Artificial Intelligence Utilization in Libraries

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Artificial intelligence is becoming more and more crucial each passing day. This study initially will present artificial intelligence utilization in libraries. In 1950, Alan Turing came up with the idea that computers might be able to imitate human behavior. According to Turing, artificial intelligence could analyze texts, make modelling the knowledge to help decision-making, reproduce a standard reasoning and use this information to make decisions and to produce knowledge thanks to machine learning. In this research, a literature review is conducted concerning different aspects of the subject. This study will lead to better focus on different scientific point of view about the artificial intelligence.

Keywords: *artificial intelligence, libraries, technology, digital transformation, smart libraries*

Introduction

Artificial intelligence or AI is a sub-branch of computer science built on computing machines and systems that can mimic human learning and decision-making (Castro & New, 2016). Here, the word intelligence refers to the ability to perceive and process data and turn it into information, and then use this information as a source for decision-making processes and behaviors carried out in this direction (Paschen et al., 2019). AI use algorithms that are human-made imitation of some laws that exist in nature for problem-solving (Zhang & Dahu, 2019). The problem-solving capacity of AI technologies makes them an important option in decision-making processes, and it is predicted that AI and other smart technologies will be the main actors in transition to automation (Jarrahi, 2018). AI, which is an interdisciplinary subject, has relations with different disciplines such as philosophy, mathematics, and statistics (Zhang & Dahu, 2019).

In 1943, McCulloch and Pitts put forward a theory based on Boolean functions and Alan Turing's Turing Machines for understanding the mental processes of neural mechanisms through logic and mathematics (Piccinini, 2004). In 1950 English mathematician Alan Turing's article entitled "Computing Machinery and Intelligence" is considered the first sign of the concept of AI (Smith et al., 2006). Pinar Saygin et al. (2019) underlined that Turing's idea has

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been both developed and criticized since the 1950s. The authors said that one end considers this approach the beginning of AI, while the other qualifies the Turing Test as useless or even harmful. Nevertheless, it is possible to say that Imitation Game or Turing Test is the starting point of almost every study on AI today (Warwick & Shah, 2016). The work by Turing is based on the "Imitation Game" and the question "Can machines think?" (Turing, 1950). Herewith, after the advent of the computer in the 1940s, it was understood that besides simple operations, these machines could do much more complex and intellectual tasks that required human intelligence (Wang, 2019). As a matter of fact, in the mid-1950s John McCarthy, one of the inventors of the concept, explained artificial intelligence as the operation of machines as if they had human intelligence (Ertel, 2018) and coined the term AI in a conference dated 1956 (Smith et al., 2006). This conference organized by John McCarthy and his colleagues at Dartmouth College formed the intellectual basis of AI (Hamet & Tremblay, 2017).

When we look at the short chronological history of AI, it is possible to say that Turing's 1950 article was a critical moment for AI, as we mentioned earlier. Drawing attention to this situation, Buchanan (2005) stated that the first book on the subject was "Computers and Thought" published by Julian Feldman in 1963, knowledge-based systems came into play and institutions began to support AI in the 1960s and 1970s, one of the first conferences on the subject was held by Donald Michie in Edinburgh in 1965. Haenlein and Kaplan (2019), on the other hand, underlined that Isaac Asimov, who wrote a book developed by engineers in a similar period to Turing but in geography 3000 miles away from him, should also take place in this history by influencing many researchers on robotics, AI and computer sciences. Zhang et al. (2023) stated that the symbolism paradigm (first generation) was dominant until the end of the 1980s, and the connectionism paradigm (second generation) was dominant in the 1990s in AI research. The authors stated that the third generation combines the knowledge-based approach of the first generation with the data-driven approach of the second. Based on a bibliometric analysis of AI research between 1990 and 2019, De la Vega et al. (2023, p. 1724) stated that research in this period focused on "machine learning, deep learning, robotics, natural language processing". Kaplan and Haenlein (2019) identified the first-period AI ("artificial narrow intelligence") with systems capable of performing specific tasks assigned to it, the second-period AI (artificial general intelligence) systems with the ability to solve problems it had not encountered before, and third-period AI (artificial super intelligence) as systems that have self-consciousness that are able to make people unneeded. Marsden (2017) has presented a detailed timeline showing AI robots starting with the Turing Test in 1950 and evolving with the support of researchers and various global companies (see Marsden, 2017). In addition, there are others who accept the beginning of AI as the emergence of the word robot and state that this word was first mentioned in a 1921 book by an author named Karel Capek (Hamet & Tremblay, 2017).

Metaxiotis and Samouilidis (2000) discussed expert systems, which can be considered as a sub-branch of AI in the field of medicine. In this study, the authors pointed out that although expert systems may be the subject of wrong use and applications from time to time, they will offer important opportunities in terms of

"decision support" and "decision making". In his study dealing with the use of decision support and exper systems in the fields of management and administration, Edwards (1992) drew attention to the fact that the first approach was based on information systems and operational research, while the second one was based on artificial intelligence.

AI language is used in decision support systems due to its ability to imitate human language, wide application area, flexibility, and speed (Rowe & Roberts, 1998). Knowledge management has become a tool used by businesses to provide profitability, productivity, and competitive advantage in areas such as customer relationship management, product and value proposition development since the 90s (Tsui et al., 2000). Noting that the increase in the use of artificial intelligence in businesses provides the opportunity to manage large-scale data in real time, Perez-Vega et al. (2021) emphasized the importance of theories explaining human behavior in the further development of theory for this area. Machine learning systems powered by big data makes possible unmanded decision (OECD, 2021).

More concretely, we can see the use of artificial intelligence in different area of our lives (Analytixlabs 2020). Marketing, social media, video games, travel, agriculture, business operations, healthcare, energy, environment, transportation, education are examples of these fields (Castro & New, 2016; Analytixlabs 2020). Although AI is a concept that emerged in the 1950s, it was included in the business environment and daily conversations approximately 50 years after this date (Haenlein & Kaplan, 2019). Stating that AI technologies have spread to social and behavioral sciences apart from computer sciences thanks to big data, Robila and Robila (2022) mentioned that "random forests, neural networks and elastic net" are the most frequently applied methods in these disciplines. The study of AI by social scientists in the fields of philosophy, psychology, cognitive science and human-computer intelligence revealed important results and constitutes a promising field of research (Miller, 2019). Wirth (2018) stated that AI is the most important game changer of today, and this can be understood in daily life from conferences, startups and large companies that invest in this field. Also, it should not be forgotten thatAI systems require various control mechanisms (such as rules, laws, constant monitoring) to be kept under control so that they can both complete their work without errors and not get out of control and become harmful (Kaplan & Haenlein, 2019).

In the next part of our study, we examine the literature review of the artificial intelligence focused on the library use.

Literature Review

In the literature, we first focused on Libraries and their role in society. Libraries are institutions that have ideally set the mission of "All information for all people at all time" for many years (Li et al. 2019) and have been at the key point of sustainable development due to their mission of disseminating information (Msauki 2021). Digital transformation, on the other hand, requires organizations to constantly update their business models to remain competitive, such agility makes it easier to control unexpected situations such as COVID-19

(Okunlaya et al. 2022). Fourth Industrial Revolution brought many transformations on knowledge society and these changesets put disruptive technologies such as artificial intelligence, automation, and mobile applications on the agenda of libraries (Msauki 2021). Being a pioneer in the use of technologies such as AI encourages the diffusion of new technologies, and this movement is in line with the mission of public libraries (Finley 2019).

In the context of Digital transformation in libraries, it exists many scientific researches. In the past, technical transactions such as questioning or borrowing books in libraries were carried out over the phone and fax, through time computer and internet technologies allowed the automation and digitalization of libraries (Ali et al. 2021). With the development of Web 2.0 technologies, libraries have also started to integrate the mobile leg of technological developments into their applications under the roof of library 2.0, and this transformation has followed a development process parallel to information and internet technologies (Li et al. 2019). Library 4.0, which is an extension of Industry 4.0, improves the relationship of libraries with their stakeholders by providing convenience and speed advantage, thus expanding the local status of libraries and their mission of presenting information (Msauki 2021). "Technological environment changes; the extensive and rapid growth of data; and the increase in and diversification of user needs" (Cao et al. 2018, p. 811) have created an environment full of opportunities and threats for libraries and led to the emergence of "smart libraries" (Cao et al. 2018). Li et al. (2019) stated that the digital library concept can be considered as an extension of Dowlin's "electronic library" concept coined in 1984 meaning the assistance by electronic technology in the management of information resources.

"Smart", "intelligent", "participatory" libraries are studied by many researchers. The concept of "smart libraries" was conceptualized by Aittola, Ryhanen, and Ojala in 2003 (from Aittola et al. 2003 cited by Zimmerman and Chang 2018). Smart libraries aim to improve, ameliorate, and facilitate the services they offer to users by making use of information and communication technologies (Gul and Bano 2019). Smart libraries are expected to be user-oriented and easily adapt to the changing expectations, requests and needs of users (Cao et al. 2018). Gul and Bano (2019) in their literature study on smart libraries, stated that libraries can use technologies emerging with developments in information and communication technologies such as "internet of things, RFID technologies; cloud computing, artificial intelligence, data mining, sentiment mining, augmented reality and other digital technologies like library robots and ambient intelligence, blockchain technology" (p. 778) to improve the service they offer to different stakeholders.

Cox et al. (2018) drew attention to the fact that "intelligent libraries", which is an output of the application of AI in libraries, will improve various subjects such as research, publishing, and education. The authors cited ethical concerns, reluctance to invest in these issues, and data quality as the barriers to progress in this area. The concept of "Participatory library" is another concept related to these issues conceptualized by Lankes et al. in 2007 (Yao et al. 2015). Lankes et al. (2007) defined the "participatory library" as a system for communicating with different stakeholders (users, other libraries...) by making use of web 2.0

technology's opportunities as an alternative approach to traditional and rigid systems.

University libraries use also artificial intelligence. As universities also contribute to sustainability as they are the epicenter of science, it is possible to say that academic libraries also have an important place in this process (Huang 2022). The use of AI in libraries, due to its disruptive nature, is an issue that can provide significant returns to this field if it is managed correctly (Massis 2018). While academic libraries are developing their services, they have to manage many challenging tasks such as managing printed and electronic resources, providing services suitable for changing needs, and integrating the developments in computer technology and AI into systems (Duncan 2022). Allison (2012) in a pilot study based on a system that answers students' questions with a chatbot over an AI-based system in the university library, stated that as the data increases, the quality of the chatbot's answers increases, but the main challenge remains as enabling users to reuse the chatbot. The author drew attention to the importance of integrating applications such as AI into existing systems of libraries in order to attract the attention of today's students who open their eyes to a digital world.

Artificial intelligence as a discipline was presented by McCarthy et al. in 1955 as a Dartmouth summer research project (McCarthy et al. 2006). Artificial intelligence, which is used in many sectors, refers to "machines (that) can exhibit judgment or make decisions that are consistent with human judgment and decision-making" (Wheeler and Buckley 2021). As well as the traded sectors (e.g., Alhashmi 2020, Lyu and Liu 2021, Sharma et al. 2022) artificial intelligence is a topic that is referred to in higher education (Becker et al. 2017). Automation and machine learning, which we encounter in many different industries, are also concepts related to artificial intelligence (Wheeler and Buckley 2021). Automation is the ability to carry out works based on human or, in some cases, animal power, without the need for these elements while machine learning refers to machines mimicking people's judgment and decision-making process (Wheeler and Buckley 2021).

The use of AI in libraries requires significant investment in infrastructure, funding, and training; for this reason, it can be said that large libraries such as academic libraries have started to adopt the use of AI, although not as fast as large-scale companies (Harisanty et al. 2022). Li et al. (2019), on the other hand, stated that a significant amount of software and hardware investment still needs to be made to adapt the developments in information and internet technologies to libraries. In terms of libraries, artificial intelligence can be used both to improve the services offered to the users and to facilitate background work (Bates 1999). An example of this background technical work is "collection development, acquisition of library material, classification of library material and cataloging, library automation systems" (Ali et al. 2021, p. 12). In terms of services offered to users, AI technologies (via chatbots) can perform operations such as notifying libraries when a new book is available or suggesting suitable books on the subjects sought (Oyelude 2021). Universities can improve their education and research processes and improve learning services by making use of AI (Okunlaya et al. 2022).

Asemi et al. (2021), in their literature studies focusing on the applications of artificial intelligent systems in libraries, stated that the collaboration of librarians and information technology employees will provide various benefits and conveniences to libraries. Harisanty et al. (2020) pointed out that AI can free library staff from backstage routine work, so they can devote more time to professional development and library improvement. Thanks to AI, contributing to knowledge-sharing libraries via expert systems and robots also provides an environment other than a local for community members (Msauki 2021).

Information Technology (IT) systems are used by many libraries in different fields such as online public access to catalogs, gate systems, and cataloging (Harisanty et al. 2022). Most of the AI applications currently used in libraries are standard solutions developed for the business world but in the following period, more library-oriented applications support (e.g., budget, reference, collection development...) can emerge (Duncan 2022). Dhamija and Bag (2020) in their study in which they discussed the outputs of artificial intelligence use with bibliometric analysis in organizations defined 6 clusters as "Artificial Intelligence and Optimization, Industrial Engineering/Research and Automation; Cluster, Operational Performance and Machine Learning; Cluster, Sustainable Supply Chains and Sustainable Development; Cluster, Technology Adoption and Green Supply Chain Management and Cluster, Internet of Things and Reverse Logistics". Yao et al. (2015) discussed the use of artificial intelligence in libraries through a smart-talking robot that they developed themselves in their study, in which they collected data with different stakeholders such as students and librarians through different data collection methods such as survey, in-depth interview and statistical analysis. In this study, they determined the success of such applications, which will be prominent in the future, as "self-learning, vivid logo and language, modular architecture and artificial intelligence".

We can find researches in the field of Diffusion of innovation. Cox et al. (2018) stated that artificial intelligence is most commonly used in academic libraries in the fields of research, chatbots and text and data mining, and the most important problem in this regard is user acceptance and system limitations. Lund et al. (2020) stated that libraries are enthusiastic and generally early-adopter in adopting artificial intelligence applications in their study with Rogers's theory of Diffusion of Innovation. At this point, the authors drew attention to the importance of knowledge sharing in the diffusion of innovation with reference to Rogers. Huang (2022) conducted a gap analysis study comparing the use of AI in academic libraries with librarians using and not using AI. The authors reported that their findings are parallel to Lund et al.'s (2020). Okunlaya et al. (2022) developed an Artificial Intelligence Library Services Innovative Conceptual Framework (AI-LSICF) based on the existing literature on libraries' adoption of AI applications to adapt to digital transformation. Blut et al. (2021) stated that the theory is less robust than thought in their studies on the Unified Theory of Acceptance and Use of Technology (UTAUT), which deals with technology adoption, with a meta-analysis. The authors made suggestions to make the model more inclusive by adding and testing the extensions and moderators.

We distinguished also our literature review depending various studies in different countries. According to the literature, it can be said that studies on the digital transformation process in libraries exist in both developed and developing countries. Harisanty et al. (2022) in their research with library managers, staff, and scientists to understand the perspective on the use of AI in academic libraries found that the participants viewed AI positively and were aware of its benefits. In their study of the use of AI in libraries in Pakistan Ali et al. (2021) stated that libraries use various applications such as "machine learning-based Discovery and Data Visualization Labs for security, self-check-in, checkout, citation and research analysis". In their study of the digitization process of libraries in China, Li et al. (2019) stated that the main contribution of AI to libraries can be summarized under three main headings as "resource construction, information organization and information service". Rubin et al. (2010) discussed the use of conversational agents in Canadian libraries for "educational, informational, assistive, and socially interactive" purposes. The authors stated that although these applications may seem difficult and costly to implement especially for small-scale libraries, they will become more accessible and viable with sharing-oriented library initiatives. Harisanty et al. (2022) stated that library use, preparation and awareness of AI is an understudied area, especially in developing countries.

In this stage, we focused the literature review on the impact on existing librarian profession. Automation, artificial intelligence, and machine learning technologies, which are also in the interest of non-profit organizations today, can be perceived as a threat to existing business lines (Wheeler and Buckley 2021). The threat posed using AI in the librarianship profession can be shown as one of the concerns of those working in this field (Cox et al. 2018). Wood and Evans (2018) in their research on Academics librarians' view of artificial intelligence revealed that librarians do not feel as threatened as people working in the law and medicine field and do not expect a radical change before 30 years. To avoid the risks of artificial intelligence applications in libraries, it is recommended to carry out changes carefully and systematically (Huang 2022). It will take many years for these technologies to pose a risk to existing employees, and the effect can be regulated by government regulations (Wheeler and Buckley 2021).

Bates (1999) drew attention to the necessity of looking at the applications that AI brings to libraries as a tool that reduces the drudgery of routine work rather than a threat to employees. The author stated that by using systems such as machine learning and image recognition in search processes in digital collections, they can make an additional contribution by revealing important findings that cannot obtained by human mind power. Duncan (2022) stated that by making one-to-one copies of rare materials available thanks to AI technologies, students can access these publications more easily and without waiting in line. The author stated that AI technologies will never threaten librarians and can only be a complementary and supportive tool for them. At this point, the author pointed to Liu's (2011) work on the benefits of using intelligent systems in libraries. Liu (2011) stated in this study that although there are many "architectures, frameworks and models" related to the smart systems in libraries in the literature, their application and research are understudied topics.

Although many researchers accept that the use of AI is a disruptive situation, they argue that librarians should see it as a "help", not a "replacement" (e.g., Rubin et al. 2010, Oyelude 2021). Cox et al. (2018) due to the AI's effect trabsforming librarianship-related professions these professions will also need statistical knowledge and a relatively low-paid sector will need to produce a solution in this regard. In addition, the authors stated that the use of AI in the library will not be able to radically change the traditional library in the near future, and the limited impact will also differ in the sub-branches of academic libraries. Robinson and Bawden (2017) conducted a study on the first group of students and practitioners who took the data literacy course included in the library and information science curriculum. Researchers found that the course positively regulated the participants' relationship with data in many aspects such as technological, social, and ethical.

Another aspect is the Task-technology fit model. Tu et al. (2021) discussed university students' perceptions about learning through a social media-based mobile library application, with Technology Acceptance Model and the Theory of Task-Technology fit (TTF). Through a structural equation model, the authors found that technology characteristics and task-technology fit determines consumer attitudes. Jeyaraj (2022) in their research examining the studies dealing with the Task-technology fit (TTF) model in information systems with a holistic view by meta-regression analysis revealed that the effect of TTF was affected by "type of, dependent variable and type of TTF variable". Benslimane et al. (2000) presented a model that deals with the antecedents and consequences of the use of the world wide web with the Task-Technology fit model from the buyer's perspective. Subsequently, the same authors (Benslimane et al. 2003) discussed the TTF model in business-to-business e-commerce transactions. The authors revealed scales for the application of the Task-Technology Fit Model to electronic commerce with the research they conducted on 110 corporate buyers.

Conclusion

This case study describes how AI (Artificial intelligence) technology is being used in various areas of university library operations. In the literature review, libraries and their role in society are firstly focused on and then digital transformation in libraries is discussed in detail. Then, the study presents the smart, intelligent and participatory libraries studied by many researchers. University libraries use also artificial intelligence. Some of the studies are shown in our paper. Due to the significant infrastructure, financial, and training investments needed to use artificial intelligence in libraries, it can be said that the big respected academic libraries have begun to adopt the technology. We also found some studies in the field of diffusion of innovation. We based our literature review on numerous studies conducted in various nations. According to the literature, studies on the process of digital transformation in libraries exist in both developed and developing nations. During our literature review, we found that one of the worries of those who work in this field can be seen to be the threat that artificial intelligence poses to the librarianship profession. Another side of this research is the Task-technology fit model. Some authors found that technology

characteristics and task-technology fit determine consumer attitudes. For a further work, we want to realize a survey that we will ask questions to librarians in order to measure their attitude toward the artificial intelligence use in the libraries.

References

Agrawal A, Gans J, Goldfarb A (2018) *Prediction machines: the simple economics of artificial intelligence.* Harvard Business Press.

Alhashmi SF, Alshurideh M, Kurdi BA, Salloum SA (2020) A systematic review of the factors affecting the artificial intelligence implementation in the health care sector. In *The International Conference on Artificial Intelligence and Computer Vision*, 37–49. Cham: Springer.

Ali MY, Naeem SB, Bhatti R (2021) Artificial Intelligence (AI) in Pakistani university library services. *Library Hi Tech News* 38(8): 12–15.

Allison D (2012) *Chatbots in the library: is it time?* Library Hi Tech.

Analytixlabs (2020, July 1). *15 real world applications of artificial intelligence*. Available at: https://www.analytixlabs.co.in/blog/applications-of-artificial-intelligence/.

Asemi A, Ko A, Nowkarizi M (2020) Intelligent libraries: a review on expert systems, artificial intelligence, and robot. *Library Hi Tech* 39(2): 412–434.

Bates MJ (1999) The invisible substrate of information science. *Journal of the American Society for Information Science* 50(12): 1043–1050.

Becker SA, Cummins M, Davis A, Freeman A, Hall CG, Ananthanarayanan V (2017) *NMC horizon report: 2017 higher education edition.* The New Media Consortium.

Benslimane Y, Plaisent M, Bernard P (2000) Using the world wide web for ecommerce: applying the task-technology fit model to corporate buyers. In *AMCIS 2000 Proceedings*, 392.

Benslimane Y, Plaisent M, Bernard P (2003) Applying the task-technology fit model to WWW-based conceptualization and measurement. In *36th Annual Hawaii International Conference on System Sciences Proceedings.* IEEE.

Blut M, Chong A, Tsiga Z, Venkatesh V (2021) Meta-analysis of the unified theory of acceptance and use of technology (UTAUT): challenging its validity and charting a research agenda in the red ocean. *Journal of the Association for Information Systems*, forthcoming.

Cao G, Liang M, Li X (2018) How to make the library smart? The conceptualization of the smart library. *The Electronic Library* 36(5): 811–825.

Carter M (2007) *Minds and computers: an introduction to the philosophy of artificial intelligence.* Edinburgh University Press.

Cox AM, Pinfield S, Rutter S (2018) The intelligent library: thought leaders' views on the likely impact of artificial intelligence on academic libraries. *Library Hi Tech* 37(3): 418–435.

Dhamija P, Bag S (2020) Role of artificial intelligence in operations environment: a review and bibliometric analysis. *The TQM Journal* 32(4): 869–896.

Duncan ASP (2022) The intelligent academic library: review of AI projects & potential for Caribbean libraries. *Library Hi Tech News* 39(5): 12–15.

Finley TK (2019) The democratization of artificial intelligence: one library's approach. *Information Technology and Libraries* 38(1): 8–13.

Gul S, Bano S (2019) *Smart libraries: an emerging and innovative technological habitat of 21st century.* The Electronic Library.

Harisanty D, Anna NEV, Putri TE, Firdaus AA, Azizi NAN (2022) Leaders, practitioners and scientists' awareness of artificial intelligence in libraries: a pilot study. *Library Hi Tech* (Apr).

Huang YH (2022) Exploring the implementation of artificial intelligence applications among academic libraries in Taiwan. *Library Hi Tech* (ahead-of-print).

Jeyaraj A (2022) A meta-regression of task-technology fit in information systems research. *International Journal of Information Management* 65(Aug): 102493.

Lankes RD, Silverstein J, Nicholson S (2007) Participatory networks: the library as conversation. *Information Technology and Libraries* 26(4): 17–33.

Li S, Hao Z, Ding L, Xu X (2019) Research on the application of information technology of Big Data in Chinese digital library. *Library Management* 40(8/9): 518–531.

Liu G (2011) The application of intelligent agents in libraries: a survey. *Program* 45(1): 78–97.

Lund BD, Omame I, Tijani S, Agbaji D (2020) Perceptions toward artificial intelligence among academic library employees and alignment with the diffusion of innovations' adopter categories. *College & Research Libraries* 81(5): 865.

Lyu W, Liu J (2021) Artificial Intelligence and emerging digital technologies in the energy sector. *Applied Energy* 303(Dec): 117615.

Massis B (2018) Artificial intelligence arrives in the library. *Information and Learning Science* 119(7/8): 456–459.

McCarthy J, Minsky ML, Rochester N, Shannon CE (2006) A proposal for the dartmouth summer research project on artificial intelligence, august 31, 1955. *AI Magazine* 27(4): 12–12.

McCulloch WS, Pitts W (1943) A logical calculus of the ideas immanent in nervous activity. *Bulletin of Mathematical Biophysics* 5(Dec): 115–133.

Merritt D (2005) *AI Newsletter.* Available at: http://www.ainewsletter.com/newsletters/aix_0501.htm.

Metaxiotis KS, Samouilidis J-E (2000) Expert systems in medicine: academic illusion or real power? *Information Management & Computer Security* 8(2): 75–79.

Msauki G (2021) *Library 4.0 and sustainable development: opportunities and challenges. examining the impact of ındustry 4.0 on academic libraries*. Emerald Publishing.

Okunlaya RO, Abdullah NS, Alias RA (2022) Artificial intelligence (AI) library services innovative conceptual framework for the digital transformation of university education. *Library Hi Tech* 40(6): 1869–1892.

Oylude AA (2021) *AI and libraries: trends and projections*. Library Hi Tech News.

Pinar Saygin A, Cicekli I, Akman V (2000) Turing test: 50 years later. *Minds and Machines* 10(4): 463–518.

Robinson L, Bawden D (2017) "The story of data": a socio-technical approach to education for the data librarian role in the CityLIS library school at City, University of London. *Library Management* 38(6/7): 312–322.

Rubin VL, Chen Y, Thorimbert LM (2010) Artificially intelligent conversational agents in libraries. *Library Hi Tech* 28(4): 496–522.

Sharma P, Shah J, Patel R (2022) Artificial intelligence framework for MSME sectors with focus on design and manufacturing industries. In *Materials Today: Proceedings*.

Tu YF, Hwang GJ, Chen JCC, Lai C (2021) University students' attitudes towards ubiquitous library-supported learning: an empirical investigation in the context of the Line@ Library. *The Electronic Library* 39(1): 186–207.

Turing A (1950) *Computing machinery and intelligence*. Available at: http://www.abelard.org/tur pap/turpap.htm.

Wheeler AR, Buckley MR (2021) The current state of HRM with automation, artificial intelligence, and machine learning. In *HR without People?* Emerald Publishing Limited.

Wood BA, Evans D (2018) Librarians' perceptions of artificial intelligence and its potential impact on the profession. *Computers in Libraries* 38(1).

Yao F, Zhang C, Chen W (2015) Smart talking robot Xiaotu: participatory library service based on artificial intelligence. *Library Hi Tech* 33(2): 245–260.

Zimmerman T, Chang HC (2018, May) Getting smarter: definition, scope, and implications of smart libraries. In *Proceedings of the 18th ACM/IEEE on Joint Conference on Digital Libraries*, 403–440.