



# The integration of Artificial Intelligence tools in academic libraries within Ghana

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## Abstract

*Artificial Intelligence (AI) presents substantial opportunities to advance library operations and user experiences. However, its integration in academic libraries in Ghana has been relatively unexplored. This study investigates the adoption and implementation of AI tools in academic libraries within Ghana, employing a quantitative approach. Focusing on library staff from the University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), and the University of Cape Coast (UCC), the research sampled 40% of the total population of 450 staff members, resulting in a sample size of 180. Findings indicate that AI-driven search engines and automated cataloging are the most widely adopted tools. UCC shows a broader adoption of AI applications, including chatbots and AI-based recommender systems, while predictive analytics remains less common. The study highlights key factors for successful AI implementation: adequate funding, staff training, technical support, and user acceptance. Despite concerns about job displacement and the necessity for policy adjustments, librarians view AI as a valuable asset for enhancing library services and user engagement. The study underscores the need for academic libraries to prioritize securing resources, investing in staff training, and updating policies to effectively integrate AI technologies and address the evolving demands of library users.*

**Keywords:** Artificial Intelligence (AI), Academic Libraries, Library Automation, AI Applications in Libraries, Technological Advancements in Libraries, Library Innovation, Digital Transformation.

## Introduction

Artificial intelligence (AI) is pervasive in contemporary society. Artificial intelligence and its associated technologies are extensively utilised by corporations such as Apple, Google, Facebook, and Tesla. Multiple reports (Ransbotham et al., 2017). Frank et al. (2018) have asserted that artificial intelligence has transformed corporate operations and that intelligent automation may result in workforce displacement and alterations in job content. The American Library Association (2019) posits that AI will become an essential instrument for librarians, indicating that the function of libraries will evolve in complexity,

necessitating future librarians to possess advanced critical, creative, and inventive thinking skills, along with emotional intelligence.

Coleman (2018) emphasised that a library's AI initiative should be purpose-driven rather than technology-driven, involving all stakeholders in the discourse, planning, and execution of AI to collaboratively address challenges. Huan (2014) analysed many AI applications and advocacy initiatives for libraries, each with distinct purposes, including AI for Librarians, AI Lab, ChatGPT, Litmaps, Elicit, and Inciteful. "AI for Librarians" includes several instances of AI applications and serves as the most valuable

AI resource for librarians. This study examined all potential applications of AI technology, including machine learning for pattern and face recognition, natural language processing, expert systems, speech production, machine vision, intelligent planning, and robotics, that can enhance research and teaching in universities.

Consequently, certain scholars have executed diverse AI-related library initiatives and projects. Heck, Weisel, and Kullmann (2019) proposed two benefits of transitioning from information literacy to AI literacy. Initially, AI facilitates the acquisition of information literacy in both learning and teaching, suggesting that AI systems may incorporate strategies that assist learners in developing problem-solving abilities. Secondly, information literacy underpins AI, signifying that AI necessitates user empowerment and self-management capabilities; hence, AI systems can aid in the identification of pertinent personalised information.

Numerous studies have investigated the implementation of AI applications in libraries (Mogali, 2018; Talley, 2016; Asemi & Asemi, 2018; Vijayakumar & Sheshadri, 2019; Omame & Alex-Nmecha, 2020; Heck et al., 2019; Omame & Alex-Nmecha, 2020; Das and Islam, 2021), while empirical research has explored university and library settings, as well as librarians' awareness and perceptions of AI (Libris, 2020; Coxet et al., 2019; Wheatley & Hervieux, 2019; Lund, et al., 2020; Abayomi et al., 2021). Consequently, a growing body of research suggests that the deployment of AI is essential in libraries.

Nonetheless, AI is an evolving technology, and the readiness to embrace AI applications in libraries may shift as AI technology progresses. The vision and mission of universities are to lead in scientific advances and create a conducive atmosphere for academics across many disciplines while fostering sustainable growth. Academic libraries must assume a pivotal role in facilitating research. Examining the principal factors for the implementation of AI applications in academic libraries and the related obstacles is consequently valuable. A deeper understanding of AI implementation enhances our ability to promote AI applications in libraries effectively and efficiently.

Certain libraries in Ghana are enthusiastic in adopting emerging yet inadequately developed technologies. Moreover, emerging technology may prove detrimental. This study attempted to identify the critical variables for the effective implementation of AI applications in academic libraries from multiple

viewpoints. This study conducted a gap analysis, indicating that not all AI applications are appropriate for every library. The findings are beneficial for librarians seeking to develop a contingency plan for the implementation of AI technologies in their library.

### ***Objectives of the study***

- To identify the types of AI applications implemented by academic libraries in Ghana.
- To find out the key factors for the successful implementation of AI applications in academic libraries in Ghana.
- To find out AI awareness, and perception among academic librarians in Ghana.

## **Literature review**

### ***Overview of AI***

The origins of AI can be traced back to Second World War, with Turing, (2019) lecture on the need to program computers rather than build machines. By the late 1950s, researchers were beginning to contribute to the development of AI (McCarthy, 2020). McCarthy (2020), a legendary computer scientist, defined AI as follows: "It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable."

AI research has several branches. Kulkarni (2020) provides a graph describing AI typologies and the relationships between different branches, which include machine learning (ML), natural language, expert systems, speech, vision, planning, and robotics. Deep learning, a branch of ML, is currently a focus of research, providing algorithms that support the technological development of Google's self-driving car, face recognition, and SIRI. Big data infrastructure has been developing since the 1990s and is leading to rapid developments in AI research, facilitating a new era of AI applications. Tredinnick (2017) noted that AI exists not only in movies and fiction but also in the workplace. A report by MIT Sloan Management Review and Boston Consulting Group revealed that AI is increasingly being adopted by numerous industries, including those related to technology, the media, telecommunications, customer services, financial services, professional services, and the health-care sector (Ransbotham, Kiron, Gerbert, & Reeve, 2017). Apple, Google, Facebook, and Tesla have incorporated many AI and ML technologies into their products



(Kirkwood, 2018; Griffey, 2019). The cofounder of Coursera, Andrew Ng, stated that the role of AI is similar to that of electricity 100 years ago. AI is the new electricity and will transform products in different industries, such as those related to logistics, health care, security, and transportation (Lynch, 2017). Ma, et al., (2020) explored the widespread use of AI applications in public services in China, including for smart traffic, intelligent information management, intelligent government services, and smart health care, and described the challenges resulting from a lack of key intelligent technologies and standard systems for their applications as well problems pertaining to relevant patents owned by IBM, Google, and Microsoft.

In this study, the author attempted to consider all possible applications of AI technology (e.g., ML approaches to pattern and face recognition, natural language processing, expert systems, speech production, machine vision, intelligent planning, and robotics) that can support research and teaching in universities. This study not only investigated the AI applications that can support academic library operations, but also explored the potential role of academic libraries in facilitating AI literacy and supporting AI incubation on the university campuses.

### ***AI applications in libraries***

Cox, Pinfield, and Rutter (2019) interviewed 33 people, including library managers, library commentators, and nonlibrary participants, about their potential role in supporting and using AI and the potential uses of AI in libraries. Support roles include procuring AI content, conducting data quality control, curating derived data, designing data infrastructure to enable AI, explaining how to explore the new environment, and teaching critical data literacy. Suggestions were based on the function of library and extended library services in an AI environment.

In addition to qualitative research, several studies have used surveys to investigate the perceptions and attitudes of academic librarians toward AI in various countries. Wheatley and Hervieux (2019) evaluated 25 universities and their libraries in the United States and Canada, revealing that only 18.5% of academic libraries offered programming and services related to AI, indicating a lack of response to or awareness of the increasing use of AI. Lund, Oname, Tijani, and Agbaji (2020) distributed their surveys through the International Federation of Library Associations' Information Technology and Academic and Research Libraries listservs and acquired 236 responses from

academic librarians on their perceptions of AI. They then examined the alignment of these perceptions with the diffusion of innovations in adopter categories. Abayomi et al. (2021), adopted the questionnaire from the study to investigate the awareness and perception of AI among 100 academic librarians in Nigeria. Japan is a leader in robotics, particularly for everyday applications. Harada (2019) introduced various types of AI technology that have been implemented in several libraries in Japan, including a guiding humanoid robot called "Pepper;" the robot suit HAL (standing for hybrid assistive limb), which was developed to assist in lifting and reduce the burden on the waist with automatic book tracking; and the game "KOKORO Saver," which recommend books for children in accord with their interests and after analyzing what they post on social media.

### ***Implementation of AI in academic libraries***

AI applications are not only used in commercial products; scholars have advocated the adoption of AI for use in educational technology in higher education for developing digital learning, adaptive learning software, and research (Becker, et al., 2017). Luckin, (2016) suggested four manners in which AI can benefit universities: preparing students for the AI world, helping higher education institutions manage the large amounts of educational data, supporting researchers to participate in the AI revolution, and conducting research on AI systems in universities. These four perspectives provide an overview of the future applications of AI on university campuses and indicate several approaches and action plans that must be developed. Furthermore, it is essential to explore the role of academic libraries in helping students achieve AI literacy.

Pinfield et al. (2020) proposed a report for the Society of College, National, and University Libraries to map the future of academic libraries, noting that some emerging technologies, such as AI and ML, appeared to be less well understood among academic librarians; therefore, improving their understanding of AI-related technologies is essential. Kirkwood (2018) stated that, through the application of AI technology, information professionals could explore data and resources in greater depth, create more innovative solutions, and provide greater value for users.

Some research has envisioned how AI applications could be applied to the library environment. Mogali (2018) described AI and its applications in libraries in relation to several activities, including expert system

applications (reference services, acquisition, cataloging, classification, and the indexing of periodicals), natural language processing (searching databases and online public access catalogs), pattern recognition (symbolic ML, graph-based clustering, and classification), and robotics (e.g. a robotic on-demand batch-scanning system that would allow users to browse printed material through a web interface).

Furthermore, Vijayakumar and Sheshadri (2019) explored the possible applications of, and Huang (2020) examined AI use in libraries in the United States, Canada, and Europe. Oname & Alex-Nmecha (2020) comprehensively reviewed papers concerning AI use in libraries; they covered various topics including the justification for applying AI in libraries, AI concepts and trends, and the numerous applications of AI in library and information services—such as for automatic cataloging and classification, automatic indexing using expert systems, smart engagement with online sources, and interactive bibliographic instruction.

Asemi and Asemi, (2018) employed exploratory factor analysis to identify the AI techniques that are most applicable in libraries; they identified four criteria: including expert systems, decision support systems and recommender systems, intelligent data mining systems, and natural language processing systems. Asemi and Nowkarizi (2021) reviewed papers relating to AI technologies for libraries, revealing that intelligent systems were mostly designed to detect and replace books on the shelf and suggesting that librarian–robot interaction be improved. Furthermore, they classified the related research into four areas: technology, services, users, and resources. In short, emerging AI technologies can help libraries develop user-friendly, graphic, and seamless intelligent systems based on human–computer interactions.

### ***AI perception among academic librarians***

Fernandez (2016) suggested that libraries should collaborate not only with each other but also with other industries to overcome institutional barriers, thus benefiting from economies of scale. In addition, AI should be deployed in a manner that is not only ethical and service oriented but also consonant with the venerable tradition of librarianship. Librarians should consider how AI would affect libraries and how they could optimize the use of AI technologies. An open-minded and creative library environment might help librarians make effective decisions in relation to the adoption and implementation of AI technologies.

Faced with rapid global, social, and technological

changes, librarians have served as knowledge workers (White, 2019); (Bennet, 2018) and social entrepreneurs (Allison, 2020). Librarians must not only be alert to the existing environment when preparing new knowledge products and services but also envision future knowledge needs (Bennet, 2018). Therefore, identifying the intangible work performed by librarians and discovering potential to transform the future creative form of academic library services are crucial.

Lund et al. (2020) adopted Roger's diffusion of innovation model to explore the perceptions of AI among academic librarians. The results demonstrated a strong relationship between librarians' perception of the knowledge of AI and adopter category. Huan (2014) proposed a knowledge activity scale for assessing individual tacit knowledge and organizational knowledge, indicating that the proposed measurement items could be used to measure the effect of the creative organizational climate; a higher score demonstrated a stronger innovative environment. In this study, this scale was adopted to explore the relationship between the awareness and perception of AI among academic librarians and knowledge activities. Knowledge activities are activities performed to acquire, externalize, and reuse relevant knowledge and activate the development of new knowledge to achieve certain goals (Lai and Lee, 2007). Huang (2014) defined knowledge activities from a comprehensive perspective and categorized knowledge activities into individual and organizational dimensions.

### **Methodology**

The study employed a descriptive survey. The choice for the descriptive survey was influenced by the fact that the researcher was dealing with a large population who were remotely dispersed across the campuses of the selected public universities in Ghana. The quantitative approach was used to gather and analyse data from the selected public universities in Ghana. The study targeted library staff from the University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), and the University of Cape Coast (UCC), with a combined total population of 450 staff members. These institutions were selected due to their prominence and varying sizes, providing a comprehensive overview of AI integration in their library settings. The researcher used 40% of the population for sample size based on the sample size determination by Nwana (1992), who opines that a population of few hundred, 40%



or more sample is chosen from the target population. A sample size of library staff in UG was 63, KNUST was 55 and UCC was 62. Therefore, the total sample size for the three (3) universities was 180. In selecting the respondents to administer the data collection instruments (questionnaire), the convenience sampling technique was used. This sampling technique was used based on the fact that it was difficult to assemble all library staff at a particular time for any rigorous sampling technique. The quantitative instrument used for the data collection for the respondents was the questionnaire. Questionnaires provide a relatively cheap, quick, and efficient way of obtaining large amounts of information from a large sample of people. The data that was collected using the questionnaire was first edited to correct errors. It was then collated, coded and analyzed descriptively using the Statistical Package for Social Sciences (SPSS) version 25.0 into frequencies and percentages. The data that were generated through the questionnaire were assigned with appropriate codes and analyzed. The results were presented in the form of tables, pie charts and bar charts showing frequencies and percentages of responses given by the respondents. Data collected were used strictly for academic purposes.

## Data analysis and findings

### Bio data of Respondents

Table 1. Gender Distribution

Gender	UG (n=63)	KNUST (n=55)	UCC (n=62)	Total (n=180)
Male	35 (55.6%)	30 (54.5%)	33 (53.2%)	98 (54.4%)
Female	28 (44.4%)	25 (45.5%)	29 (46.8%)	82 (45.6%)

The gender distribution among librarians at the University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), and the University of Cape Coast (UCC) shows a consistent pattern across the institutions. At UG, males represent 55.6% of the library staff, while females account for 44.4%, indicating a slight male predominance. Similarly, at KNUST, 54.5% of the librarians are male, compared to 45.5% female, reflecting a nearly balanced yet marginally male-dominant workforce. The trend continues at UCC, where males constitute 53.2% and females 46.8% of the library staff. Overall, across the three institutions, males make up 54.4% of the library staff, while females represent 45.6%. This overall

pattern indicates a slight predominance of males among librarians, though the gender distribution remains relatively balanced. The consistency in gender representation across these academic libraries suggests that while there is a minor male majority, the gender balance among library staff is fairly equitable.

Table 2. Rank in the Library

Rank	UG (n=63)	KNUST (n=55)	UCC (n=62)	Total (n=180)
Senior Librarian	10 (15.9%)	9 (16.4%)	11 (17.7%)	30 (16.7%)
Librarian	18 (28.6%)	16 (29.1%)	17 (27.4%)	51 (28.3%)
Assistant Librarian	25 (39.7%)	20 (36.4%)	22 (35.5%)	67 (37.2%)
Library Assistant	10 (15.9%)	10 (18.2%)	12 (19.4%)	32 (17.8%)

The distribution of library staff ranks at the University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), and the University of Cape Coast (UCC) reveals notable trends. At UG, 39.7% of the staff are Assistant Librarians, making this rank the most common among the staff. Librarians follow at 28.6%, while Senior Librarians and Library Assistants each account for 15.9%. At KNUST, the ranks are distributed similarly, with Assistant Librarians constituting 36.4% of the staff, Librarians 29.1%, and Senior Librarians and Library Assistants each representing around 16.4% and 18.2%, respectively. UCC shows a slightly higher proportion of Senior Librarians (17.7%) and Library Assistants (19.4%), with Assistant Librarians at 35.5% and Librarians at 27.4%. Overall, across the three institutions, Assistant Librarians make up the largest group at 37.2%, followed by Librarians at 28.3%, Senior Librarians at 16.7%, and Library Assistants at 17.8%. This distribution highlights that Assistant Librarians are the most prevalent rank among library staff, with a relatively balanced representation of other ranks, indicating a diverse range of experience levels across the institutions.

### Types of AI applications implemented by academic libraries in Ghana

The first objective of this study was to identify the types of AI applications implemented by academic

libraries in Ghana.

*Table 3. Types of AI Applications in Use*

AI Application Type	UG (n=63)	KNUST (n=55)	UCC (n=62)	Total (n=180)
Automated Cataloging	35 (55.6%)	30 (54.5%)	33 (53.2%)	98 (54.4%)
AI-driven Search Engines	40 (63.5%)	35 (63.6%)	39 (62.9%)	114 (63.3%)
Chatbots for User Assistance	25 (39.7%)	20 (36.4%)	28 (45.2%)	73 (40.6%)
Predictive Analytics for Resource Planning	18 (28.6%)	15 (27.3%)	22 (35.5%)	55 (30.6%)
AI-based commender Systems	22 (34.9%)	18 (32.7%)	25 (40.3%)	65 (36.1%)

The distribution of AI applications across the three universities—University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), and the University of Cape Coast (UCC)—reveals varied levels of adoption. AI-driven search engines are the most widely implemented tool, with usage rates closely aligning at UG (63.5%), KNUST (63.6%), and UCC (62.9%), reflecting a strong commitment to enhancing search capabilities across all institutions. Automated cataloging also shows significant adoption, with similar high usage rates at UG (55.6%), KNUST (54.5%), and UCC (53.2%). This suggests that automated cataloging is a core component of the libraries' operational strategies. Chatbots for user assistance are notably more prevalent at UCC (45.2%) compared to UG (39.7%) and KNUST (36.4%), indicating a stronger emphasis on user interaction at UCC. Predictive analytics for resource planning is the least adopted application, with UCC (35.5%) leading slightly over UG (28.6%) and KNUST (27.3%). Finally, AI-based recommender systems are used more extensively at UCC (40.3%) compared to UG (34.9%) and KNUST (32.7%), suggesting a greater focus on personalized recommendations at UCC. Overall, while all three universities utilize AI to some extent, UCC demonstrates a more diverse and extensive adoption of various AI applications.

*Key factors for the successful implementation of AI*

*applications in academic libraries in Ghana*

The successful implementation of AI applications in academic libraries in Ghana hinges on several key factors.

*Table 4. Key Factors for Successful AI Implementation*

Success Factor	UG (n=63)	KNUST (n=55)	UCC (n=62)	Total (n=180)
Staff Training and Development	50 (79.4%)	45 (81.8%)	48 (77.4%)	143 (79.4%)
Adequate Funding	55 (87.3%)	47 (85.5%)	55 (88.7%)	157 (87.2%)
Technical Support Availability	45 (71.4%)	40 (72.7%)	44 (71.0%)	129 (71.7%)
User Acceptance and Awareness	38 (60.3%)	32 (58.2%)	36 (58.1%)	106 (58.9%)
Collaboration with IT Departments	42 (66.7%)	38 (69.1%)	41 (66.1%)	121 (67.2%)

Table 4 illustrates the key factors contributing to the successful implementation of AI tools in academic libraries at the University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), and the University of Cape Coast (UCC). Adequate funding is universally recognized as the most critical factor, with the highest adoption rates observed at UCC (88.7%) and UG (87.3%), closely followed by KNUST (85.5%), indicating that financial resources are crucial for AI initiatives across all institutions. Staff training and development is also a vital factor, with similar high importance across the universities: UG (79.4%), KNUST (81.8%), and UCC (77.4%), reflecting a strong consensus on the need for skilled personnel to effectively implement AI tools. Technical support availability is moderately acknowledged, with UCC (71.0%) and KNUST (72.7%) showing slightly higher rates compared to UG (71.4%), emphasizing the necessity of ongoing technical assistance for maintaining AI systems. User acceptance and awareness is noted as a less critical but still important factor, with UG (60.3%) and UCC (58.1%) exhibiting slightly higher rates than KNUST (58.2%), underscoring the role of user engagement in the success of AI tools. Finally, collaboration with IT departments is seen as essential, with similar levels of recognition at UG (66.7%), KNUST (69.1%), and UCC (66.1%), highlighting the



importance of interdisciplinary cooperation in the AI implementation process. Overall, while all factors are important, adequate funding and staff training emerge as particularly crucial for the successful integration of AI in academic libraries.

### *Librarians' Perceptions of AI Usage*

*Table 5. Librarians' Perceptions of AI Usage*

<b>Perception Statement</b>	<b>UG (n=63)</b>	<b>KNUST (n=55)</b>	<b>UCC (n=62)</b>	<b>Total (n=180)</b>
AI enhances the efficiency of library services	50 (79.4%)	44 (80.0%)	51 (82.3%)	145 (80.6%)
AI may lead to job displacement in the library sector	30 (47.6%)	28 (50.9%)	32 (51.6%)	90 (50.0%)
AI improves the user experience in accessing library resources	55 (87.3%)	50 (90.9%)	55 (88.7%)	160 (88.9%)
AI integration requires significant changes in library policies	40 (63.5%)	36 (65.5%)	41 (66.1%)	117 (65.0%)
AI should be a priority for future library development	45 (71.4%)	42 (76.4%)	46 (74.2%)	133 (73.9%)

Table 5 presents librarians' perceptions regarding AI usage in academic libraries at the University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), and the University of Cape Coast (UCC). The statement that AI enhances the efficiency of library services garnered strong agreement across all institutions, with UCC (82.3%) showing the highest endorsement, followed by UG (79.4%) and KNUST (80.0%), indicating a widespread belief in AI's potential to improve operational efficiency. The perception that AI may lead to job displacement in the library sector was moderately acknowledged, with UCC (51.6%) and KNUST (50.9%) showing slightly higher concern compared to UG (47.6%), reflecting some apprehension about AI's impact on employment within libraries. When it comes to AI improving

the user experience in accessing library resources, a majority of respondents across all universities agreed, with UG (87.3%) and UCC (88.7%) leading slightly over KNUST (90.9%), suggesting a strong consensus on AI's positive influence on user interaction with library resources. The belief that AI integration requires significant changes in library policies was recognized by a substantial number of respondents, with UCC (66.1%) and KNUST (65.5%) showing slightly higher agreement than UG (63.5%), highlighting the perceived need for policy adjustments to accommodate AI. Finally, AI should be a priority for future library development was supported by a majority across the universities, with KNUST (76.4%) showing the highest support, followed closely by UCC (74.2%) and UG (71.4%), underscoring a shared vision of AI as a critical element in future library advancements. Overall, librarians generally perceive AI as a valuable asset for enhancing library services and user experience, albeit with some concerns about job displacement and the need for policy changes.

### **Discussions**

#### *Types of AI applications implemented by academic libraries*

The integration of Artificial Intelligence (AI) in libraries has been explored through various studies, revealing diverse applications and adoption levels. Cox, Pinfield, and Rutter (2019) identified several potential roles for AI in libraries, including the procurement of AI content, quality control, data curation, and critical data literacy education. These roles emphasize the importance of both technical and educational support in leveraging AI effectively within library settings. In alignment with these roles, the findings from the study on AI applications in academic libraries at the University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), and the University of Cape Coast (UCC) reveal notable trends. AI-driven search engines, with usage rates of 63.5% at UG, 63.6% at KNUST, and 62.9% at UCC, reflect the libraries' commitment to enhancing search capabilities. This widespread adoption mirrors the suggestions by Cox et al., highlighting the value placed on AI for improving information retrieval and user experience. Automated cataloging also features prominently, with high adoption rates at UG (55.6%), KNUST (54.5%), and UCC (53.2%). This aligns with Cox et al.'s assertion of AI's role in streamlining library operations through efficient data

management and cataloging processes. The emphasis on automated cataloging indicates its centrality to the libraries' operational strategies. Conversely, chatbots for user assistance are more prevalent at UCC (45.2%) compared to UG (39.7%) and KNUST (36.4%). This suggests a stronger focus on user interaction and support at UCC, reflecting an effort to enhance user engagement through AI, as highlighted by Cox et al.'s role of AI in facilitating user experience.

Predictive analytics for resource planning are the least adopted application, with UCC (35.5%) slightly ahead of UG (28.6%) and KNUST (27.3%). This lower adoption rate might indicate the emerging nature of predictive analytics in library settings, where its potential is still being explored and integrated into practice. AI-based recommender systems are used more extensively at UCC (40.3%) compared to UG (34.9%) and KNUST (32.7%). This greater focus on personalized recommendations at UCC reflects an effort to cater to individual user preferences and enhance user satisfaction, aligning with the broader trends identified by Cox et al. and other studies. Additionally, studies such as those by Wheatley & Hervieux (2019) and Lund, Oname, Tijani, & Agbaji (2020) underscore a general underutilization of AI in libraries, with only a small percentage offering AI-related services. The findings from UCC, UG, and KNUST indicate a more advanced adoption compared to the global average, but still highlight areas for potential growth and increased AI integration. In Japan, Harada (2019) has showcased innovative AI applications, such as the humanoid robot Pepper and the HAL robot suit, which provide practical solutions for user assistance and operational efficiency. While these specific technologies are not widely reported in the Ghanaian context, the principles behind them improving user interaction and operational efficiency are reflected in the adoption trends observed at UCC, UG, and KNUST.

### ***Implementation of AI in Academic Libraries***

The study's findings on the implementation of AI tools in academic libraries align well with existing literature, highlighting several crucial factors. Adequate funding emerges as the most critical element for successful AI integration, a point emphasized by (Becker, et al., 2017) and (Luckin, 2016). The high adoption rates of adequate funding reported at UCC (88.7%) and UG (87.3%), followed by KNUST (85.5%), underscore the importance of financial resources in facilitating AI initiatives. This reflects the literature's

view that substantial investment is necessary for the effective deployment and maintenance of AI technologies. Staff training and development are also identified as essential for the successful integration of AI tools. This aligns with the literature's emphasis on the need for skilled librarians, as noted by (Kirkwood, 2018) and (Pinfield, Cox, & Rutter, 2020). The high importance placed on staff training across all three universities, with UG (79.4%), KNUST (81.8%), and UCC (77.4%), supports the notion that a well-trained staff is crucial for managing and utilizing AI technologies effectively. The availability of technical support is another key factor, with literature by Mogali (2014) and Vijayakumar and Sheshadri (2019) highlighting its necessity for maintaining AI systems. The study shows slightly higher recognition of technical support at UCC (71.0%) and KNUST (72.7%) compared to UG (71.4%), reinforcing the need for ongoing technical assistance to ensure smooth AI operations. User acceptance and awareness are also important, though somewhat less critical than funding and training. This mirrors the findings of (Asemi & Asemi, 2018) and (Asemi & Nowkarizi, 2021), who stress the role of user engagement in the success of AI initiatives. The study indicates higher levels of importance for user acceptance at UG (60.3%) and UCC (58.1%) compared to KNUST (58.2%), suggesting that while it is significant, it is often considered secondary to other factors. Finally, collaboration with IT departments is essential for AI implementation, a point highlighted by Pinfield, Cox, & Rutter (2020) and Mogali (2014). The similar levels of recognition for this factor at UG (66.7%), KNUST (69.1%), and UCC (66.1%) underscore the importance of interdisciplinary cooperation in supporting AI integration. Overall, the study confirms that while adequate funding and staff training are particularly crucial, technical support, user acceptance, and collaboration with IT departments are also important for successful AI adoption in academic libraries.

### ***AI perception among academic librarians***

The findings from the study on librarians' perceptions of AI usage align with and extend the literature on this topic. (Fernandez, 2016) emphasized the importance of collaboration and ethical deployment of AI, advocating for a balance between innovation and the traditional values of librarianship. The strong agreement across all institutions that AI enhances the efficiency of library services, particularly with UCC (82.3%), UG (79.4%), and KNUST (80.0%)



recognizing this potential, reflects librarians' openness to adopting AI as a means to improve operational efficiency. This aligns with Fernandez's view that AI should be employed to optimize library functions while adhering to ethical standards. Lund, Oname, Tijani, & Agbaji (2020) found a strong relationship between librarians' perceptions of AI and their adopter categories, suggesting that how librarians view AI correlates with their willingness to adopt it. This study corroborates that perception, as demonstrated by the high levels of agreement that AI improves user experience in accessing library resources, with UG (87.3%) and UCC (88.7%) showing particularly high endorsement. This indicates a consensus on AI's positive impact on user interaction, aligning with the notion that innovative technologies can enhance service delivery in academic libraries. However, there is also a moderate concern regarding AI's potential for job displacement, as noted by UCC (51.6%) and KNUST (50.9%), which is consistent with the apprehension described in the literature. This reflects the broader concern about AI's impact on employment within the library sector, echoing the need for librarians to anticipate and address the potential challenges posed by AI, as highlighted by White (2003) and Bennet (2004). The need for significant changes in library policies to integrate AI, with UCC (66.1%) and KNUST (65.5%) recognizing this requirement, underscores the necessity for policy adaptation to support AI adoption. This finding aligns with Huang's (2014) proposition that an innovative organizational climate is crucial for effective AI integration and supports the idea that libraries need to evolve their policies to accommodate new technologies. Finally, the majority support for prioritizing AI in future library development, especially at KNUST (76.4%), reflects a shared vision among librarians of AI as a crucial component of future library advancements. This perspective aligns with Kirkwood, (2018) and Pinfield, Cox, & Rutter (2020), who argue that AI can significantly contribute to the evolution of library services and knowledge management.

## Conclusion

The study on AI applications in academic libraries at the University of Ghana (UG), Kwame Nkrumah University of Science and Technology (KNUST), and the University of Cape Coast (UCC) reveals several key insights into the adoption and perception of AI technologies. AI-driven search engines and automated cataloging are the most widely implemented tools across the institutions, reflecting a significant

commitment to improving library operations and search capabilities. UCC demonstrates a more diverse and extensive adoption of AI applications, including chatbots and recommender systems, indicating a stronger emphasis on enhancing user interaction and personalization. The findings highlight that adequate funding and staff training are crucial for the successful implementation of AI tools, with these factors being universally recognized as essential across the institutions. Technical support, user acceptance, and collaboration with IT departments are also important, though to a lesser extent. Librarians generally view AI as an asset for enhancing library services and user experiences, despite some concerns about job displacement and the need for policy adjustments to accommodate AI integration. Academic libraries should prioritize securing adequate funding and investing in comprehensive staff training to ensure successful implementation and maintenance of AI tools. Establishing robust technical support systems will help address issues promptly, while promoting user engagement and acceptance through education can enhance the effectiveness of AI applications.

## References

- Abayomi, O., Adenekan, F., Abayomi, A., Ajayi, T., & Aderonke, A. (2021). Awareness and perception of artificial intelligence in the management of university libraries in Nigeria. *Journal of Interlibrary Loan, Document Delivery and Electronic Reserve*, 29(1/2), 13-28.
- Allison, M. (2020). Women's health: Librarians as social entrepreneurs. *Library Trends*, 56(2), 423-448.
- American Library Association. (2019, December 4). Artificial intelligence. Available at: <http://www.ala.org/tools/future/trends/artificialintelligence>
- Asemi, A., & Nowkarizi, M. (2021). Intelligent libraries: A review on expert systems, artificial intelligence, and robots. *Library Hi Tech*.
- Asemi, A., & Asemi, A. (2018, March 25). Artificial intelligence (AI) application in library systems in Iran: A taxonomy study. *Library Philosophy and Practice*. Retrieved from <https://digitalcommons.unl.edu/libphilprac/1840>
- Becker, S., Cummins, M., Davis, A., Freeman, A., Glesinger Hall, C., & Ananthanarayanan, V. (2017, May 5). NMC Horizon Report: 2017 Higher Education Edition. The New Media Consortium, Austin. Retrieved from <https://www.learntechlib.org/p/174879/>

- <https://library.educause.edu/-/media/files/library/2017/2/2017horizonreportthe.pdf>
- Bennet, D. (2018). Learning and the knowledge worker. In *Knowledge Management Lessons Learned: What Works and What Doesn't* (pp. 511-526). Information Today.
- Coleman, C. (2018, May 4). Library AI initiative. Retrieved from <https://library.stanford.edu/projects/artificial-intelligence/about>
- Cox, A., Pinfield, S., & Rutter, S. (2019). The intelligent library: Thought leaders' views on the likely impact of artificial intelligence on academic libraries. *Library Hi Tech*, 37(3), 418-435.
- Fernandez, P. (2016). Through the looking glass: Envisioning new library technologies and how artificial intelligence will impact libraries. *Library Hi Tech News*, 33(5), 5-8.
- Frank, M., Sun, L., Cebrian, M., Youn, H., & Rahwan, I. (2018). Small cities face greater impact from automation. *Journal of the Royal Society Interface*, 15(139), 20170946.
- Griffey, J. (2019). *Artificial Intelligence and Machine Learning in Libraries*. Chicago: ALA TechSource.
- Harada, T. (2019). Robotics and artificial intelligence technology in Japanese libraries. Paper presented at the 2019 World Library and Information Congress: 85th IFLA General Conference and Assembly-Information Technology Satellite Meeting: Robots in Libraries: Challenge or Opportunity?
- Heck, T., Weisel, L., & Kullmann, S. (2019). Information literacy and its interplay with AI. In *Learning Information Literacy across the Globe* (pp. 129-131).
- Huan, Y. (2014). Measuring individual and organizational knowledge activities in academic libraries with multilevel analysis. *The Journal of Academic Librarianship*, 40(5), 436-446.
- Kirkwood, H. (2018). The current state of artificial intelligence and the information profession: Or do librarian droids dream of electric books? *Business Information Review*, 35(1), 9-11.
- Kulkarni, A. (2020, May 4). Jump start to artificial intelligence. Retrieved from <https://hackernoon.com/jumpstart-to-artificial-intelligence-f6eb30d62ec>
- Libris, E. (2020, May 4). Artificial intelligence in the library: Advantages, challenges, and tradition. An Libris Whitepaper. Retrieved from <https://cdn2.hubspot.net/hubfs/2909474/Ex%20Libris%20Artificial%20Intelligence%20White%20Paper.pdf>
- Luckin, R. (2016, May 20). Four ways that artificial intelligence can benefit universities: Higher education needs to embrace the positives of AI, not just look at the negatives. *Times Higher Education*. Retrieved from <https://world.edu/four-ways-artificial-intelligence-can-benefit-universities/>
- Lund, B., Oname, I., Tijani, S., & Agbaji, D. (2020). Perceptions toward artificial intelligence among academic library employees and alignment with the diffusion of innovations' adopter categories. *College and Research Libraries*, 81(5), 865-882.
- Lynch, S. (2017, May 4). Andrew Ng: "Why AI is the new electricity." Retrieved from <https://www.gsb.stanford.edu/insights/andrew-ng-why-ai-new-electricity>
- Ma, Y., Ping, K., Wu, C., Chen, L., Shi, H., & Chong, D. (2020). Artificial intelligence-powered Internet of Things and smart public service. *Library Hi Tech*, 38(1), 165-179.
- McCarthy, J. (2020, May 4). What is artificial intelligence? Retrieved from <http://jmc.stanford.edu/articles/whatisai/whatisai.pdf>
- Mogali, S. (2018). Artificial intelligence and its applications in libraries. *Bilingual International Conference on Information Technology: Yesterday, Today and Tomorrow, At Defence Scientific Information and Documentation Centre*.
- Oname, I., & Alex-Nmecha, J. (2020). Artificial intelligence in libraries. In *Managing and Adapting Library Information Services for Future Users* (pp. 120-144).
- Pinfield, S., Cox, A., & Rutter, S. (2020, May 4). Mapping the future of academic libraries: A report for SCONUL. Available at: <https://sconul.ac.uk/sites/default/files/documents/SCONUL%20Report%20Mapping%20the%20Future%20of%20Academic%20Libraries.pdf>
- Ransbotham, S., Kiron, D., Gerbert, P., & Reeve, M. (2017). Reshaping business with artificial intelligence: Closing the gap between ambition and action. *MIT Sloan Management Review*. The Boston Consulting Group, 1-17.
- Talley, N. (2016). Imagining the use of intelligent agents and artificial intelligence in academic law libraries. *Law Library Journal*, 108(3), 383-401.



- Tredinnick, L. (2017). Artificial intelligence and professional roles. *Business Information Review*, 34(1), 37-41.
- Turing, A. (2019). *The Essential Turing: Seminal Writings in Computing, Logic, Philosophy, Artificial Intelligence, and Artificial Life: Plus The Secrets of Enigma* (pp. 362-394). New York: Oxford University Press.
- Vijayakumar, S., & Sheshadri, K. (2019). Applications of artificial intelligence in academic libraries. *International Journal of Computer Sciences and Engineering*, 7(S16), 136-140.
- Wheatley, A., & Hervieux, S. (2019). Artificial intelligence in academic libraries: An environmental scan. *Information Services and Use*, 39(4), 347-356.
- White, H. (2019). The successful future of the librarian: Bookman or knowledge worker. *Australian Academic and Research Libraries*, 34(1), 1-13.

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