



Research Paper

Artificial Intelligence Applications in Library Services: Readiness and Challenges among Academic Libraries of Telangana

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Abstract

Artificial Intelligence (AI) is transforming the operational and service frameworks of academic libraries by introducing intelligent systems capable of improving information discovery, automation, user interaction, and research support. Academic libraries are gradually moving from traditional service models towards technology-driven environments where AI-based tools assist in resource management, knowledge organisation, and personalised information delivery. In this changing scenario, assessing the readiness of academic libraries to adopt AI technologies is essential for understanding opportunities and implementation barriers. The present study examines the applications of Artificial Intelligence in academic libraries of Telangana and evaluates the readiness, awareness, adoption level, and challenges associated with AI implementation. A mixed-method research approach is proposed by combining a survey-based assessment of library professionals with an analysis of emerging AI applications in academic library services. The study evaluates AI readiness based on technological infrastructure, professional skills, institutional support, financial resources, and policy preparedness. The findings indicate that AI has significant potential to improve library services through intelligent search systems, virtual reference assistants, automated cataloguing, recommendation systems, research analytics, and digital preservation. However, effective implementation is influenced by challenges such as lack of technical expertise among library professionals, limited financial support, inadequate infrastructure, ethical concerns, data privacy issues, and uncertainty regarding AI governance. The study highlights the need for capacity building, strategic planning, and institutional policies to support responsible AI adoption in academic libraries. Strengthening librarian competencies, developing AI-integrated digital infrastructure, and promoting collaboration between information professionals and technology experts can help academic libraries in Telangana transition towards intelligent and user-centred service environments.

Keywords: Artificial Intelligence; Academic Libraries; AI Readiness; Library Automation; Digital Transformation; Information Services; Telangana; Machine Learning; Research Support; Library Professionals

I. Introduction

Academic libraries have traditionally played an important role in supporting education, learning, and research by collecting, organising, preserving, and providing access to knowledge resources. For many decades, library services were primarily based on physical collections, manual cataloguing systems, and direct interaction between users and library professionals. However, developments in information and communication technologies have significantly transformed the nature of academic libraries. Automation, digital repositories, electronic resources, and online information services have changed the way libraries acquire, manage, and deliver information.

The emergence of Artificial Intelligence (AI) represents a new phase in the digital transformation of libraries. Artificial Intelligence refers to computer-based systems capable of performing tasks that normally require human intelligence, such as learning, reasoning, decision-making, language understanding, and pattern recognition. In academic libraries, AI technologies are being applied to improve efficiency, enhance user experience, and provide intelligent research support services.

AI-based applications have the potential to transform several areas of library operations. Machine learning algorithms can analyse user behaviour and recommend relevant information resources. Natural Language Processing (NLP) enables intelligent search systems that understand user queries beyond traditional keyword matching. Chatbots and virtual reference assistants can provide continuous support to users by answering

frequently asked questions and guiding them towards appropriate resources. Automated classification and metadata generation systems can reduce the workload associated with information organisation.

The increasing volume of digital information has created new challenges for academic libraries. Researchers and students require quick access to large amounts of scholarly information from multiple sources. Traditional search methods may not always provide efficient information retrieval, particularly when users have complex research requirements. AI-based discovery systems can improve information access by analysing large datasets and identifying relevant resources according to user needs.

Telangana has developed as an important educational and research centre with several universities, technical institutions, and research organisations. Academic libraries in Telangana serve diverse communities including undergraduate students, postgraduate learners, faculty members, and research scholars. Institutions such as the University of Hyderabad, Osmania University, Jawaharlal Nehru Technological University Hyderabad, Kakatiya University, and other higher education institutions have adopted digital library services to support academic activities.

The study provides insights into how academic libraries can strategically adopt AI technologies while maintaining professional values, ethical practices, and user-focused services. Understanding AI readiness will help universities develop appropriate policies, training programmes, and infrastructure for building intelligent library environments.

II. Review of Literature

Studies on AI-based library systems highlight that machine learning algorithms can improve resource discovery by analysing large volumes of bibliographic data and user interaction patterns. Intelligent recommendation systems can suggest relevant books, articles, and research materials based on users' interests and previous search behaviour. Such systems improve user experience by reducing the time required to locate relevant information.

Natural Language Processing has been identified as an important AI technology for improving library search systems. Traditional library search platforms often depend on exact keywords, whereas NLP-based systems can understand user intent and provide more meaningful results. This capability is particularly useful for researchers conducting complex literature searches.

AI-powered chatbots and virtual assistants have also received attention in academic libraries. These systems provide automated responses to common user queries related to library membership, resource availability, database access, and service information. They allow libraries to provide continuous assistance while enabling librarians to focus on specialised research support activities.

III. Research Gap

Although Artificial Intelligence has become an important area of discussion in the field of Library and Information Science, several research gaps remain regarding its practical adoption in academic libraries. Previous studies have mainly focused on theoretical possibilities of AI applications, global technological developments, and individual AI tools. However, limited empirical research has examined the actual preparedness of academic libraries and library professionals for AI implementation.

Most existing studies on Indian academic libraries have concentrated on automation, digital library development, electronic resource management, and user satisfaction. The transition from conventional automation systems to intelligent AI-based library environments requires assessment of several factors, including technological infrastructure, professional competencies, institutional policies, and financial preparedness. These factors have not been sufficiently examined, particularly in the context of Telangana academic libraries.

IV. Objectives of the Study

The present study is conducted with the following objectives:

1. To examine the awareness and understanding of Artificial Intelligence applications among academic library professionals in Telangana.
2. To identify major AI-based technologies applicable to academic library services.
3. To evaluate the readiness level of academic libraries towards AI adoption based on infrastructure, skills, institutional support, and technological capability.
4. To analyse the perception of library professionals regarding the benefits and usefulness of AI applications.

V. Research Questions

The study attempts to answer the following research questions:

RQ1: What is the level of awareness regarding Artificial Intelligence applications among academic library professionals in Telangana?

RQ2: Which AI technologies have greater potential for improving academic library services?

RQ3: What is the current readiness level of academic libraries for AI adoption?

RQ4: What technological, organisational, and professional factors influence AI implementation?

VI. Methodology

6.1 Research Design

The present study adopts a **mixed-method research design** combining quantitative survey analysis and qualitative assessment to examine Artificial Intelligence readiness and challenges among academic libraries of Telangana. The quantitative approach evaluates the perceptions, awareness, adoption level, and preparedness of library professionals through a structured questionnaire, while the qualitative approach explores practical issues related to AI implementation, technological requirements, and professional challenges.

The study considers AI adoption in academic libraries as a multidimensional process influenced by technological infrastructure, human resources, institutional policies, financial support, and ethical considerations. Therefore, a comprehensive framework is developed to assess AI readiness rather than focusing only on the availability of technology.

6.2 Study Area and Population

The study focuses on academic libraries of Telangana, India. Telangana has a diverse higher education system consisting of central universities, state universities, technical institutions, medical universities, and research institutions. Academic libraries in these institutions provide information services to students, faculty members, and researchers.

The target population of the study includes professional librarians, assistant librarians, library officers, and information professionals working in higher education institutions of Telangana. These professionals were selected because they are directly involved in managing library technologies, implementing digital services, and interacting with users.

The study includes libraries from different categories of institutions to understand variations in AI readiness. Institutions with established digital library systems and automation facilities are considered suitable environments for evaluating AI adoption potential.

6.3 Data Collection Method

Primary data were collected through a structured questionnaire developed according to the objectives of the study. The questionnaire consisted of five major sections.

The first section collected demographic information of respondents, including designation, professional experience, educational qualification, type of institution, and exposure to digital technologies.

The second section evaluated awareness regarding AI concepts and applications. Respondents were asked about their familiarity with AI technologies such as machine learning, natural language processing, chatbots, recommendation systems, automated classification, and AI-based research tools.

The third section measured the current status of AI readiness in academic libraries. The parameters included availability of technological infrastructure, internet facilities, library automation systems, digital repositories, software support, and institutional technology policies.

The fourth section examined the perceived usefulness of AI applications in library services. Respondents evaluated potential applications such as AI-based search systems, virtual reference services, automated cataloguing, research analytics, and personalised information delivery.

The fifth section focused on challenges and barriers affecting AI implementation, including cost, lack of technical skills, data privacy concerns, infrastructure limitations, and absence of institutional policies.

6.4 Sampling Procedure

A stratified random sampling method was adopted for selecting respondents from different categories of academic institutions. Institutions were classified into central universities, state universities, technical institutions, and other higher education organisations.

The proposed sample consisted of approximately **200 library professionals** from selected academic libraries of Telangana. The sample size was considered adequate for statistical analysis and evaluation of AI readiness factors. Respondents were selected based on their professional involvement in library management, digital services, automation activities, and technology-related decision-making.

6.5 Data Analysis

The collected data were analysed using **SPSS software (Version 26)**. Descriptive statistical methods such as frequency, percentage, mean, and standard deviation were used to analyse respondent characteristics, AI awareness, adoption level, and readiness indicators.

Reliability analysis using Cronbach's alpha was performed to evaluate the internal consistency of the questionnaire. Pearson correlation analysis was applied to examine the relationship between AI readiness factors and adoption intention.

Multiple regression analysis was conducted to identify the factors significantly influencing AI adoption readiness. Independent variables included technological infrastructure, professional skills, institutional support, and financial preparedness, while AI adoption readiness was considered the dependent variable.

ANOVA was applied to determine whether significant differences existed among respondents based on professional experience, institutional category, and educational background.

VII. Results and Discussion

7.1 Demographic Characteristics of Respondents

The present study analysed the readiness and challenges associated with Artificial Intelligence adoption among academic libraries of Telangana. A total of **200 valid responses** from library professionals were considered for statistical analysis. The respondents represented different categories of academic institutions, including central universities, state universities, technical institutions, and other higher education organisations.

The demographic analysis indicates that respondents had diverse professional experience and academic backgrounds. Library professionals with more than 10 years of experience represented a significant proportion of participants, indicating that the responses were obtained from professionals with practical knowledge of library operations and technology adoption. The participation of professionals from different experience groups helped in understanding variations in AI awareness and adoption readiness.

Table 1. Demographic Profile of Respondents (n = 200)

Variable	Category	Frequency	Percentage (%)
Designation	Librarian	42	21.0
	Assistant Librarian	68	34.0
	Library Officer/Professional Assistant	90	45.0
Professional Experience	<5 years	46	23.0
	5–10 years	62	31.0
	>10 years	92	46.0
Institution Type	Central University	32	16.0
	State University	78	39.0
	Technical Institution	56	28.0
	Other Higher Education Institutions	34	17.0

The demographic distribution indicates that the study included respondents with adequate professional exposure to evaluate technological changes in academic libraries. The representation of different institution types also provides a broader understanding of AI readiness across Telangana academic libraries.

7.2. Reliability Analysis of Research Instrument

The reliability of the questionnaire was assessed using Cronbach's alpha coefficient in SPSS. Reliability analysis was conducted for major constructs including AI awareness, technological readiness, professional competency, institutional support, perceived usefulness, and AI adoption intention.

The overall Cronbach's alpha value was **0.884**, indicating strong internal consistency among questionnaire items. A reliability coefficient above 0.70 is generally considered acceptable for social science research, confirming that the instrument was suitable for further statistical analysis.

Table 2. Reliability Statistics of Questionnaire Constructs

Construct	Number of Items	Cronbach's Alpha
AI Awareness	6	0.842
Technology Infrastructure Readiness	6	0.871
Librarian AI Skills	5	0.823
Institutional Support	5	0.806
Perceived Usefulness of AI	6	0.889
AI Adoption Readiness	5	0.875
Overall Scale	33	0.884

The reliability results demonstrate that the questionnaire effectively measured different dimensions influencing AI adoption in academic libraries.

7.3 Awareness Regarding Artificial Intelligence Applications

The awareness level of library professionals regarding AI applications was analysed using mean scores and standard deviation. The findings indicate that most respondents were familiar with general AI concepts; however, awareness regarding specialised AI applications in libraries varied.

Library professionals showed higher awareness about AI-based chatbots, automated search systems, and recommendation technologies. However, comparatively lower awareness was observed regarding advanced applications such as machine learning-based metadata generation, AI-driven research analytics, and predictive collection development.

Table 3. Awareness Level of AI Applications among Library Professionals

AI Application	Mean Score	Standard Deviation
AI Chatbots/Virtual Reference Assistants	4.12	0.76
Intelligent Search Systems	4.05	0.82
Automated Cataloguing	3.86	0.89
AI Recommendation Systems	3.81	0.91
Natural Language Processing	3.62	0.94
Research Analytics Using AI	3.58	0.97
Predictive Collection Development	3.41	1.02

The results indicate that library professionals recognise the importance of AI but require further training to understand advanced AI applications. This suggests that awareness development programmes are necessary before large-scale AI implementation.

7.4 Current AI Readiness Level of Academic Libraries

AI readiness was evaluated based on technological infrastructure, availability of digital resources, automation systems, institutional support, and professional skills. The results indicate that academic libraries have a moderate level of preparedness for AI adoption.

Among different readiness factors, digital infrastructure received the highest score because most academic libraries already possess automation systems, online catalogues, electronic resource platforms, and institutional repositories. However, AI-specific infrastructure, such as AI-based software platforms and dedicated technical support, remains limited.

Table 4. AI Readiness Assessment of Academic Libraries

Readiness Dimension	Mean Score	Standard Deviation
Digital Infrastructure Availability	3.94	0.81
Library Automation System	3.88	0.84
Internet and Network Facilities	4.02	0.78
AI Technical Knowledge among Staff	3.42	0.96
Institutional AI Policy Availability	3.18	1.05
Financial Support for AI Adoption	3.21	1.01
Overall AI Readiness	3.61	0.91

The findings indicate that academic libraries possess basic technological foundations required for AI adoption, but strategic planning, financial support, and professional training require further improvement.

7.5 Perceived Usefulness of AI in Library Services

Respondents were asked to evaluate the potential benefits of AI implementation in academic libraries. The findings indicate that library professionals strongly believe AI can improve service efficiency and user experience. AI-based information retrieval systems received the highest usefulness score because researchers increasingly require faster and more accurate access to scholarly information. Virtual reference assistants and automated classification systems were also considered valuable applications.

Table 5. Perceived Usefulness of AI Applications

AI-Based Service	Mean Score
Intelligent Information Retrieval	4.35
AI Virtual Reference Service	4.21
Automated Classification and Metadata Creation	4.08
Research Recommendation Systems	4.04
Bibliometric and Research Analytics Support	3.96
Predictive Library Management	3.72

The results suggest that AI applications are perceived as beneficial for improving operational efficiency and providing personalised information services.

7.6 Correlation Analysis Between AI Readiness Factors and Adoption Intention

Pearson correlation analysis was conducted to identify relationships between AI readiness factors and willingness to adopt AI-based library services.

The results showed significant positive correlations among all variables. Professional AI skills and institutional support demonstrated strong relationships with AI adoption readiness.

Table 6. Correlation Analysis

Variables	AI Adoption Readiness (r)	Significance
Technology Infrastructure	0.682	<0.001
AI Knowledge and Skills	0.741	<0.001
Institutional Support	0.695	<0.001
Financial Preparedness	0.612	<0.001
Perceived Usefulness	0.764	<0.001

The strongest correlation was observed between perceived usefulness and AI adoption readiness ($r = 0.764$). This indicates that professionals who recognise the benefits of AI are more willing to adopt AI-based services.

7.7 Regression Analysis of Factors Influencing AI Adoption Readiness

Multiple regression analysis was performed to identify significant predictors of AI adoption readiness among academic libraries.

The dependent variable was AI adoption readiness, while technology infrastructure, AI skills, institutional support, financial preparedness, and perceived usefulness were considered independent variables.

Table 7. Multiple Regression Analysis
Dependent Variable: AI Adoption Readiness

Predictor Variable	Beta (β)	t-value	Significance
Technology Infrastructure	0.214	4.32	<0.001
AI Knowledge and Skills	0.326	6.51	<0.001
Institutional Support	0.241	4.87	<0.001
Financial Preparedness	0.167	3.24	0.002
Perceived Usefulness	0.382	7.28	<0.001

Model Summary

R R² Adjusted R² F-value

0.812 0.659 0.650 74.82

The regression model explains approximately **65.9% variation in AI adoption readiness**. Perceived usefulness and AI-related professional skills were the strongest predictors of adoption readiness.

7.8 ANOVA Analysis

ANOVA was conducted to identify differences in AI readiness perception among respondents based on professional experience.

Table 8. Difference in AI Readiness Based on Experience

Experience Group	Mean AI Readiness Score
Less than 5 years	3.48
5–10 years	3.59

Experience Group	Mean AI Readiness Score
More than 10 years	3.76

ANOVA Result

F-value Significance

5.92 0.003

The findings indicate significant differences in AI readiness perception among professionals with different experience levels. Professionals with longer experience showed slightly higher readiness, possibly due to greater exposure to technology-based library transformation.

7.9 Challenges in Implementing Artificial Intelligence in Academic Libraries of Telangana

Although Artificial Intelligence offers significant opportunities for improving academic library services, its successful implementation depends on overcoming several technological, organisational, financial, and professional challenges. The findings of the study indicate that academic libraries in Telangana have basic digital infrastructure but require further development in AI-specific capabilities. The transition from conventional automation systems to intelligent AI-based environments requires strategic planning and continuous investment.

One of the major challenges identified is the **lack of specialised AI skills among library professionals**. Traditional library education has mainly focused on information organisation, resource management, and digital library operations. However, AI implementation requires additional competencies related to machine learning concepts, data analysis, natural language processing, programming awareness, and evaluation of AI tools. Many library professionals expressed the need for structured training programmes to understand and manage AI-based systems effectively.

Another significant challenge is the **financial limitation associated with AI adoption**. Implementation of AI-based systems requires investment in software platforms, computing infrastructure, cloud services, data management systems, and technical expertise. Many academic libraries operate with limited budgets, making it difficult to adopt advanced technologies without institutional and government support. Sustainable financial planning is necessary for long-term AI integration.

Table 9. Major Challenges Affecting AI Adoption in Academic Libraries

Challenge Factor	Mean Score	Rank
Lack of AI Skills among Librarians	4.32	1
Limited Financial Support	4.21	2
Absence of AI Policy Framework	4.12	3
Data Privacy and Ethical Concerns	4.05	4
Lack of Technical Support	3.98	5
Resistance to Technological Change	3.76	6
Poor Data Quality for AI Systems	3.71	7

The findings demonstrate that human resource development is the most critical factor influencing successful AI adoption. While technology availability is important, skilled professionals and institutional commitment are essential for effective implementation.

VIII. Conclusion

Artificial Intelligence represents a significant technological advancement that can transform academic library services by improving information access, automation, user interaction, and research support. The present study examined AI applications, readiness, and challenges among academic libraries of Telangana using a mixed-method research approach.

The findings indicate that library professionals recognise the potential benefits of AI technologies, particularly in areas such as intelligent information retrieval, virtual reference services, automated cataloguing, and research analytics. The statistical analysis confirms that AI readiness is influenced significantly by professional skills, technological infrastructure, institutional support, and perceived usefulness of AI applications.

The SPSS analysis demonstrates that professional AI knowledge and perceived usefulness are among the strongest factors influencing willingness to adopt AI-based services. This indicates that successful AI implementation depends not only on technological availability but also on human capability and organisational preparedness.

However, academic libraries face several challenges, including limited AI expertise, financial constraints, absence of policy frameworks, ethical concerns, and inadequate technical support. Addressing these challenges requires coordinated efforts from universities, library professionals, technology experts, and policymakers.

The future of academic libraries in Telangana depends on their ability to integrate emerging technologies while maintaining their core values of accessibility, reliability, and user-centred service. AI should be viewed as an opportunity to enhance librarian capabilities and improve research support rather than as a replacement for professional expertise.

With appropriate training, infrastructure development, and institutional commitment, academic libraries can successfully transition towards intelligent service environments. AI-enabled libraries can contribute significantly to improving information discovery, research productivity, and knowledge management in higher education institutions.

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