selected 50 libraries of the stipulated area. Available data have been analyzed and presented in graphic representation. Statistical analysis of data by SPSS has also been done. Observation of the researchers has also been used as primary data. Relevant government agencies have been contacted for their comments on the existing situation of the libraries. A literature review is done, and a few publications are found in school libraries. However, specific comprehensive studies have not been found on school, college, and madrasah libraries in rural areas of Bangladesh. So this study is quite justified. According to the analysis of the collected data as described in tabular form. The researchers found that the infrastructure of the libraries is not satisfactory. The reading environment is not conducive to proper study. The collection is poor and outdated in most of the libraries, and there is no yearly

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budget for purchasing books, etc. Computer and internet facilities are available only in a few libraries. Qualified and trained librarians are lacking in most libraries. The library literacy program is found absent, violating the government order. The experiences gathered by the researchers by physically inspecting the libraries are that most of the libraries could not fulfill the desired satisfaction in terms of having an optimum level of use by the students, neither providing them proper facilities nor good library literacy, which might be an asset for their future life. Based on the analysis, a few problems have been identified, and the final recommendations are that, as per the government orders, every school, college, and madrasah library should provide proper space conducive to reading; qualified librarians; an up-to-date collection of reference books, journals, magazines, and newspapers; a yearly budget for procuring learning materials; a computer with a high-speed internet connection; a library literacy program; and different activities and programs for increasing the reading habits of the students.

Keywords

Bangladesh Education System, Rural Libraries, Library Literacy, Library Services in Bangladesh, Educational Institutions, Library Development.

Introduction

Bangladesh conforms fully to the UN's Education for All (EFA) objectives, Millennium Development Goals (MDGs) as well as other education related international declarations. Now the Government of Bangladesh tends to align the curriculum that meets the Sustainable Development Goals (SDG)-4, i.e. ensuring Inclusive and Equitable Quality Education. The goal ensures that all girls and boys complete free primary and secondary schooling by 2030.

According to Education Statistics of Bangladesh 2023, there are 1,14,630 primary schools, 23,500 Secondary schools 18,968 (628), 1,480 (63) 3341 (637) colleges, 9259 (3) Madrasas, 2547 (317) Technical-Vocational institutions, and 173 Universities (Public 57 and Private 116). Besides there are independent Professional institutions.

Though Bangladesh has, during the last few decades, made significant progress in socioeconomic sectors and strived to make headway in education sector, it lagged behind in providing quality education. UNICEF, World Bank and other agencies relating to education opine that the quality of primary and secondary education of Bangladesh does not meet the desired standard and are lagging behind from neighboring Sri Lanka and India.

As per educational needs and the requirements of the government every educational institution must have well equipped library for providing necessary information (learning resources both printed and digital) for meeting the needs of the students to enhance their knowledge. However, the available information on the status of the school, college and madrasah libraries (excepting very few) gives us a dismal picture in terms of their infrastructural facilities, learning materials, services and so on.

Among all kinds of libraries, Academic libraries are considered to be the foundation of all libraries. Because the students get the primary idea and encouragement of increasing their knowledge base from their institutional libraries and get prepared for future life. The

students who got out of their institutions having habituated with library use the foundation of their education becomes better than who have not been habituated with library use. But facts remain that the overall condition of the school, college and madrasah libraries of Bangladesh in terms of infrastructure, book collection, staffing is not as standard as stipulated in the government's required norms and procedures. The government has issued circular to establish libraries with certain areas of space, trained manpower, furniture and hold library classes for each class everyday but it is unearthed that in majority of the institutions are not in the position to comply the order.

The study provides a picture of the selected 50 (fifty) libraries (school 15, college 25, and madrasah 10) of Ashulia, Savar of Dhaka district. The size of the population was 300 (150 students, 100 teachers and the 50 librarians). Following the analysis of the collected data the researchers have made recommendations on the subject so that all stakeholders particularly the decision makers can get appropriate clue to take proper decision to improve the libraries of schools, colleges and madrasah libraries of Bangladesh.

Objectives of the study

The general objective of the study is to reveal the existing situation of the few school, college and madrasah libraries of Ashulia, Savar, Dhaka compare them with government's requirements and fixed standard, determine the gap between and make recommendations to improve.

Literature Review

A British Council report claimed that almost everyone who goes to the library thinks that libraries are highly valuable for society, about 63% of users perceive Bangladeshi libraries as not being technologically modern, and library services are not creative enough. Katz (2016) noted that most children in Bangladesh only have access to textbooks at school; additional materials like storybooks and educational games are rare and 40% of children do not have books other than religious texts at home. Similarly, Tasneem (2017) reported that 40% of librarians in Bangladesh mention the lack of availability and variety of books as one of the critical problems they face in their daily responsibilities at work which adversely affect school libraries in attempting to achieve their educational potential. In many schools, colleges and madrasahs, where there are libraries, but services are not robust and a lack of updated resources is a common challenge. A study by Shuva and Akter (2011: 69) claims, "ICT status in school and college libraries in Bangladesh is very much disappointing". Imon's (2017) study further pointed out that in secondary schools in Bangladesh students has almost no access to digital libraries. The World Bank (2013) further reported that many underprivileged schools do not have the capacity to invest in libraries and laboratories or these facilities risk being underutilized. For Non-Government Secondary Schools (NGSS) to receive MPO recognition they need to fulfill specific requirements and having a library is one of them. However, for the some 20,000 NGSS in Bangladesh, there are only 12,198 school librarians (BANBEIS Database, 2017b) and approximately 9000 schools have dedicated libraries or reading rooms (SLP3—see Methodology section). Abbas (2018) reported that

various MPO-listed non-government secondary educational institutions across the country do not have proper libraries despite the availability of librarians. In Bangladesh, only a few scholars have conducted research in relation to school libraries and school librarians based on secondary literature. Those studies identified that the importance of developing school, college and madrasah libraries and creating qualified library professionals for the longest time, has been overlooked by policymakers in Bangladesh (Dhaka Tribune, 2018a; Islam and Chowdhury, 2006; Rahman, 2017). These libraries are considered the last item on the school, college and madrasah priority list and there is no regular subvention for libraries in the country's annual budget (Islam and Chowdhury, 2006; Rahman, 2017). Overall, school, college and madrasah libraries and librarians in Bangladesh are facing significant challenges, mainly due to lack of continuous professional development opportunities, will and awareness, the nonexistence of national policy on the school library system and of course the apathetic attitude of the authorities. Against this background, it appears that understanding the current situation of school, college and madrasah libraries and librarians of Bangladesh straight from the school library practitioners is critical. Besides, in view of the lack of literature on school libraries in Bangladesh, it is also equally important to picture the solid context, challenges and focus points for improvement for an array of stakeholders, including librarians, researchers, educators and policymakers.

Methodology of the Study

Interview method through questionnaire was applied. Three questionnaires were prepared (1 for students, 1 for teachers and 1 for the librarians.) Secondary sources were also used in the work. After completion of the survey, efforts were made to compile and edit the collected data to ensure the accuracy and validity of the collected information emphasizing on the qualitative interpretation. Simple statistical method, such as, total number, percentage, etc. have been applied.

Analysis of Data and Findings

Data have been collected from the librarians/in-charge of the libraries of 50 institutions, Teachers, and students on the following subjects which vividly depicted the ill scenario of school, college and madrasah libraries of Bangladesh:

Analysis of the questionnaire filled out by the librarian/in-charge Infrastructure

Table 1

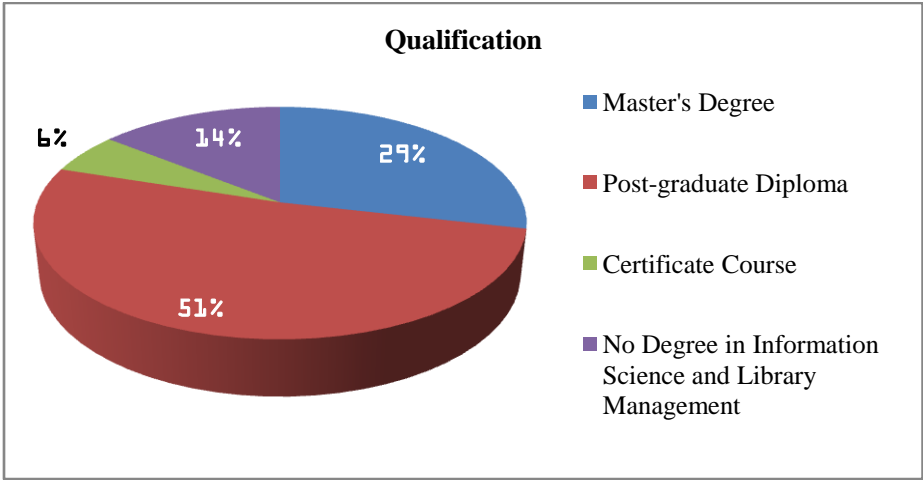
Type of Building	Number	%
Pucca concrete building	33	94.3%
Tin-shed building	2	5.7%
Total	35	100%

Table 2

Separate Room	Number	%
Yes	2	5.7%
No	33	94.3%
Total	35	100%

The above tables show that out of 35 institutions 33 (94.3 %) have libraries in pucca concrete buildings with reading room facilities. Only two (5.7%) librarians have separate rooms to sit on. The rest 2 (5.7%) institutions have tin-shed buildings and have no specific place for the librarians to sit on and they maintain their library services from the same rooms and/or other make-shift places.

Manpower Figure 1



The figure 1 shows the manpower position of the surveyed 35 libraries. Among them Ten libraries (28.6%) have librarians having Master’s degree in information science and library Management, 18 (51.4%) hold Post-graduate Diploma, 2 (5.7%) have Certificate Course (Semi-professional degree) on the same discipline and 5(14.3%) are teachers/officers having no degree in library information science.

Library Collection (Print matter)

Table 3

Quantity of Books	Number	Percentage
More than 5,000 books	1	2.9%
Around 5,000 books	5	14.3%
Less than 1,000 books	19	54.3%
Less than 500 books	10	28.6%
Total	35	100%

The collection of learning resources (printed matter) of the surveyed libraries indicate that only one library (2.9%) contains 21,404 books, magazines and newspapers. The rest 5 (14.3%) libraries have around 5,000, 19 (54.3%) have less than 1,000 and 10 (28.6%) have less than 500 books. Excepting only one library, collection of print matter of the rest 34 libraries gives a dismal scenario of the library collection of the surveyed libraries.

Digital Resources
Table 4

PCs with internet connection	Number	Percentage
Yes	10	28.6%
No	25	71.4%
Total	35	100%

According to the Table - 4 it is observed that out of 35 libraries surveyed 10 (28.6%) have PCs with internet connection. Students and teachers seldom use these PCs for meeting their information needs. However, students don't have freedom to use these PCs independently. They have to meet their digital need via the librarians. No digital resources or database/s are procured, preserved and/or searched for study, teaching and research purposes. In the age of Fourth Industrial Revolution (4IR) and Artificial Intelligence (AI), the students and teachers of a few schools, colleges and madrasahs of suburban area of Bangladesh don't have so much taste on searching digital resources on the internet for study and teaching purposes which demonstrate a sad picture of school, college and madrasah libraries of Bangladesh.

Budget Allocation

No data found on the recurring allocation of budget for the libraries 35 (100%). However, occasional allotment of money is available sometimes for purchasing reading materials. Library fees collected from the students at the time of their admission form a small budget which is used for purchasing of books, observing other festivals, etc. It may be mentioned that the researchers could not identify any concrete data regarding library budget of the studied institutions. Library rules have not found in any library.

Analysis of the questionnaire filled out by the Teachers

One hundred teachers (Male 55 and Female 45) took part in the survey, aged 25 - 55 years in the present study. The queries of the questionnaire included the nature of purpose of their library use, staff behavior, availability of reading materials, borrowing facilities, reading environment, reprographic facilities, E-book and digital resources facilities, library literacy program, holding library class, etc. According to the available data the researchers found 77 (77%) Teachers (Male 41 Female 36) opined that they use the library but 33 (33%) do not go to the library. As per as purpose is concerned 19 (24.68%) opined that they go to the library for self-study, 20 (25.97%), 18 (23.38%) for research and teaching preparation respectively. Only 10 libraries have computer and internet facilities under the custody of the librarians. So the

teachers do not have any dedicated computer with internet facilities for online database or book searching. Within these limitations the teachers have to perform their library work.

Analysis of the questionnaire filled out by the Students

According to the analysis the researchers found that 20 (18.18%) students (Male 10 Female 10) use library every day, 22 (20%) twice a week, 40 (26.67%) do not go to the library. As per as purpose is concerned 54(49.09%) opined that they go to the library for reading books, 30 (27.27%) for gossiping, 26 (23.64%) to read newspapers. Seventy three (66.36%) students have library cards. The behavior of the library staff is excellent is opined by 50 (45.45%) students. Reprographic facilities are available was stated by 50 (45.45%) students. No library briefing or orientation is held opined by 62.73% students. Based on the survey the researchers came to the conclusion that 8.57% libraries' performance is satisfactory. The experiences gathered by the researchers by physically inspecting the libraries is most of the libraries could not fulfill the desired satisfaction in terms of having optimum level of use by the students, neither providing them proper facilities nor good library literacy which might be the asset for their future life.

Besides the opinion of the librarians, teachers and students of the studies institutions, the researchers study the following governmental policies regarding the school, college and madrasah libraries of the studies area.

Directives from the government

The respective department of the Ministry of Education, Government of Bangladesh has issued notification/s mentioning all the requirements to get approval imparting lessons/MPO. In case of school and college the issuing authority is Board of Intermediate and Secondary Education BISE and in case of Madrasah it is Madrasah Education Board. The notification clearly mentioned that the requirement of the library of a school and a college is mandatory to be approved.

Compliance with the government directives

When compared with the government directives, the researchers found that only 08% schools have fulfilled the board's requirements and 15% colleges could fulfill. 5% Madrasahs could comply with the directives. According to data and the opinion of the researchers is that the compliance rate is not satisfactory. The institutions have to have special attention for the compliance with the government directives and the monitoring system should be strengthened more to bring the libraries of the schools, colleges and madrasahs of Ashulia, Savar area under compliance of the government directives.

Status of Compliance with the Government directives

A total of 4 government orders/principles have been collected by the researchers including application forms for approval of the school, college and madrasa, Monthly Pay Order MPO, etc. Though these orders/principles did not mention specifically the

requirements of the library of a school, college and madrasah but there are urges that without libraries no approval could be obtained.

Recommendations

Developing school, college, and madrasah libraries in Bangladesh requires a multi-faceted approach involving infrastructure improvement, trained library personnel, resource enhancement, digital transformation, capacity building by allocating budget and increasing users' engagement, and above all compliance of the existing government orders and normal standards. Here are key measures that should be taken into consideration:

A. Infrastructure Development

Renovation and Expansion of the libraries. Upgrade existing library spaces with proper seating arrangements, lighting, ventilation, and shelving.

B. Qualified and Trained Manpower

The principal reason for lagging behind the libraries in terms of poor collection, less user engagement, proper services and robust public relations is lack of driving force of the libraries, i.e., competent library staff.

C. Enhancing Learning Resources

Regularly update books, including Bangla and English literature, academic references, and competitive exam materials along with daily newspapers and magazines.

D. Increase Users' Engagement

Quality education is deeply related to the use of library. Nonetheless, libraries should take measures to enhance users' engagements through Information Literacy Programs, Book Exhibition, Book Jacket Display, Observing Library Day, Book Day, etc. Besides, students' orientation about library use, Promoting a Reading Culture, Incentivize Usage, like reward for frequent library users with certificates or small prizes, holding library class and related functions are suggested.

E. Digital Transformation

Dedicated computer terminal with internet connection in the library for the readers, is a must for the development of the libraries of the schools, colleges and madrasahs of Bangladesh. The computer should have database for their own collection with search facilities and should be linked with other databases.

Beside existing suggestions, the researchers also recommend to focus on these following issues; such as provide professional training for Library Lecturer or Assistant Teacher (Library and Information Science), increase budget allocation, compliance of Government orders, community and corporate involvement, donation and public-private partnerships, regular audits, feedback mechanisms, and teacher-librarian Collaboration.

Conclusion

When the question of sustainability comes up, we need to remember that education is the basis of development – physical, mental, intellectual, economic and infrastructural. However, the complete and quality education cannot be materialized without proper development of libraries in schools, colleges and madrasahs. The condition of the libraries of these institutions of Savar area has been found improving day by day and hopefully shall gain momentum in future.

By implementing the above recommendations, Bangladesh can transform its high school, college, and Madrasah libraries into dynamic learning hubs that support academic excellence, digital literacy, and lifelong learning. Strong government support, community involvement, and technological integration will be crucial for success.

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Exploring Faculty Perceptions of AI Integration in Academic Libraries: A Case Study of the National University, Bangladesh

Anita Helen¹

Abstract

Background/Purpose: Artificial Intelligence (AI) is revolutionizing library and information services globally through automation, personalized learning, and enhanced knowledge management. This study aimed to assess faculty members' awareness, perceptions, and readiness regarding the integration of AI technologies in the National University library system. It also sought to identify existing knowledge, training, and infrastructure gaps while suggesting strategies for effective AI adoption.

Methodology: A quantitative research design was employed using a structured questionnaire administered to 72 on-campus faculty members of the National University. The instrument contained demographic questions and Likert-scale items related to awareness, perceived benefits, challenges, and readiness. Data were analyzed using descriptive statistics (frequency, percentage, mean, and standard deviation) and inferential tests (t-test and ANOVA) to examine group differences.

Findings: The study revealed that faculty members were moderately aware of AI applications in libraries but demonstrated limited hands-on knowledge. While most respondents recognized AI's potential benefits—such as improved efficiency, user support, and resource management—they identified several challenges, including insufficient infrastructure, lack of technical expertise, and absence of institutional policy. Overall, the National University library was perceived as not yet fully prepared for AI integration.

Practical Implications: The findings highlight the need for targeted training programs, capacity-building initiatives, and the development of clear institutional policies to facilitate AI adoption. Collaborative efforts among faculty, librarians, and IT professionals are essential to strengthen institutional readiness for digital transformation.

Conclusion: This study contributes valuable insights into faculty perceptions of AI in academic libraries within the Bangladeshi context. It emphasizes that fostering awareness, enhancing technical skills, and improving infrastructure are crucial for successfully integrating AI into higher education libraries.

Keywords

Artificial Intelligence (AI), Academic Libraries, Faculty Perceptions, Library Readiness, Higher Education, Bangladesh

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AI Literacy and Ethical Awareness among LIS Students in Bangladesh: Exploring Socio Demographic and Curriculum Perspectives

Md. Sakib Biswas¹
Zakir Hossain²

Abstract

Bangladesh demonstrates a strong policy commitment to Artificial Intelligence (AI), earning a perfect score in the 'Government AI Vision' category of the 2024 Oxford AI Readiness Index. However, its overall ranking of 80th—due to low scores in human capital and maturity—reveals a critical gap between strategic vision and implementation capacity. This discrepancy highlights the need to enhance AI capabilities within the education sector. Within this context, Library and Information Science (LIS) programs play a crucial role in preparing future information professionals for the AI-driven knowledge economy. This study explores AI literacy of Bangladeshi LIS students, understanding how demographic factors, including gender, university type, qualification level and English proficiency, relate to their AI literacy, tool usage and ethical awareness.

A cross-sectional survey was conducted among LIS students across public and private universities. Participants reported their demographic details and self-assessed AI literacy levels (from "No experience" to "Expert"). Descriptive statistics were used to analyze AI familiarity, usage patterns, learning sources and application areas. Multinomial logistic regression predicted the likelihood of attaining higher AI literacy, while nonparametric tests (Mann–Whitney U and Kruskal–Wallis H) examined group differences in literacy, understanding, proficiency and ethical attitudes.

Findings revealed that most students possessed at least a basic understanding of AI. Only 4.9% reported no experience, while 73.3% demonstrated basic or higher proficiency, and 25.7% identified as "Expert" users. Formal education emerged as the leading learning source (71.6%), followed by social media, web browsing, peer interaction and news media. Among AI tools, ChatGPT was overwhelmingly dominant (used by 60.6% of participants), with Gemini and Bing following. Common AI applications included speech-to-text systems (61.1%), text-to-image generators (51.3%) and virtual or augmented reality tools (48.4%), reflecting engagement with both accessibility and creative technologies. Students used AI most frequently for information searching and answering questions (mean ≥ 2.16 on a 0–3 scale), while generating research ideas was less common (mean ≈ 1.92).

Regression and rank tests identified significant demographic effects. University type, qualification and English proficiency were strong predictors of AI literacy. Students from public universities were significantly more likely to achieve 'Advanced or Expert' levels of AI literacy than those from private institutions ($p < .001$). Bachelor's students reported higher overall AI literacy, proficiency and ethical concern, while master's students scored higher in AI familiarity and

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understanding. This suggests that undergraduates are more practically engaged, whereas postgraduates possess stronger conceptual awareness. English proficiency was a decisive factor—students with upper-intermediate English skills demonstrated superior literacy and proficiency, while beginners lagged. Gender differences were statistically insignificant, suggesting equitable engagement across male and female students.

Ethical understanding among participants was moderate. While over half agreed that AI enhances academic work, they also recognized risks to academic integrity (mean $\approx 3.3/5$). The most frequently cited ethical issues were patron data privacy (71%), algorithmic bias and fairness (56%), and security risks in AI-enabled libraries (51%). Reported challenges included limited technical comprehension, uncertainty about ethical implications and difficulties integrating AI into traditional library practice, compounded by resource constraints and minimal practical exposure.

Overall, the study underscores the urgency of embedding AI literacy and ethics training into LIS curricula in Bangladesh. Programs should emphasize practical engagement with AI tools, strengthen English-language technical competence and promote awareness of critical, ethical and responsible AI use. Policymakers and educators must collaborate to bridge institutional and linguistic disparities, ensuring that all LIS students—regardless of background—are equipped to thrive in an AI-augmented information environment.

Keywords

AI competence, ethical AI use, demographic determinants, generative AI, higher education in Bangladesh, library and information science education.

AI Literacy of Library Professionals in Bangladesh, India and Pakistan: An Empirical Assessment

Zakir Hossain¹
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Abstract

Artificial intelligence (AI) is transforming the landscape of library and information services, offering unprecedented opportunities while introducing complex ethical and practical challenges. As frontline facilitators of information access and digital literacy, librarians are increasingly expected to develop AI literacy that integrates theoretical knowledge, practical skills and ethical awareness. This study provides an empirical baseline of AI literacy among library professionals in South Asia, focusing on participants from Bangladesh, India and Pakistan, and explores how demographic and institutional factors shape their knowledge, skills and attitudes toward AI.

A total of 196 librarians from academic, school, public and special libraries participated in this cross-sectional survey. Data were collected through a structured self-administered questionnaire measuring AI literacy across three dimensions: cognitive (knowledge), behavioral (practical skills) and normative (ethical awareness). The instrument employed five-point Likert scales and demonstrated high internal reliability (Cronbach's $\alpha > 0.85$). Descriptive statistics were used to establish competency levels, while non-parametric tests (Kruskal-Wallis H Test and Mann-Whitney U Test) determined the influence of demographic and professional factors, such as education, experience, age, library type, country and gender.

Findings reveal that librarians in the three countries possess a strong theoretical understanding and ethical awareness of AI but limited practical experience. Respondents reported high familiarity with AI fundamentals and tools (mean ≈ 4.3) and strong awareness of AI's limitations and ethical implications, particularly concerning privacy, bias and transparency (mean ≈ 4.0). However, their practical competencies lagged: many had little experience applying AI in library workflows (mean ≈ 3.0) and only moderate confidence in integrating AI into daily professional activities (mean ≈ 3.5). This gap between knowledge and practice suggests that, although librarians recognize the strategic importance of AI in contemporary librarianship, they lack sufficient training and institutional support to apply AI effectively in their workplaces.

Significant differences in AI literacy were observed across demographic and professional variables. Librarians with postgraduate qualifications and longer professional experience demonstrated significantly higher AI literacy than those with less education or early-career status ($p < 0.05$). Mid-career and senior librarians outperformed younger colleagues, indicating that advanced education and professional experience enhance AI competencies. The library workplace also mattered: participants from university libraries reported higher AI literacy than those in school or public libraries, particularly in knowledge and practical domains. In contrast, the

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Kruskal-Wallis H test revealed no statistically significant differences in AI literacy across countries or by gender (p -values for all dimensions > 0.05), suggesting that AI literacy challenges are regionally consistent and not shaped by national or gender-based disparities. Finally, participants rated existing AI training for librarians as only moderately effective, with an average score of approximately 3.1 out of 5.

The findings from this study serve as a call to action for library stakeholders in the Global South and beyond for targeted professional development and structured training initiatives. To bridge this skills gap, practical and context-sensitive strategies are required, such as low-cost workshops or job-alikes, online courses, and peer mentoring with open-source AI tools tailored to South Asia's economic context. Library and Information Science (LIS) curricula in Bangladesh, India and Pakistan can integrate AI literacy components, complemented by in-service training focused on applied practice and ethical reflection. At the policy level, it is imperative to embed AI literacy into national library strategies and to establish clear ethical frameworks for AI use. Librarians themselves voice a strong demand for such guidelines (mean agreement 4.32). By investing in policy and technical competencies, library leaders in the Global South can empower professionals to harness AI responsibly, bridging current gaps and advancing the future of librarianship in the generative AI-driven information environment.

Keywords

Generative AI, AI in libraries, professional development, librarianship in South Asia, LIS education

Artificial Intelligence in Academic Libraries: Perspectives of LIS Professionals in Bangladesh

Anita Helen¹
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Abstract

Artificial Intelligence (AI) is increasingly reshaping academic libraries worldwide, offering opportunities to enhance information retrieval, automate routine tasks, and deliver personalized services. This study investigates how Bangladeshi LIS professionals consider AI applications in library services. This study employed a quantitative survey method to collect responses, which were carried out to study the perceived benefits, requisite AI-related competencies and level of understanding among library professionals in Bangladesh. In this research, data were collected through an online questionnaire administered via Google Forms. The survey link was distributed to participants working in selected university libraries using email, WhatsApp, and other social media platforms to ensure broad accessibility. The collected data were analyzed using descriptive statistics, including mean, frequency counts, and percentages. A convenience sampling technique was adopted, focusing on the target library professionals. The data obtained from the test and re-test method was calculated using Cronbach's alpha (α) reliability test technique to ensure consistency. Non-parametric tests such as the Mann-Whitney U test and the Kruskal-Wallis H test were used to examine the differences between demographic characteristics of the respondents and their opinions regarding perceptions, potential benefits, and challenges of AI. Furthermore, inferential statistics, notably the t-test, were employed to identify significant variations in respondents' perceptions of AI adoption based on demographic variables. The statistical analysis was performed using SPSS software.

The results indicate a strong inclination toward AI adoption, highlighting its potential to enhance information retrieval, automate repetitive tasks, and improve data analysis. Findings reveal that LIS professionals are well aware of the positive effects for their own libraries (e.g., smart cataloguing, virtual reference service or predictive analytics), but there are concerns concerning infrastructure limitations, inadequate training and ethical issues. The research identifies and discusses opportunities and barriers to AI adoption, which highlight the importance of strategic planning, professional development, and policy frameworks for supporting AI transformation in academic libraries in Bangladesh. Additionally, the research highlights key AI-related skills that LIS professionals need to undertake the incorporation of AI appropriately. Moreover, the results suggest targeted training programs and infrastructure investments to address resource limitations and ethical challenges. These findings extend the worldwide discourse on AI in librarianship, while anchoring the discussion within the context of developing countries like Bangladesh.

Keywords

Artificial Intelligence, Library Services, Academic Libraries, LIS Professionals, AI Adoption, Bangladesh

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Librarianship of Bangladesh in the Era of AI

Dr. Syed Robiul Bashar¹

Abstract

In the age of AI, the activities of libraries and the librarianship are transforming dramatically, and facilities are modernizing dynamically through digitizing, and integration systems with AI powered tools and techniques. In Bangladesh, a few researches on AI were done in this area in the last couple of years, and recently a good number of researches is ongoing, and also it became the hot favorite topic to the students, specially, in the field of library science, computer science, information, and communications. So, the librarianship of the country is changing frequently, and the library professionals are enthusiastic in adapting the changes due to AI, allies with previous, and existing systems. In addition, the main concerns of AI are maintaining ethical, legal and social issues. Data quality, privacy, and transparency are also concerning. Library and librarianship are addressing the challenges, upholding, and adapting the changes due to the influences of the AI. Bangladesh has established the “National Artificial Intelligence Policy 2024” to address the social, legal, and ethical challenges caused by AI. These ethical, legal and social issues can be addressed by organizing discussions, workshops, seminars, training, and lecture programs at different levels. AI influences the education institutions very much, and students are potential users of AI, so education institutions can include academic curriculum about these AI to make them aware of fair uses, and take maximum benefits. Also, establishing AI laboratories in the universities, and prospective institutions in organizing AI seminars and workshops, and creating an AI research and training center to fulfill the need of the age.

Key words

Artificial Intelligence (AI), Librarianship, Library professionals, AI ethics, AI Policy.

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Artificial Intelligence Competencies and Skill Development among Academic Library Professionals: A developing country perspective

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Afrin Sultana³
Ziaur Rahman⁴

Abstract

Purpose

The emergence of Artificial Intelligence (AI) is transforming the landscape of libraries and information services worldwide by integrating intelligent systems, automatic metadata creation, chatbot reference services, and data driven approaches. Academic libraries play a pivotal role for growth mindset, in this context academic libraries provide better up-to-date services to the academic community but in this age of AI revolution, for providing innovative and technological services, library professionals need to be more competent, which requires robust AI and technological competencies. This study aims to investigate AI competencies and skill development level of academic library professionals of Bangladesh as a developing country.

Methodology

Using qualitative approach, the authors conducted semi-structured interviews with a random sampling technique among twenty professionals working in different academic libraries such as East West University, North South University and Uttara University to understand their AI competencies and skill development levels for providing better services in this digital age. The collected interview data were analyzed by using grounded theory segments approach. All responses systematically categorized using open coding, axial coding, and selective coding. The study examined the level of awareness, current competencies, perceived benefits, and challenges associated with AI adoption.

Finding

Findings revealed that majority of the library professionals demonstrate positive attitudes towards AI integration in areas of cataloging, digital resource management, information retrieval and research support. The main challenges identified include insufficient training, lack of infrastructural support, lack of access to AI tools, and absence of AI policy.

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Originality

The originality of this study offers insights into the need for structured professional development, curriculum integration and policy development to enhance AI readiness among library professionals.

Conclusions

The conclusions will provide deep insights into the policy makers and academic institutions in understanding how library professionals in developing countries can strengthen their AI-related skills to support innovation, efficient service delivery, and evidence-based decision-making in academic environments.

Keywords

Artificial intelligence, Academic libraries, Skill development, AI competency, Developing countries.

Navigating Administrative Challenges in ETDs Management: Insights and Strategies from Engineering and Technology University Libraries in Bangladesh.

Md. Sharif Hossain¹
Md. Abdul Hakim Shah²

ABSTRACT

Purpose of the study: *Electronic Theses and Dissertations (ETDs) are vital for research as they enhance accessibility, visibility, and the dissemination of scholarly knowledge. However, Engineering and Technology University Libraries in Bangladesh encounter notable administrative challenges that hinder the efficient management of ETDs. This study aims to explore these administrative challenges and propose actionable strategies for the implementation of ETDs management in the context of Bangladeshi Engineering and Technology University Libraries.*

Methodology: *This study used a descriptive research design and qualitative technique. Data were acquired from five Engineering and Technology University Libraries using semi-structured questionnaire. Statistical analyses were performed using SPSS version 26.0. Descriptive statistics was used to summarize and interpret the findings.*

Findings: *The study found that while digital repositories like DSpace are being rapidly adopted, several significant challenges hinder effective ETDs management. These include inadequate staffing and technical expertise, poor monitoring and evaluation mechanisms, voluntary rather than mandatory student participation, low awareness of ETDs, the absence of a dedicated project leader, limited financial resources, and concerns regarding the effectiveness of library leadership.*

Recommendations: *To address the Administrative challenges, the study recommended prioritizing staff training, implementing strategic monitoring and evaluation plans, appointing a dedicated project champion, increasing financial investment, and enhancing promotional activities. Addressing these challenges will improve research accessibility, strengthen academic scholarship, and ensure the long-term sustainability of digital repositories.*

Implication: *This study will assist library administrators and policymakers in evaluating the effectiveness of future ETDs management systems and identifying areas for improvement. Additionally, the recommendations will provide actionable strategies for enhancing ETDs management and promoting digital literacy not only in Bangladesh but also in other developing countries.*

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Limitations: *The study provides a comprehensive analysis of Administrative Challenges in ETDs management; it is geographically limited to Engineering and Technology University Libraries in Bangladesh. Additionally, the reliance on purposive sampling may limit the generalizability of the findings to other contexts.*

Originality/Value: *This study represents the first initiative to explore the Administrative Challenges of ETDs management in Engineering and Technology University Libraries in Bangladesh. It provides a valuable baseline for future research and policymaking, contributing to the global research community.*

Keywords

Electronic Theses and Dissertations, ETDs Management, Administrative Challenges, Engineering and Technology University Libraries, Bangladesh.

Implementing a Google DialogflowChatbot at North South University Library: A Case Study

Md. Ashikuzzaman¹
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Md. Shariful Islam³

Abstract

The increasing demand for instant access to information and continuous library support has encouraged academic libraries to adopt artificial intelligence (AI) technologies to enhance user engagement and improve service efficiency. In response to this global trend, the North South University (NSU) Library initiated a project to design and implement an AI-driven chatbot using Google Dialogflow, aiming to automate responses to frequently asked questions and provide round-the-clock virtual assistance. This study aims to thoroughly examine the design and development process of a Google Dialogflow-based library chatbot, outline its workflow, and identify potential limitations associated in applying such systems within a modern library context. The insights gained from this case study are intended to guide other libraries in developing and implementing their own cost-effective chatbot solutions. To achieve this, commonly requested library information was categorised into eight key areas: Library Services, Library Resources, Library Policies, Printed Resources, Library Timings, Contact Information, Research Support Programs, and Digital Tools. Questions likely to be asked by patrons were analyzed and assigned to library officers specializing in each area. Finally, intents were then created in Google Dialogflow, where user expressions were added and corresponding chatbot responses were developed to ensure accurate and relevant interactions.

This study focuses on how the chatbot was conceptualized, designed, trained, and tested to meet the information needs of library patrons. The development followed a structured model that involved requirement analysis, creation of intent and entities, mapping of conversation flow, integration with the library website, and iterative user testing. The system's advanced Natural Language Understanding (NLU) capabilities enabled it to respond intelligently to frequently asked questions about library services, resources, and policies. Preliminary results from the pilot implementation indicate that the chatbot is effective in reducing repetitive manual queries, enhancing accessibility, and supporting users beyond regular service hours. However, challenges such as interpreting complex academic queries, managing language variations, and the integration of legacy systems remain areas for further refinement. The findings add to the emerging body of research on AI adoption in academic libraries, highlighting the potential of chatbots to enable more responsive, inclusive, and user-centered digital service environments.

Keywords

Google DialogflowChatbot, requirement analysis, intent and entities, conversation flow, integration with the library website, iterative user testing, North South University Library

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Exploring Digital Preservation Practices through Survey: Institutional Repositories in Private Universities of Bangladesh

Shatabdi Chakraborty¹
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Abstract

Introduction: *In today's world, society is surrounded by digital technologies and academic institutions are not beyond society. In the context of Bangladesh, private universities are gradually adopting institutional repositories (IRs) to preserve their academic and administrative resources. This study investigates the digital preservation practices of selected private universities in Dhaka, Bangladesh, focusing on their strategies, tools, and the challenges they face.*

Objectives: *The study aims to explore the current scenario of digital preservation practices like how the information are being preserved and the tools or software's are being used for this preservation and what are the challenges they faced for implementing those digital tools.*

Methodology: *A mixed-method research design was used. Five top-ranked private universities in Dhaka—North South University Library, Ayesha Abed Library, BRAC University, Library of Independent University Bangladesh, Dr. SR Lasker Library, East West University, and Daffodil International University Central Library were purposively selected for their strong academic profiles, advanced ICT infrastructure, and active engagement in digital content management. Data were collected via structured questionnaires administered to library professionals in digital preservation. Quantitative responses were analyzed using Microsoft Excel 2019, and qualitative responses were analyzed thematically.*

Results: *We have found that those private universities have implemented IRs like DSpace and still face some barriers such as lack of well-trained staff, poor infrastructure, and limited institutional awareness. The mostly common preserved institutional documents including theses and research papers.*

Implications: *The study marks the need of training the staffs, better planning for preservation, and administrative support to make digital preservation more effectful in private universities.*

Value: *This study adds to the expanding corpus of research on digital preservation in underdeveloped nations by providing a useful summary of the initiatives and constraints seen in Bangladesh's private universities. In order to enable long-term digital stewardship, it emphasizes the necessity of institutional commitment, open-source adaptability, and strategic planning (Conway, 2010; Harvey, 2012).*

Keywords

DSpace, Private University, Preservation, Institutional Repository, Content Management.

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Managing ETDs in the Digital Era: Technological Challenges and Practical Solutions for Engineering and Technology University Libraries in Bangladesh

Md. Abdul Hakim Shah¹

Abstract

Electronic Theses and Dissertations (ETDs) are essential for research by enhancing accessibility, visibility, and the dissemination of scholarly knowledge. However, Engineering and Technology University Libraries in Bangladesh encounter notable Technological Challenges that hinder the efficient management of ETDs. This study aims to explore these Technological Challenges and propose actionable strategies for the implementation of ETDs management in the context of Engineering and Technology University Libraries in Bangladesh.

This study used a Descriptive Research design and a Quantitative technique. Data were collected from five (05) Engineering and Technology University Libraries using structured questionnaire. SPSS version 26.0 was used for data analysis. Descriptive Statistics used to summarize and interpret the findings.

The study found that while digital repositories like DSpace are increasingly implemented, several Technological Challenges impede effective ETDs management. Key issues—including the inadequate ICT infrastructure, limited technical expertise, and resistance to technological advancements—continue to hinder effective ETDs management. The study further highlights inconsistencies in digitization efforts across institutions, emphasizing that it requires standardized policies and enhanced technological support. The recommendations include strengthening technological infrastructure, addressing resistance to innovation, and streamlining the conversion of physical theses to electronic formats.

This research investigates the challenges of managing ETDs in Bangladesh and develops the Electronic Theses and Dissertations Management at Engineering and Technology University Libraries (ETDMETUL) framework. Grounded in both theoretical foundations and empirical findings, this framework aims to guide library practices and inform future research and policy development at both national and international levels.

Keywords

Electronic theses and dissertations, ETDs management, Digital repositories, Metadata compliance, ICT infrastructure, Engineering and Technology university libraries, Bangladesh.

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Evaluating the Effectiveness of the AI-Powered Chatbot in Advancing User Support in Academic Libraries

Reza, Raiyan Bin¹
Ali, Md. Liton²

Abstract

AI-powered chatbots are increasingly being integrated into academic libraries to enhance user support and streamline information services. However, their effectiveness in addressing diverse user queries remains underexplored in the context of Bangladeshi academic institutions. This study aims to evaluate the efficacy of the IUT Library chatbot (based on tawk.to) in handling user queries, focusing on accuracy, response time, and user satisfaction. A total of 170 real user queries from 63 Chat volume of IUT Library chatbot were analyzed. Queries were categorized into three types: informational, directional, and transactional. Performance metrics included response accuracy, average response time, and user feedback ratings. Data were analyzed using descriptive statistics and thematic analysis for qualitative feedback. Preliminary analysis indicates that the chatbot successfully resolved most informational queries (approx. 80%) with an average response time of 3.25 seconds. Noteworthy, performance was significant in terms of complex or context-specific queries with more than 90 percent accuracy. Although response time was higher and hit 9.35 seconds almost three times of the average response time. User satisfaction was generally moderate to positive, with more than 95% rating the experience as moderate or satisfactory. Less than 5% reported dissatisfaction. The IUT Library chatbot demonstrates strong potential in improving library service efficiency, particularly for routine queries. Nonetheless, enhancements in contextual understanding and integration with library databases are necessary to improve performance for complex queries. These findings provide actionable insights for optimizing AI-driven library services in academic settings.

Keywords

AI Chatbot, Academic Libraries, User Support, Library Services, IUT Library

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The Role of Authors in the Development of Libraries at the Age of AI

Sabiqun Nahar Chowdhury Panna¹
Syed Robiul Bashar²

Abstract

Author and library have had great and sticky ties from the beginning of the library's history. Authors write books, libraries collect the books, and give access to the readers. Libraries are platforms for the authors to showcase their works, and the authors are the ambassadors of the libraries. Libraries also act as connectivity between authors and readers. Every year, around 2.2 to 2.4 million new books were published that included print books, eBooks, audiobooks, and everything in between. Recently BookBub surveyed 1,200 authors and found 45 percent are using generative AI in some form, whether for writing, marketing, research, or other tasks. In the age of Artificial Intelligence (AI), authors are not only creators of knowledge but also active contributors to the transformation of libraries. Through data-driven research, open access initiatives, and machine-readable formats, they are making libraries smarter and more inclusive. The collaboration among librarians, authors, and AI technologies is opening new horizons in modern library information management. From a global perspective, Bangladesh is not standing still; even at a slow pace, we are moving forward. Bringing AI into the process, we face certain specific challenges in implementing plans on the same platform with libraries, authors, and librarians, and we also have practical strategies to overcome them. These challenges include lack of technical infrastructure, inadequate training for library professionals, limited access to AI tools, and insufficient collaboration between authors and librarians. To overcome these barriers, capacity-building initiatives, institutional funding, and the integration of AI education into library and information science curricula are essential.

Keywords

AI technologies, AI Tools, Data-Driven Research, Capacity-Building Initiatives, Open Access Initiatives, and Machine-Readable Formats

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Status of the Madrasah Libraries of Bangladesh in the Age of AI

Md. Mostafizur Rahman¹

Syed Robiul Bashar²

Mohammad Armanul Hoque³

Abstract

In Bangladesh, madrasah education has long been a significant history in the country's educational and cultural sectors for providing moral and religious education to millions of students. This madrasa system of education is mainly of two types: (1) Qawmi madrasas, which are independent and community-based, and (2) Aliya madrasas, which are run under the government. According to various sources, there are over 29,000 madrasas in Bangladesh, with around 5 million students studying in Qawmi madrasah. However, official statistics of BANBEIS indicated that around 2.76 million students were enrolled in the 9.3 thousand madrasahs in 2023. The latest statistics are unavailable due to a shortage of data in this field. Interestingly, some studies have shown that a good number of madrasa students are using computers, and also around 65 percent of students are actively using the internet for social media activities on their mobile phones and other devices. But they are often unaware of the AI-powered interfaces that they use to engage and access them. Currently, AI has already revolutionized library services worldwide, automating various types of posts on social media, where they also engage in multimedia access, and enabling customized information delivery. However, madrasah libraries in Bangladesh are still underdeveloped due to a lack of resources, untrained staff, and outdated systems. These shortcomings are most visible in rural areas where most madrasahs are located. While general school and college libraries are gradually being modernized, madrasah libraries are lagging. Nevertheless, growing awareness among Bangladeshi scholars and librarians highlights the potential of AI to revolutionize services in this area, enabling the digitization of Islamic texts, increasing multilingual search capabilities, and integrating e-learning tools. However, issues such as funding shortages, infrastructure gaps, and ethical concerns remain significant barriers to large-scale implementation in this field.

Keywords

Madrasah Library, Artificial Intelligence (AI), Education, Digital Literacy, Innovation, Resources, Services.

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Need assessment and user satisfaction of the Daffodil International University Library at the Age of AI

Md. Rashed Nizami¹

Abstract

Daffodil International University (DIU) is a leading private research university in Bangladesh, renowned for its commitment to innovation, academic excellence, and global engagement. DIU has consistently played an active role in promoting innovation, entrepreneurship, digital transformation, and quality education in Bangladesh. At present about 25,000 students are studying at the DIU in different programs. DIU Library users are the central focus of the university library. So, libraries' target is to fulfill their needs and expectations. Our potential users are student, teacher and researcher. User need and satisfaction are core goals which change frequently due to influence of modern technology. At the same time due to misinformation, fake information, disinformation, hybrid information library users need right information at the right time. In recent survey, it was shown that about 82% of university students of Bangladesh are using AI. So, libraries should be their main focus in these issues. The effectiveness of a library is largely determined on how satisfied its users are. To achieve this, library administrators must identify and understand user demands. This study aims to evaluate the needs and satisfaction levels of users at the Daffodil International University Library at the age of AI. In this study, data on the demographics of students, their needs, requirements, satisfaction and opinions of the services provided to the library were gathered using a survey questionnaire. The primary goal of this study is to assess the needs and satisfaction levels of users of the Daffodil International University Library in the context of the Age of AI.

Keywords

Need assessment, User satisfaction, Artificial Intelligence (AI) in libraries, Academic library services, Digital transformation, Higher education

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Digital Transformation in Information Systems and Organizations: A Systematic Literature Review

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Abstract

During last two decades, university libraries have stimulated from random automation projects to institution-wide digital transformation (DT) programmes. The aim of the study is to identify the existing literature and get the insight of the scholarly outputs regarding DT to enhance the adoption of transformation process in information systems and organizations. Using Okoli& Schabram's four-stage protocol, we systematically reviewed 142 peer-reviewed articles and conference papers published between 2010 and 2025. Our concept-centric synthesis shows that DT in information institutions is driven chiefly by heightened user expectations, post-pandemic service reconfiguration, and emerging technologies such as AI, IoT, and cloud platforms. Five recurrent challenge themes—funding & infrastructure, staff competencies, organizational readiness, policy gaps, and equity/privacy concerns—reappear across regions. Conversely, opportunities cluster around enhanced service quality, data-driven decision-making, personalized user engagement, and new collaborative models. We conclude with a practice-oriented roadmap that aligns organisational, technological, and environmental (TOE) factors and highlights priority research gaps for 2025–2030.

Key words

Digital transformation; Academic libraries; Information institutions; Challenges; Opportunities; Systematic review; TOE framework

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Ethical & Responsive AI with Emphasis on LIS Sectors: Examples from South Asia

Partha Chattopadhyay¹

Abstract

The use of Artificial Intelligence (AI) and its associated technologies has become prevalent in every sphere of life including LIS sectors to improve service delivery and efficiency. These technologies also pose significant ethical challenges and risks including bias and discrimination, privacy and security, automation and job displacement and lack of human touch in service delivery. This paper gives an overview of the key ethical frameworks and principles relevant to the use of AI in the countries of South Asia especially. This paper also throws light on future aspect of AI and it's both advantages as well as disadvantages. Overall, it gives an understanding of the implications of AI in Library & Information Science (LIS) field with suitable examples.

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Improving Library Services for Educational Development: Insights from School, College, and Madrasah Libraries of Ashulia, Savar, Dhaka.

Md. Mahmudul Hasan¹

Parul Parvin²

Khadiza Parvin³

M A Matin⁴

Abstract

No nation can achieve further development without developing proper libraries in their institutions of learning and communities that will provide quality education and produce responsible citizens. Keeping this view in mind, the researchers started the project. The purpose of the study is to explore the existing status of library information services of 50 (school 15, college 25, and madrasah 10) libraries of the Ashulia, Savar area, compare them with the government's requirements and fixed standards, determine the gap between, and make recommendations to improve. The study provides a picture of the selected 50 libraries of the said suburban area of Dhaka district. The size of the population was 300, including the students (150), teachers (100), and librarians (50). Following the analysis of the collected data, the researchers have made recommendations on the subject so that all concerned, particularly the decision-makers, can get appropriate clues to take proper decisions to improve the school, college, and madrasah libraries of Bangladesh, which certainly shall help ensure quality education and national sustainable development and bring Bangladesh's education to a good position in global rankings. The study has been conducted based on primary sources. Data collection is done through structured questionnaires and face-to-face interviews. Secondary data has also been used in some cases in limited form. The study provides a picture of the selected 50 libraries of the stipulated area. Available data have been analyzed and presented in graphic representation. Statistical analysis of data by SPSS has also been done. Observation of the researchers has also been used as primary data. Relevant government agencies have been contacted for their comments on the existing situation of the libraries. A literature review is done, and a few publications are found in school libraries. However, specific comprehensive studies have not been found on school, college, and madrasah libraries in rural areas of Bangladesh. So this study is quite justified. According to the

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analysis of the collected data as described in tabular form. The researchers found that the infrastructure of the libraries is not satisfactory. The reading environment is not conducive to proper study. The collection is poor and outdated in most of the libraries, and there is no yearly budget for purchasing books, etc. Computer and internet facilities are available only in a few libraries. Qualified and trained librarians are lacking in most libraries. The library literacy program is found absent, violating the government order. The experiences gathered by the researchers by physically inspecting the libraries are that most of the libraries could not fulfill the desired satisfaction in terms of having an optimum level of use by the students, neither providing them proper facilities nor good library literacy, which might be an asset for their future life. Based on the analysis, a few problems have been identified, and the final recommendations are that, as per the government orders, every school, college, and madrasah library should provide proper space conducive to reading; qualified librarians; an up-to-date collection of reference books, journals, magazines, and newspapers; a yearly budget for procuring learning materials; a computer with a high-speed internet connection; a library literacy program; and different activities and programs for increasing the reading habits of the students.

Keyword

Bangladesh Education System, Rural Libraries, Library Literacy, Library Services in Bangladesh, Educational Institutions, Library Development

Manuscript Traditions in Bangladesh: An Analysis of Scripts, Materiality and Meaning

Tahmina Kabir Tresha¹

Abstract

The manuscript traditions of Bangladesh provide profound insights into the region's intellectual, religious, and cultural history. Spanning centuries, these manuscripts primarily written in Bengali and Sanskrit serve as vital records of historical events, literary evolution, and spiritual practices. This paper examines the evolution of the Bengali script, the materiality of manuscripts, and their semantic dimensions. It explores how the script, from its ancient Brahmi origins to its modern forms, influenced the region's literary and administrative traditions. Additionally, the study highlights the various materials used for manuscript production, such as palm leaves, birch bark, and jute paper, each contributing to the manuscripts' cultural significance. Illuminations and artistic expressions in these manuscripts provide further insight into their aesthetic and narrative purposes. The content of the manuscripts covers diverse genres, including religious texts, philosophy, and medicine, with annotations that contextualize their historical relevance. Finally, the paper discusses contemporary challenges in manuscript preservation and the need for digitization to safeguard this invaluable cultural heritage.

Keywords

Bangladesh, manuscript traditions, Bengali script, materiality, illuminations, cultural heritage, preservation, digitization, religious texts, manuscript conservation.

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Perceived Value of Emotional Intelligence in the Age of AI: An Academic Library Perspective

Jannatul Islam Muna¹

Abstract

The rapid advancement of Artificial Intelligence (AI) is transforming the operational and service landscapes of academic libraries worldwide. Libraries are increasingly adopting AI-driven technologies to automate information services, enhance research support, and improve user experiences. The role of human-centered competencies such as Emotional Intelligence (EI) has become more critical than ever. This study investigates the perceived value of Emotional Intelligence among academic library professionals in the context of the AI era. It seeks to understand how EI competencies, namely self-awareness, self-regulation, conflict resolution, motivation, empathy, and social skills contribute to effective library management, staff collaboration, and quality user service in technologically augmented environments.

Using a qualitative research design, data was collected from academic librarians through semi-structured interviews. The collected interview data were analyzed by using a grounded theory approach. All responses are systematically categorized using open coding, axial coding, and selective coding. The findings revealed that Emotional Intelligence remains a vital determinant of job performance, adaptability, and user satisfaction, despite increasing technological automation. Participants acknowledged that while AI can replicate cognitive and procedural functions, it cannot substitute the uniquely human capacity for empathy, ethical judgment, and emotional connection. It was also found that AI can assist library professionals in managing their routine repeated tasks as a time saver where library professionals can concentrate more on providing innovative services to their patrons. The study concludes that fostering EI among library professionals is essential in achieving a harmonious balance between technological innovation and human interaction. It recommends incorporating EI training and awareness programs into professional development initiatives to strengthen resilience, teamwork, and leadership effectiveness in academic libraries. By emphasizing the enduring importance of Emotional Intelligence in the AI age, this research highlights the need for human-AI synergy to ensure sustainable, user-centered, and emotionally intelligent library services.

Keywords

Emotional Intelligence, Artificial Intelligence, Academic libraries, Library professionals, Human-AI interaction.

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Designing and Implementing an AI-Based Model Consortium for College Libraries in Dhaka, Bangladesh: A Suggestion

Bilkis Begum¹

Afrin Sultana²

Abstract

Library collaboration, networking, and resource sharing are equivalent to the alliance and reciprocal behavior of the library and information center. Consortia, interlibrary loans, remote access, circulation, document delivery, and shared in domestic services are all included under this safeguard phrase. The study sought to investigate the current state of college libraries in terms of accessible resources, services, and AI digital-based infrastructure, as well as to evaluate the viability of an AI-based consortium for Dhaka City's college libraries in Bangladesh. Determine specifically how college library employees feel about the library AI based model consortia. Ten libraries were chosen as research locations, and a semi structured questionnaire was created based on a review of the literature. To analyze the data, SPSS 26th Version was used. According to the report, college libraries are currently in a poor state and face several significant challenges, including institutional hurdles, a lack of digital infrastructure, financial limitations, undertrained staff, a lack of collaboration, and legislative actions. To address this, further training courses, professional communication sessions, and AI technology should be planned. The results of this proposal, a model plan, will shed light on the current state of AI-constructed design and implementation of a group of college LIS professionals using digital services, as well as their degree of preparedness to deal with technology transfer, resource sharing, smart services, and innovative services based on AI. The institute, college professionals, policy officials, and users will all profit from these findings as they promote and reshape their AI-based smart services and call for the integration of AI smart service trainings to increase their ability to provide services in this new era. For focused resource consumption at low cost, time, and space, library professionals in Bangladesh should feel that consortium efforts are similar to those in wealthy nations.

Keywords

College Library, Dhaka, Bangladesh; Library Consortium; Artificial intelligence

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