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AI and University Libraries in Research and Innovation: Transforming Academic Knowledge Systems

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Abstract

Artificial Intelligence (AI) is one of the most impactful technologies of this information age and is having a strong impact on the daily operations of Higher Education Institutions and Academic libraries (Russell & Norvig, 2021). University libraries were traditionally viewed as a place for books and other scholarly resources, with the duties of acquisition, organization, preservation, and dissemination. But, the rapid advances in technology, digital scholarship, open science and the growth of research ecosystems have transformed university libraries into intelligent knowledge hubs and system of support for research innovation (Borgman, 2007; Pinfield, Cox, & Smith, 2014).

Artificial Intelligence (AI) technologies like machine learning, natural language processing, robotics, AI-powered expert systems, computer vision, predictive analytics, and deep learning are transforming academic library services and research support mechanisms. Information retrieval, digital archiving, metadata generation, cataloguing, plagiarism detection, user help and research analytics are all enhanced by AI technologies. In the current era, libraries in the university are evolving into smart libraries which offer intelligent, personalized, user-centred and data-driven services to students, faculty members and researchers (Yu & Breivold, 2020).

This paper reflects a critical analysis of the changing role of AI in the university libraries and how it has been contributing to the research and innovation systems in the university libraries in Higher Education Institutions. The paper examines the conceptual links between AI, libraries, research support and knowledge production. It also explores the significant use of AI in academic libraries such as smart information retrieval systems, automated cataloguing systems, recommender systems, digital preservation, chatbots, predictive analytics, and robotics. Furthermore, the paper assesses the usefulness of AI applications for enhancing the efficiency of operations, access, research productivity, scholarly communication, and innovation ecosystems.

Additionally, the paper identifies critical issues in implementing AI, such as financial constraints, ethical concerns, algorithmic biases, privacy and security concerns, technological skill deficits, infrastructure limitations, and resistance to technological change. Ethical and legal concerns are addressed in Library Systems using AI, such as privacy, transparency, accountability and intellectual property rights. The evolving nature of the role of the librarian as an information specialist, digital curator, research facilitator, and technology mediator in the AI era in the academic setting is also explored.

The paper presents a synthesis of findings from the literature reviewed, the experience of university libraries around the world, and current technological trends, and finds that AI holds great promise for transforming university libraries into innovative and intelligent academic environments that can promote research excellence, interdisciplinary collaboration, knowledge dissemination, and digital learning. But to achieve effective implementation of AI, it is crucial to establish ethical governance, ongoing professional education, build digital infrastructure, provide institutional backing, and foster a harmonious relationship between humans and machines.

Keywords: Artificial Intelligence, University Libraries, Smart Libraries, Research Support Services, Innovation, Machine Learning, Digital Scholarship, Information Retrieval, Knowledge Management, Academic Libraries

1. Introduction

In the era of rapid growth of information and communication technologies, the higher education system and academic institutions around the world are significantly transformed (Bawden & Robinson, 2020) [5]. Artificial Intelligence (AI) is one of the most influential and

transformative technologies of the twenty-first century that has impacted on education, healthcare, governance, banking, communication and knowledge management systems (Russell & Norvig, 2021) [31]. AI is defined as the ability of computer systems and machines to carry out tasks normally associated with human intelligence, such as learning, reasoning, decision making, understanding language, recognizing patterns and making predictions.

University libraries play a pivotal role in higher education institutions, serving to enhance teaching and learning, research and innovation, and the dissemination of knowledge. Libraries were primarily involved in the collection, organization, preservation and circulation of print books, journals, manuscripts, and scholarly materials. The role of the university library, however, has changed with the digital revolution, increasing use of Internet technologies, growth of electronic publishing, and changing information-seeking patterns of users (Borgman, 2007) [9].

Students, researchers and faculty members today expect information resources to be available instantly, accurately, personally and remotely. As a result, university libraries are increasingly adopting Artificial Intelligence technologies to boost efficiency, enhance user experiences, augment research support services, and build innovative learning spaces. With the advent of artificial intelligence, AI technologies like machine learning, natural language processing, expert systems, robotics, predictive analytics, and digital assistants are helping libraries to automate repetitive tasks, enhance information retrieval systems, manage digital collections, assist with scholarly communication, and optimize decision-making based on data (Cox, Pinfield, & Rutter, 2019) [15].

This idea of "smart library" has been developed by bringing together the technologies of artificial intelligence, cloud computing, Internet of Things, robotics and big data analytics. Smart libraries deliver intelligent, interactive and user-centred services and enable digital learning, collaborative research, open science and academic innovation. In this rapidly evolving context, university libraries are no longer just repositories of information but are active players in institutional research and innovation ecosystems (Lankes, 2016) [24].

At the same time, the open access movement, open science, digital scholarship and research data management have increased the roles of academic libraries even more around the globe. Libraries now play a full role in the research process, from literature discovery, data management, citation analysis and plagiarism detection, to scholarly publishing and research impact assessment (Pinfield, Cox, & Smith, 2014) [30].

Although AI is becoming increasingly crucial in the context of university libraries, there are still some difficulties to consider when it comes to its effective implementation. While AI is rapidly becoming a vital tool in the university library's toolbox, there remain a number of challenges in its application to the effective use of this tool in university libraries. Some of the challenges of the transformation process are still financial restrictions, lack of technical competency, ethical issues, data privacy concerns, algorithmic bias, digital divides, and resistance to technology change (Wheatley & Hervieux, 2019) [39].

This research paper critically reviews the relationship between Artificial Intelligence and university libraries that emphasizes research support services and innovation systems. This study discusses the concept of AI, evolution of university libraries, applications of Artificial Intelligence (AI) technologies, how AI can be beneficial to library users, the ethical issues surrounding the use of AI, the role of the librarian in the age of AI, smart libraries, future trends, and policy implications for the integration of Artificial Intelligence (AI) in university libraries.

2. Objectives of the Study

The major objectives of this research paper are:

1. To investigate how Artificial Intelligence is going to change the conventional university libraries to smart and intelligent academic knowledge systems.
2. To examine the uses of AI technologies across the university library, research support systems, scholarly communication and innovation ecosystems.
3. To assess the advantages, problems, ethical considerations, and legal considerations of using AI in academic libraries.
4. To analyze the evolving nature of librarianship and propose future directions and policy action to effectively use AI in the university library context.

3. Research Methodology

The methodology of this research paper is qualitative and analytical which is used to understand the role of Artificial Intelligence in University Library and how it affects research and innovation system. This study predominantly focuses on secondary data sources obtained from scholarly books, peer-reviewed journal articles, conference papers, institutional reports, policy documents, and International publications on AI technologies, Digital libraries, Smart libraries, Research support services, and Academic innovation.

Relevant literature was systematically sourced from various academic databases including Scopus, Web of Science, Google Scholar, ERIC, ResearchGate and institutional repositories. Collected literature was analyzed through thematic and descriptive methods to identify themes, trends, challenges, applications and future prospects of university library integration with AI.

This study combines the theoretical views, empirical research, and international practices on AI technologies in academic libraries. Themes of intelligent information retrieval, automated cataloguing, research analytics, digital preservation, plagiarism detection, smart libraries, ethical issues and evolving roles of the librarians were critically analysed in order to grasp the scope of the overall transformation in academic knowledge systems.

The analytical review method was effective in analyzing the opportunities and challenges of the use of AI in University Libraries and in developing policy recommendations and future scenarios for enhancing academic library ecosystems with AI.

4. Conceptual relationship Between Artificial Intelligence, University Libraries, Research, and Innovation

AI, university libraries, research and innovation are interwoven elements in today's knowledge societies. New

knowledge is created through research, innovation converts knowledge to practical applications, and the university library serves as a knowledge intermediary that helps users access information, engages in scholarly communication, and promotes dissemination of knowledge (Borgman, 2015) [10]. AI enhances this connection by making library systems more efficient, accessible, and intelligent.

The university library is a conceptual construct composed of information resources, digital technologies, research support systems and innovation infrastructures, which interact dynamically, and are enabled by AI. AI technologies can help to overcome information asymmetry, enhance decision-making processes and promote interdisciplinary collaboration by organizing and accessing scholarly information efficiently (Lankes, 2016) [24].

AI-enabled university libraries play a role in fostering innovation through digital scholarship, open science, research analytics, and collaborative learning. The intelligent systems enhance literature discovery, automate metadata generation, enable predictive analysis, and support the data-driven research process. These functions promote the research productivity and help deliver innovation capacities within institutions.

The application of AI is also connected to the research lifecycle-from idea generation to literature review, data collection to analysis, dissemination to research impact assessment. Through intelligent services, digital tools, and automated research support systems, AI-powered libraries can help with every step of this research lifecycle (Pinfield, Cox, & Smith, 2014) [30].

The conceptual connection between AI, libraries, research and innovation thus points towards the transformation of university libraries from information repositories to knowledge facilitators, from digital innovation hubs to strategic research partners.

5. Concept of Artificial Intelligence

Artificial Intelligence is the ability of machines to replicate the human intelligence by programming them to think, reason, learn and make decisions like humans. The AI systems can perform cognitive functions like speech recognition, language translation, data analysis, pattern recognition, and predictive decision making (Russell & Norvig, 2021) [31].

Artificial Intelligence was coined by John McCarthy in the Dartmouth Conference in 1956. Since then, AI has developed into a multi-disciplinary area of computer science, mathematics, linguistics, psychology and information science.

Major Components of Artificial Intelligence

The following is a description of the main components of AI.

1. **Machine Learning:** ML is a way that computers learn from data and get better at some task without being explicitly programmed. Recommendation systems, predictive analytics, automated classification, and user behavior analysis are common applications of machine learning in university libraries. Users' reading and search behavior are used by ML algorithms to suggest useful scholarly resources, enhancing personalized learning experiences (Pandey & Misra, 2018) [29].
2. **Natural Language Processing:** NLP is the ability of computers to comprehend, interpret, and manipulate human language written and spoken. AI Chatbots, virtual assistants, intelligent search systems and library voice assistants are all powered by NLP technologies. These systems enhance the accessibility, interaction and searching experience for the users in university libraries (Yu & Breivold, 2020) [41].
3. **Expert Systems:** Expert systems mimick the knowledge, logic and the problem solving ability of an expert and assist the decision making process. In university libraries, expert systems can be used to support reference services, database recommendations, guidance on research, and information management activities (Asemi, Ko, & Nowkarizi, 2021) [2].
4. **Robotics:** Robotics includes automated machines that are able to do physical jobs, like shelving, inventory, security monitoring, and moving books. In recent years, as university libraries have become more advanced, robotics technologies are playing an increasing role in helping to streamline operations and minimise repetitive, manual tasks (Cox, Pinfield, & Rutter, 2019) [15].
5. **Deep Learning:** Deep learning is learning by analyzing complex patterns and large amounts of data using a neural network model. In the academic library realm, deep learning can be leveraged to create intelligent search systems, speech recognition solutions, automated indexing, and metadata generation.
6. **Computer Vision:** AI systems can identify images, text, and visual patterns with computer vision technology. Computer vision has been employed in a variety of ways at the University libraries: digitisation, document scanning, Optical Character Recognition (OCR), facial recognition systems and digital preservation activities.

6. Evolution of University Libraries

In the past, technological developments, digitalization and evolving educational requirements have profoundly changed the character of university libraries (Breeding, 2017). Libraries were primarily used as sources of printed materials and manual cataloguing systems. Later on, automation technologies brought in the computerised databases and integrated library systems.

The digital libraries have enabled easier access to e-books, e-journals, web-based databases, and institutional repositories. With the emergence of Artificial Intelligence, cloud computing, big data analytics, and smart technologies today, smart libraries have emerged that can offer intelligent, interactive, and customized services.

The changing nature of university libraries mirrors the evolving landscape from information management to digital knowledge ecosystems for research, innovation, and lifelong learning.

7. Applications of AI in University Libraries

The application of Artificial Intelligence (AI) technologies in university libraries has become more prevalent to boost operational efficiency, boost research support services and provide better user experiences (Cox, Pinfield, & Rutter, 2019) [15]. Automated systems with Artificial Intelligence

(AI) can help libraries automate repetitive tasks, enhance information retrieval processes, aid in digital scholarship, and provide intelligent academic services.

Information retrieval systems with artificial intelligence to quickly and accurately retrieve relevant scholarly resources. In the past few years, the traditional keyword-based information retrieval method is being gradually replaced by a new method which is semantic or context-aware search, which can understand users' query and can analyze the large data sets (Pandey & Misra, 2018) [29]. These systems deliver customized search results, suggestions based on context, automatic indexing, and voice search options. The application of intelligent retrieval systems can enhance the quality of academic information retrieval, shorten the searching time, and help to improve the satisfaction of library users thereby improving the library research productivity.

Chatbots and virtual assistants are tools that can be utilized using AI technology to answer students, researchers and faculty questions about books, databases, research materials, library policies, and digital resources, providing constant support (Yu & Breivold, 2020) [41]. These systems are used to find scholarly materials, train users in the use of databases, to assist users with research, and to remind users of due dates and institutional notices. Chatbots can provide assistance to library staff by handling twenty-four hours of service and enhance the efficiency of library services.

Some of the most time consuming library operations is cataloguing and classification. Machine learning algorithms and metadata generation systems have worked wonders in this aspect on improving automation (Das & Islam, 2020) [18]. AI systems process content of documents, find keywords, create metadata, and classify documents automatically. The automated cataloguing decreases manual labor, increases accuracy and improves discoverability of digital collections and institutional repositories.

Users' search trajectory, reading behavior, and academic interests can be used to recommend relevant books, journals, databases, and scholarly articles using AI recommendation systems (Xu & Du, 2018) [40]. Personalized recommendation services enhance user engagement, facilitate self-learning, and aid researchers in finding valuable academic resources.

University libraries have a significant role to play in the preservation of rare books, manuscripts, research papers, institutional records and historical documents. The use of AI technologies helps in digital preservation, such as Optical Character Recognition (OCR), automated scanning, metadata creation, image restoration, and digital archiving systems (Das & Islam, 2020) [18]. The technologies enhance long-term preservation, accessibility and organization of academic resources.

Plagiarism detection software powered by artificial intelligence (AI) is designed to search academic texts against a vast database and online sources to identify similarities and guarantee originality in research papers (Sharma & Yadav, 2022) [32]. The systems promotes academic honesty, ethical research and quality assurance in universities.

AI technologies can help researchers conduct literature reviews, analyze citations, identify trends, analyze data, and assist with scholarly communication tasks. Researchers can save time and boost their research productivity with citation management systems, research analytics platforms, and automated summarization tools.

In advanced university libraries, robots are growing in importance in order to shelve books, control the stock, guide the reader and keep an eye on security. (Cox, Pinfield, & Rutter, 2019) [15] The use of robotics in libraries enhances the efficiency of operations and eliminates repetitive manual work, thereby freeing up time for library staff to dedicate to research and academic support.

Predictive analytics with AI can aid libraries in analyzing user behavior, determining resource needs, optimizing collections, and making better use of space. Data-driven decision making improves use of resources and boosts library planning.

8. The contribution of the University libraries to research and innovation.

University libraries have a critical role to play in research and innovation, promoting access to scholarly knowledge, building research capacity, enabling digital scholarship and promoting open science practices (Pinfield, Cox, & Smith, 2014) [30]. AI technologies have also enabled libraries to increase its research support capabilities and make it part of the innovation ecosystems of the institutions.

University libraries make available access to scholarly journals, books, databases, institutional repositories, datasets, and grey literature. Researchers can do systematic reviews and efficiently access academic resources using digital libraries and AI-powered discovery tools (Borgman, 2007) [9]. Access to quality information is a positive factor for research productivity and innovation.

Data-intensive research is growing in numbers and research data management is becoming more important. University libraries assist researchers to document, create and maintain metadata, store and preserve data and share open data (OECD, 2015) [28]. AI systems enhance data organization, retrieval, and analysis, and promote transparency and reproducibility in research.

The library has a significant role in Scholarly Communication, which includes the support of open access publishing, institutional repositories, digital archives, and copyright management. AI technologies are capable of finding appropriate journals, quantifying impact of citations and preventing predatory publishing (Beall, 2015) [6].

Libraries supply bibliometric and altmetric tools for research impact assessment, such as citation analysis, h-index, research profiling and research visibility tools (Sugimoto & Larivière, 2018) [34]. AI technologies enhance research analytics and facilitate academic performance evaluation through data analysis.

University libraries contribute to open science by fostering open access publishing, open data repositories, and collaborative research platforms (UNESCO, 2021) [38]. AI-powered libraries enable interdisciplinary research, knowledge sharing, and innovation through the bridge between researchers, institutions, industries, and society.

9. Benefits of AI in University Libraries

University libraries can benefit from the integration of AI in several ways, particularly in terms of enhanced operational efficiency, user experience, research assistance, and digital

innovation (Asemi, Ko, & Nowkarizi, 2021) [2].
Repeatable tasks like cataloguing, indexing, inventory, circulation and metadata generation are performed by AI. Automation can benefit in accuracy, decrease human error, and save time and institutional resources.
Personalized recommendation systems, intelligent search tools and virtual assistants provide customized and interactive services to enhance the user's satisfaction (Xu & Du, 2018) [40].
AI systems search large amounts of data and grasp user intent to deliver relevant and context-appropriate results in real time. Improved retrieval boosts research productivity and academic efficiency. By analyzing user behavior and information needs, predictive analytics systems enable libraries to optimize their resources, space, and collection development.
AI chatbots and digital assistants deliver continuous support services and enhance the access to academic resources and digital library services. Automation helps to cut down the operational inefficiencies, manual workloads, and administrative costs. While implementing AI comes with a cost, the efficiency gains are expected to lower the overall expenses.
Literature reviews can be aided by AI tools, which help researchers locate relevant studies and locate trends, cite sources, and prevent plagiarism, ultimately enhancing research quality and efficiency. Voice recognition systems, text-to-speech technologies, and multilingual AI tools create more accessibility to information for people with disabilities and various linguistic backgrounds.

10. The Future of Libraries and Information Technology in Higher Education: AI's Potential and the Road Ahead

However, there are several structural, technological, ethical and financial challenges to implementing AI in university libraries (Wheatley & Hervieux, 2019) [39].
There are significant investment needs for infrastructure, software, cyber security systems, hardware, and technical maintenance associated with the use of AI technology. The adoption of AI may be constrained by financial constraints, especially in developing nations. Librarians might not have the technical expertise or training needed to effectively manage AI systems. This means continuous professional development and training in digital literacy is a must.
AI systems gather extensive user data – such as search history and reading patterns. This is a problem of confidentiality, surveillance, cyber security, and misuse of data (Cox, Pinfield & Rutter, 2019) [15]. The algorithms might be biased, not transparent, and might be based on automated decision-making processes that can lead to unfair or discriminatory results. Thus, ethical AI governance is required.
Library professionals and users can also be skeptical of the implementation of AI technologies because they fear that it will impact their jobs, be difficult to use, or not be known to them. Digital barriers and uneven access to technology and internet infrastructure at educational institutions exacerbate the inequalities in technology adoption and use, especially for AI implementation. The development of AI systems introduces additional layers of complexity, such as the need for ongoing surveillance, software updates, cybersecurity management, and technical maintenance.

11. Ethical and Legal Issues in AI-Based Libraries

While the potential applications of AI in university libraries are promising, ethical and legal issues surrounding privacy, transparency, intellectual property rights, accountability, and fairness need to be raised and considered (Cox, Pinfield, & Rutter, 2019) [15].
These AI systems gather and process a vast amount of information from users, including their borrowing history, search trends, and online habits. Libraries are required to have strong privacy policies, and security protocols, to safeguard user confidentiality. The issues of copyright law, licensing agreements, and fair-use policies are raised with the AI-generated outputs and digital content management. Libraries are responsible for abiding by intellectual property laws.
Training sets that are not representative can yield discriminatory search results and unequal accessibility of information. The continuous monitoring of AI systems is essential to guarantee fairness and inclusiveness. Some users may not be aware of how AI systems make recommendations and/or classify resources. Libraries should therefore foster clear practices in the use of AI and provide clarity about how the systems work. Despite the possibility that automation could diminish the need for certain traditional library activities, it can also lead to increased opportunities for the development of new digital and analytical skills for library workers.

12. Role of Librarians in the AI Era

There is a tremendous change in the concept of librarianship due to the integration of AI and digitalization in higher education institutions (Kumar & Kaliyaperumal, 2019) [23].
Librarians remain engaged in providing users with access to reliable, authentic and scholarly information resources and continue to promote information literacy. They run institutional repositories, digital archives and electronic resources, and are responsible for the preservation of academic materials over time. Library practitioners assist users in comprehending and applying AI tools, learned databases, plagiarism detection tools, and digital learning platforms.
Literature reviews, research analytics activities, data organization, citation management, plagiarism checking are activities that librarians can assist with. Libraries have come a long way in aiding researchers to organize, preserve, document and manage research data and digital archives. Further Librarians conduct digital literacy, ethical information use, and AI training sessions, workshops, and orientation programs.
AI technologies are not taking the place of librarians, but rather adding to and changing their work.

13. AI and Smart Libraries

Smart Libraries are academic libraries that have been technologically advanced with Artificial Intelligence, Internet of Things (IoT), cloud computing, robotics, and big data analytics, which are capable of delivering intelligent and personalized library services (Yu and Breivold, 2020) [41].
Smart libraries are characterized by automated functioning, remote access, individual customer service, intelligent search systems, smart resources management and co-

learning digital spaces. Smart libraries can enhance user experiences, create robust research support systems, and foster innovation-driven academic ecosystems with the help of AI technologies.

Smart libraries promote interactivity in learning, interdisciplinary research, digital scholarship, and easy access to academic resources. The libraries serve as intelligent hubs for knowledge, and are capable of facilitating modern teaching, research and innovation activities.

14. Future Prospects of AI in University Libraries

Artificial Intelligence is anticipated to become more vital in future of University Libraries and Academic Knowledge Systems (Sharma & Yadav, 2022) [32].

Future AI systems will be more like advanced research assistants that can summarize literature, be able to come up with research ideas, analyze datasets, and identify research gaps. Moreover, voice control AI will enhance accessibility and allow users to access information using conversational interfaces and voice commands.

AR/VR technologies can provide immersive learning experiences, virtual exhibitions, interactive educational environments and simulation learning systems. Shelving, navigating, assisting users and automating inventory will be performed by future robotic technologies that will take on complex library functions.

AI technologies can analyse behaviour and recommend the appropriate academic resources for users based on their learning needs. More technological advancements to facilitate multilingual access to global academic information resources will be made possible by AI. Advanced AI systems will generate more insights into the impact of research, scholarly communication and institutional academic performance.

The future university library will probably be the fully intelligent, interactive and data-driven academic environment.

15. Suggestions for Effective AI Implementation

For effective integration of the technologies of Artificial Intelligence in libraries of universities, certain measures must be taken.

1. The universities should prioritize the provision of high-speed Internet access, advanced technological equipment, and digital infrastructure, including cloud computing systems, to enable the implementation of AI.
2. Ongoing professional development opportunities must be provided for librarians to build skills in AI technologies, digital tools, machine learning and data management.
3. Educated and well-designed institutional policies should be drawn up on data privacy, transparency and accountability, ethical and good use of AI technologies, and responsible information management.
4. Libraries should cooperate with researchers, software developers and technology specialists and academic institutions to enhance innovation and technological development.
5. The use and misuse of digital information, online research, and digital literacy should be taught, along with students, faculty members, and researchers' knowledge of AI tools.
6. AI technology should be used to augment-not replace-human skills. Efficient cooperation between AI systems and librarians is essential to ensure personalized and ethical academic services.

University libraries should regularly review AI systems to check their effectiveness, reliability, satisfaction with the service, and long-term sustainability.

16. Conclusion

The AI revolution has given a new dimension to University libraries as they move from the era of information repositories to become intelligent Knowledge Ecosystems that can facilitate research, innovation, digital scholarship and collaborative learning. AI technologies, including machine learning, natural language processing, robotics, predictive analytics, and expert systems, are revolutionizing information retrieval, digital preservation, scholarly communication, research support services, and user engagement.

By leveraging AI, university libraries improve operational efficiency and accessibility, personalize experiences, boost research productivity, and strengthen their position in institutional innovation ecosystems. The modern library becomes an intelligent academic environment, which enables interdisciplinary research, openness of science, digital learning and dissemination of knowledge.

Despite these developments, there are still many issues to be addressed when implementing AI in university libraries. Budget constraints, technical deficiencies, ethical issues, algorithmic bias, privacy concerns, infrastructure challenges, and the lack of willingness to change are still significant hurdles to overcome. Some of these challenges will only be overcome if there is institutional commitment, policy support, development of digital infrastructure, ongoing professional training, and ethical governance frameworks.

Librarians' tasks are also changing in the era of AI in academia. AI technologies do not replace librarians as information specialists, digital curators, research facilitators or technology mediators, but are meant to support them. The successful realization of human-machine collaboration is crucial to provide effective, responsible, and inclusive academic library services.

Finally, AI has the potential to transform the role of the university library and boost its role in promoting research excellence, innovation, scholarly communication, and knowledge-based development. The academic library will evolve into an intelligent, interactive, and data-driven learning environment in the future, where technology and human resources will be part of a learning space that enhances learning, teaching, and social development.

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