



## POTENTIAL APPLICATIONS OF ARTIFICIAL INTELLIGENCE: BUILDING KNOWLEDGE BASES AND IMPROVING THE EFFICIENCY OF EDUCATIONAL PROCESS ORGANIZATION

### APLICACIONES POTENCIALES DE LA INTELIGENCIA ARTIFICIAL CONSTRUCCIÓN DE BASES DE CONOCIMIENTO Y MEJORA DE LA EFICACIA

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#### ABSTRACT

Efficient information services provided in a convenient form and at convenient time is a major trend, including in education. Global technological advancement, lower costs of computing power, and the ever-increasing amount of data that needs to be managed and processed necessitate a revision and refinement of methods and approaches for managing this data. Developments in artificial intelligence, machine learning, and natural language processing have made it possible to greatly simplify the methods and approaches to managing and generally interacting with data and to automate processes and routine tasks involved in processing textual data. The paper sheds light on the theoretical aspects and principles of creating university knowledge bases using AI. The study examines the key advantages of applying AI in creating knowledge bases for universities, which include speedier information search, improved content quality, clear and concise organization and user-friendly interface, search functions, and collaboration tools.

#### Keywords:

Knowledge base, artificial intelligence, machine learning, natural language processing, databases.

#### RESUMEN

La prestación de servicios de información eficientes de forma cómoda y en el momento oportuno es una tendencia importante, también en la educación. El avance tecnológico global, el abaratamiento de la potencia de cálculo y la cantidad cada vez mayor de datos que hay que gestionar y procesar hacen necesaria una revisión y un perfeccionamiento de los métodos y enfoques de gestión de estos datos. Los avances en inteligencia artificial, aprendizaje automático y procesamiento del lenguaje natural han permitido simplificar en gran medida los métodos y enfoques de gestión e interacción general con los datos y automatizar los procesos y tareas rutinarias que conlleva el tratamiento de datos textuales. El artículo arroja luz sobre los aspectos teóricos y los principios de la creación de bases de conocimiento universitarias mediante el uso de la IA. El estudio examina las principales



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ventajas de aplicar la IA en la creación de bases de conocimiento para universidades, entre las que se incluyen una búsqueda de información más rápida, una mejora de la calidad de los contenidos, una organización clara y concisa y una interfaz de fácil uso, funciones de búsqueda y herramientas de colaboración.

#### Palabras clave:

Base de conocimientos, inteligencia artificial, aprendizaje automático, procesamiento del lenguaje natural, bases de datos.

## INTRODUCTION

In the context of global technological development and the lowering costs of computing power, the issues of efficient search and management of the data available to educational institutions. This includes storing, structuring, and categorizing data, ensuring that the system can be searched quickly and provide relevant search results, and automating routine tasks that arise in the process of using the data. This requires a revision and improvement of methods and approaches for data retrieval and analysis and the automation and simplification of processes involved in handling textual data used in university education.

Having a knowledge base is vital for universities, because these bases allow for centralized storage and organization of important information and knowledge. This information can include instructional materials, university policies and procedures, information on educational services, etc. (Vasilev et al., 2020). With a well-organized knowledge base, students and faculty can easily access the information needed to perform their duties, which increases the efficiency of the educational process (Abdullayev et al., 2024).

A university knowledge base can assist in standardizing processes and procedures throughout the educational organization, ensuring the consistency and quality of the provided educational services (Akhmetshin et al., 2021). In the end, a knowledge base is a powerful tool for improving collaboration, communication, and knowledge sharing within the university, leading to improved learning outcomes (Shirinkina, 2023).

Artificial intelligence creates extensive opportunities for the creation of knowledge bases that allow searching large volumes of natural language data even if the user has incomplete knowledge of the object they are looking for.

As suggested by Hao et al. (2020), a knowledge base is, with some approximation, a database designed to manage data and information, i.e., to collect, store, structure, classify, search, and produce relevant results. With the advent and development of AI that deals with natural language processing (NLP), it became possible to combine

traditional approaches to data search and storage with cutting-edge methods to automate routine tasks and optimize work with textual data (Lin et al., 2020; Abdullaev et al., 2023).

AI solutions are the result of interdisciplinary research at the intersection of social sciences, computer science, mathematics, automation, and robotics (Raiman & Raiman, 2018; Yadav, 2023). Studies on AI are aimed at creating software that can solve non-standard problems that cannot be represented by a simple algorithm (Denning & Denning, 2020). In classical definitions, AI refers to programs that perform tasks that would require some intelligence if performed by humans (Pearlman, 2020).

Problems related to the use of AI in information management arise mainly in the field of bibliography and information science. Among the works on this problem, we can distinguish several main directions of study:

- presentation of knowledge in AI-based systems (Xu & Barbosa, 2019; Cohen et al., 2023);
- big data processing using AI (Ortona et al., 2018; Wang et al., 2018);
- creating knowledge bases using AI mechanisms (Forbus, 2023).

Therefore, an AI-powered knowledge base is a centralized system that stores, organizes, and manages data and information using AI algorithms and machine learning (ML). Because it is more dynamic than traditional knowledge bases, it can respond to queries faster, providing users with accurate and up-to-date information. As a result, AI-powered knowledge bases increase satisfaction by allowing users to find answers without human intervention or using chatbots or other AI assistants.

AI-based knowledge bases can be put into one of the three categories:

- Structured: this type of knowledge base works on information that can be organized and formatted, such as frequently asked questions, user manuals, articles, and troubleshooting guides. Because the knowledge base structures information hierarchically, when people search for information, it provides the most up-to-date information possible (Forbus, 2023);
- Unstructured: unlike structured, this type of knowledge base does not organize information into specific categories and fields, and the data has no defined structure;
- Automated: AI algorithms produce user-generated content and instant responses in real time using chatbots or other AI models. Nevertheless, the knowledge base continues to learn, meaning it updates and improves the

content based on data analysis and user interactions. The knowledge base identifies frequently asked questions and detects potential gaps in knowledge.

In a traditional knowledge base, content is organized and updated manually and needs to be structured by keywords and categories to retrieve relevant information. In contrast, an AI-based knowledge base automated knowledge management using two key components:

- NLP, which allows interpreting human language and understanding the context of queries, whether they are given as text or speech (Ortona et al., 2018);
- ML algorithms, which are used by AI-powered knowledge bases to make predictions, recognize patterns, and improve search results by learning from user input and interaction, thus improving decision-making.

The majority of modern AI applied in knowledge bases rely on neural networks, which learn to recognize patterns and connections between objects, exposing the network to databases containing a huge variety of examples that illustrate the desired objects (Nze, 2024). The development of AI solutions, especially those designed for human interaction, depends not only on technological solutions, but also on user attitudes and behavior.

The key goal of our study was to consider the opportunities and prospects of creating university knowledge bases with the use of AI.

MATERIALS AND METHODS

The study employs a complex methodological approach combining literature review to study the capabilities and prospects of AI-powered university knowledge bases with an expert survey.

Literature sources were searched in foreign databases via Google Scholar. In addition, web resources were searched using global search engines. The collected materials were subjected to qualitative analysis to identify the main directions of research on the use of AI in creating knowledge bases. The analysis of academic literature allowed us to compile a detailed description of the capabilities of AI-based university knowledge bases focusing on the categories and main components of these tools.

In accordance with the established research objectives, we sought to illustrate the benefits of AI in the process of creating university knowledge bases by means of an expert survey, which included 40 experts. The selection criterion for the expert pool was having at least three publications on the research problem in peer-reviewed journals. The experts were invited to participate in the survey via email. A total of 38 respondents agreed to take part in the survey. During email correspondence, they each provided a list of benefits resulting from the use of AI in creating university knowledge bases. Subsequent processing determined the ranks and weights of these benefits.

The experts were presented with a list of different AI-based knowledge base solutions that are most suitable for university settings and asked to rank them in order of importance and justify their decisions. Each of the methods used has contributed significantly to a comprehensive analysis of the problem, allowing us to understand different aspects of creating AI-powered university knowledge bases.

RESULTS AND DISCUSSION

Experts suggest that AI-based software designed to be used as a knowledge base has certain advantages over other solutions (Table 1).

Table 1. Advantages of applying AI in creating university knowledge bases.

Advantage	Description	Rank	Weight
Speedier information search	AI-based knowledge base software simplifies the retrieval of specific knowledge, improving the efficiency of work	1	0.29
Improved quality of content	AI can fill in gaps in knowledge, i.e., determine what the knowledge base is missing and offer to generate content, e.g. knowledge base articles, on a particular topic. Furthermore, AI can detect obsolete content, giving an opportunity to create new content based on user feedback so as to make the information accurate and up to date by combining automatic updates with regular reviews by experts. In addition, individual elements can be updated independently as needed (instead of updating and uploading the entire document)	2	0.24



Search functions	AI-based knowledge bases include a reliable search function that presents relevant results based on the user's query, making it easier to find the information they are looking for. AI understands what users are searching for and can promptly provide them with the most relevant article, monograph, etc.	3	0.19
Clear and concise organization and user-friendly interface	AI-based knowledge bases are easy to navigate and have intuitive categories and subcategories that make information search easier; AI-based knowledge bases are developed to satisfy the demands on the end user and have user-friendly interfaces	4	0.16
Collaboration tools	AI-based knowledge bases facilitate cooperation and knowledge exchange, including tools that allow users to contribute to the knowledge base, such as wikis, forums, and comment sections. These functions help to keep the information up to date and relevant while fostering a culture of collaboration and continuous learning	5	0.12

Based on the analysis of scientific literature and the expert survey,

Table 2 describes AI-powered knowledge base solutions that are most suitable for university settings.

Table 2. AI-powered knowledge base solutions.

AI-powered knowledge base	Characteristic	Rank	Weight
Slite	Provides a single source of reliable data with the «Ask» search function, has a flexible editor with many formatting options including videos, links, emoticons, attachments, and quotes	1	0.26
Tettra	Offers an organized repository of information for distributed knowledge with an intuitive interface; advanced search functions deliver results within seconds for every user query	2	0.22
Document360	An AI-based knowledge base that helps create knowledge bases, API documentation, user guides, wikis, etc.; intuitive user interface makes the process of creating and managing content easier; improves collaboration with a visually appealing and intuitive dashboard that provides a comprehensive view of the available information	3	0.19
Korra	An AI-powered search engine and discovery platform that uses NLP to deliver straight answers based on search results; a comprehensive SaaS solution with advanced search and automation features; searches files in any format using advanced NLP functions	4	0.14
Bloomfire	AI-based knowledge management software that is easy to customize; great search capabilities allow users to browse articles with specific keywords	5	0.11
Guru	Centralizes information using AI and optimizes file and data sharing, unifying existing workflows and systems through robust integrations with Slack, Google Drive, Box, and GitHub	6	0.08

Source: Prepared by authors

The expert survey suggests that AI-powered knowledge bases provide extensive opportunities to connect with users and provide online information services. Advanced AI-based interactive online services provided in real time, seem to fully meet user expectations, offering the widest range of features.

The core functionalities of AI-based knowledge base software should include:

- NLP capability, meaning that an AI-based knowledge base must interpret and understand user queries, extracting meaning from text and supporting complex linguistic tasks, such as sentiment analysis and semantic search;
- Advanced search capabilities — an efficient search engine that easily finds information according to user queries, including features such as contextual search, keyword matching, and relevance ranking;
- ML algorithms, which enable AI-based knowledge base software to identify patterns and generate recommendations to enhance the overall accuracy and relevance of the information provided;
- Collecting information on user experience and tracking interactions to improve the performance of the knowledge base and keep it up to date;
- Effective data structuring, so that data can be structured, labeled and categorized, preferably in a logical and hierarchical manner that facilitates information retrieval.

An analysis of virtual Q&A chatbots points out a wide range of advantages: ability to serve a large number of users, work in real time, automatic saving and control of queries, as well as profiling of services and preparation of reports. Additional advantages include: determining the search strategy together with the user and filling in forms in databases and search engines; co-browsing, i.e., monitoring what databases and websites are accessed by the user and browsing them with the user; displaying certain websites on the screen and sending other pages and files to the



user's browser; automation of certain actions by selecting scripts from drop-down lists; integrated knowledge bases and the ability to create custom databases (Nze, 2024).

The use of virtual advisors, consultants or assistants is an activity that is part of a new Internet trend called Web 3.0. In Web 3.0, the traditional knowledge base search engine window will be replaced by an avatar, a virtual agent powered by AI solutions that communicates with the user in natural language and is equipped with a speech synthesizer. The use of virtual avatars in providing the services of the university knowledge base is an attempt to solve problems related to the main global trends on the Internet: increasing the efficiency of user service, striving for humanization and personalization of contact, and intelligent automation of service processes. Without a doubt, this form of service automation is a great solution both for providing information services through the university knowledge base and for providing simple information (class schedules, etc.) that users cannot or do not want to look for on the university website.

Relying on the work of Wang et al. (2018), we can highlight functional capabilities of AI adapted to the needs of knowledge base users. When AI is integrated with a knowledge base and equipped with a semantic search system, the user can formulate a query in natural language to obtain information about educational materials, books on a given topic and their availability, clarify bibliographic data, and more. Moreover, the virtual assistant can recommend materials worth reading and provide a list of the most popular ones.

Experts emphasize the importance of choosing AI-based software for the university knowledge base. First, the chosen solution needs to offer something beyond a simple up-to-date AI-enabled search engine. The AI-powered knowledge base has to incorporate other technologies, such as ML and NLP. In this way, the software will be able to better respond to user queries, fill gaps in knowledge, and improve students' satisfaction. Furthermore, the system has to be able to manage knowledge and organize it hierarchically to simplify the process of obtaining information on the search query.

Second, the knowledge base needs to be integrated with existing tools and workflows. This integration not only improves overall efficiency but improves the flow of data by eliminating the need to constantly switch between different applications and allowing to get the necessary information in the application used at the moment. For example, Guru can be integrated with most of the tools available on the market and its search engine is integrated with such apps as Slack, Microsoft Teams, and Dropbox.

Third, due attention must be paid to security and confidentiality (Vasyukov & Khisamova, 2021). AI-based

knowledge bases commonly deal with confidential information. Therefore, it is only natural that they need to comply with security and privacy precautions to prevent unwanted cyberattacks and other incidents (Tebenкова, 2023). Best security practices may include data encryption, permissions, and access control.

Fourth, consideration must be given to usability. If an AI-based knowledge base system is too difficult to understand, it will inhibit search actions. Simply put, the instrument needs to have a user-friendly and intuitive interface that is easy to navigate.

Fifth, the software solution needs to be scalable. The chosen tool has to be able to process large volumes of data as the knowledge base is expanded and scaled up. Scalability means that the tool should adapt to changing needs, be it handling more complex data, serving a wider audience, or integrating with other tools, which should be accomplished without compromising performance or response time.

In conclusion, the literature review leads us to hypothesize that the future of AI in knowledge base management, albeit distant, lies in adapting strong AI solutions. The latter concept describes the direction of AI research aimed at creating systems that possess all the functions and capabilities of the human brain (Denning & Denning, 2020). AI solutions connected with these trends can support knowledge base management processes, powering more time-efficient, accurate, and advanced data processing. Thus, cutting-edge knowledge bases can simplify the analysis of large volumes of unstructured data from various sources.

## CONCLUSIONS

Due to global technological advances and increasing volumes of data, the efficient retrieval, analysis, and management of said data is becoming ever more important. In this context, universities can utilize knowledge bases to store, structure, quickly search, and share instructional materials, methodological guidelines, and student self-study materials.

The paper describes the advantages of applying AI in university knowledge bases, which include speedier information search, improved content quality, clear and concise organization and user-friendly interface, search functions, and collaboration tools.

To summarize, AI can become instrumental in synthesizing current scientific knowledge. It can simplify (speed up, improve or incorporate) the process of reviewing the content available in citation databases. The introduced opportunities for dialog enable a conversation and even a discussion with the knowledge base based on the direction taken by the inquirer. Thus, the level of available

knowledge on a topic can be evaluated considering some interesting (e.g., problematic) nuances.

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