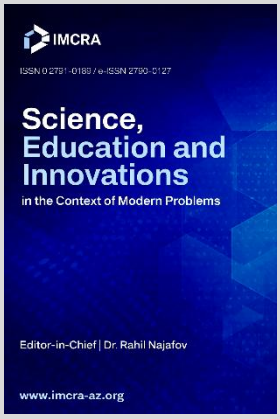


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RESEARCH ARTICLE

# Artificial Intelligence and Knowledge Organization in the Web Environment: An Approach to Improving the Digital Transformation of Libraries Towards an Intelligent Model

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**Keywords** artificial intelligence, knowledge organization, semantic web, digital transformation, smart libraries, information specialist.

**Abstract**

The rapid development of the digital information environment and the continuous increase in the volume of information available on the web have made the organization, structuring and effective management of knowledge one of the main challenges of the modern information society. In this context, artificial intelligence technologies create new opportunities for improving the organization of knowledge in the web environment, processing information and obtaining meaningful knowledge. The main goal of the study is to reassess the future role of the information specialist in the context of the rapid spread of artificial intelligence technologies and to determine the position of libraries in the intelligent transformation process. The article emphasizes that libraries should not be passive observers of technological changes, but active participants in the information ecosystem. In terms of protecting the reliability of information, efficient organization of knowledge and ensuring users' access to reliable sources, the adaptation of libraries to new technological realities is of strategic importance. At the same time, the application of artificial intelligence technologies without taking into account the theoretical foundations, ethical principles and social consequences may pose certain risks for the academic community and society. The study analyzes the issue of whether artificial intelligence will replace the functions of the information specialist. The study shows that libraries have continued their activities throughout history, adapting to technological innovations, and their main mission - organizing knowledge and providing access to information - has remained unchanged. In this regard, the information specialist of the future is considered a professional who not only uses artificial intelligence and semantic web technologies, but also plays an active role in the creation, classification, presentation and management of digital knowledge. The article identifies the main characteristics of the fourth generation information specialist, analyzes new professional competencies and "algorithmic literacy" skills related to artificial intelligence technologies. In addition, the main processes of organizing knowledge in the web environment, the creation and management of digital content, the secure sharing of knowledge and the provision of reliable access in the open information environment are examined. The study also systematically reviews smart technologies that can support knowledge organization on library web platforms and the main problems that arise in the era of artificial intelligence. As a result, it is determined that artificial intelligence is not a replacement for the information specialist, but a technological tool that transforms and expands his professional activities. The transition of libraries to a smart model requires the provision of information specialists with new knowledge and skills, as well as the application of innovative approaches in the field of knowledge organization.

**Citation**

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## Introduction

The modern world is experiencing deep and multifaceted transformations under the influence of the digital revolution. Among the main driving forces of these transformations, artificial intelligence technologies and web-based knowledge organization systems occupy a special place. These technologies are radically reshaping the structure of the information environment, knowledge management mechanisms, and forms of library service provision. In this context, libraries are beginning to act not only as traditional institutions storing information, but also as strategic knowledge centers managing the processes of creating, organizing, and sharing knowledge. As a result, it is considered necessary for libraries to rebuild their systems and services in accordance with the requirements of digital transformation and to adopt a smart library model based on the integration of technology and knowledge management.

In the era of artificial intelligence, the organization of knowledge in the web environment reflects fundamental changes in the essence of the information specialist profession and requires the formation of a new set of knowledge, skills, and competencies for this profession. The modern web is no longer just a technical platform designed for storing and accessing information; it has been transformed into a complex semantic ecosystem where unstructured content is transformed into machine-understandable and processable knowledge through ontologies, controlled vocabularies, semantic technologies and machine learning algorithms. In such an environment, the information specialist acts as one of the main actors in the construction and management of knowledge organization systems. This requires the skills to effectively use artificial intelligence tools to design and manage ontologies, ensure semantic interoperability between systems, as well as improve search and discovery processes.

At the same time, the rapid development observed in digital transformation technologies such as cloud technologies, Internet of Things (IoT), big data (Big Data) and artificial intelligence has necessitated the redefinition of the professional identity of information specialists. Their activities are no longer limited to traditional document mediation or the provision of limited digital services. Modern information specialists are expected to have advanced digital competencies in the areas of creation, collection, processing, preservation and presentation of digital resources and content in accordance with international standards. These competencies also include skills such as big data management, application of semantic analysis methods and management of artificial intelligence-based interactive knowledge platforms.

The professional future of information specialists directly depends on their ability to adapt to the new digital environment and master the skills required to operate in this environment. In this regard, the organization of library content in the web environment can be assessed as a dynamic process that requires a synthesis of technical knowledge and a deep understanding of user needs. Therefore, the development of specialized and continuous training programs, the development of digital competencies, as well as the application of artificial intelligence-supported knowledge management and web content organization strategies are considered one of the main conditions for information specialists to contribute to the development of scientific research, education and reading culture, as well as to ensure their active participation in the formation of a knowledge society.

## Research Problem

The study is based on the following main scientific problem: How can the integration of artificial intelligence and web-based knowledge organization technologies contribute to strengthening the digital transformation of university libraries towards a smart model?

In order to answer this question, the study uses a comparative-analytical approach that combines the analysis of international scientific literature with the study of local experiences and seeks answers to the following research questions:

What are the main theoretical and methodological principles of knowledge organization in the web environment?

What contributions does artificial intelligence make to the knowledge organization processes carried out by information specialists?

What basic skills are required for information specialists to effectively use artificial intelligence technologies and integrate them into library activities?

What are the main challenges facing Algerian libraries in transitioning to a smart library model and implementing digital transformation using artificial intelligence technologies?

## Significance of the Study

The importance of this study lies in providing a theoretical and practical framework that integrates artificial intelligence and semantic web technologies for the development of libraries. The study explores the possibilities of improving cataloging and

indexing processes, increasing the accuracy of search and information retrieval, as well as providing personalized services to users.

In addition, the study aims to determine the role of the aforementioned technologies in supporting institutional decision-making processes, increasing operational efficiency, and forming an innovative service and knowledge environment within libraries. These issues are of strategic importance, especially for university libraries, where research and innovation activities are intensively carried out.

### Research Objectives

The main objectives of the study are as follows:

To analyze the role of artificial intelligence in reshaping web-based knowledge organization methods and accelerating digital transformation processes in libraries;

To explore the application possibilities of intelligent technologies such as machine learning, semantic web, and natural language processing in the process of intelligent organization of knowledge in the web environment;

To identify the main opportunities and challenges faced by libraries in the process of applying artificial intelligence technologies and transitioning to a smart library model.

### Study Terminology

**Knowledge Organization on the Web:** Knowledge organization on the web is a systematic process aimed at describing, indexing, linking, and organizing digital content on the Internet using modern tools and technologies such as metadata, the semantic web, and intelligent applications. This facilitates rapid and accurate access to information and its use in modern environments such as smart libraries. Thus, web-based knowledge organization involves building structures and standards for classifying and linking digital information online so that it can be efficiently retrieved and used. It differs from traditional organization (manual cataloging or software-assisted automated cataloging) because it relies on algorithms, metadata, and artificial intelligence. It focuses on interaction with users and meeting their knowledge needs within an interactive and intelligent environment.

**Digital Transformation:** Digital transformation represents a strategic reformulation of business models and processes through the use of technologies such as artificial intelligence (AI), the Internet of Things (IoT), and Big Data to enhance performance and customer experience (Rane et al., 2024). It refers to the comprehensive integration of digital technologies across all areas of an institution, resulting in radical changes in processes, culture, and interaction mechanisms with beneficiaries. Digital transformation is not merely the replacement of manual work with automated processes; rather, it is a strategic vision that turns the library into a smart knowledge institution capable of adapting to the enormous flow of information and providing high-value services with speed and precision. It thus becomes a strategic necessity for public reading libraries in Algeria to keep pace with the global digital environment and strengthen their position as active cultural and knowledge institutions.

**Artificial Intelligence:** Artificial intelligence is viewed in the scientific literature as a multidimensional field that combines advanced computational technologies with the ability to simulate human cognitive patterns such as reasoning, learning, and decision-making. Definitions vary between technical and functional perspectives. Technically, it is defined as computer systems that exhibit intelligent behavior by analyzing their environment and making autonomous decisions to achieve specific goals. Functionally, it is defined as a set of tools that enable machines to perform tasks that usually require human intelligence, such as understanding, learning, and problem-solving (Triguero et al., 2023; Sangwan & Bansal, 2024).

Forms of artificial intelligence vary according to their capabilities, technologies, and applications. These include narrow artificial intelligence directed toward specific tasks such as cataloging or recommendation systems; general artificial intelligence, which seeks to simulate human capabilities across multiple domains; and superintelligence. From these emerge technologies such as machine learning, neural networks, natural language processing, and computer vision, in addition to generative artificial intelligence, which has brought about a qualitative leap through its ability to produce new content, whether text, images, or audio (Triguero et al., 2023; Sangwan & Bansal, 2024).

In this sense, artificial intelligence is no longer merely a theoretical concept or software tool; it has become a practical reality affecting various sectors, including libraries and information institutions, opening broad horizons for service development, accelerating access to knowledge, and strengthening the role of libraries in a changing digital environment.

## 1. Digital Transformation and Knowledge Organization on the Web: General Concepts

The term digital transformation became widespread after 2010 and, in its simplest sense, refers to converting all transactions, documents, and procedures from paper-based to electronic formats. It can also be considered the process through which institutions move toward a business model based on digital technologies to innovate products and services and provide new revenue channels and opportunities that increase the value of their products (Al-Bar, p. 02). Many studies agree that digital transformation is "a reshaping of the way people live and a radical change in the construction of knowledge societies" (Khawathra, 2021). It constitutes a radical change in people's attitudes toward technology, behaviors, and transactions. The

key technologies and drivers of digital transformation include artificial intelligence, blockchain, big data, the Internet of Things (IoT), and cloud computing. This transformation has also significantly affected libraries, their services, resources, and the professional practices of their staff, leading to the restructuring of functions and skills required to cope with these changes.

In this context, it is illogical for libraries of all types to remain outside the scope of the major transformations brought about by information and communication technologies. Rather, it has become necessary for them to keep pace with these changes in order to improve their services and meet users' expectations. This drives libraries toward digital transformation as a comprehensive process that goes beyond automating operations, introducing computers into administrative work, or providing library services. Instead, it involves a complete restructuring of processes, services, and operational models through investment in the capabilities offered by modern digital technologies, such as artificial intelligence and its various applications (recommendation algorithms, automated indexing, intelligent conversational interfaces or chatbots), big data (analyzing user behavior and monitoring search trends), intelligent storage and cloud computing (providing flexible platforms for storing and exchanging information), and the Internet of Things (connecting devices and resources to smart library services).

On the other hand, the web is witnessing tremendous growth in the amount of available information, making the organization of this information and the extraction of knowledge from it a major challenge. At the same time, artificial intelligence and the previously mentioned digital transformation applications provide powerful tools and techniques that can be used to improve knowledge organization on the web. The term knowledge organization generally refers to "the set of activities related to describing, indexing, and classifying documents in libraries, bibliographic databases, archival centers, and all methods through which information can be organized and processed in order to retrieve the most useful and beneficial information" (Ben Zayed & Qamouh, 2021).

Knowledge organization on the web by information specialists can take many forms, such as creating an integrated digital library containing multiple resources, including electronic resources and digital and intelligent services. Information specialists can also use artificial intelligence technologies to analyze user data, track information-seeking behavior, and provide recommendations related, for example, to the acquisition of books and other resources based on users' previous interests. These modern technologies also enable information specialists to organize library digital content using advanced classification systems such as semantic classification, making it easier for users to quickly access information relevant to their research topics. At the same time, they add a standardized and modern dimension to library work. Tools such as intelligent chat systems or virtual assistants can also be used to provide rapid responses to users as part of reference services, as well as to organize online workshops and seminars to teach users how to use digital systems and enhance access to knowledge and lifelong learning.

2. The Use of Artificial Intelligence in Knowledge Organization: Opportunities and Tools

The deployment of artificial intelligence technologies in libraries represents a qualitative shift in knowledge management, as it contributes to improving user experience, automating technical operations, and developing an innovative educational environment within society or affiliated institutions. Recent studies confirm that the application of these technologies enhances institutional performance and significantly increases service efficiency (Qawali & Nour Eddine, 2026). It also offers numerous advantages to libraries, such as facilitating access to information in complex digital environments through improving search quality via semantic search engines. Furthermore, it supports smart libraries, universities, and knowledge societies as a whole in accelerating digital transformation and enhancing the production and dissemination of knowledge within an interactive environment.

### 2.1 Knowledge Discovery

Artificial intelligence has brought about a radical transformation in knowledge discovery on the web, moving from keyword-based searching to deep search that understands intentions and generates new insights almost independently. Today, tools such as OpenAI's Deep Research and generative systems are capable of analyzing vast amounts of data and extracting patterns and knowledge at unprecedented speed.

Many artificial intelligence tools and applications are characterized by their ability to create knowledge maps and connections among topics, sources, and citations. This facilitates the work of information specialists in designing visual maps of relationships among similar information sources, analyzing citations, tag clusters, or resources tagged by users. An example of this type of application is **Connected Papers**, a platform ideal for librarians conducting research as part of their work or while preparing their own academic papers. A clear advantage of this tool is that it helps librarians understand relationships among sources, identify emerging research trends, and discover important recent research papers that may not yet be available in other databases.

### 2.2 Intelligent Classification and Cataloging

The use of machine learning techniques to analyze and automatically index content reduces manual effort and increases the accuracy of classification and intelligent categorization. Among the applications in this field is the Wise platform developed by OCLC, which offers many advantages beyond cataloging and classification, including content recommendations,

marketing, and web-based library management. Another popular application in this area is Alma, a comprehensive library software designed to assist in acquiring, cataloging, and sharing digital resources with other libraries. It provides data assistance features and uses generative artificial intelligence to suggest improved catalog descriptions, helping librarians and information specialists make library resources available in a more consistent and intelligent manner.

Applications of artificial intelligence in cataloging and classification include the following (Abdel Hadi, Mohamed Fathy, 2025):

- Automatic generation and enrichment of metadata (descriptive elements): Artificial intelligence systems can extract, generate, and enrich metadata from digital resources through machine learning, thereby reducing manual data entry.
- Subject heading assignment: Natural language processing techniques are used to automatically identify subject headings for library materials.
- Authority control: Artificial intelligence can help maintain consistency in names and distinguish between similar names. Some experts have indicated that machine learning algorithms can improve authority control for names.
- Support for multilingual cataloging: Artificial intelligence technologies facilitate cataloging in multiple languages. Some studies explore how machine translation can support catalogers working with materials in languages they do not speak, helping translate book titles, descriptions, and even full texts. This is particularly useful for libraries holding multilingual collections.
- Enhanced classification: Machine learning algorithms can be used to automatically assign classification numbers to library materials. They can also enhance existing systems and develop more flexible classification systems. Artificial intelligence supports the implementation of faceted classification systems, as machine learning can assist in generating and applying facets, thereby improving the multidimensional representation of library resources. In classification processes, machine learning algorithms can analyze text, images, and metadata to create categories for materials. One study showed that deep learning models can achieve classification accuracy of approximately 90% for visual content.
- Recommendations and user experience: Artificial intelligence-based recommendation systems analyze user behavior, such as search queries, to suggest appropriate materials. This enhances user experience by recommending resources that match users' needs.

As for cataloging resources generated using generative artificial intelligence tools, tools such as ChatGPT and others produce textual content including articles, books, and more. This creates new challenges for libraries and catalogers, as handling such resources requires the development of technical practices related to content reliability, identifying the primary author, and incorporating intelligent tools within modern information organization standards. There are also guidelines for cataloging AI-generated resources according to the MARC 21 standard, including recommendations issued by the Program for Cooperative Cataloging (PCC) concerning the cataloging of resources generated using generative artificial intelligence tools.

Among the artificial intelligence technologies suitable for cataloging operations are machine learning, natural language processing, and computer vision. Machine learning algorithms can learn from large datasets of existing catalog records to identify patterns and make predictions about new materials. Supervised learning techniques have shown promise in automating subject classification and metadata creation. Natural language processing (NLP) enables computers to understand, interpret, and generate human language. In cataloging, NLP can be used to extract metadata from unstructured text, such as book descriptions or full-text content. NLP techniques can also automatically generate subject headings and abstracts for library materials. Computer vision enables artificial intelligence systems to analyze, interpret, and categorize images and videos. In library contexts, computer vision can be applied to analyze book covers, images, and other visual materials to extract relevant metadata (Abdel Hadi, Mohamed Fathy, 2025).

### 2.3 Artificial Intelligence Agents and Intelligent Assistants

The simplest examples are retrieval-based conversational generators, which transform traditional library website interfaces into dynamic and interactive experiences. These assistants possess data that enable them to answer users' questions and replace reference service specialists. Users can ask questions and receive immediate answers to frequently asked questions (FAQs) at any time.

Libraries currently use—or should use—AI-powered chatbots to answer reference inquiries and refer complex questions to information specialists. This saves time when responding to more complex inquiries while ensuring that services remain available twenty-four hours a day, seven days a week. For example, **JotForm** is an AI-powered library automation tool that can help create forms, answer users' questions and frequently asked questions, support library marketing, and provide numerous other benefits that information specialists can utilize.

Agentic artificial intelligence operates autonomously by leveraging technologies such as Natural Language Processing (NLP), Reinforcement Learning (RL), Machine Learning (ML) algorithms, and Knowledge Representation and Reasoning (KR). Building AI agents is not merely about asking a question and receiving an answer; it involves giving artificial intelligence a complex objective or a specific strategy that the library wishes to achieve. It is akin to building a digital information specialist.

Retrieval-based conversational generators represent a breakthrough in information retrieval interfaces. These interfaces have evolved from retrieving information materials to enabling interactive dialogue between the system and the user. They go beyond this by conducting conversations that require the system to return to a knowledge base and select a set of answers representing the retrieval of specific knowledge segments through which subject-related needs can be met using directed knowledge summaries, without the need to browse through numerous results. These generators possess several characteristics (Ibrahim, Sayed Rabie, 2024):

- Open Retrieval: Search and retrieval are represented as a dialogue between the system and the user, reaching deep or multi-stage levels of questioning and response.
- Dialogue and Conversation: Knowledge retrieval is not presented as results or information units but rather as a conversation characterized by answers and logical interaction, where the results are embedded within the ongoing discussion.
- Grounded Information Needs: The generator continuously prompts the user to specify the information they seek. Users formulate their inquiries using relevant keywords and anticipated answers, enabling the system to establish semantic and topical relationships among knowledge segments and reorganize them into a knowledge structure suited to the intended response.
- Context History: The conversational system uses chronological ordering and dialogue sequencing with its users, allowing it to collect various contexts from the beginning to the end of the conversation and use them in representing answers extracted from the knowledge base. This increases the number of knowledge entities involved and enhances the system's ability to connect these entities within more interconnected and complex knowledge structures, thereby supporting the user's knowledge objectives.

### 2.4 Intelligent Search Engines and Knowledge Engines

Intelligent search engines are the advanced generation of search systems that rely on artificial intelligence to understand the meaning and context behind user queries rather than merely matching keywords. They are search systems that use technologies such as Natural Language Processing (NLP) and machine learning to analyze user intent and provide more accurate and relevant results, while adapting to users' interests and behavior. Semantic search and intelligent interaction are among their most important features.

Knowledge engines, on the other hand, are based on constructing organized knowledge bases that connect concepts and facts. They do not merely search but provide direct answers based on knowledge networks. They serve as tools for generating ready-to-use answers and knowledge. One of the most prominent AI-supported semantic engines is **Semantic Scholar**.

Since their inception, web search engines have sought to achieve efficiency in retrieving information resources relevant to search terms. This has been accomplished through indexing and analysis mechanisms and the use of metadata that reveal the subject matter of web resources to provide the highest levels of matching and recall. However, information retrieval has generally dealt with information resources as whole units without examining their internal knowledge content or the informational entities they contain.

This is where the qualitative shift toward knowledge generation systems and engines begins. These systems move analysis to the level of knowledge content rather than the information resource itself. They identify the knowledge entities embedded within contextual details rather than treating the source as a single general unit. Moreover, they establish interconnections among these knowledge entities and link them through thematic relationships, thereby reshaping and redirecting them. Knowledge generation engines can also construct entirely new knowledge structures on demand, designed specifically to serve the knowledge objectives of users. Consequently, analysis and retrieval become real-time processes dependent on the engine's ability to perform knowledge analysis and linking, as well as its capacity for understanding and conversational interaction with users.

To achieve this, knowledge generation engines must possess the ability to capture key terms, search heterogeneous sources while processing queries, and create on-demand knowledge graphs by applying the Resource Description Framework (RDF) semantic linking approach to knowledge fragments. The resulting knowledge graph represents the entities collected from integrated sources and the relationships among those entities (Ibrahim, Sayed Rabie, 2024).

In general, there are many other contributions that artificial intelligence provides to libraries, whether for information specialists or for users.

3. Strategies for Organizing Content and Knowledge on the Web

### Metadata

Metadata, or descriptive data, is a means of encoding information within a framework of specific rules created using tags linked to web pages. Search engines use these tags to classify those pages. Metadata is embedded within the page's coding and is not visible to readers when viewing the page (Tiranim & Slimani, 2024). This is why it is referred to as hidden data or metadata. Michel Gorman considers metadata as a third method for organizing knowledge and electronic resources and facilitating access to them, as a solution following:

- The first method: the use of directories and search engines. However, this method is criticized for the limited coverage of search engines and the lack of precision in organization, as it provides users with a large number of unwanted resources that do not accurately answer their inquiries.
- The second method: the use of descriptive cataloging (MARC) for cataloging digital resources. From some perspectives, this system is considered complex and costly, although effective (Al-Sharif & Mansour, 2024).

Among the semantic standards and metadata schemes employed by libraries in organizing their web-based data are:

- RDF and SPARQL: for representing data and linking it together.
- Dublin Core: a standard for describing digital resources.
- Schema.org: for standardizing content descriptions across search engines.

### Taxonomy and Folksonomy

Taxonomy is one of the methods used in website construction and search directories. Website pages are classified to build browsing tools, and search directories provide a list of choices containing key terms. Users select a term from the list, which leads them to another level, and so on until they reach six or seven levels deep (Hussein, n.d.). It was defined by the American standard **ANSI/NISO Z39.19-2005**, adopted in July 2005, as "a set of controlled vocabularies arranged hierarchically, where each term in the taxonomy may have more than one broader term and more than one narrower term" (Al-Sulami, 2018).

Taxonomy plays a role in organizing information and improving search and browsing processes on the Internet. A prominent example is the massive website Amazon. Searching within such a platform would be difficult without categorization and classification of its contents. Classification provides users with a starting point for their searches and represents a systematic narrowing of search results from the main category, making it easier for users to find what they are looking for quickly and efficiently.

Folksonomy, on the other hand, is based on **Tags and Tagging**, whereby users assign keywords to the content of resources or websites. This enables users to participate in organizing knowledge and facilitates retrieval while reducing the effort required from information specialists in directing the interests of each user.

### Semantic Search Engines and Ontology Construction

Semantic search engines are intelligent engines that search for keywords according to meaning and provide accurate and relevant results for requested queries. They also ensure results related to the meaning of the searched keywords. Semantic search engines use the concept of ontology to achieve meaningful information retrieval and highly accurate results.

The semantic web is used to structure data in an organized format and helps in understanding more information available on the web. It is employed in many applications, including digital libraries, where it facilitates the discovery of more compatible and integrated data from different sources and provides users with more accurate results compared to current web search engines (Abeid & Nassib, 2024).

Modern search engines rely on artificial intelligence to understand user queries more deeply and provide more accurate and relevant results. They can understand complex questions and provide direct answers, making them a preferred resource for students, specialists, and researchers.

### Natural Language Processing

Natural Language Processing (NLP) is defined as the interaction between artificial intelligence and computers through the natural processing of language. Its purpose is to combine human learning with machine logic and to create computer programs that enable interaction between humans and computers for storing primary information and performing numerous functions such as spelling correction, sentence structure formation, and providing semantic relationships (Al-Hilali, 2024).

Among the knowledge organization processes that use NLP are:

- **Entity Extraction:** Identifying the names of people, institutions, places, and concepts within digital texts and linking them to standardized metadata.
- **Automatic Classification:** Using machine learning algorithms to classify documents and content into specific subjects or knowledge domains.
- **Semantic Indexing:** Employing technologies such as RDF and OWL to connect concepts and meanings, thereby facilitating intelligent search.
- **Automatic Summarization:** Producing accurate summaries of long texts to facilitate rapid access to information.
- **Sentiment Analysis:** Understanding the orientation of texts (positive, negative, neutral) to support decision-making in knowledge environments.
- **Intelligent Recommendation:** Building systems that suggest resources or articles related to users' interests through language analysis.

4. Information Specialist Skills in the Age of Artificial Intelligence

Artificial intelligence has become an essential component of the modern digital information infrastructure, redefining how knowledge is collected and processed. This has transformed the role of the information specialist from a mere organizer into a facilitator of intelligent information, leveraging artificial intelligence capabilities in big data analysis.

According to LinkedIn's latest report, **"Artificial Intelligence and the Global Economy" (2025)**, AI literacy is the most in-demand skill in job advertisements, and companies are expected to collaborate more extensively with educational institutions to train their employees in this area. While organizational changes may occur within academia to support this need, librarians are particularly qualified to teach AI literacy due to their strong background in information literacy and their focus on information verification (EBSCOpost, 2025).

### 4.1 Technical Skills of Information Specialists in the Age of Artificial Intelligence

In an AI-driven environment, information specialists require a range of technical skills that have become essential for managing and organizing knowledge across the web and smart libraries. These skills combine a deep understanding of modern technologies with the ability to apply them in academic and professional contexts:

- **Programming Language Proficiency:** Learning core programming languages such as Python and R, which form the backbone of AI applications in knowledge organization.
- **Understanding Machine Learning and Deep Learning:** Possessing strong knowledge of machine learning and deep learning to help develop innovative solutions for information classification and retrieval.
- **Using AI Tools and Applications:** Employing advanced AI tools to improve search, cataloging, and digital content organization processes effectively.
- **Big Data Analysis and Representation:** The ability to analyze massive volumes of data and represent them in ways that provide clear and actionable insights, supporting decision-making (Qamouh, Badi, & Attia, 2024).
- **Management of Smart Platforms:** Operating smart library systems that rely on artificial intelligence and predictive analytics.

### 4.2 Professional Skills of Information Specialists in the Age of Artificial Intelligence

In an AI environment, the professional skills required of information specialists expand to include advanced capabilities that go beyond traditional cataloging toward intelligent data management and predictive analytics. These skills form the backbone of the transition toward smart libraries.

*Digital Content Creation and Organization on the Web*

This field refers to the ability to create, edit, integrate, and modify digital content, whether pre-existing or developed from scratch. It encompasses four skills (Qamouh, Badi, & Attia, 2024):

- Digital content development.
- Digital content integration and adaptation.
- Understanding and protecting intellectual property and authorship rights.
- Programming skills.

This field also includes the use of emerging tools and technologies to create accessible digital content, develop content, utilize Content Management Systems (CMS), classification and tagging tools, and represent knowledge through AI technologies for search and retrieval purposes.

*Data, Content, and Knowledge Base Management*

The ability to analyze big data and design, maintain, and retrieve information from digital knowledge bases.

*Query Engineering and Intelligent Interface Development*

Building front-end and back-end interfaces for knowledge websites that utilize artificial intelligence technologies to provide a suitable and interactive user experience.

*Digital Presence and Communication Skills*

These include solving digital problems, understanding digital culture and rights, identifying technological needs, digital communication, digital creativity, improving user experience, and interacting with intelligent content.

*Information Security Skills*

Libraries are required to train their staff in innovative mechanisms for the technical and legal protection of digital content and its circulation, especially with the development of Digital Rights Management (DRM) systems. Cybersecurity is among the most important digital skills that information specialists must strengthen, particularly as many information and archival institutions transition to cloud computing environments. Cybersecurity is broader than information security, as it includes securing data and information transmitted through internal and external networks and stored on servers inside or outside organizations against breaches (Qamouh, Badi, & Attia, 2024).

In technology generally, practical or applied skills are more important than merely possessing traits or characteristics. Practical skills in analyzing, organizing, and classifying data using AI tools have become among the most important competencies required in information research environments and smart institutions. These skills are not limited to technical aspects but also include the ability to transform raw data into usable knowledge through the following processes:

- **Data Analysis:** Using machine learning techniques to discover patterns and relationships and applying algorithms such as clustering and regression to understand trends.
- **Data Organization:** Transforming unstructured data (such as texts or images) into organized databases and building Knowledge Graphs that connect concepts and entities.
- **Data Classification:** Using models such as BERT or GPT to classify texts by topic or domain and applying Named Entity Recognition (NER) techniques to identify people, places, and institutions.

The following tools support these skills:

| Tool | Supported Skill | Practical Use |
|---|---|---|
| KNIME | Analysis and Organization | Building workflows for analyzing big data and linking it to multiple sources |
| Power BI | Organization and Classification | Creating interactive dashboards that support decision-making |
| Lang Chain | Classification and Analysis | Automating knowledge workflows and linking texts to research questions |
| ChatGPT | Summarization and Classification | Extracting summaries from lengthy reports and classifying them by topic |
| LlamaIndex | Organization and Analysis | Building knowledge bases from academic documents |

**Table:** Some practical skills in data organization using artificial intelligence tools.

With the expansion, adoption, and application of this technology, librarians and library staff are now obliged to learn skills related to various AI applications (such as identifying and distinguishing texts and images generated by intelligent applications, for example) and contribute to transferring these skills to users. This implies an expanded role for librarians and the need to direct it toward promoting the responsible use of this technology by educating and raising awareness about its advantages and positive impact not only on knowledge productivity but also on daily life in general. At the same time, its negative effects must not be overlooked, particularly the growing spread of misinformation and disinformation, as well as security and privacy concerns resulting from the excessive use of artificial intelligence.

5. Challenges of Knowledge Organization in Libraries in the Age of Artificial Intelligence

The results of numerous studies, including the study by Sayed Mohamed and colleagues, indicate that the main challenges facing libraries in adopting artificial intelligence technologies relate to technological infrastructure, high costs, training on the use of technologies, resistance to change among employees, and the protection of personal data. This aligns with the study

by Jelouli and Al-Sayyid (2025), which confirmed that there is considerable resistance to change among information specialists in Algerian libraries due to fear of technology and rejection of new developments. Information specialists also lack sufficient awareness of artificial intelligence and its applications in libraries, and there is confusion between AI technologies and information technology in general, indicating a lack of knowledge in this area.

The challenges also include ensuring the accuracy and reliability of information, as artificial intelligence may contribute to the dissemination of incorrect or misleading information. Furthermore, issues related to privacy and security arise, as sensitive data may be exposed to risk. Knowledge organization also requires the use of new tools and technologies, such as machine learning and data analysis, to improve access to information. This requires information specialists to be flexible and knowledgeable about all developments and changes.

Ultimately, a balance must be achieved between innovation in artificial intelligence and maintaining the quality of available information. Rapid technological changes, both current and future, must also be taken into account, necessitating continuous updates to knowledge organization strategies and the skills required to implement them.

| Challenge | Brief Description | Practical Solution | Expected Outcome |
|---|---|---|---|
| Library Digital Infrastructure | Weak networks and lack of modern equipment | Gradual investment in digital transformation by first equipping a model library | Increased operational efficiency and easier scalability |
| Training Information Specialists | Lack of expertise in managing intelligent systems | Specialized training programs in collaboration with universities and research centers | Sustainable human capacity building |
| Privacy and Ethics | Concerns about leakage of users' data | Adoption of data protection policies according to ISO standards | Enhanced trust and transparency |
| Investment Costs | High cost of commercial systems | Adoption of open-source solutions such as KNIME and Lightdash | Reduced costs and greater flexibility |
| Local Integration | Weak compatibility of systems with the Arabic language and human resources | Selection of platforms that support Arabic and integrate with university systems | Easier use and broader adoption |
| Resistance to Change | Reservations among some administrators and employees | Awareness campaigns and workshops on the benefits of smart libraries | Increased institutional acceptance |

**Table:** Challenges of using artificial intelligence to build smart libraries and solutions to overcome them.

Conclusion

The future of libraries in the age of artificial intelligence is expected to witness a qualitative transformation that redefines their traditional functions and grants them new dimensions in knowledge management and organization. Technologies based on machine learning and natural language processing will enable libraries to develop intelligent search systems, provide personalized recommendations and knowledge services, and enhance their capabilities in big data analysis and digital content management.

This transformation will make the library an interactive space for innovation and knowledge production, extending beyond its traditional role as a repository of information to become a dynamic center supporting research, education, information literacy, and the promotion of digital reading culture. Nevertheless, the challenge remains significant, and one of the greatest responsibilities of library managers and information specialists is to achieve a balance between leveraging the capabilities of artificial intelligence and preserving the human and cultural dimensions of the library. This will ensure the continuity of its social, cultural, and developmental mission and reinforce its position as a key actor in building a knowledge society.

The study proposes the following recommendations for library development and the enhancement of transformation opportunities:

- Developing training and educational programs for information specialists in Algerian universities and making them more modern through the introduction of courses on artificial intelligence, data analysis, and data modeling, along with practical applications.
- Promoting continuous professional development and self-learning among information specialists and encouraging participation in Arab and international conferences and workshops to keep pace with developments in the profession.

- Activating libraries of various types according to the characteristics of their users; for example, establishing laboratories within libraries for experimenting with artificial intelligence applications, programming, and robotics. Partnerships may be established with specialized private schools, university departments of computer science and artificial intelligence, or workshops conducted by postgraduate students in the field.
- Developing a digital transformation plan for libraries and achieving smart libraries through the efforts of supervisory authorities and higher bodies, considering libraries as a central component of innovation and transformation strategies.

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### Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

### Ethical Approval

This study is based on a review and analysis of published literature, theoretical frameworks, and publicly available scholarly sources concerning artificial intelligence, knowledge organization, semantic web technologies, and digital transformation in libraries. No human participants, personal data, clinical materials, or experimental procedures were involved. Therefore, ethical approval was not required.

### Data Availability Statement

No primary datasets were generated or analyzed during the current study. All information used in this article is derived from published academic literature, official reports, and publicly accessible sources cited in the reference list. Additional information may be obtained from the corresponding author upon reasonable request.

### Author Contributions

**Benzekka Wissem:** Conceptualization, methodology, literature review, theoretical framework development, investigation, writing – original draft preparation, supervision.

**Torchane Hanane:** Literature review, data collection, analysis and interpretation, writing – review and editing, validation, visualization, and manuscript refinement.

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### Declaration of Originality

The authors declare that this manuscript is an original work, has not been published previously, and is not under consideration for publication elsewhere. All authors have read and approved the final version of the manuscript and agree to its submission for publication.

### Use of Artificial Intelligence

Artificial intelligence tools may have been used solely for limited language refinement, grammar checking, or translation assistance during manuscript preparation. The authors take full responsibility for the content of the manuscript, including the accuracy of the information presented, the interpretation of findings, and the conclusions drawn. Artificial intelligence tools did not contribute to the scientific analysis, conceptual development, or scholarly conclusions of this study.

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