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**ARTIFICIAL INTELLIGENCE FOR SERVICE DELIVERY IN ACADEMIC
AND RESEARCH LIBRARIES**

BY

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Introduction

Librarianship is an old profession that changes with the developments of technologies in any prevailing era. It has developed from clay tablet to electronic tablet and it is still growing. These constant developmental changes dictate the nature or form of service delivery the library adopts. These changes also affect the way a library is defined, for example, from being defined as a "store or room of knowledge" to "a repository of information and knowledge, typically in the form of books, journals, and other printed materials as well as electronic resources that is organised and made available for use by members of a community". Libraries are

found in academic institutions, public buildings, and private organizations and they serve a variety of functions, including supporting research and education, preserving cultural heritage, and promoting literacy and lifelong learning. The concept of a library has existed for thousands of years, with early examples including the Library of Alexandria in ancient Egypt and the libraries of the Chinese emperors. In the modern era, libraries have evolved to encompass a wide range of materials and services, including electronic resources, multimedia materials, and specialised collections (Owushi & Udo 2023)

Academic Libraries

These are libraries attached to tertiary institutions such as universities, polytechnic institutions, colleges of education, colleges of agriculture, colleges of technology and also research institutes (Akporhonor, 2005). Singh and Kaur (2009) stressed that preservation and access to knowledge and information is the main mandate of academic libraries alongside supporting the mission of their parent institutions which is teaching, research and community service.

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Research library

This is a specialized library that primarily serves the needs of researcher, scholars, and academics, It contains an extensive collection of materials, both in print and electronic formats that are relevant to various academic disciplines and fields of study. These libraries house a wide range of resources, including books, journals, periodicals, manuscripts, maps, archives, and digital databases, which are carefully curated to support in-depth research and scholarly inquiry. (Source: Google)

Types of Information Services Delivered in Academic Libraries and Research Libraries

Library services refer to the range of services that libraries provide to their users to support their learning, research, and leisure needs. Here are some common library services according to ALA2021:

- (i) Reference and research assistance: Libraries offer reference services to assist users in finding information, answering questions, and conducting research. Reference librarians provide expert guidance in using library resources, such as databases, online catalogues, and reference materials.
- (ii) Interlibrary loan: Libraries offer interlibrary loan services to allow users to borrow materials from other libraries that are not available locally. This service helps users to access a wider range of resources and information.
- (iii) Collection development: Libraries develop and maintain collections of materials in various formats, such as books, journals, audio-visual materials, and digital resources. Collection development involves selecting, acquiring, and evaluating materials to support the needs and interests of library users.
- (iv) Technology services: Libraries provide access to computers, printers, scanners, and other technological resources. Libraries also offer technology training and assistance to help users develop digital literacy skills.
- (v) Programming and events: Libraries offer a range of programming and events, such as author talks, book clubs, story times, and workshops. These events provide opportunities for learning, socializing, and cultural enrichment.

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Trends in Academic and Research Libraries in the 21st Century

As academic libraries evolve to meet the changing needs of students in the digital age, the emphasis has shifted from the physical book collection to a suite of services incorporating innovations in teaching, technology, and social media. These services tend to facilitate creativity, engagement, and the ability to access resources anywhere any time (Andrews et al., 2016). While there is much "crystal ball gazing," little assessment of how academic libraries have come to implement 21st century trends has taken place (Garofalo, Johnston, & Lupold, 2015). Data collection efforts such as those conducted by organizations like the Integrated Postsecondary Education Data System (IPEDS) and the Association of Research Libraries (ARL) describe what libraries have done or what researchers and faculty want, but they do not operationalize what a 21st century library looks like. In this study, the authors first identified the most commonly cited trends that comprise 21st century libraries, then evaluated the websites of over 300 academic libraries to determine the extent to which they adopted these trends. The 300+ sample included a mix of ARL member libraries, ARL branch libraries, and randomly selected non-ARL academic libraries. The authors also investigated which institutional factors, such as number of librarians on staff, budget, collection size, institution size, and institution status (private versus public), predicted the adoption of these trends.

A review of the literature indicated no single definition or description of a 21st century library. However, some authors made the following submissions:

Garofalo et al. (2015) advocated focusing on "engagement" and striving to connect with patrons, whether it is through personalized librarians, shared spaces, or collaboration with other services like writing centres. Leong (2013) also supported community engagement and outreach as a 21st century library goal.

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One particularly innovative way some libraries are engaging their patrons is by creating makerspaces, which encourage exploration and innovation by allowing people to create, build, and experiment with a variety of equipment, software programs, and tools (Harris & Cooper, 2015; Herron & Kaneshiro, 2017; Nichols, Melo, & Dewland, 2017);

Knowledge management, data management, digital humanities, and geographic information systems (ACRL, 2017).

The American Library Association's (ALA) The State of America's Libraries report (Rosa, 2016) confirmed this further, noting that academic libraries are "embracing new responsibilities in such areas as scholarly communication, digital archives, data curation, digital humanities, visualization, and born-digital objects" (p.3) as well as working in areas like altmetrics and research data management.

An important recent initiative in information literacy and evidence of learning is the Assessment in Action (AiA) program lead by ACRL. AiA challenged participating institutions to plan and implement projects "that aligned with institutional priorities and contributed to campus assessment activities" (Brown, 2017, p.1). The three-year program produced several documents describing multiple ways in which libraries can positively impact student success. ACRL's report documents five areas where the library had a particularly positive impact on student learning and success, two of which concern information literacy instruction and one that concerns library partnerships with other campus units such as writing centres (Brown, 2017).

Innovative or non-traditional reference services are another area that could be considered a 21st century library trend. Increasingly, academic librarians are developing new and innovative ways to reach their patrons, whether finding students and faculty where they are (e.g., dorms and academic buildings outside the library) or through virtual services such as chat or LibAnswers (via Springshare). MacDonald and McCabe (2011) reported on a service called iRoaming in which librarians walk around the library with tablets to assist patrons at point of need. Other libraries have employed tablets mounted on robots which telechat to provide reference services remotely (Hartsell-Gundy, Johnson, & Kromer, 2015). Coleman, Mallon, and Lo

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(2016) investigated the impact of innovative reference services at academic libraries and found that many libraries have developed alternate ways of

reaching patrons including using a cooperative reference service, methods for making appointments with librarians, creation of an FAQ, and creation of a blog to enable patrons to see answers to questions already asked. Finally, Li (2013) discussed how distance education has caused reference services to adjust, offering various virtual reference services such as chat, videoconferencing, voice-over IP, co-browsing, instant messaging, use of a toll-free telephone number, and email.

Influence of ICT on information service delivery in ARL

Recent advances in IT have not only increased tremendously the ability to access, store and process information within the library but also have brought significant changes in the concept, organisation, functioning and management of library and information systems (Peyala, 2011). The IT revolution has facilitated the processes of searching for and recovering information; ICT improves the efficiency of organizational management processes and provides new ways of improving the capacity of response to its users (López, Peón, & Ordás, 2009). Use of ICT applications can assist in creating, storing, transferring and using tacit and explicit knowledge (Okumus, 2013). Buarki, Hepworth, & Murray (2011) have carried out a study on "ICT skills and employability needs at the LIS programme Kuwait: a literature review". In the study, authors reviewed an enormous number of ICT related literature. They have concentrated on information and communication skills (ICT) of library and information science students in global LIS education and compare them with those skills needed by the job market in Kuwait. They found that, "ICT skills have been recognised as essential qualities for LIS graduates' employment'. Therefore, at present days, ICTs skills have become the prerequisite and central attention to judge a candidate for the employment. Anunobi & Edeka (2010) have discussed how university library plays a pivotal role as an information providing system; it supports teaching, learning, and research with information materials of various types. Amongst the different information materials, serials or periodicals are most obligatory mainly

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for faculties and researchers. Earlier, the serials operation was manual; but with the development of ICT the acquisition of serials or periodicals became easy as well as its retrieval. In line with the above perspective, users' curiosity for seeking information changed from print to e-resources. Haneefa (2007) investigated the application of information and communication technologies (ICT) in special libraries in Kerala, India. In the study, it is found that the library catalogue was the utmost popular area for automation. The investigation revealed that, inadequate ICT infrastructure as the major cause of users' dissatisfaction. The study has recommended to enhance library automation and to focus on effective and efficient application of ICT. Chandrakar & Arora (2010) provided the Indian approach on the use of information technology on copy cataloguing from different trusted sources such as IndCat, and catalogue of Library of Congress. So, the overall review illustrates that, the appropriate use of ICT in library is much essential. It is also considered that the proper infrastructure and ICT enabled environment can provide better and faster services to users.

Concepts of Artificial Intelligence(AI)

The sound of the term artificial intelligence often conjures images of robots or computers that talk. Artificial intelligence is an aspect of computer science that focuses on how computers learn (Machine Learning), interpret information, vision: character recognition, picture analysis, 3D perception, and modelling of the function of the eye; furthermore, it encapsulates speech recognition, speech production, understanding and use of natural language (Natural Language Processing), and Expert System which continues to gain more attention. Furthermore, artificial intelligence is the programming and development of computers to perform human required-intelligence task, such as speech recognition, decision-making, visual perception, language translation, talking and emotional feelings (Irizarry-Nones, Palepu & Wallace, 2017)

Application of Artificial Intelligence in Libraries

Libraries have evolved structurally and content-wise through different eras: the ancient, medieval and modern era. In the ancient times, clay tablets and stones were used as media for transmitting information, through the medieval era of papyrus and parchments and the modern era of paper, microform and now the digital or electronic media (Gustavsson & Hedlund, 2011). Libraries have acquired and maintained various forms of information resources throughout these eras so as to meet the information needs of its user communities. Similarly, a library was formally defined as a function of the physical building where books were kept for reading and other purposes. However, the definition of library today has gone beyond the physical building, it now centres on the collections and services offered, since virtual libraries have no physical walls and services could be rendered to users from remote locations.

Consequently, in the effort to satisfy the dynamic information needs of its clientele at the same time uphold its relevance in this ever-changing technological society, libraries have explored, incorporated and metamorphosed through different technological revolutions of clay tablets, stones, papyrus, parchments, paper, microforms, computers, Internet, virtual libraries, library 2.0, cloud computing etc. Interestingly, artificial intelligence is the current technology that has evolved with huge prospects and promising applications in libraries. Hence, the need to also explore this tech; its pros and cons, in order to adequately maximize its rich benefits for innovative and optimal services delivery in libraries. Corke (2013) asserted that artificial intelligent systems (robots) will be an important technology in this century. In a nutshell, the crux for applying artificial intelligent systems in libraries is the fact that they are less prone to errors unlike human beings; they can work for 24 hours/7 days without getting tired thereby freeing the librarians to do other jobs. Ultimately, since computers can operate efficiently at a scale and speed beyond human abilities, it will maximize speed, efficiency and effectiveness in processing library materials and enhance library services delivery at all levels.

Daniel (2023) provided seven ways by which Artificial intelligence can be applied in libraries which includes:

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Content indexing,

Document matching,

Death of citation (AI algorithms, which are based on the actual content of papers, will create far better mapping systems of the actual research, and be of major help to librarians and researchers alike (as opposed to the network of researchers presented in the citation system),

Content summarization,

Quality of service (AI has penetrated the world of librarians and researchers in the form of chatbots that can answer directional or simple questions, alert when a new book is published, and direct a customer to specific library resources. The automation of conversations between a user and a machine will enable librarians to embed their focus on more difficult questions and save time answering repetitive ones. This will also enable libraries to extend the opening hours of both in-person and online services.

The Impact Factor of the Future which is a measure of the relative importance and quality of the individual publication, journal, or researcher to literature.

Better Operational Efficiency- Libraries can identify and magnify operational efficiency by improving service effectiveness and reducing operational costs with process automation, optimized research data management, and digital asset management (DAM).

The LinkedIn team (2023) submitted that "AI can be applied to various aspects of library services, such as cataloguing, classification, recommendation, reference, discovery, and preservation. For example,

AI can help librarians automate the process of metadata creation and extraction, enhance the quality and consistency of bibliographic records, and identify and correct errors and inconsistencies.

AI can also help librarians provide personalized and relevant recommendations to their patrons, based on their preferences, behaviour, and context.

AI can also assist librarians in answering complex and diverse queries, using natural language processing and semantic analysis.

Furthermore, AI can help librarians discover new and emerging topics, trends, and patterns in the information landscape, using data mining and machine learning.

AI can help librarians preserve and digitize their collections, using image recognition and optical character recognition"

improving the efficiency and accuracy of library data,

increasing the relevance and diversity of resources and services,

Expanding access to information, and supporting innovation and learning.

AI can reduce manual and repetitive tasks for librarians, minimize errors and inconsistencies in data, provide tailored recommendations to patrons, enable interactions with the library anytime and anywhere, and facilitate the discovery of new knowledge"

Librarians' skills and AI-enabled Services

Librarians possess a range of skills that are highly relevant to the field of AI-enabled services in libraries. These skills enable them to effectively leverage AI technologies to enhance library services.

Artificial Intelligence has become the new emerging trend for libraries. Artificial intelligence has proven to be a breakthrough for information sectors. Artificial Intelligence has had positive impacts on academic libraries and has brought changes in search and retrieval methods, discovery search, chatbots, text mining, and data mining (Fernandez, 2016, p. 22). The prospect of artificial intelligence (AI) in library and information science (LIS) in the 21st century is substantial (Bawden, 2019). The rapid advancements in technology, particularly in the field of artificial intelligence (AI), have

had a profound impact on various industries. In the 21st century, libraries and information science have also embraced AI to enhance their operations, improve user experiences, and optimize information retrieval processes. The 21st century has witnessed the rapid adoption of artificial intelligence (AI) in the field of library and

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information science (LIS). AI technologies have revolutionized traditional library services, enhancing information retrieval, knowledge organization, and the user experience. AI-powered systems, such as natural language processing and machine learning algorithms, have significantly improved the efficiency and effectiveness of library operations, leading to improved access to information for users (Kumar & Rani, 2018). AI-based technologies in LIS have enabled advanced information retrieval techniques. Intelligent search engines, chat bots, and recommendation systems leverage AI algorithms to provide users with personalized and contextually relevant information. These systems utilize machine learning and data mining techniques to analyse user preferences, behaviours, and interactions, facilitating more accurate and tailored search results. AI also plays a crucial role in automated indexing and metadata generation, helping librarians organize and categorize vast amounts of information efficiently (O'Leary, 2020). AI technologies have the potential to revolutionize various aspects of LIS, including information retrieval, cataloguing and classification, user services, data analysis, and knowledge management (Chandrashekara, 2018). Here are some key areas where AI can make a significant impact;

Information Retrieval:

AI can enhance information retrieval systems by improving search algorithms, natural language processing, and recommendation systems. AI techniques such as machine learning and deep learning can help in understanding user preferences, context, and semantic meaning, leading to more accurate and personalized search results.

Cataloging and Classification:

AI can automate the cataloging and classification process, making it more efficient and accurate. Machine learning algorithms can analyse and extract metadata from various types of documents, reducing the manual effort required for cataloguing. AI can also assist in automated subject indexing and classification of resources based on their content.

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User Services:

AI-powered virtual assistants and Chatbot can provide personalized assistance to library users. These virtual assistants can answer queries, provide recommendations, and guide users through the library's resources and services. Natural language processing and machine learning techniques enable virtual assistants to understand and respond to user queries effectively (Agrawal, 2017).

Data Analysis:

Libraries generate vast amounts of data, including circulation statistics, user behaviour, and resource usage. AI techniques can be applied to analyse this data and extract meaningful insights. Machine learning algorithms can identify patterns, trends, and correlations in the data, enabling libraries to make data-driven decisions for collection development, service improvement, and resource allocation (Thakur, 2019).

Knowledge Management:

AI can aid in knowledge organization and management by automating processes such as text summarization, information extraction, and knowledge discovery. These capabilities can support efficient knowledge sharing and collaboration among library professionals and researchers.

Challenges

Idemudia & Makinde (2022) presented the perceived challenges of AI application to library services such as "privacy, linguistic styles, bias, and quality of intelligence, intellectual freedom, and cost". In the same vein, Subaveerapandiya (2023) raised concerns on ethical issues, privacy issues, and the need to ensure equitable access to information are important factors that must be carefully addressed.

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Recommendations

The followings are some recommendations for addressing the challenges and effectively implementing AI-enabled services in libraries;

- 1. Prioritize Data Privacy and Security:** Develop robust data privacy policies and security measures to protect patron information. Ensure compliance with relevant data protection regulations, such as GDPR or local privacy laws.
- 11. Ethical AI Use:** Establish clear ethical guidelines for AI use in libraries, emphasizing fairness, transparency, and responsible data handling. Regularly review and audit AI systems for bias and fairness.
- III. Allocate Adequate Resources:** Secure sustainable funding models to support AI initiatives in libraries. Consider partnerships, grants, or collaborations with academic institutions or organizations to access additional resources.
- IV. Integration Planning:** Plan for seamless integration of AI systems with existing library management systems and workflows. Ensure that AI complements rather than disrupts existing services.
- V. Staff Training:** Invest in training and professional development for librarians and staff to build their AI literacy and technical skills. Provide ongoing education to keep up with AI advancements.

VI. User-Centric Approach: Prioritize user experience and feedback when designing AI-enabled services. Conduct usertesting and surveys to understand patron expectations and preferences.

VII. Bias Mitigation: Implement strategies to mitigate bias in AI algorithms, such as diverse training data, bias audits, and transparency in algorithm decision-making.

VIII. Maintenance and Updates: Develop a schedule for regular maintenance and updates of AI models and systems. Monitor AI performance and address issues promptly.

IX. Digital Inclusion: Bridge the digital divide by offering alternative access

options for patrons who may not have access to AI-enabled services at home. Consider providing training and support to underserved communities.

X. Adopt Standards: Collaborate with library consortia, organizations, and standards bodies to establish best practices and standards for AI in libraries. Ensure adherence to these standards in AI implementations.

These recommendations can help libraries harness the potential of AI while addressing the associated challenges, ultimately enhancing the quality and accessibility of library services for their communities.

Conclusion

In conclusion, the integration of AI into libraries is a journey that requires libraries to uphold their core values of equitable access, privacy, and information stewardship while embracing the potential for innovation. By addressing challenges and embracing these recommendations, libraries can position themselves as dynamic, user-centric, and responsible providers of AI-enabled services that enrich the lives of their communities. The future of libraries is one where AI and human expertise work hand in hand to create a more accessible, inclusive and knowledge-rich world for all.

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