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Hanan Ahmed Farag
Imam Abdulrahman Bin Faisal University, hafarag@iau.edu.sa

Sameh Nour Mahfouz
Imam Abdulrahman Bin Faisal University, snmahfouz@iau.edu.sa

Samia Alhajri
Imam Abdulrahman Bin Faisal University, smhajri@iau.edu.sa

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By:

Dr.Hanan Ahmed Farag , Imam Abdulrahman Bin Faisal University

Dr.Sameh Nour Mahfouz, Imam Abdulrahman Bin Faisal University

Dr.Samia Alhajri , Imam Abdulrahman Bin Faisal University

Abstract

This study deals with the changes that occur because of the artificial intelligence techniques in academic libraries, using the survey method (descriptive and analytical) in describing and analyzing the reality of employing and using artificial intelligence technology in Saudi academic libraries, and the extent of the libraries' readiness to invest this technology and the challenges they face. The study concludes that there is a lack of physical equipment that is available inside the headquarters of academic libraries for technological development, and this explains the result related to the weak awareness of the concept of artificial intelligence among the majority of workers in those libraries by 69%.

Keywords: artificial intelligence, academic libraries.

Introduction

The rapid technological developments that occur in the world have caused fundamental changes in the features of life. The need to use technology has become an urgent necessity to facilitate the daily life of individuals and create the future of the next generations.

In the twenty-first century, a new magical thing has entered our lives called artificial intelligence (AI), providing many innovations that become a reality we live in. It places the library profession at the center of this change such as the digital aids that help people in their daily life in all fields like the Google Assistant, Alexa, and other digital assistants that grow daily.

When contemplating such techniques, it will become clear to us that artificial intelligence pulls the carpet from under the feet of all that is

traditional to open the way for the emergence of techniques that years ago were a fantasy. Digital assistants respond and use voice commands to help the owners to answer questions, complete simple tasks, and make life easier in general.

Study Problem

Although some librarians realize the importance of artificial intelligence (AI) and some of them expect that it will be the fertile field that will get the professionals in library and information search for useful ways to invest in it for improving their business as well as the quality of their services and special experiences, many professionals in the field still lack awareness of the concept of artificial intelligence, and they are not able to make the best use of this technology.

As with other sectors, libraries have been affected by the changes that happen because of artificial intelligence techniques. These artificial intelligence techniques have brought about changes in the needs of beneficiaries and the information services that must be provided to them. Thus, this calls for the need for libraries to adapt to this technology and enhance their services to become more flexible and responsive. In the developed countries, libraries can introduce these techniques and employ them early due to their high readiness and the availability of all requirements and equipment necessary to introduce these advanced smart techniques. Therefore, this study attempts to answer the following questions: What is the reality of employing artificial intelligence technology in Saudi academic libraries? To how much extent the libraries are ready to invest in this technology and the challenges they face?

The study problem aims at answering the following questions:

Q1: What is artificial intelligence?

Q2: What are the factors for adopting artificial intelligence in academic libraries?

Q3: What is the reality of activating artificial intelligence in Saudi academic libraries?

Q4: What are the barriers to realizing the full potential of artificial intelligence in academic libraries?

Q5: What are the requirements for investing in artificial intelligence techniques in academic libraries?

Study Objectives

This study aims at identifying the concept of artificial intelligence, and how it can be employed in several fields within academic libraries, starting from administration and organization for attracting the masses and facilitating the benefit to get knowledge, by studying the extent of readiness of Saudi academic libraries and their ability to use artificial intelligence technology. Thus, the study aims at:

- know about the concept of artificial intelligence and the changes that bring about in libraries.

-know the readiness of academic libraries to employ artificial intelligence.

-identify the challenges that libraries face in applying artificial intelligence.

-know the requirements for entering the academic libraries sector in using artificial intelligence technology.

Curriculum Used

The study uses the survey method (descriptive and analytical) to identify the reality of using artificial intelligence applications and how to invest them in Saudi academic libraries.

Data Collection Tools

To access the scientific material according to the curriculum followed by the study to have an adequate theoretical background on the subject, the intellectual production concerned with the subject is compiled and collected by searching the various tools that include:

-Searching various databases in intellectual production such as EBSCO, ProQuest, and EduaSearch.

- Using some search engines and objective pieces of evidence to search for some terms such as artificial intelligence, academic libraries, and readiness.

Study Sample

The study depends on a random sample to identify the reality of using artificial intelligence technology in some Saudi academic libraries. It is conducted with a sample of 29 individuals, representing 29 Saudi university libraries. The questions are asked to the studied sample members through an electronic questionnaire to measure some variables that can be enumerated in five areas:

-Knowledge background on artificial intelligence.

-Whether or not to use artificial intelligence techniques in libraries.

-Obstacles of using artificial intelligence applications within academic libraries under study.

-The requirements from the point of view of individuals under study.

Limits of the Study

- **Spatial boundaries**: Saudi academic libraries.

- **Objective boundaries**: The study shows the reality of activating artificial intelligence applications and the ways to invest them in Saudi academic libraries.

Terminology of Study

-Academic libraries are that group of libraries that are established and financed by universities, colleges, or various educational institutes, to present and provide information and library services to the academic community that includes students, teachers, and workers in these institutions ((Wikipedia, 2020).

-Artificial intelligence is the behavior and characteristics of certain computer programs that make them simulate human mental abilities and their working patterns. One of the most important of these characteristics is the ability to learn, conclude and react to situations that have not been programmed into the machine (Wikipedia, 2018).

Previous Studies

The world heritage is rich in many studies that deal with the relationship between artificial intelligence technology and libraries, with

the registration of a quantum leap in those studies in the last ten years with the spread of the use of aspects of that technology in global libraries. On the other hand, a relative scarcity of this type of study has been recorded in Arab science in general.

-The study of "Smart Libraries: An Emergent and Innovative Technological Environment in the Twenty-first Century":

This study sheds light on emergent and innovative techniques that integrate to establish smart libraries as the basic component of the new generation of libraries that integrate smart techniques, users, and smart services. In their study, the researchers conduct a comprehensive review of the scientific literature on the topic of smart libraries to monitor emerging techniques in them. The results of this study confirm that libraries have become smarter with innovative and emerging techniques, and this enhances their practical potential and satisfies their users. The application of these smart techniques in libraries bridged the gap between the services provided by libraries, and the changing needs of library users (Gul & Bano, 2019).

- The Study of "Artificial Intelligence in Academic Libraries": An Environmental Survey

The study aims at measuring the role that artificial intelligence technology plays in university libraries in North America, and the interest of the latter in supporting the adoption of this technology at all levels. The researchers evaluate thirty university libraries in Canada and the United States to determine the effectiveness of artificial intelligence in-office services, and they reach a set of results, the most important of which is the libraries. The study sample undertakes a varying level of the use of artificial intelligence within its strategic plan. However, most of

them participate in providing courses on artificial intelligence for students. Some of these libraries collaborate with other units within their universities to coordinate efforts and initiatives on artificial intelligence (Hervieux & Wheatley, 2019).

- Afaf' study (2010) for some Sudanese universities: "The use of artificial intelligence applications in university libraries: designing a model for an expert system in references for the published University of Khartoum library":

The study aims at identifying the applications of artificial intelligence technology, areas of its use, and the ways to benefit from it in Sudanese university libraries, with proposing an expert system in references using the experimental approach. The researcher adopts in her study, in addition to the experimental approach, the descriptive-analytical approach, the survey approach, and the case study approach, using the method of focus group and interview as tools to collect information and data from a sample consisting of 55 users of the automated system of libraries, 100 users of the reference service within libraries, and 25 librarians. They all represent 11 Sudanese universities. The most prominent results are as follows:

-The expert systems in Sudanese university libraries are still in the establishment stage, and they have not been adopted as a strategy for managing libraries.

-No importance is given to expert systems technology.

- Librarians' lack of familiarity with artificial intelligence techniques.

Artificial Intelligence

The term artificial intelligence is used for the first time in 1956 by the American researcher McCarthy) when he decides to use the term (Intelligence Artificial) as a title for a conference at the American University of Dartmouth, to indicate to start researching artificial intelligence as a field independent of computing and automation sciences (Nilsson, 1998). McCarthy defines artificial intelligence at that time as "the science and engineering of making intelligent machines" (Bohyun, 2019). However, he modifies his previous definition in 2007, relating it to smart computer programs when he says, "artificial intelligence is the science and engineering of making intelligent machines, especially smart computer programs" (McCarthy, 2007).

Some researchers contribute to defining artificial intelligence, and these definitions differ according to the scientific affiliation, interpretation contexts, and the technological environment in which each researcher grows up. Heinrich and Willis (2014) sum up artificial intelligence in everything that can be understood and perceived in similar ways to humans. Moreover, Nelson (1998) defines artificial intelligence. According to him, artificial intelligence is concerned with the intelligent behavior of the software of the automated world. Nilsson Mughali, in her definition of artificial intelligence, says that "artificial intelligence is based on analyzing and implementing smart tasks such as thinking, learning new skills, and adopting new attitudes" (Mogali, 2014). Tridnik proposes a definition of artificial intelligence, saying that it is "a set of techniques and approaches for computing that are concerned with the ability of computers to make flexible rational decisions in response to unexpected environmental conditions (Mogali, 2014).

Despite the multiplicity of the definitions of artificial intelligence and their differences for the mentioned reasons, it can be considered to be a smart machine if it has the following nine characteristics: the ability to learn, understand ambiguity, deal with complicated data, rapid response, thinking and analysis, deduction, pattern identification, remembering previous tasks, and suggesting solutions based on inputs and experience (Kumar, 2008). The impact of this early wave of artificial intelligence applications (AI) is still uncertain in many fields, but it is time to include artificial intelligence in our professional agenda and our national conversation.

The concept of artificial intelligence has reached what it is now, and this is due to the combination of many factors (Ahmat, & Hanipah, 2018)

1 – **Massive data**: The availability of greater amounts of data and its sources (organized and unorganized) today allows for the existence of artificial intelligence capabilities.

2 - **Cloud computing**: Breakthroughs in cloud computing technology have reduced the cost and have increased the speed of handling large amounts of via enhanced systems through parallel processing.

3. **Social Media Platforms**: The existence of open source gatherings contributes to the development and exchange of tools and applications of artificial intelligence to facilitate the progress of many aspects of artificial intelligence such as deep learning and reinforcement.

4- **Open source software and data**: They accelerate the use of artificial intelligence because it allows less time to be spent on routine programming and industry standardization.

5. **Expert systems**: They are the knowledge-based computerized systems that are based on knowledge or that play the role interface or portal of the

artificial intelligence, aiming at facilitating access to the database and obtaining relevant information. The most prominent components of expert systems are the knowledge base, inference engine, and user interface.

Areas of Using Artificial Intelligence in Academic Libraries

Some researchers and observers agree that artificial intelligence will become a staple number in the global economy. In terms of numbers, Gartner's research network expects that the global economy of artificial intelligence will rise from about $ 1.2 trillion in 2018 to $ 39 trillion in 2022. On the other hand, McKinsey believes that artificial intelligence technology will achieve a global economic activity of $ 13 by the beginning of 2030. Price water house Coopers estimates a total of 15.7 as net worth. Further, a technology investor, Kohli Tej, believes that the growth in demand for artificial intelligence will be much faster, and its economy will likely reach a value of $ 150 trillion in 2052 (cave, 2019). More than 60% of consumers and decision-makers of AI companies believe that it can help to provide the most important solutions to the problems that face modern society.

Library professionals are looking for the benefit of artificial intelligence (AI) and its sub-groups, and they can solve urgent work problems, making them race to obtain techniques and expertise that they can operate. There are a lot of opinions that agree that artificial intelligence will be the fertile field that will occupy specialists in the field of libraries and information to search for useful ways to use and invest them to facilitate their work and improve the quality of their services and their expertise. Specialists have taken advantage of this technology, and

have produced many systems in storage, retrieval, indexing, extracting, and reference works. They must have experience and interact with different aspects of life and other skills such as classification, academic experience, interviewing, building thesaurus, and knowledge of the beneficiaries' needs.

Models of Used Smart Systems

 - Coder is a project developed by fox that aims at developing a knowledge base that includes analyzing and retrieving documents.

- Rebeic is a system that searches for word patterns within the texts of direct automatic search, instead of retrieving previously exposed documents. The knowledge base relies on rules and their difficulty as it provides specialized rules for each user.

- Esscape is a project in which two systems of experts have been built in library cataloging and the main work to test access point test to identify the main and additional entries. The conclusion is the system that can be used in cataloging to produce the correct bibliographic entries and is also useful in non-traditional work.

- Gemi is an expert system that has been applied in the field of information retrieval, and it is based on the rule base by using a compatible microcomputer where the user can know the reference in his field of interest by providing a bibliography with an extract of all references that are available in university libraries. This system has been applied in Iraq in the field of libraries and information, and when applying the system. When applying the system, the nature of the beneficiary and his cultural level - usual beneficiaries or familiar - the profession have been taken into consideration.

In the context of the task of permanent storage and retrieval, many libraries such as the Macquarie University Library in Australia, the National Library of New Zealand, Limerick University Library in Ireland, and the Santa Clara University Library in the United States have accepted the use of the Automated Storage and Retrieval System, which greatly reduces the human role in the aforementioned processes with a measured level of processing and velocity (Heinrich & Willis, 2014).

In the field of robotics used in libraries, artificial intelligence has contributed to making the robot intelligent and independent in performing its tasks, not only the mechanical tasks, but also the cognitive ones, including leadership, interacting with the external environment in natural language, translation, and face recognition. The robot, Auross (Autonomous Robotic Shelf Scanning System), is an automated rack-scanning system developed in Singapore by the Agency for Science Technology and Research that scans RFID (adios Frequency identification) marks in books. In the same context, the Chicago Public Library takes advantage of a robot of finish type to help its subscribers and visitors to learn programming and language skills.

Picture (1): the reboot (Tu Bao)

The University of Oklahoma American Library chooses the intelligent hypothetical assistant (Alexa) designed by Amazon as an assistant in bibliographic research services (Bohyun, 2019), while the library of the Chinese University of Nagining relies on the robot Tu Bao as a receptionist (Wang, 2019).

Factors Contributing to a Successful AI Culture within Academic Libraries

Library leaders need to develop a strong foundation for an AI culture. We explore several factors that contribute to a successful AI culture in libraries:

-Learning the hidden things of AI by chief executives of artificial is the only way to ensure that the works of AI work and convince every unit that intelligence is a priority.

- Success in dealing with artificial intelligence techniques requires the presence of employees who can know how to operate these technologies. Chen and Zhang (2014) say that data science jobs have grown as much as 20 times in the last three years.

-Instructing the existing employees by educating them on the potential applications of artificial intelligence.

-Artificial intelligence can answer a big number of questions, but it also shows the need for organizations not to be distracted and should focus on the parts that will benefit from artificial intelligence. It also seems that there are a large number of organizations that adopt only artificial intelligence, without any strategy.

-The use of a wide range of data sources, so it is important for libraries to also search outside the walls of their business for data sources that provide content that is easily used while working on enrichment with metadata to facilitate the implementation of artificial intelligence initiatives.

-Risk Management: When a library makes a decision, using artificial intelligence, it must constantly follow the process of active supervision of the risks involved in dealing with smart technologies. Microsoft is one of the largest companies to adopt artificial intelligence, but it has tempered this enthusiasm very cautiously because it has alerted the possibility that the AI algorithms may be flawed. It also warns of insufficient or biased information in the dataset, and it indicates that these deficiencies can undermine decisions, predictions, or analyses produced by AI applications. However, the biggest risk that libraries face today comes from completely ignoring the AI revolution and lagging behind their competitors (Hayek, 2019).

-The survey study on the reality of using artificial intelligence technology within the Saudi academic libraries.

Results of the Study Questions

The study is conducted with a sample of 29 individuals, representing 29 Saudi university libraries. The questions are asked to the studied sample members through an electronic questionnaire to measure some variables that can be enumerated in five areas:
- Knowledge background on artificial intelligence.
- Whether or not to use artificial intelligence techniques in libraries.
 -Obstacles of using artificial intelligence applications within academic libraries under study.

-The requirements from the point of view of individuals under study.

The first axis: background knowledge on artificial intelligence

Table (1): Knowledge background on artificial intelligence

%	Repetition	Background knowledge on artificial intelligence
41 %	12	Robot use of robots
31 %	9	Modern technology in computers and their programs
28 %	8	I do not know
100 %	29	Total

It seems clear from the frequency and ratios mentioned in the table, the absence of knowledge about artificial intelligence where 12 individuals out of the total vocabulary of the sample have an inaccurate understanding about artificial intelligence, and this high percentage is an indication of the poor awareness of most members of the study population of the concept of artificial intelligence despite its use in most of the services and jobs provided by Saudi academic libraries. Also, their mental images of artificial intelligence are the use of robots where most of the services they provide at present represent one of the manifestations of artificial intelligence techniques. Cheniguel's study (2019) indicates that the concept of investing in artificial intelligence in libraries is not sufficiently understood. Although its use in most services and jobs, workers do not realize this, and they believe that it only depends on the use of robots. Some of the most important of these functions is the process of supply, indexing, and classification. It is also invested in helping workers to make decisions, understanding and meeting the needs of the beneficiaries, and the workers must be supported by attending seminars, conferences, and training courses on artificial intelligence to clarify the concept of artificial intelligence techniques correctly.

The second axis: the use of artificial intelligence in academic libraries.

Table (2) identifies the reality of using artificial intelligence applications in Saudi academic libraries. A question is asked about the existence of artificial intelligence technology in the library responsible for it as follows:

Table(2) responses of the individuals under study about the presence of artificial intelligence technology in the library responsible for it

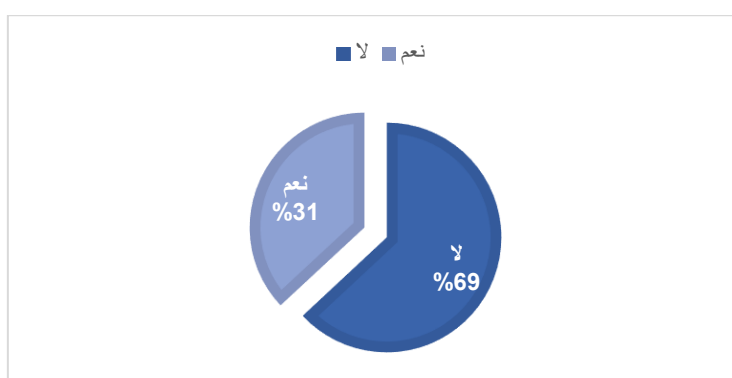| %	Repetition	Availability of artificial intelligence technology in the library
69 %	20	Yes
31 %	9	No
100 %	29	Total

Figure (1): Responses of the study population about the existence of artificial intelligence technology in the library responsible for it

Perhaps the data presented in Table (2) show the low adoption of artificial intelligence technology by academic libraries despite their full conviction of the importance of this technology and its necessity for the development of performance and services within those libraries. The study population is classified into two groups depending on the answer to this question. The first group includes those who have artificial intelligence technology to answer all five axes of the questionnaire from

the reality of using the requirements for investing artificial intelligence technology, in Saudi academic libraries. The second group includes those who do not have artificial intelligence technology, so they are asked directly to answer the last four axes: jobs and services, obstacles of using artificial intelligence applications, ways to apply artificial intelligence, the technical and human requirements to exploit artificial intelligence technology. Since they do not apply artificial intelligence, they do not have the reality of use that can be answered.

The third axis: Aims to measuring the obstacles to the adoption of artificial intelligence techniques by Saudi academic libraries

The entry of libraries and information institutions in the field of application and use of artificial intelligence technology will not be immediate, but it requires the use of methodologies and strategies that are related to study the challenges they face before as well as after the application process. The main reasons for delaying the application of modern techniques are the high financial costs to buy smart systems and devices.

Abdullah (2019) states that the expansion of the use of artificial intelligence technology may lead to cause some security holes and penetration of devices to access data, resulting in problems related to privacy and confidentiality, and this leads the beneficiaries to feel anxious about their privacy and the confidentiality of their data. Also, he indicates that the lack of qualified personnel is a challenge to the libraries that benefit from artificial intelligence techniques. Thus, libraries need training programs to enhance their capabilities and raise their productivity in the long term. Moreover, they feel anxious and afraid of replacing them with robots and smart technologies because of their high efficiency

and the ability to complete tasks very quickly. This calls for supporting policies to solve job security for library workers. On the other hand, Abdullah (2019) indicates that the use of artificial intelligence techniques may create in libraries a kind of digital divide for library workers as we find some of them are attracted to use technologies while others feel anxious about using that and reject the policy of change and development, especially concerning the use of modern technologies.

Table (3): Obstacles to using artificial intelligence in Saudi academic libraries

%	Repetition	academic Obstacles of using artificial intelligence in Saudi libraries
% 100	29	Poor communication network infrastructure, and the lack of technical capabilities
% 100	29	Lack of experts and suppliers in the field of artificial intelligence for libraries, and the difficulty of dealing with technical problems of electronic systems
% 100	29	Poor training and innovation in the field of artificial intelligence in those libraries
% 93	27	Lack of clarity of the concept of artificial intelligence among library workers
% 66	19	Lack of budgets for buying software and applications
% 38	11	Weak technical experience of the beneficiaries in dealing with artificial intelligence technology
% 28	8	The absence of will on the part of decision-makers

Saudi academic libraries face a set of challenges that represent an obstacle to their ability to use and benefit from artificial intelligence techniques. The most prominent challenges are weak physical equipment about 56%, weak training and innovation in the field of artificial intelligence, and the absence of the will to adopt by decision-makers in libraries.

Park (2019), a researcher in the field of electronic information, believes that the absence of strategies to adopt smart innovations in these libraries stands as a barrier to improving the performance of library institutions. The second barrier for adopting smart systems in libraries, according to Dr. Park, is the absence of composition on two levels: First, at the level of designing and inventing systems within universities and research centers, second, on the level of training the staff who use technology, which in turn remains dependent on the will of the decision-makers who have the responsibility to determine whether or not to adopt smart systems (Park, 2019).

Table (3) refers to the obstacles of adopting and using artificial intelligence applications in Saudi academic libraries which are arranged in descending order according to the approval of the individuals under study as follows:

1. Weakness of infrastructure for using modern techniques. The individuals of the sample indicate that technical challenges are the biggest obstacles that Saudi academic libraries face in their ability to create smart systems. The library must have the most current technology equipment, such as computers and others.

2. The scarcity of suppliers of artificial intelligence techniques in the field of libraries locally and the constant need to update programs and applications are since suppliers carry out the maintenance, repair, and development of these systems. Naseej' company is considered one of the most important suppliers of artificial intelligence techniques for libraries in Saudi Arabia.

3. Lack of experts in the field of artificial intelligence specialized for libraries and the difficulty of dealing with the technical problems of electronic systems. There are many Saudi experts of artificial intelligence who are graduates of Saudi universities or who have been sent abroad, who can develop the systems used by academic libraries, but the lack of plans to develop libraries, including the goal of contracting with these experts and benefiting from their expertise, is regarded to be the basic problem.

4. Lack of human competencies trained in artificial intelligence technology to work in libraries.

5. The concept of artificial intelligence is not clarified for library workers.

6. Lack of budgets for purchasing programs and applications. This indicates the approval of the deans and agents of the Saudi academic libraries that the most important obstacles to the application of artificial intelligence are the weakness of financial support for development and modernization.

7. Weak technical experience of the beneficiaries in dealing with artificial intelligence technology, and this indicates the weak content of the curricula through which researchers and students are trained to use digital databases.

8. The absence of supreme will on the part of decision-makers because it is necessary to educate employees and senior management on the importance of artificial intelligence and its role in providing better service.

The fourth axis: the readiness of Saudi academic libraries in the application of artificial intelligence

Libraries have struggled to adapt to modern techniques and technological revolutions, especially the libraries of major countries that seek to make clear and thoughtful plans to facilitate dealing with the changes brought about by artificial intelligence technology in all fields, and the necessity to urgently develop future strategies that reflect the characteristics and vision of libraries and provide a clear and comprehensive analysis of the requirements of information and the beneficiary community and the continuous provision of information to the beneficiary community. Ahmat and Hanipat (2008) state that the managers of organizations face the greatest obstacle to influence on employees to accept and adapt to any change as it is necessary for the survival and development of the organization. The following table shows the readiness of Saudi academic libraries to apply artificial intelligence.

Table (4): The extent of Saudi academic libraries possessing artificial intelligence application equipment

No.	Statement	Frequency	percentage
1	The library uses audio-to-digital text-to-digital programs by artificial intelligence technology.	29	% 100
2	The library has an electronic system based on artificial intelligence that bibliographic indexing of the vessels according to the Anglo-American indexing rules such as Coder.	26	% 90
3	The library uses artificial intelligence technology in the field of indexing language.	22	% 76
4	The library uses an automated system to store and retrieve books from the repository such as the Robotic Arm (ASRS).	18	% 62
5	An electronic system for the library's online databases is used to respond to inquiries of beneficiaries and solve problems such as the chatbot system.	11	% 38

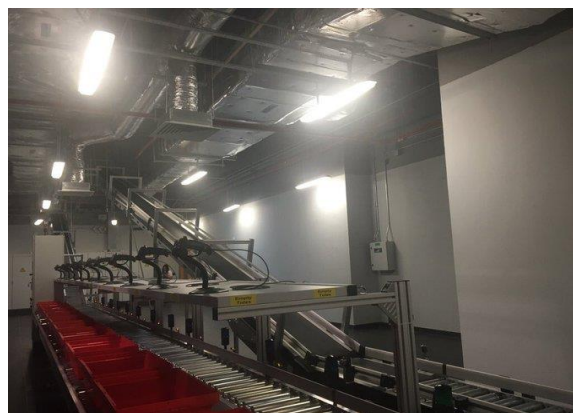|			
6	The library uses artificial intelligence technology in the field of information retrieval such as Gemi.	9	% 31
7	The library builds DSpace Digital Repositories for scholarly productivity and research preservation.	9	% 31
8	The library uses optical character recognition (OCR) software. That depends on artificial intelligence technology.	8	% 27.5
9	The library uses digital text coding programs with the use of artificial intelligence technology.	8	% 27.5
10	The library has artificial intelligence technology of classification such as Coal SORTوEP-X و 4. BIOSIS.	7	% 24
11	A model is used based on artificial intelligence to analyze and retrieve documents such as Coder.	6	% 21
12	The library has computer programs that mimic expert procedures in solving problems.	4	% 14
13	The library uses artificial intelligence technology in reading guidance by determining the percentage of confidence in the references and answering the questions of the beneficiaries	4	% 14
14	The library has one of the robot systems that offer library services and dealing with beneficiaries	1	% 3

The previous table shows the readiness of Saudi academic libraries in their application and use of artificial intelligence techniques, which are arranged in descending order according to the number of libraries that acquire this technology as follows:

1. The library uses digital voice-to-text and text-to-digital programs with the use of artificial intelligence techniques. This technology is used in the case of people with special needs such as blind. The services for people with special needs are not provided in all academic libraries.

2. The library uses artificial intelligence techniques, and this indicates that Saudi academic libraries depend on modern technological systems. They also have a large percentage of the capabilities required to establish digital libraries, and they train their human cadres, to achieve the standards of the International Federation of Libraries (IFLA) which assures that the most important capabilities of establishing digital library projects, which depend on artificial intelligence, is the availability of trained human cadres.

3. The library uses artificial intelligence technology in the field of indexing language in academic libraries; see Picture (2-19), the indexing interface. This can be explained as it is one of the most widespread bibliographic control languages and considered to be the link between researchers and digital information sources, and it is used in the Saudi Digital Library.

4. The library uses an automated system to store and retrieve books from the repository such as the automatic arm (ASRS). This automatic arm is only used in the Central Library at Princess Noura Bint Abdul Rahman University in Riyadh. It has five million books. The book requested by the beneficiary can be transferred easily, see picture (2).

picture (2): the automatic arm of the Central Library at Princess Noura University

5- An electronic system for the library's online databases is used to answer beneficiaries' inquiries and solve problems such as the chatBot system because most of the databases on the Saudi Digital Library use the instant chat system.

6. The library uses artificial intelligence technology in the field of information retrieval such as Gemi, and the process of providing new sources and identifying the needs of the beneficiaries is done by artificial intelligence technology. The library uses optical character recognition (OCR) programs that depend on artificial intelligence technology. It uses digital text coding programs, using artificial intelligence technology. Saudi Digital Library provides a Gemi system by which references are collected in a particular specialty, and a summary for each reference is provided so that the researcher can identify the source's content. One of the most famous databases that provide this service is (Dar Al-Nizamah), and it is the most used database among students and researchers. We find that by using "OCR" technology, pdf documents are converted into word documents. They are not widespread in academic libraries, and they are often paid services.

7. Bibliographic lists are provided with an extract of all references available in the library, using artificial intelligence.

8. The library has artificial intelligence technology of classification such as Coal SORT, EP-X, and 4. BIOSIS. An artificial intelligence model is used to analyze and retrieve documents such as Coder, and the users can deal with artificial intelligence techniques that are available in the library easily and without assistance.

 9. The library uses artificial intelligence techniques in reading guidance by determining the percentage of confidence in the references and their answers to the inquiries of the beneficiaries. DSpace Digital Repositories

is used for scientific productivity, preservation of research, and students' projects with the technique of artificial intelligence DSpace. This indicates the impartiality of the deans and agents of academic libraries to provide some artificial intelligence techniques, and it is since most electronic channels do not specify the percentage of confidence in the reference. Also, the university administrations do not save all scientific production for students and researchers electronically to be available for benefit, and this is due to the weakness of the capabilities in most academic libraries.

10. The library has computer programs that simulate the procedures of experts in solving problems. Beneficiaries can obtain their needs through electronic channels that are based on artificial intelligence technology without human intervention.

11. The library has one of the robotic systems that provide library services and dealing with beneficiaries. The scarcity of acquisition of this technology is since robotic systems that provide library services and dealing with beneficiaries require advanced technological experience in dealing with and maintaining them, their high price, weak researchers and students' skill in dealing with it directly, and seeking help from the library staff.

The fifth axis: What are the requirements for employing this technology in Saudi academic libraries?

In light of the availability of artificial intelligence technology, it has become necessary for libraries to take advantage of their applications and develop their services and benefit from them. To achieve this, there some requirements are not available, and they can be divided into three main sections (human requirements, financial requirements, technical requirements).

- **Human requirements**: Workers are the link between technology and the public, so it is necessary to train and qualify the skills that help them to overcome obstacles and possess the competence to deal with modern techniques.

- **Financial requirements**: It is one of the most important elements on which the application of technology in any institution depends, so the inputs of the organization must be studied and the possibility of providing new resources (Abdullah, 2019).

-**Technical requirements**: Equipping the library with the appropriate infrastructure, and providing a strong communication network as well as modern equipment are the most important technical requirements for adopting artificial intelligence techniques.

To identify the technical and human requirements that are necessary to exploit this technology in academic libraries, the frequencies and percentages of responses of the individuals under study are used as follows:

Table (5): The necessary technical and human requirements to exploit this technology in academic libraries

No.	Statement	Frequency	Percentage
1	Providing software and applications related to artificial intelligence technology.	29	100 %
2	Providing reliable, secured, and high-speed networks	29	100 %
3	Seeking help from the experts of artificial intelligence to install, update, and maintain systems.	20	69 %
4	Providing evidence on the use of artificial	20	69 %

	intelligence technology		
5	Providing hardware and devices through which traditional sources will be converted to digital using artificial intelligence techniques.	19	66 %
6	Providing software to protect intellectual property rights for information sources.	17	59 %
7	Providing a specific format for document data and document sources.	8	28 %
8	Good training for workers in the artificial intelligence sector in libraries.	6	21 %
9	Providing financial support.	5	17 %

Table (5) indicates that there is a variation in the acceptance of the individuals' understudy to the terms of the technical and human requirements that are necessary for exploiting artificial intelligence technology in Saudi academic libraries. This axis consists of eight statements that deal with these requirements, arranged in descending order according to the approval of the individual understudy as follows:

1. Providing the software and applications that are related to artificial intelligence technology. This is since programs and applications are the most common technologies used by researchers and students.

2. Providing reliable, secured, and high-speed communication networks since artificial intelligence technology rely heavily on the internet and need high-speed and secured networks.

3. Providing hardware and equipment through which traditional sources will be converted to digital using artificial intelligence techniques that can be circulated electronically.

4. Providing security software and verifying the identity of users of artificial intelligence techniques by identifying the identity of the

researcher and his university through the protection program to prevent the digital library from being randomly used.

5. Providing a specific format for document data and documenting sources. This indicates the strong approval of the deans and agents of the Saudi academic libraries that the most important requirement for applying artificial intelligence is the adoption of a unified method for preserving documents and data.

6. Providing software and applications of artificial intelligence technology and the hardware through which traditional sources are converted to digital, using artificial intelligence techniques and providing cybersecurity software.

7. Weak experience of workers in dealing with technological innovations, and this indicates the weak content of the training through which workers are trained to use these modern technologies.

Study Results

- Weak awareness of the concept of artificial intelligence where the individuals under study respond by 69% that they do not have artificial intelligence and 31% of them have artificial intelligence. This confirms the misunderstanding of the concept of artificial intelligence and investing in it.

-The uses in which artificial intelligence technology is currently invested in Saudi academic libraries are (indexing, analysis, retrieval, storage, photography, and meeting the needs of the beneficiaries).

- The weak training for workers in the artificial intelligence sector within the Saudi academic libraries because of to the lack of training courses for workers to gain experiences that qualify them to help the beneficiaries in

dealing with modern artificial intelligence techniques, to keep abreast of technical developments, and to invest artificial intelligence techniques for libraries.

- The systems used by the Saudi academic libraries and that depend on artificial intelligence, are the indexing language, the chatbot system, optical character recognition "OCR" programs, the Gemi system, and Coal SORT, EP-X, and BIOSIS. 4.

- The individuals under study refuse to use robotics technology because the internal environment of the Saudi academic libraries is not qualified for that, and they need advanced technological experience in dealing with and maintaining them. Other reasons are their high price and the weakness of researchers and students in dealing with them.

- The individuals under study approve that artificial intelligence techniques should be an assistive technology for the library specialist, and not to depend on it completely to perform jobs and provide services to the beneficiaries and this represents the current reality of investing artificial intelligence applications in the Saudi academic libraries.

- Jobs that can be replaced by artificial intelligence technologies (expert systems) are the replacement of online document managers directly, managers of electronic or online archives, digital resources coordinator, the borrowing and self-return service is done by using self-checkout devices RFID, digital resources librarian replacement, and information specialist.

- The services in which artificial intelligence can be invested are the providing of bibliographic lists for the beneficiaries, the prediction of the beneficiaries' future needs from the sources, the training of the beneficiaries, on the use of electronic containers, the provision of reading

guidance service, and the provision of document analysis and retrieval, using artificial intelligence technology.

- The weakness of the material equipment available inside the academic libraries, and justifies the lack of capabilities and budgets for technological development.

-The lack of suppliers of artificial intelligence technologies in the field of libraries locally in the light of the constant need to update programs and applications and the lack of cooperation and use of academic libraries with artificial intelligence experts as consultants represents the main problem.

- The lack of experience of researchers and students in dealing with technological innovations, and is due to the weak content of the courses that train researchers and students to use digital databases.

Recommendations

Based on presenting the most important results of the previous study, the study recommends the following:

- Supporting employees to attend seminars, conferences, and training courses on artificial intelligence to clarify the concept of artificial intelligence technologies correctly.

- Providing academic libraries with modern technologies in the field of artificial intelligence and preparing the internal environment in academic libraries to use robotics technology to benefit from the advantages it provides through financial, technical, and human support.

- Continuous updating of digital software, hardware, and equipment to keep pace with the rapid development in the field of artificial intelligence technologies.

- Preparing studies and workshops on the experiences of leading libraries in using artificial intelligence techniques to extract the most important lessons besides the strengths and weaknesses of these technologies.

- Providing several requirements for using artificial intelligence technologies, including the provision of reliable, secured, and high-speed communication networks, with the help of artificial intelligence experts to install, update and maintain systems.

- Providing the software and applications of artificial intelligence technology, besides the hardware through which traditional resources are converted to digital, using artificial intelligence techniques, and providing cybersecurity software.

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