

**UDC 004.8:027**

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## Artificial Intelligence in Academic Libraries: Foreign and Ukrainian Experience

**The objective** is to determine the direction of implementing artificial intelligence (AI) in the activities of foreign and domestic academic libraries. **Methods.** The research is based on a combination of the method of analyzing the content of publications with the methods of systematization, generalization, surveying employees of academic libraries in Ukraine, and the method of comparative analysis. **Results.** It was found that the general directions for practical application of AI technologies in academic libraries of foreign and Ukrainian countries are: training, reference work, intelligent user service, and collection management. The main direction of the ChatGPT application is: to study this tool, and its application in reference and advertising activities. It was established that in libraries of foreign universities, the following are being initiated: the creation of intellectual spaces (USA); the use of robotics (Canada, China); and the formation of a smart library (USA, China). **Conclusions.** The importance of implementing AI technologies in the activities of academic libraries, which create new opportunities for scientific research and education, is confirmed. At the same time, the research confirms the insufficient level of AI implementation by university libraries to provide innovative alternative services. It is urgent to develop a strategy for the university library regarding implementing AI technologies and developing employees' relevant competencies.

*Keywords:* academic libraries; ChatGPT; artificial intelligence (AI); foreign experience; Ukrainian experience

### Introduction

Globalization and the widespread integration of digital technologies cause libraries to be in constant search for ensuring and strengthening their competitiveness in the information services market. Changes in users' information needs, new means, and technologies for recording, processing, and storing documents and information require the involvement, first of all, of new intellectual products in academic libraries to increase the efficiency of performing the main functions: informational, educational, cultural, and research.

An innovative technology that has become a breakthrough for many industries is artificial intelligence (AI). This technology has been developed for several decades but has recently achieved significant growth. According to the Concept of the Development of Artificial Intelligence in Ukraine (2020), artificial intelligence is defined as “an organized set of information technologies, with the use of which it is possible to perform challenging complex tasks by using a system of scientific research methods and algorithms for processing information obtained or independently created during work, as well as to create and use one’s own knowledge bases, decision-making models, algorithms for working with information and determine ways to achieve the set tasks” (Cabinet of Ministers of Ukraine, 2020). This concept indicates the emergence of

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new opportunities for libraries aimed at improving services in the scientific and educational environment, increasing the efficiency of interaction with teachers, scientists, students, and other users.

Optimization of the research process and dissemination of scientific results in the context of open science stimulates academic libraries to use artificial intelligence technologies. Artificial intelligence differs from traditional computer systems in its ability to solve tasks that usually require human intelligence. At the same time, artificial intelligence tools can not only carry out given instructions but also improve their knowledge and skills through self-learning processes. They can create their own knowledge bases to improve their functions and expand their capabilities. This feature contributes to obtaining new opportunities for improving library services and expanding innovative methods and tools based on artificial intelligence. Modern developments and tools based on artificial intelligence technologies are even more actively influencing library activities. Academic libraries are actively discussing the possibilities of these technologies. This is evidenced by a significant burst in publications in which library professionals reveal the features of artificial intelligence, raise problems of use, highlight the application of various AI-based tools for their services, express concern about their competence, skills, and knowledge of the new technology and its consequences for professional activities.

Publications in which researchers analyze the literature on AI require attention. This research A. Hussain (2023), in which 411 publications were analyzed for the period 2002–2022 based on the selection of documents in the scientometric database Scopus. Problems of implementing artificial intelligence in academic libraries are noted. Other researchers S. B. Mitha and M. Omarsaib (2024) also used the method of bibliometric analysis to determine the impact of artificial intelligence on the activities of university libraries. Most authors reveal the areas of use of AI applications and tools in libraries of higher education institutions in the following countries: USA, China, United Kingdom, India, Nigeria, Canada, Pakistan, Australia, Spain, and South Africa.

In general, it is stated that artificial intelligence technologies in library activities are most useful in the following areas: content indexing, cataloging, classification, document comparison; reference services; creation and retrieval of metadata; abstracting and summarizing information; advertising, semantic analysis of texts and multimedia (Okunlaya, Syed, & Alias, 2022). In addition, it is noted that data mining is used in online library systems to study information needs and user behavior.

Foreign and Ukrainian authors reveal potential opportunities for collaboration between libraries, researchers, and other specialists in the application of ChatGPT and AI-based chatbots. The publication M. Afjal (2023) highlights possible areas of cooperation for strategic planning and decision-making regarding ChatGPT. The characteristics of chatbots and chat services and their use in academic libraries are provided by a team of Canadian authors (Guy, Pival, Lewis, & Groom, 2023). They define a chatbot as a system that is a conversational agent, i.e., it simulates a conversation with a person in real time using AI technology. The features of modern AI tools are thoroughly covered by Ukrainian scientists (Yaroshenko & Iaroshenko, 2023). They focus on the shortcomings of ChatGPT related to inaccurate information, erroneous results, incorrect links to articles, etc.

The challenges and prospects of implementing artificial intelligence in academic libraries abroad are revealed in a collective monograph edited by (Hervieux & Wheatley, 2022). In the mentioned work, the authors of the publications discuss expanding the capabilities of libraries by developing an open curriculum based on AI, academic library seminars on AI Literacy, creating a multidisciplinary research space; organizing information literacy for international students on the

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use of AI tools for translating information; applying machine learning to classify images and improving the accessibility of collections; using robotics; implementing handwriting recognition technologies to support research; creating the first AI laboratory in an academic library in the United States. The researchers also discuss ethical issues related to AI (Hervieux & Wheatley, 2022).

Powerful research by foreign scholars S. Hervieux, A. Wheatley (2021) aims to reveal directions of mastering artificial intelligence technologies by academic libraries in the United States and Canada. The research subject by scientists Y. Huang, A. M. Cox, J. Cox (2023) is the use of AI in university libraries. The authors focused on comparing the current state of artificial intelligence implementation in university libraries of the top 25 universities in the UK and the top 25 universities in mainland China.

The above-mentioned authors have found slow progress in the implementation of artificial intelligence in university libraries due to insufficient qualifications of employees, cautious attitudes towards AI technologies, concerns about ethical consequences, and limited funds.

Ukrainian authors also study the application of AI in library activities. Thus, Nadiia Maranchak (2023) highlights current and promising directions for using artificial intelligence in foreign libraries. The main aspects of using artificial intelligence in Ukrainian libraries are investigated by O. V. Ivashkevych (2023). Ukrainian scientists emphasize the need to develop an AI policy for academic libraries.

It is also advisable to create an appropriate infrastructure and technology for using AI to develop users' digital literacy. The problems of the legal and regulatory framework of AI are raised by M. Sokil, and A. Zvorsky (2024). Researchers also pose a logical question: how can AI-based tools and methods improve library operations? To do this, it is proposed to determine which operations and processes can be replaced by AI agents without the use of control by a library employee. Most researchers emphasize that artificial intelligence technologies are gradually being used in library activities to support the learning, teaching, and research process.

Thus, there is a fairly wide range of publications, but specific aspects of AI usage in foreign and national experiences of academic libraries require clarification and generalization.

Therefore, the purpose of this article is to highlight the directions for implementing artificial intelligence in foreign and Ukrainian academic libraries.

### Methods

The study of the state of AI implementation in foreign libraries is based on the analysis of publications related to specific library experience and their systematization and generalization.

To clarify the directions of AI applications in Ukrainian libraries, a survey of academic library employees was conducted in May 2024 based on a Google form in the online space, in particular on Facebook. The questionnaire included nine questions related to:

- identifying specific AI tools used in the library;
- identifying areas of library activity in which AI tools are used;
- finding out whether AI is being implemented to manage library collections; whether AI is used to collect data about users and the use of information resources;
- establishing the date from which the library began using AI tools;
- finding out the attitude of library specialists towards AI.

The comparative analysis method was applied to determine the main directions and services based on artificial intelligence that are used in academic libraries.

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To compare the directions of the application of artificial intelligence technologies in foreign libraries, the authors (based on the analysis of publications) singled out countries and university libraries that have achievements in this aspect. Attention was paid to the organization of training (forms, means, events, etc.); the creation of special structures (departments, sectors, laboratories, centers, etc.); and the implementation of AI for information resource management (automation, search).

To compare the directions of application of artificial intelligence technologies in Ukrainian libraries, we chose specific AI tools and features of their use as the main criterion.

### Results and Discussion

Recent research has shown that AI and related technologies have several areas of practical application in university libraries.

First, university libraries in different countries are gradually joining AI tools such as ChatGPT. They consider this tool as an assistant in research, mainly for text editing and keyword generation, and also use it for training, consultations, and reminders (Cox & Tzoc, 2023). Researchers note that the ChatGPT 3.5 and ChatGPT 4 models understand questions, prompts, and provide relevant answers well. Thus, ChatGPT 4 had a 96% success rate in understanding questions, and ChatGPT 3.5 had an 84% success rate (Wheatley & Hervieux, 2024). However, both models have problems with the accuracy of references to sources, in particular scientific information. In most libraries, the main focus is on studying this tool and conducting experiments for application in library activities.

Secondly, the analysis of publications suggests that the next step after studying AI tools is training colleagues and library users. Training in the use of AI is the most common direction. At universities in the USA, UK, Canada, China, and other countries, libraries offer master classes and seminars, week-long summer camps, and other programs and services. (Hervieux & Wheatley, 2021, 2022).

US university libraries are beginning to create intellectual spaces for experiments and training, the main goal of which is to support students, faculty, and staff in the context of studying and researching AI. The experience of the University Rhode Island Library (USA), which launched the Library AI Lab in 2018, is extremely interesting. The lab is supported by library staff in collaboration with higher-education teaching personnel from various faculties. In this case, librarians have a leading position (Kim, 2019). The lab focuses on big data, artificial intelligence technologies (programmable robots, high-end laptops (TensorBook\$)), access to high-performance computing (HPC) resources, and learning (Hervieux & Wheatley, 2022). A similar initiative is being implemented by the Stanford University Library, which has an artificial intelligence studio, but its activities are managed by volunteers. The studio's operation has implications for improving access to library collections, using machine learning for image classification, etc. (Hervieux & Wheatley, 2021, 2022). The University of Oklahoma Library has also organized an innovation space – it is the Center for Digital Skills. The main activities of the center are to hold seminars and events in partnership with other universities and departments; to introduce students to new technologies, including AI; and to create a database of research projects related to artificial intelligence (PAIR) (Hervieux & Wheatley, 2022). It is worth emphasizing that this direction is consistent with the trend of libraries to create different spaces for their users.

University libraries in the UK use data mining tools (Oxford University), seminars, and other forms of training, create guides on machine learning and artificial intelligence (Queen Mary

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University of London), and carry out a set of events (The University of Edinburgh) (Huang, A. M. Cox, & J. Cox, 2022).

The experience of implementing artificial intelligence technologies in Canadian university libraries is interesting and useful. First, the libraries of two universities – the University of Calgary and Mount Royal University – have prepared specialized guides on artificial intelligence (Guy, Pival, Lewis, & Groom, 2023). Secondly, more than 70% of university libraries offer chatbots and chat services. However, only two libraries use the chatbots created by Ivy.ai for the users' reference service (Guy, Pival, Lewis, & Groom, 2023). Thirdly, the support for AI research is expanding. In particular, the University of Toronto libraries are seeking to support teaching, learning, and research, including business, engineering, entrepreneurship, law, and the humanities. Fourthly, there are examples of using robotics at university libraries. For example, robotic cranes store, search, and retrieve documents at the request of users at the University of Technology Sydney (Hervieux & Wheatley, 2022).

In China, according to researchers (Huang, A. M. Cox, & J. Cox, 2023), nine university libraries use intelligent virtual agents, robots, or Chatbot services, and the development of smart libraries is being initiated.

In 2020, the Tsinghua University Library introduced the Intelligent Q&A System, one of the elements of which is the Xiaotu robot, which talks and performs information and reference work. The library has upgraded it and added an intelligent question-and-answer system and information service system. Shanghai Jiao Tong University has established a joint research and development center for "Intelligent Library Service of the Future" and uses the robot "Intelligent Book Inventory Taker". A similar intelligent robot was created at Nanjing University with the participation of library specialists. This library has achieved significant success in the development of products related to artificial intelligence. In particular, the innovative library service platform of Nanjing University is being created. This platform is essentially a prototype of the next-generation intelligent library management system, that is, the foundation for a smart library is being laid. It is also worth noting the achievements of the Peking University Medical Library, which introduced an automated storage and retrieval system (AS/RS), which helped free up space for library documents. The hosting of the smart library forum is offered by the library of Harbin University of Technology. Also noteworthy is the cooperation of the Wuhan University Library with the largest Chinese search engine Baidu Inc. in the direction of creating an artificial intelligence library (Huang, A. M. Cox, & J. Cox, 2023).

The National Science Library of the Chinese Academy of Sciences (NSLC) has made significant achievements related to artificial intelligence. The library's specialists have created an open data ecosystem with big data and artificial intelligence as the core technologies. This system consists of a national database of scientific and technological innovations, a new generation of AI tool platforms, and an AI service system for knowledge management, open knowledge, intelligence analysis, and technological solutions (Huang, A. M. Cox, & J. Cox, 2023). That is, artificial intelligence serves as the basis for scientific innovation activities.

University libraries in Pakistan are also beginning to implement artificial intelligence tools for natural language processing, creating chatbots. AI-based chatbots are mostly used for reference work. However, not all chatbots are based on artificial intelligence technologies. Private university libraries are more active in using AI tools compared to public universities. This is most likely because private university libraries have close links with the IT-university department; there are better financial conditions, and more developed information and communication technology infrastructure for creating library services based on AI technology (Ali, Naeem, & Bhatti, 2024).

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In many countries, leading libraries have begun implementing artificial intelligence to automate cataloging and indexing processes, develop recommender systems, create interactive chatbots, improve search engines, access information, and other areas of professional activity. The use of artificial intelligence technologies allows you to significantly reduce the cost of time and resources on routine tasks, which provides the opportunity to focus on more complex and important aspects of library activities (Barki, 2022).

The US Library of Congress, the James B. Hunt Library of the University of North Carolina, the Johns Hopkins University Library in the USA, and the Humboldt University Library in Berlin Germany have successful experience in specified processes (Maranchak, 2023).

Therefore, the above indicates that university libraries are on the path of rethinking their activities in connection with the surge in the development of products and services based on artificial intelligence and their gradual inclusion in the processes of their implementation and creation.

As for Ukrainian academic libraries, a questionnaire was distributed to study the areas of application of artificial intelligence tools. Unfortunately, only a few libraries answered the question. The survey was attended by specialists from the following libraries: the Library of the Kharkiv State Academy of Culture, Kharkiv; the Library of the National Aerospace University “Kharkiv Aviation Institute” NAU “KhAI”, Kharkiv; the Scientific Library of the V. O. Sukhomlynskyi Mykolaiv National University, Mykolaiv; the Scientific Library of the Admiral Makarov National University of Shipbuilding, Mykolaiv; the Scientific Library of the Kyiv National University of Culture and Arts, Kyiv; the Library of the PHEI “Kharkiv International Medical University”, Kharkiv; the Scientific Library of the Khmelnytskyi National University, Khmelnytsky; the Kharkiv State Scientific Library of Vladimir Korolenko, Kharkiv.

The survey revealed that ChatGPT has been in the greatest demand since 2023. This tool is used for preparing exhibitions, advertising activities, and editing texts. In particular, the Scientific Library of the Kyiv National University of Culture and Arts uses ChatGPT to generate names of exhibitions, events, competition slogans, and posts on social networks. The Scientific Library of the Admiral Makarov National University – for text editing and translation. The Library of the Kharkiv International Medical University – for creating library media content: posts on social networks, scripts for book trailers, virtual exhibitions, and texts; generating ideas, and headlines.

In addition, the Library of Kharkiv International Medical University uses several other tools, including: for translation – DeepL 2; for images – Leonardo AI, DALL-E 3; for video – Runway, Leonardo AI 4; for sound – Eleven Labs 5; for avatars – HeyGen, D-ID. This library is the most active among the university libraries that participated in the survey. It launched the project “Using Generative Neural Networks and Artificial Intelligence to Create Library Content”. This allows you to create unique and attractive content for library users and contributes to a positive image of the university.

Since April 2024, the Library of the Kharkiv State Academy of Culture has been using artificial intelligence technologies to translate texts and search for scientific sources using tools such as ResearchRabbit. The Scientific Library of Khmelnytskyi National University has been using ChatGPT and Canva in its activities since 2023.

Specialists of the Kharkiv State Scientific Library of Vladimir Korolenko use such AI tools as ChatGPT, Gemini, Canva, Leonardo, Wepik for teaching, seminars, pieces of training, as well as for performing various tasks, including for creating content and graphic materials.

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It is noteworthy that the majority of libraries that participated in the survey have a positive attitude toward the use of AI in professional activities. This indicates that Ukrainian academic library employees consider tools based on artificial intelligence to be promising.

It is also worth adding that the Scientific Library of Ivan Franko National University of Lviv has made significant achievements. Ivashkevych O. (2023) notes that the Library uses a chatbot in the reference and information service, elements of artificial intelligence in the processes of automatic cataloging and classification using optical character recognition (OCR), automatic translation of foreign language materials using natural language processing (NLP), automatic indexing using expert systems. Also, O. Ivashkevych (2023) reports that the library of the Ukrainian Catholic University and the Library of the National Technical University of Ukraine “Igor Sikorsky Kyiv Polytechnic Institute” apply artificial intelligence in intelligent management systems of the library book depository using RFID technology.

Of course, the study's results cannot be considered representative. However, it can be argued that using artificial intelligence in library activities is at an early stage, but it has a wide range of potential opportunities.

### Conclusions

Artificial intelligence is becoming an important partner in the development of library activities in the scientific and educational space. Thanks to artificial intelligence, new opportunities for research and education are created.

In foreign experience, most libraries are starting to use AI for training, consultations, working with text, and intelligent data analysis; the creation of intellectual spaces is initiated (the library laboratory of artificial intelligence, the studio of artificial intelligence, the center of digital skills); robotics is applied; chatbots based on AI are used for reference activities; the foundations of a smart library are laid.

Ukrainian libraries are also initiating the use of AI tools to work with texts, videos, images, exhibition and advertising activities, information search and learning, cataloging and classification, and library collection management. Most academic libraries are at the initial stage of studying the capabilities of various AI tools.

It is urgent to develop a strategy for the development of the university library taking into account the innovative foreign experience and modern challenges and realities.

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*Conference Proceedings*, 8, 194-201. doi: [https://doi.org/10.15802/unilib/2023\\_294639](https://doi.org/10.15802/unilib/2023_294639) (in English)

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### Штучний інтелект в академічних бібліотеках: зарубіжний та

### український досвід

**К** Метою є визначення напрямів впровадження ШІ в діяльність зарубіжних та вітчизняних академічних бібліотек. **Методика.** Дослідження ґрунтується на поєднанні методу аналізу контенту публікацій з методами систематизації, узагальнення, опитування працівників академічних бібліотек України та з методом порівняльного аналізу. **Результати.** Виявлено, що спільними напрямками практичного застосування технологій ШІ в академічних бібліотеках зарубіжжя та України є: навчання, довідкова робота, інтелектуальне обслуговування користувачів, управління колекціями. Основним напрямом застосування ChatGPT є: вивчення цього інструменту, застосування в довідковій та рекламній діяльності. Встановлено, що у бібліотеках зарубіжних університетів започатковується: створення інтелектуальних просторів (США); використання робототехніки (Канада, Китай); формування розумної бібліотеки (США, Китай). **Висновки.** Підтверджена важливість впровадження технологій ШІ в діяльність академічних бібліотек, що створюють нові можливості для наукових досліджень та освіти. Разом з тим дослідження підтверджує недостатній рівень впровадження університетськими бібліотеками використання ШІ для надання інноваційних альтернативних послуг. Нагальним є розробка стратегії університетської бібліотеки, щодо впровадження технологій ШІ та розвитку відповідних компетенцій співробітників.

*Ключові слова:* академічні бібліотеки; ChatGPT; штучний інтелект (ШІ); зарубіжний досвід; український досвід

Received: 16.08.2024

Accepted: 12.12.2024