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Transforming Public Libraries through Emerging Technologies: An Analytical Study

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Abstract

Public libraries are undergoing a significant transformation due to the adoption of emerging tools and technologies such as Artificial Intelligence (AI), Internet of Things (IoT), cloud computing, learning analytics, discovery services, digital repositories, and mobile applications. These technologies have reshaped library operations, improved service efficiency, enhanced user experience, and promoted digital inclusion. This study examines the impact of emerging tools and technologies on public library performance, service delivery, and user satisfaction. A mixed-method research approach, including questionnaires, interviews, and observational assessments, was employed public libraries of Mangaluru. Findings indicate increased accessibility, improved operational efficiency, and higher community engagement. Challenges include digital literacy gaps, budgetary constraints, and policy inadequacies. Recommendations include strategic investment in infrastructure, continuous staff training, user-centered service design, and adoption of digital policies to ensure sustainable technology integration.

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Public Libraries, Emerging Technologies, AI, IoT, Cloud Computing, Digital Inclusion, Library Services

Introduction

Public libraries are evolving from traditional repositories of books into smart, technology-driven knowledge centres. The integration of emerging tools such as AI-based cataloguing and recommendation systems, IoT-enabled automation, cloud-based library management, mobile applications, and discovery tools has transformed the way users access, search, and consume information (Sharma & Singh, 2022; Li, 2021).

These technologies address challenges such as information overload, limited accessibility, and the digital divide. Modern public libraries now serve as centres for lifelong learning, digital literacy, civic engagement, and community empowerment (IFLA, 2023; UNESCO, 2022).

Emerging tools and technologies have significantly influenced public libraries over the past two decades. Researchers widely acknowledge that digital transformation reshapes library services, user engagement, and resource accessibility. According to Bertot, Jaeger, and Hansen (2016), the integration of ICT tools—such as automation software, discovery layers, and digital repositories—has redefined public library workflows and expanded user outreach. Similarly, Das *et al.*, (2021) highlights that modern libraries increasingly adopt AI-driven services, mobile applications, and data analytics to meet evolving community needs.

Several studies focus on specific tools that enhance service efficiency. For example, Caldwell-Stone (2010) explained that RFID technology, self-check stations, automated sorting systems, and smart circulation tools

significantly reduce staff workload, accelerate circulation transactions, improve inventory management, and enhance user convenience by enabling self-service borrowing and returning.

Additionally, the adoption of makerspaces, digital literacy tools, and learning management systems is shown to promote community participation (Kroski, 2018).

Cloud-based library systems such as Koha, Evergreen, and DSpace have also been identified as critical enablers for scalable library operations in developing nations. Furthermore, AI-powered recommendation systems and automated metadata extraction tools are transforming cataloguing and discovery processes.

Cole and Robinson (2022) examined the applications of artificial intelligence in library operations, highlighting its role in improving cataloguing, information retrieval, and user services. The study also emphasized ethical considerations and the need for librarians to develop AI-related competencies.

Kaur and Chatterjee (2021) explored the opportunities and challenges of AI adoption in libraries, focusing on applications such as chatbots, recommendation systems, and automated indexing. The authors concluded that effective implementation depends on adequate infrastructure, staff training, and ethical practices.

Overall, the literature indicates that emerging tools not only enhance operational efficiency but also strengthen the social and learning functions of public libraries. The gap found in the literature is the limited comprehensive analysis of the combined impact of these tools on public library performance, particularly in the context of developing countries.

The study aims to identify the emerging tools and technologies being implemented in public library systems and evaluate their impact on library service delivery and user satisfaction. It further seeks to examine the opportunities and challenges associated with the adoption of these technologies while assessing their effectiveness in enhancing library operations and user engagement. Based on these findings, the study intends to propose practical strategies for strengthening public library services through the effective integration of modern technologies, thereby improving accessibility, efficiency, and the overall quality of information services.

Materials and Methods

This study adopted a mixed-method research design combining qualitative and quantitative approaches to evaluate the impact of emerging tools and technologies on the public library system. Quantitative data were collected through a structured questionnaire administered during January–February 2025 to assess user satisfaction, tool adoption rates, and the perceived usefulness of emerging technologies. Qualitative data were gathered through interviews with librarians to obtain insights into implementation strategies, challenges, and outcomes associated with the adoption of these technologies.

In addition, annual reports, technology policies, and library usage logs of the selected public libraries were reviewed to supplement the primary data. The study followed the guidelines of the American Psychological Association for citations, references, writing style, and overall manuscript structure.

Results and Discussion

The findings are organized using figures and tables to provide a clear understanding of the study variables. The results are presented systematically to facilitate meaningful interpretation and discussion.

Figure 5.1 shows that out of the total respondents, 58 (56.9%) were female and 44 (43.1%) were male, indicating that female respondents constituted the majority of the study participants.

Table 5.1 shows that the majority of the respondents (57, 55.9%) belonged to the 21–30 years age group, followed by 31–40 years (29, 28.4%), while only 5 (4.9%) were above 50 years of age. Most respondents were users (82, 80.4%), followed by librarians (13, 12.7%) and assistant librarians (6, 5.9%).

Regarding the frequency of use, 47 (46.1%) respondents used the service weekly, 36 (35.3%) used it daily, 13 (12.7%) used it monthly, and 6 (5.9%) accessed it rarely, indicating that the majority of respondents used the service on a regular basis.

Table 5.2 highlights that E-resources (72.5%) were the most widely known library tool among respondents, followed by the Mobile App (62.7%), QR codes (56.9%), and OPAC 2.0 (54.9%), while awareness of the Digital Repository (33.3%) and RFID (34.3%) was comparatively lower.

Table.1 Demographic Information

N=102			
General Information	Value	Number	%
Age Group	< 20	0	0.0
	21-30	57	55.9
	31-40	29	28.4
	41-50	11	10.8
	>50	5	4.9
User Type	Above 50	0	0.0
	Librarian	13	12.7
	Ass Lib	6	5.9
	Users	82	80.4
Frequency	Daily	36	35.3
	Weekly	47	46.1
	Monthly	13	12.7
	Rarely	6	5.9

Table.2 Awareness of tools used in the library

N=102			
Sl. No.	Aware of tools used in the library	Number	%
1	Koha / ILS	46	45.1
2	OPAC 2.0	56	54.9
3	Digital Repository	34	33.3
4	QR codes	58	56.9
5	RFID	35	34.3
6	Mobile App	64	62.7
7	AI-based recommendations	42	41.2
8	E-resources	74	72.5

Table.3 Regular use of library Tools and services among the respondents

N=102			
Sl. No.	Tools regularly use	Number	%
1	OPAC	50	49.0
2	E-resources	60	58.8
3	Digital archives	36	35.3
4	RFID Self-check	12	11.8
5	Mobile services	64	62.7
6	None	8	7.8

Table.4 Frequency of using library tools

Frequency	Number	%
Daily	39	38.2
Weekly	43	42.2
Monthly	13	12.7
Rarely	7	6.9
Total	102	100.0

Table.5 Respondents satisfaction with emerging tools and services

Sl. No.	Emerging Tools	Satisfaction N=102				
		5	4	3	2	1
1	Ease of using OPAC	23 (22.5)	49 (48.0)	23 (22.5)	4 (3.9)	3 (2.9)
2	Speed of searching resources	14 (13.7)	58 (56.9)	28 (27.5)	1 (1.0)	1 (1.0)
3	Convenience of RFID self-check system	13 (12.7)	43 (42.2)	35 (34.3)	6 (5.9)	5 (4.9)
4	Access to digital resources	16 (15.7)	61 (59.8)	20 (19.6)	4 (3.9)	1 (1.0)
5	Mobile app notifications / alerts	20 (19.6)	38 (37.3)	39 (38.2)	3 (2.9)	2 (2.0)
6	Quality of e-services	16 (15.7)	62 (60.8)	20 (19.6)	3 (2.9)	1 (1.0)
7	Staff support for digital tools	24 (23.5)	58 (56.9)	17 (16.7)	3 (2.9)	0 (0.0)

Table.6 Respondents Perception of the Impact of Emerging Tools on Library Services

Impact of Tools on Library Services		N=102	
		Number	%
Reduced waiting time	Yes	58	56.9
	No	12	11.8
	Not Suire	32	31.4
Improved overall library experience	Yes	77	75.5
	No	1	1.0
	Not Suire	24	23.5
Digital literacy support	Yes	98	96.1
	No	3	2.9
	Not Suire	1	1.0

Table.7 Areas of Library Services Improved by the Use of Emerging Tools

N=102		
Areas improved due to new tools	Number	%
Resource access	67	65.7
Borrowing/returning	42	41.2
Digital collections	49	48.0
Book searching	73	71.6
Access outside library hours	42	41.2

Table.8 Challenges and Difficulties

Sl. No.	Challenges/Difficulties	N=102	
		Number	%
1	Lack of awareness	27	26.5
2	Technical glitches	51	50.0
3	Staff shortage	18	17.6
4	Difficult to use	15	14.7
5	Poor internet	57	55.9
6	No issues	19	18.6

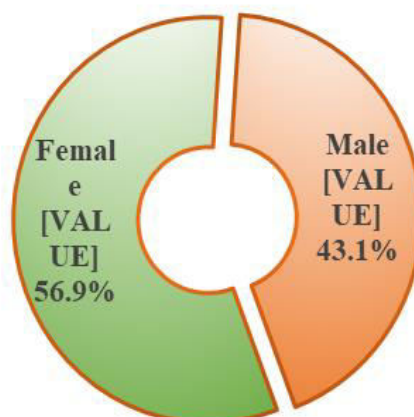
Figure.1 Gender wise distribution of respondents

Table 5.3 identifies that mobile services (62.7%) were the most regularly used library tool, followed by e-resources (58.8%) and OPAC (49.0%), while RFID self-check (11.8%) was the least used service.

Table 5.4 reveals that 42.2% of respondents used library tools and services weekly, followed by 38.2% who used them daily, indicating that most respondents accessed library tools on a regular basis.

Table 5.5 explores that the majority of respondents were satisfied or highly satisfied with emerging library tools and services, particularly access to digital resources, quality of e-services, staff support, and speed of searching resources, reflecting a high level of user satisfaction with the library's digital facilities.

Table 5.6 shows that most respondents believed emerging library tools improved digital literacy support (96.1%), enhanced the overall library experience (75.5%), and reduced waiting time (56.9%), indicating a positive impact of these tools on library services.

Table 5.7 indicate that book searching (71.6%) was the most improved library service due to emerging tools, followed by resource access (65.7%) and digital collections (48.0%), while borrowing/returning and access outside library hours were each reported by 41.2% of respondents.

Table 5.8 presents that poor internet connectivity (55.9%) and technical glitches (50.0%) were the major challenges faced by KDPL users, while 18.6% reported no issues.

Findings, Suggestions, and Conclusion

The impact of emerging technologies on public libraries is transformative and multidimensional. AI enhances accuracy and speed, digital publishing tools empower local communities, linked-data tools increase discoverability, and preservation technologies safeguard knowledge. However, challenges remain in ensuring equitable access, maintaining digital infrastructure, and scaling technology adoption across diverse library systems. Strategic planning, institutional support, and continuous professional development are essential to sustain technology-enabled growth in public libraries.

Libraries should strengthen their digital infrastructure by investing in AI, IoT, cloud systems, and advanced discovery tools while providing continuous training to staff on emerging technologies. They should also focus on user-centric services through personalized mobile and online platforms, promote digital inclusion by offering ICT awareness and training programs, develop clear digital policies and guidelines, and ensure sustainable funding for the maintenance and regular upgrading of technological infrastructure.

Libraries should invest in digital infrastructure across urban and rural areas, provide continuous staff training on AI tools, metadata standards, publishing systems, and digital preservation, and adopt open-source platforms such as Koha, DSpace, OJS, and Pressbooks to reduce costs. They should also support community publishing initiatives, implement linked data frameworks to enhance global visibility, collaborate with universities and research institutions, promote digital literacy among all

user groups, and establish strong digital preservation policies to safeguard scholarly and community knowledge.

Emerging tools and technologies have significantly reshaped the public library system, strengthening its role as a knowledge hub, scholarly communication partner, and digital innovation centre. Public libraries that embrace AI, digital publishing, open access, linked data, and preservation tools can improve service delivery, enhance community engagement, and contribute to equitable access to information. With proper training, investment, and policy support, public libraries can thrive in the rapidly evolving digital information environment.

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