



Knowledge management and artificial intelligence in higher education

Gestión del conocimiento e inteligencia artificial en la educación superior

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Abstract

Artificial Intelligence (AI) has a transformative potential in education, generating benefits and challenges. Considering the numerous debates due to the rapid advance of AI, this study is part of a master's research with the objective of identifying the state of the art of research on Artificial Intelligence in Education (AIED), organizing and categorizing information to support researchers, teachers and managers in decision-making through knowledge management. A scoping review was carried out with studies published between 2021 and 2025, following up on previous reviews. The articles selected from the Web of Science database are indexed in the Social Sciences Citation Index, which guarantees the quality of the works analyzed. After the selection process, 230 articles were included in the study from a total of more than 700 works in the area of education. The methodology adopted is qualitative and exploratory, using content analysis and descriptive statistics of some data from the articles. The results show significant progress in AIED research, including its implementation with its ethical use and impacts on higher education. There is a need for awareness and proper guidance of students, as well as regulation of the use of AI, ensuring data security and mitigation of algorithmic biases in the educational context.

Keywords: artificial intelligence, higher education, AIED, education, knowledge management, tools.

Resumen

La inteligencia artificial (IA) tiene un potencial transformador en la educación, generando beneficios y desafíos. Considerando los numerosos debates debido al rápido avance de la IA, este estudio forma parte de una investigación de maestría con el objetivo de identificar el estado del arte de las investigaciones sobre Inteligencia Artificial en la Educación (IAED), organizando y categorizando información para apoyar a investigadores, docentes y gestores en la toma de decisión a través de la gestión del conocimiento. Se realizó una revisión de alcance con estudios publicados entre 2021 y 2025, dando continuidad a revisiones previas. Los artículos seleccionados de la base *Web of Science*, son indexados en *el Social Sciences Citation Index*, lo que garantiza la calidad de los trabajos analizados. Tras el proceso de selección, se incluyeron 230 artículos a partir de un total de más de 700 trabajos en el área de la educación. La metodología adoptada es cualitativa y exploratoria, utilizando el análisis del contenido y estadísticas descriptivas de algunos datos de los artículos. Los resultados muestran un avance significativo en las investigaciones sobre Inteligencia Artificial en la Educación (IAED), incluyendo su implementación con su uso ético y sus impactos en la educación superior. Es necesaria tanto la concienciación y la orientación adecuada de los estudiantes, así como la regulación del uso de la IA, garantizando así la seguridad de los datos y la mitigación de sesgos algorítmicos en el contexto educativo.

Palabras clave: inteligencia artificial, educación superior, IAED, educación, gestión del conocimiento, herramientas.

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1. Introduction

The digital age has driven intense and accelerated technological advances, often associated with the Fourth Industrial Revolution, also called Industry 4.0. This phenomenon has given rise to the emergence of a new model of social organization, characterized by interconnectivity and intelligent automation, known as the digital society (Dobrinskaya, 2020; Fonseca, 2018; Lasi et al., 2014).

Technological revolutions occur when multiple disruptive innovations emerge simultaneously, causing structural changes in society. These periods of transformation affect various aspects, such as the environment, available resources, interpersonal relationships, health, and culture (Gabriel, 2022). In the current scenario, one of the main drivers of these changes is artificial intelligence (AI).

AI can be defined as the development of advanced systems capable of autonomously processing and analyzing large volumes of data (Vyas, 2019). In addition, it is often described as the ability of machines to simulate the functioning of the human brain, performing intellectual tasks typical of humans, such as decision-making and continuous learning (Vyas, 2019).

The development of AI-related projects began in the period after World War II, driven by the publication of Alan Turing's article "Computing Machinery and Intelligence" (1950). In this seminal work, Turing introduced the famous Turing Test and presented a debate on objections to the idea that machines could think, refuting various criticisms with logical and experimental arguments.

Russell and Norvig (2022) point out that, over time, researchers have adopted different approaches to understanding AI. While some associate it with the ability to mimic human performance, others interpret it more abstractly, linking it to the concept of rationality, i.e., the ability to make correct decisions. In this context, Gabriel (2022) draws an analogy between AI and the human brain, suggesting that the more advanced a system's processing capacity, the more agile and efficient its reasoning will be.

In the development of AI, two main theoretical approaches stand out: symbolism and connectionism (Hoffmann, 1998). The symbolic approach is based on mathematical logic and the abstract formulation of the cognitive processes that lead to

intelligent behavior. Connectionism, on the other hand, is based on the physiology of the human brain, assuming that intelligence arises from the organization and functioning of neural networks, reflecting how the biological brain processes information (Gabriel, 2022).

AI systems are often described as autonomous agents, capable of operating independently, learning from new information, identifying patterns, and making decisions based on the evaluation of different contexts (Sousa et al., 2019). These agents use large volumes of data and advanced algorithms to continuously improve their performance, becoming essential tools in various areas of knowledge.

According to Kaugman (2022), AI is present in our daily lives in countless ways. Applications such as Waze help plan routes, while search engines such as Google facilitate access to information. Streaming platforms such as Netflix and Spotify use algorithms to recommend personalized content, and Amazon analyzes user habits to suggest products based on their interactions. In addition, virtual assistants such as Siri and Alexa enable voice commands, making information retrieval more convenient and accessible. In recent decades, education has been profoundly impacted by the incorporation of technology, transforming teaching methodologies and redefining student learning processes (Hughes and Hughes, 2005; Akour and Alenezi, 2022). To increase student engagement and motivation, various digital solutions and educational applications are continually being developed (Karaođlan Yılmaz, 2022). Furthermore, Pence (2019) highlights that AI will have a significant impact in three main areas: (1) administration in higher education; (2) digital learning management systems (LMSs) and teaching and learning methods; and (3) the conduct and management of academic research.

Dennis (2018) highlights that AI has been applied to optimize various activities in the educational context, from student recruitment and enrollment to tracking academic progress. The technology helps formulate student recruitment strategies, manage enrollment processes, monitor course progress, and implement actions to improve retention and completion rates. In addition, AI plays a key role in strengthening relationships with alumni. Khare et al. (2018) highlight that its application can cover all phases of the academic experience, from the admis-

sion process to graduation and the continuation of the relationship with the institution after graduation.

Advances in AI are driven by techniques such as machine learning (ML), which allows computer programs to learn from experience without the need for explicit programming (Bishop, 2006). These systems analyze data, identify patterns, and make predictions to perform tasks autonomously. Within this field, deep learning (DL) stands out, using neural networks organized in multiple layers to process information in a more sophisticated way. This approach is widely applied in areas such as image recognition, machine translation, and speech synthesis (Russell and Norvig, 2022).

Chatbots, which combine ML and DL techniques to process natural language, have great potential in the educational context. Also known as conversational agents, these systems simulate human interactions, facilitating communication between users and automated platforms. In education, their use enables more personalized and interactive learning experiences for students (Clark and Mayer, 2016).

Natural language processing (NLP) tools, such as ChatGPT, have demonstrated a positive impact on personalized learning and increased user engagement. These platforms can process large volumes of data, adapt to interactions, and offer dynamic support to students, improving their educational experience (Rudolph and Tan., 2019; Rezaev and Tregubova, 2023). Barcaui and Monat (2023) highlight that tools such as chatbots use generative artificial intelligence (GAI) techniques, an emerging branch of AI focused on process creation and optimization. This technology enables machines to perform tasks traditionally associated with human intelligence, expanding its impact to various sectors (Jose et al., 2024).

In the literature, the most analyzed AI tools in learning are those that directly assist students. Intelligent tutoring systems (ITS), for example, offer personalized instruction, while advanced technologies analyze students' emotional and physical states, integrating virtual and augmented reality. Also noteworthy are automatic writing evaluation (AWE) tools, such as Grammarly and Turnitin's Revision Assistant, which provide feedback on text style and structure. Likewise, conversational agents (chatbots) and adaptive pedagogical agents, represented by virtual characters in online environments, are used to offer support and guidance (Cox, 2021).

AI in higher education offers benefits such as personalized learning, challenging academic environments, administrative automation, and enhanced research quality (Ivanov, 2023). However, advances in generative AI, such as ChatGPT, raise questions about academic authorship, requiring institutions to innovate in their assessment practices (Choi et al., 2023). There are also ethical challenges, such as algorithmic bias, privacy risks, and over-surveillance, as algorithms with inadequate data can reproduce discrimination (Ferrer et al., 2021; Mikalef et al., 2022). Mass data collection raises concerns about storage and access, requiring mitigation mechanisms (Ivanov, 2023). The rapid evolution of conversational AI has fueled debate about its role in personalized learning, instructional design, and academic integrity (Jensenb et al., 2024). Despite these advances, there is still a discrepancy between the capabilities of AI and the pedagogical demands of higher education, highlighting the need for further research on the topic (Barreto and Abarca, 2025).

Barreto and Abarca (2025) reported mixed results regarding the impact of ChatGPT on the SECI model, highlighting its effectiveness in certain stages of learning, but also its limitations. In the socialization phase, an increase in student involvement and participation was observed, indicating that AI can contribute to idea generation and collaborative discussions (Barreto and Abarca, 2025). However, Saude et al. (2024) acknowledge the benefits of ChatGPT for academic performance and feedback, but emphasize the importance of pedagogical support to foster the development of critical and ethical skills. While tools such as ChatGPT facilitate educational activities, studies (Damaÿsevičius, 2024) point to limitations in contextual understanding and personalization, which reduce their impact at advanced levels of learning. Prolonged use can lead to dependency, affecting critical thinking and creativity (Bonsu et al., 2023; Castro et al., 2024; Lelepary et al., 2024), indicating difficulties in promoting deep thinking and knowledge internalization. Akpan et al. (2025) analyze educational transformation through GAI, without delving into the quality of knowledge acquisition.

AI is part of various tools and techniques designed to capture, encode, and share knowledge, many of which originated in fields other than knowledge management (Dalkir, 2017). KM is based on three fundamental pillars: People, Processes, and Technology.

The People pillar refers to culture, values, and behaviors; the Processes pillar refers to the infrastructure that supports the KM cycle; and the Technology pillar refers to the connection between people and knowledge sharing (Neves et al., 2018).

KM technological tools play an essential role in capturing, organizing, and disseminating knowledge within institutions and can be classified according to their participation in the phases of the knowledge cycle (Dalkir, 2017; Ruggles, 1997). The knowledge cycle comprises: capture/creation, sharing/transmission, and acquisition/application (Dalkir, 2017). They are divided into two categories: one that facilitates the generation, codification, and transfer of knowledge, creating new knowledge (such as data mining), and another that organizes and structures knowledge, making it accessible to other users (Ruggles, 1997).

In education, KM applies tools and techniques to create, organize, and disseminate knowledge, with a focus on knowledge acquisition, which promotes the joint construction of knowledge through interaction between teachers and students (Forno et al., 2023). AI tools enhance this process, promoting socialization and collaborative learning, thus optimizing teaching through personalization and supporting decision-making by analyzing large volumes of data and identifying relevant patterns (Dalkir, 2017).

AI in higher education not only facilitates the storage and retrieval of information, but also promotes the continuous improvement of knowledge, making KM more strategic within institutions. Therefore, this study seeks to identify, organize, and map, through information management, the landscape of AIED research in higher education, highlighting recurring themes, tools used, and the most active centers and journals. This allows administrators, researchers, and teachers to continue relevant studies and make more informed decisions.

Based on the ideas of Wiig (1993), who argues that knowledge drives the ability to act intelligently and that KM makes institutions smarter by facilitating the creation, accumulation, and use of quality knowledge. Organizing knowledge about AIED allows for deeper discussions and helps higher education institutions effectively apply the best available knowledge, addressing important and relevant issues for society.

2. Methodology

This scoping review is part of a master's thesis and is intended to serve as a comparative basis, continuation, and adaptation of the study “*Towards a Tripartite Research Agenda: A Scoping Review of Artificial Intelligence in Education Research*,” published in the book *Artificial Intelligence in Education: Emerging Technologies, Models, and Applications* by Cheng et al. (2022). This qualitative, exploratory, and descriptive approach seeks to identify and categorize relevant research. The review seeks to update the landscape of AIED research, organizing and storing the results in an accessible format to facilitate information retrieval, knowledge sharing, and decision-making support for researchers and university administrators.

According to Wiig (1993), KM seeks to make organizations smarter through the creation and effective application of quality knowledge. From this perspective, the review allows for an analysis of recent advances in this field, in contrast to the scenario presented by Cheng et al. (2022). By structuring and systematizing the information, the study contributes to KM in AI applied to education, supporting more informed and strategic decision-making by researchers and managers.

This scoping review adopts the same methodology as Cheng et al. (2022), with the main difference being the time frame—focusing on the period after 2021—and the exclusive emphasis on higher education, in line with the objectives of this master's research. According to Arksey and O'Malley (2005), a scoping review is a form of literature review that allows for a quick and comprehensive mapping of the main topics and studies on a given subject. It is useful for identifying gaps in the literature and guiding future systematic reviews (Munn et al., 2018). The steps include: defining the research question, selecting and analyzing studies, mapping the data, and synthesizing the results.

The research followed the methodological steps proposed by Arksey and O'Malley (2005). The guiding question defined by Cheng et al. (2022) was: “What are the key topics of research in AIED over the last two decades?” To identify relevant studies, the search was conducted in the *Web of Science database*, considering only articles indexed in the *Social Science Citation Index (SSCI)*, which guarantees high-quality research. The selection criteria included only peer-re-

viewed articles published in English between July 2021 and 2025. The survey was conducted in January 2025.

The search strings were formulated based on the reference study, as shown in Table 1.

Table 1. *Terms and combinations used in the research*

Topic	Search terms
Artificial intelligence	artificial intelligence” OR “machine intelligence” OR “intelligent support” OR “intelligent virtual reality” OR “chatbot” OR “machine learning” OR “automated tutor” OR “personal tutor” OR “intelligent agent” OR “expert system” OR “neural network” OR “natural language processing
Education	higher education” OR college* OR undergrad* OR graduate OR postgrad* OR “K-12” OR kindergarten* OR “corporate training*” OR “professional training*” OR “primary school*” OR “middle school*” OR “high school*” OR “elementary school*” OR “vocational education” OR “adult education

Note. Cheng et al., 2022, p. 7.

For the search, the same strings presented in Table 1 were used on the Web of Science platform, except for terms related to education that did not fit the context of higher education. Additionally, to facilitate the selection of articles, the text strings had to be present in the title, abstract, plus keywords, and author keywords fields. The search yielded 738 articles. For the selection, an initial screening (filter) was performed based on titles and abstracts, considering the relevance to the topic of AI in Education and the presence of debates on the subject. Articles focused exclusively on the technical development of AI were excluded from the analysis. After this stage, 230 articles were selected for further analysis and inclusion in the results. Data mapping was performed in Microsoft Excel, which was used to organize and analyze the information collected. Following the approach of Cheng et al. (2022), the data were categorized into general information about the articles, the AI technologies used, and the ways in which AI tools were applied. For the collection, summary, and presentation of the results, descriptive statistics were used to synthesize the data in a clear and objective manner.

3. Results and discussions

3.1 Journals and distribution of publications

Of the 227 articles reviewed on AIED, 72 different journals were identified as publication outlets, as shown in Table 2. The interdisciplinary open-access journal "Sustainability" stood out as the most frequent, with 29 publications. These data indicate significant growth in scientific production on AIED, as well as an increase in the diversity of journals addressing the topic, compared to the 20 journals identified in the study by Cheng et al. (2022).

This increase suggests a growing academic interest in the intersection between AI and Higher Education, reflecting the expansion of research and scientific dissemination in the field. The growth may be explained by the significant technological advances AI has undergone in recent years, as well as by the increasing incorporation of technology into education over the past decades, which has substantially reshaped teaching methodologies and redefined students' learning processes (Hughes & Hughes, 2005; Akour & Alenezi, 2022).

Table 2. *Distribution of journals*

N.O	N0	Revistas	NO
Frontiers in Psychology	29	English for Specific Purposes (ESP)	1
Australasian Journal of Educational Technology	22	Ethics and Information Technology	1
Humanities & Social Sciences Communications	21	ETR&D-Educational Technology Research and Development	1
Amfiteatru Economic	19	Frontiers In Public Health	1
Journal of Environmental and Public Health	15	Health Education Journal	1
Behavioral Sciences	10	Healthcare	1

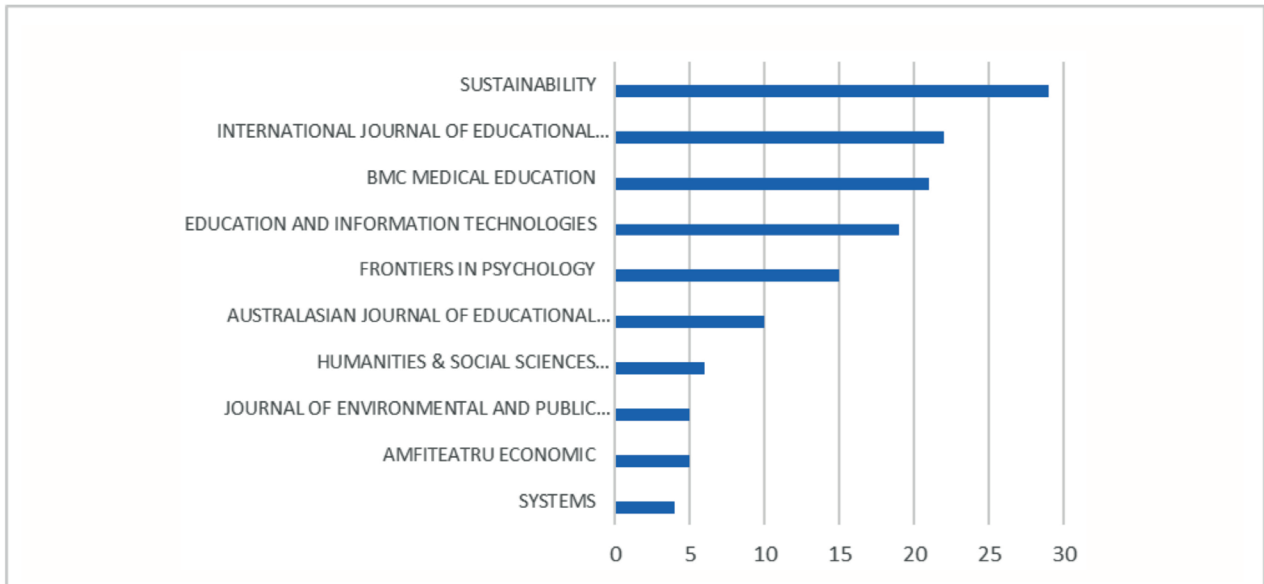
N.O	NO	Revistas	NO
BMC Psychology	6	Higher Education	1
British Journal of Educational Technology	5	IEEE Access	1
Innovations in Education and Teaching International	5	Information Technology and Libraries	1
Studies in Higher Education	4	Interactive Learning Environments	1
Systems	4	International Journal of Computer-Supported Collaborative Learning	1
Assessment & Evaluation in Higher Education	4	International Journal of Entrepreneurial Behavior and Research	1
Higher Education Research & Development	4	International Journal of Human-Computer Interaction	1
Journal of Computing in Higher Education	4	International Journal of Management Education	1
Sage Open	4	Internet and Higher Education	1
Digital Health	3	Jama Network Open	1
European Journal of Education	3	Journal of Computer Assisted Learning	1
International Journal of Environmental Research and Public Health	3	Journal of Healthcare Engineering	1
International Journal of Stem Education	3	Journal of Innovation and Knowledge	1
Journal of Science Education and Technology	2	Journal of Psycholinguistic Research	1
Wireless Communications and Mobile Computing	2	Journal of the American Medical Informatics Association	1
Acta Psychologica	2	Learning and Instruction	1
Applied Sciences-Basel	2	LIBRI: International Journal of Libraries and Information Studies	1
Behavior & Information Technology	2	Mobile Information Systems	1
BMC Nursing	2	Physical Review Physics Education Research	1
Cognitive Research-Principles and Implications	1	Information Professional	1
Computer Systems Science and Engineering	1	Reading Research Quarterly	1
Computers and Education	1	Recall	1
Computers in Human Behavior	1	Research In Social and Administrative Pharmacy	1
Convergence—The International Journal of Research into New Media Technologies	1	RIED-Ibero-American Journal of Distance Education	1
Distance Education	1	Science and Education	1
Economic Computation and Economic Cybernetics Studies and Research	1	Scientific Programming	1
Computers In Human Behavior	1	System	1
Convergence-The International Journal of Research into New Media Technologies	1	Teachers College Record	1
Distance Education	1	Teaching Of Psychology	1
Economic Computation and Economic Cybernetics Studies and Research	1	ZDM-Mathematics Education	1

Note. The authors.

Continuing with the analysis of the journals presented above, Figure 1 highlights the ten journals that have published the most studies on AIED. Sustainability tops the list with 29 publications, followed by the International Journal of Educational Technology in Higher Education (22) and BMC

Medical Education (21). These data indicate a growing dissemination of research on AIED in journals from various fields, such as educational technology, psychology, and social sciences, demonstrating the interdisciplinary nature of the topic.

Figure 1. *Top 10 journals*

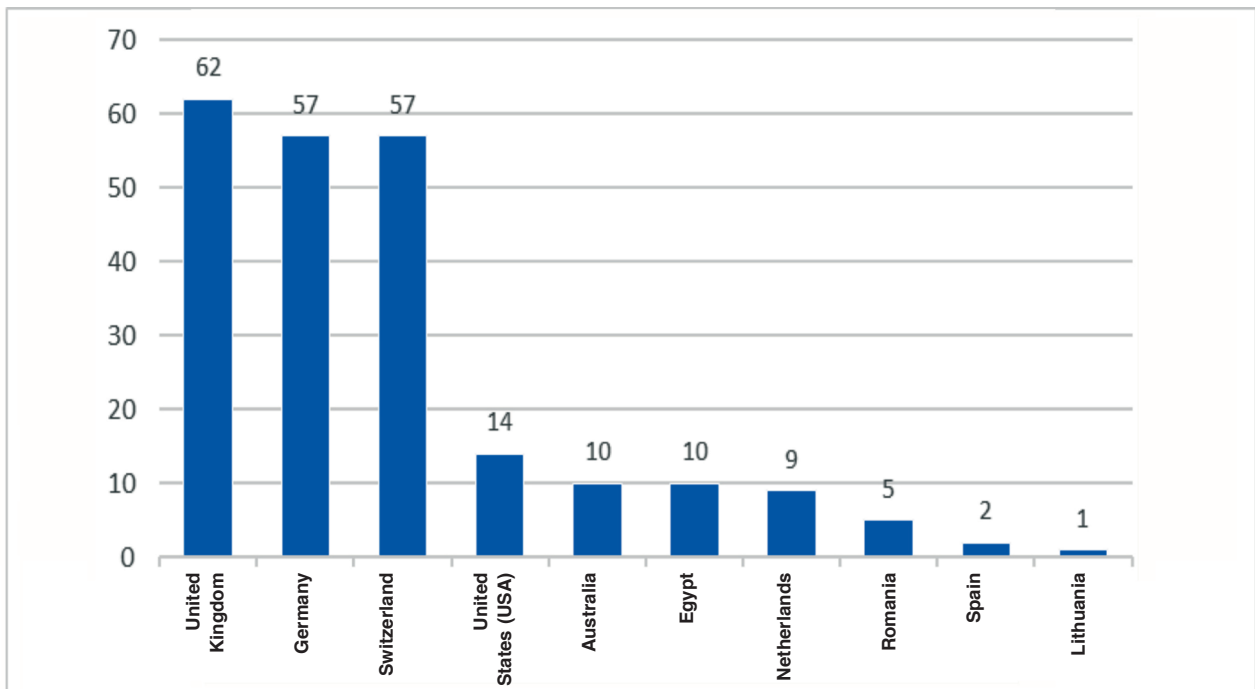


Note. The authors.

In addition to the analysis of journals, Figure 2 shows the geographical distribution of publications, indicating the countries of origin of the journals that published most of the research on AIED. Germany, the United Kingdom, and Switzerland stand out,

together accounting for more than 50% of indexed publications. These data suggest that these countries play a central role in the production and dissemination of knowledge on AI applied to higher education.

Figure 2. *Countries with the most publications per journal*

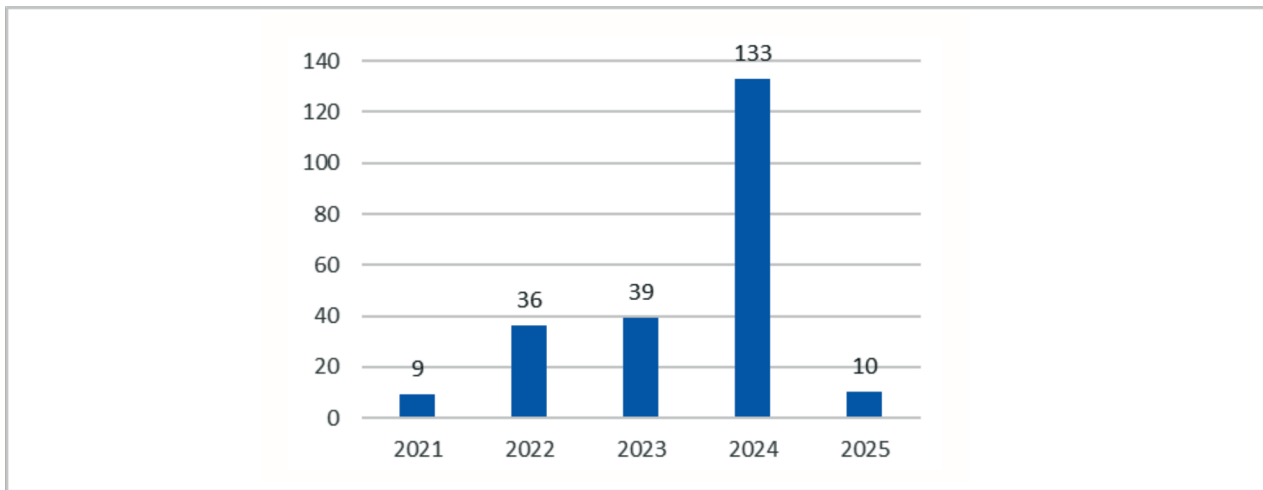


Note. The authors.

In terms of the temporal evolution of publications, the analysis covers articles published between July 2021 and January 2025. However, only 2022, 2023, and 2024 were considered complete for comparison purposes. Figure 3 reveals that the year 2024 stands out significantly, accounting for more than half of the publications analyzed (133 articles).

This significant growth may indicate increasing academic interest in the topic, driven by recent technological advances in society and by the expanding application of AI in higher education (Gabriel, 2022; Pense, 2019; Hughes & Hughes, 2005; Akour & Alenezi, 2022).

Figure 3. *Publications by year*

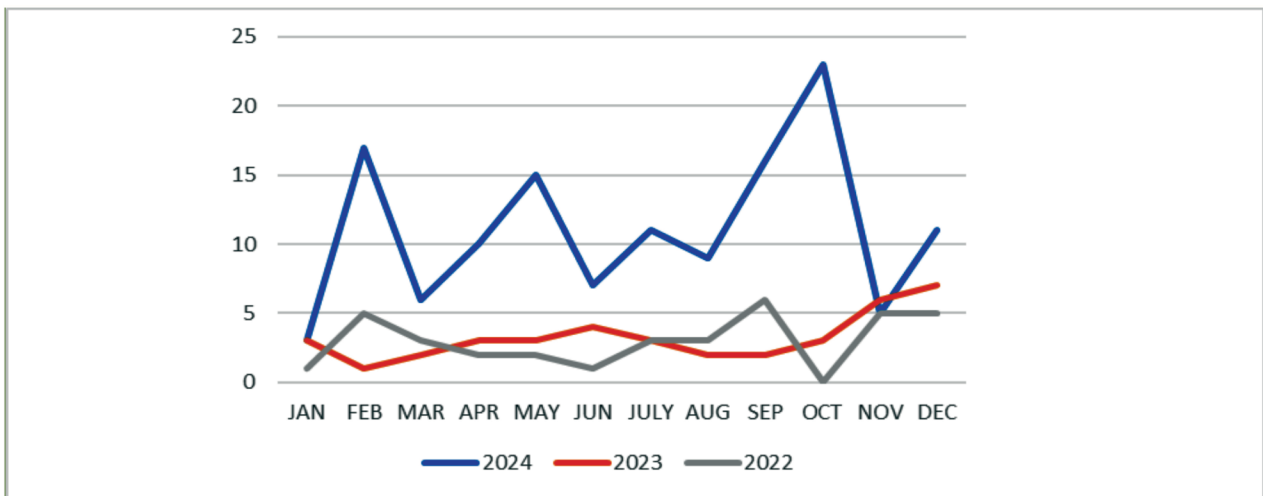


Note. The authors.

The year 2025 also shows potential for a high volume of publications, given that, although the analysis was conducted in January, ten articles have already been identified. This figure exceeds the total number of publications recorded in 2021, suggesting continued growth in AIED research. Considering the

years analyzed in their entirety, Figure 4 presents the distribution of publications by month. Note that 2024 stands out significantly, with a high volume of publications, especially in October, which recorded 23 articles, the highest monthly figure in the series analyzed.

Graph 4. *Proportion of publications over the years*



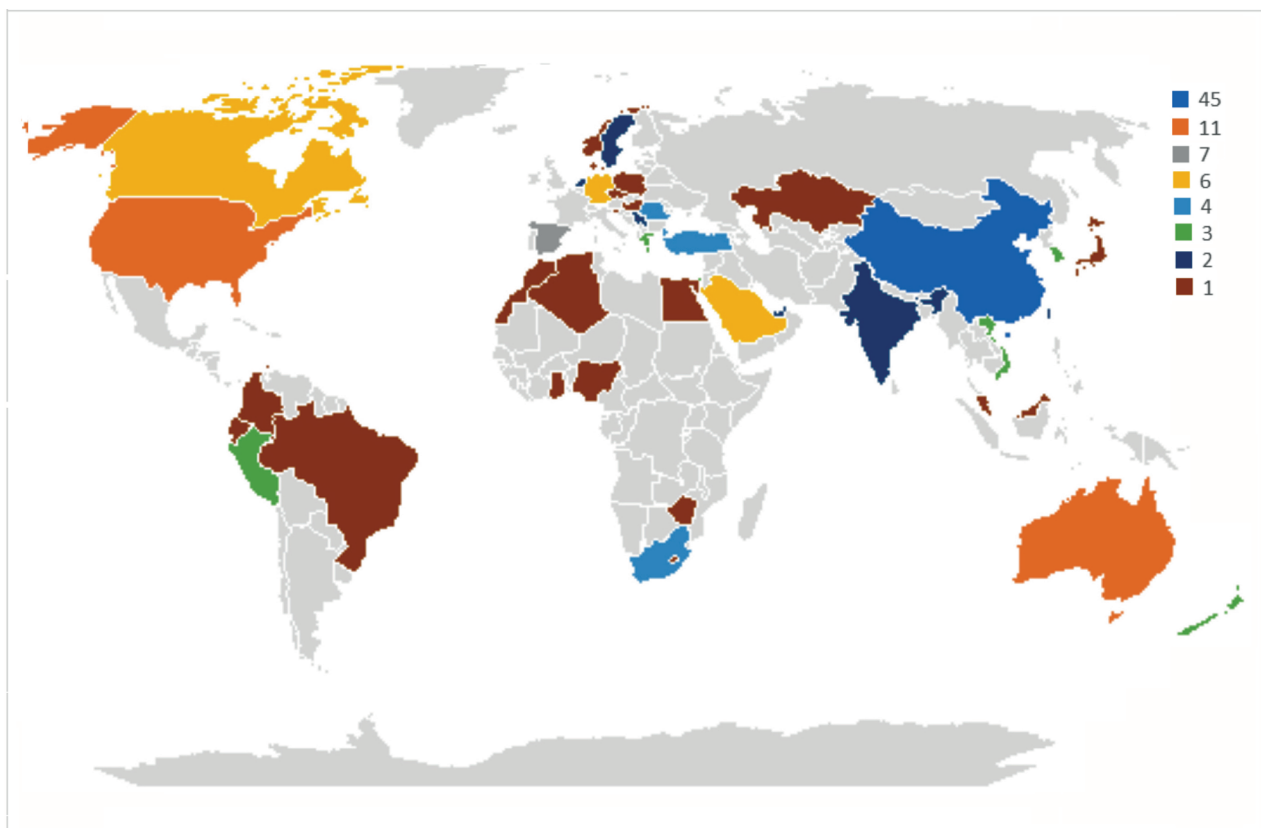
Note. The authors.

Looking at Figure 4, it is not possible to identify a clear trend in periods of higher or lower publication volume, as the variation appears to occur randomly between years. This behavior could be related to factors such as deadlines for submitting articles to journals, academic events, and research funding cycles in the field.

3.2 Distribution by study

The geographical distribution considered the location of each study when the affiliation of the authors was unclear. Figure 5 shows that China leads as the main research center in this area. However, when compared to Figure 2, it is evident that, despite the volume of studies, most Chinese publications appear in international journals, not national ones.

Figure 5. *Geographic distribution of studies*



Note. The authors.

Figure 6, compared with Table 3, clearly shows that although China is a country with solid research in the field of AIED, research conducted in more

than one geographical region leads the ranking, with 66 publications within the research period.

Figure 6. Percentage of studies

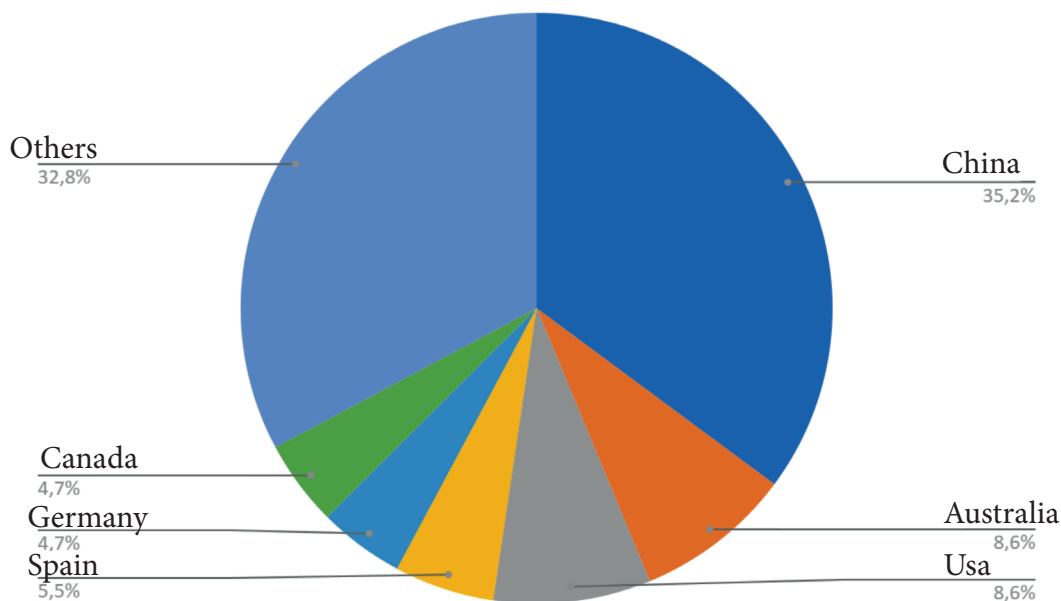


Table 3 also shows an expansion in the number of countries researching AIED, in line with the results of increased interest in the topic.

Table 3. List of studies by region

Country	n°	Country	n.º
Multicenter	66	Taiwan	2
China	45	Algeria	1
Australia	11	Brazil	1
USA	11	Kazakhstan	1
Spain	7	Colombia	1
Germany	6	Denmark	1
Saudi Arabia	6	Egypt	1
Canada	6	Ecuador	1
South Africa	4	Slovenia	1
Romania	4	Fiji	1
Turkey	4	Ghana	1
South Korea	3	Hungary	1
Greece	3	Japan	1
Hong Kong	3	Lesotho	1
Israel	3	Malaysia	1
New Zealand	3	Morocco	1
Peru	3	Nigeria	1
Vietnam	3	Norway	1
United Arab Emirates	2	Netherlands	1
Netherlands	2	Palestine	1

Country	n°	Country	n.º
India	2	Poland	1
Serbia	2	Czech Republic	1
Singapore	2	Zimbabwe	1
Sweden	2		

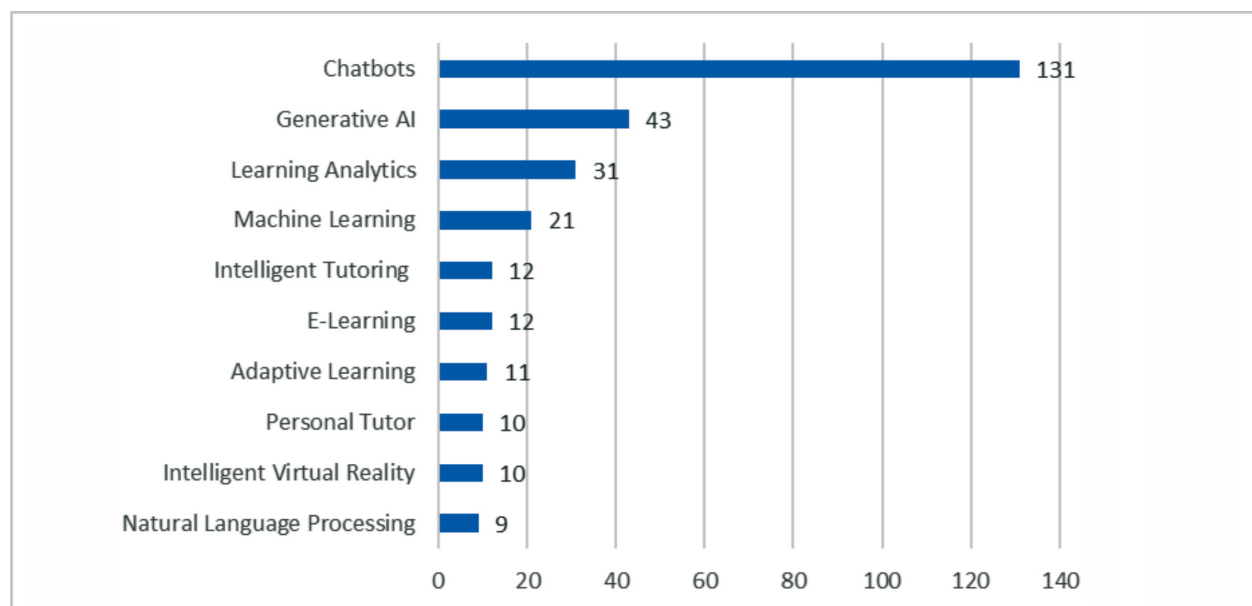
Note. The authors.

Table 3 summarizes 47 countries that have conducted at least one study on the subject, slightly higher than the 35 presented by Cheng et al. (2022). China significantly increased its output due to its extensive participation in multicenter studies conducted across various countries or regions. Australia published one study less than in the previous study; however, considering the period analyzed, its publications are relatively higher. Germany, Saudi Arabia, Sweden, and Vietnam also expanded their research activity, demonstrating growing interest and geographic diversification in scientific production related to the topic.

3.3 Analysis of tools

As a final result, the most cited tools in the articles studied were analyzed. Figure 7 clearly shows that chatbot tools occupy a prominent place in AIED research, being cited in 57.7% (131 articles out of 227) of the articles reviewed. Of the 131 articles describing chatbots, 60 referred to Chat GPT. These results explain the increase in studies since Chat GPT was made public in 2022.

Figure 7. Tools used



Note. The authors.

After analyzing the tools and their context, it was observed that most of their applications focus on content generation, learning analysis, and personalized or classification tutoring. In addition, Figure 7 clearly shows that generative AI, e-learning, and tutoring tools are also relevant to this topic. Since 2023, academic interest in AI has grown significant-

ly, leading to an increased number of publications on generative AI.

AI has various applications in education, notably in mental health (with ML-based tools for identification and treatment), medicine and nursing (with intelligent tutoring and diagnosis), and language teaching. These results corroborate those of Cheng

et al. (2022). However, many articles do not specify specific areas, focusing on ethics and other aspects of AI in education. There is also confusion in the definitions of chatbots, ChatGPT, generative AI, NLP processing, and machine learning.

4. Discussions

4.1 Journals and distribution of publications

The significant growth in scientific production on AIED and the expansion of the diversity of journals addressing the topic suggest greater academic interest in the intersection between AI and higher education, reflecting the expansion of research and scientific dissemination in this field. This increase is explained by the significant technological advances that AI has undergone in recent years and by the fact that, in recent decades, the incorporation of technology has significantly impacted education, reformulating teaching methodologies and redefining student learning processes (Hughes and Hughes, 2005; Akour and Alenezi, 2022). The results presented in Graph 03 reveal the high density of publications for the year 2024. This significant growth may indicate an increase in academic interest in the subject, driven by recent technological advances in society and the expansion of AI applications in higher education (Gabriel, 2022; Pense, 2019; Hughes and Hughes, 2005; Akour and Alenezi, 2022).

4.2 Distribution by study

The results in Table 3 and Figure 6 highlight the growing importance of AIED and the need for continued research and development in this field. Given technological advances, it is essential to make multiple efforts to ensure the quality of education. The rapid evolution of conversational AI has sparked debate about its influence on personalized learning, instructional design, and academic integrity, highlighting the mismatch between its capabilities and the demands of higher education, which reinforces the need for further study on the topic (Jensenb et al., 2024; Barreto and Abarca, 2025).

4.3 Analysis of tools

Figure 7 demonstrates the significant focus on chatbots, particularly ChatGPT. These results reflect concerns about the positive or negative impacts of these tools on education, especially learning. In addition to influencing the educational process, chatbots such as ChatGPT raise questions about academic authorship, requiring new forms of assessment and presenting ethical challenges such as algorithmic bias, data privacy, and surveillance (Ferrer et al., 2021; Mikalef et al., 2022; Choi et al., 2023; Ivanov, 2023). Ethical and pedagogical issues are evident in most of the studies analyzed.

Studies such as those by Barreto and Abarca (2025) indicate that the impact of ChatGPT on the SECI model varies, being effective in early stages of learning, such as socialization, by promoting participation and collaborative discussions. However, Saúde et al. (2024) emphasize the need for pedagogical support for the development of critical and ethical skills, in addition to recognizing the positive impact of the feedback provided by the tool. Research such as that by Damaševičius (2024) points to limitations in personalization and contextual understanding, which reduces its impact in advanced stages of learning. Furthermore, over-reliance on ChatGPT can compromise students' critical thinking and creativity (Bonsu et al., 2023; Castro et al., 2024; Leleparry et al., 2023). These criteria are so relevant that they are considered parameters that influence whether or not these students intend to use the tool (Pereira-González et al., 2025). Technologies such as ChatGPT, Google Gemini, and Microsoft Copilot exemplify this area, using deep learning to generate synthetic content such as text, graphics, videos, and audio from training data (Humble et al., 2024).

Chatbots and adaptive pedagogical agents also stand out in this scenario, being widely used to offer support and guidance to students in online environments. Represented by virtual characters, these agents can personalize interactions with students, thus contributing to the learning process (Cox, 2021). These results reinforce the growing integration of AI in education and the challenges related to its impact on the personalization of teaching, the quality of learning, and the adaptation of institutions to this new reality. After identifying the confusion in the definitions surrounding chatbots (Chat GPT, Generative AI,

PLN, and machine learning), the relationship between chatbots (such as ChatGPT), machine learning, deep learning, IAG, and PLN can be understood from the hierarchy and interconnection of these technologies.

AI is the broad field of computer science that develops systems capable of simulating human capabilities, such as learning, reasoning, and decision-making (Vyas, 2019). ML is a subset of AI that allows algorithms to learn data patterns and make decisions without the need for explicit programming (Bishop, 2006). Deep learning is an approach within machine learning that uses deep neural networks to process information in a more complex and sophisticated way, and is used in image recognition, machine translation, and speech synthesis (Russell and Norvig, 2022).

GAI is an emerging branch of AM focused on creating new content, such as text, images, videos, and audio, using advanced models such as deep neural networks to generate synthetic artifacts (Jose et al., 2024). NLP is a field within AI that enables machines to understand, interpret, and generate human language (Rudolph et al., 2019; Rezaev and Tregubova, 2023). Therefore, chatbots, such as ChatGPT, are NLP applications that use AM, AP, and GenAI techniques to interact with users in a conversational manner. These tools analyze and generate natural language to provide coherent and context-appropriate responses and are widely used in personalized learning and educational support.

5. Conclusion

This study contributed to organizing and mapping the state of research on AIED in higher education, offering a structured overview of the most discussed topics, the most widely used tools, research centers, and the most relevant journals in the field. In this way, it identified trends and challenges, providing support to institutions, administrators, researchers, and faculty to deepen their studies and make more informed decisions.

The analysis showed that AI has been widely explored as a complementary resource for pedagogical practices, but still faces conceptual and practical challenges to its full integration as a pedagogical tool. The need for greater clarity in the distinction between technologies and approaches is highlighted, as terms such as ChatGPT, chatbots, IAG, PLN, and AM have been used interchangeably. Additionally,

there is concern about its impact on the quality of learning, especially in the development of skills such as critical thinking and decision-making.

The research has limitations, such as its restriction to higher education, which prevents information from being obtained on other educational levels. The rapid evolution of the field may also affect the updating of the study, requiring continuous monitoring. The choice of keywords may have influenced the scope of the analysis. Future research should cover basic and vocational education, explore the personalization of teaching, reduce inequalities, and address challenges such as privacy and algorithmic bias. In addition, research on hybrid models that integrate AI and traditional approaches can contribute to a more efficient and responsible use of technology in education.

Authors' contributions

Ariane Simarco Scarci: data curation, formal analysis, research, methodology, visualization, writing – original draft.

Marcelo Henrique Fonseca: data curation, methodology, resources, visualization, writing – original draft, software.

Dr. Thaise Moser Teixeira: conceptualization, supervision, validation, writing – review and editing

Dr. Leticia Fleig Dal Forno: project management, writing – review and editing

References

- Akour, M. and Alenezi, M. (2022). Higher education future in the era of digital transformation. *Education Sciences*, 12(11), 784. <https://doi.org/10.3390/educsci12110784>
- Akpan, I. J., Kobara, Y. M., Owolabi, J., Akpan, A. A. & Offodile, O. F. (2025). Conversational and generative artificial intelligence and human-chatbot interaction in education and research. *International Transactions in Operational Research*, 32(3), 1251-1281. <https://doi.org/10.1111/itor.13522>
- Arksey, H. & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International journal of social research methodology*, 8(1), 19-32. <https://doi.org/10.1080/1364557032000119616>
- Barcaui, A. & Monat, A. (2023). Who is better in project planning? Generative artificial intelligence or

- project managers? *Project Leadership and Society*, 4, 100101.
<https://doi.org/10.1016/j.plas.2023.100101>
- Barreto, U. & Abarca, Y. (2025). Integration of the SECI model and ChatGPT in higher education. *Heliyon*.
<https://doi.org/10.1016/j.heliyon.2025.e42814>
- Bonsu, E. and Baffour-Koduah, D. (March 07, 2023). From the consumers' side: determining students' perception and intention to use ChatGPT in Ghanaian Higher Education
<http://dx.doi.org/10.2139/ssrn.4387107>
- Cox, A. M. (2021). Exploring the impact of Artificial Intelligence and robots on higher education through literature-based design fictions. *Int J Educ Technol High Educ.*, 18(3).
<https://doi.org/10.1186/s41239-020-00237-8>
- Cheng, E. C., Koul, R. B., Wang, T. and Yu, X. (eds.). (2022). *Artificial Intelligence in Education: Emerging Technologies, Models and Applications: Proceedings of 2021 2nd International Conference on Artificial Intelligence in Education Technology* (Vol. 104). Springer Nature.
<http://dx.doi.org/10.1007/978-981-16-7527-0>
- Choi, E. P. H., Lee, J. J., Ho, M. H., Kwok, J. and Lok, K. and W. (2023). Chatting or cheating? The impacts of ChatGPT and other artificial intelligence language models on nurse education. *Nurse Education Today*, 125, 105796-105796.
<https://doi.org/10.1016/j.nedt.2023.105796>
- Dalkir, K. (2017). *Knowledge management in theory and practice*. Routledge. <https://bit.ly/3Xqowhq>
- Damaševičius, R. (2024), Commentary: ChatGPT-supported student assessment – can we rely on it? *Journal of Research in Innovative Teaching e Learning*, 17(2), 414-416.
<https://doi.org/10.1108/JRIT-09-2024-195>
- Dennis, M. J. (2018). Artificial intelligence and higher education. *Enrollment Management Report*, 22(8), 1-3. <https://doi.org/10.1002/emt.30470>
- Dobrinskaya, D. E. (2020). Digital society: Sociological perspective. *Moscow State University Bulletin. Series 18. Sociology and Political Science*, 25(4), 175-192.
<https://doi.org/10.24290/1029-3736-2019-25-4-175-192>
- Jensen, L. X., Buhl, A., Sharma, A. and Bearman, M. (2024). Generative AI and higher education: a review of claims from the first months of ChatGPT. *Higher Education*, 1-17.
<https://doi.org/10.1007/s10734-024-01265-3>
- Pereira-González, L. M., Basantes-Andrade, A., Mora-Grijalva, M. and Galárraga-Andrade A. (2025). Dimensiones latentes en la adopción de ChatGPT en la universidad: modelo CHASSIS. *Alteridad*, 20(2), 190-202.
<https://doi.org/10.17163/alt.v20n2.2025.03>
- Ferrer, X., van Nuenen, T., Such, J. M., Cote, M. and Criado, N. (2021). Bias and discrimination in AI: A cross-disciplinary perspective. *IEEE Technology and Society Magazine*, 40(2), 72-80.
<https://doi.org/10.1109/MTS.2021.3056293>
- Fonseca, L. M. (2018, March). Industry 4.0 and the digital society: concepts, dimensions and envisioned benefits. En *Proceedings of the international conference on business excellence*, 12(1), 386-397. Sciendo.
<https://doi.org/10.2478/picbe-2018-0034>
- Forno, L. F. D., Teixeira, T. M., Natal, I. da P., Medina, T. S. and de Souza, D. Z. L. (2023). Processo de aprendizagem e sala de aula: a aquisição do conhecimento. *Caderno Pedagógico*, 20(7), 2903-2921.
<https://doi.org/10.54033/cadpedv20n7-025>
- Gabriel, M. (2022). *Inteligência Artificial: Do Zero a Superpoderes*. Grupo GEN. <https://bit.ly/3F2c40Z>
- Garcia Castro, R. A., Mayta Cachicatari, N. A., Bartesaghi Aste, W. M. and Llapa Medina, M. P. (2024). Exploration of ChatGPT in basic education: Advantages, disadvantages, and its impact on school tasks. *Contemporary Educational Technology*, 16(3), ep511.
<https://doi.org/10.30935/cedtech/14615>
- Hoffmann, A. G. (1998). *Paradigms of Artificial Intelligence: a methodological and computational analysis*. Springer Science e Business Media.
<https://bit.ly/41ibZO6>
- Hughes, J. (2005). The role of teacher knowledge and learning experiences in forming technology-integrated pedagogy. *Journal of technology and teacher education*, 13(2), 277-302.
<https://www.learntechlib.org/p/26105>
- Humble, N. (2024). Risk management strategy for generative AI in computing education: how to handle the strengths, weaknesses, opportunities, and threats?. *Int J Educ Technol High Educ.*, 21, 61.
<https://doi.org/10.1186/s41239-024-00494-x>
- Ivanov, S. (2023). The dark side of artificial intelligence in higher education. *The Service Industries Journal*, 43(15-16), 1055-1082.
<https://doi.org/10.1080/02642069.2023.2258799>
- Jose, E. M. K., Prasanna, A., Kushwaha, B. P. and Das, M. (2024). Can generative AI motivate management students? The role of perceived value and information literacy. *The International Journal of Management Education*, 22(3), 101082.
<http://dx.doi.org/10.1016/j.ijme.2024.101082>

- Khare, K., Stewart, B. and Khare, A. (2018). *Artificial intelligence and the student experience: An institutional perspective*. The International Academic Forum (IAFOR). <https://doi.org/10.22492/ije.6.3.04>
- Karaođlan Yılmaz, F. G. (2022). An investigation into the role of course satisfaction on students' engagement and motivation in a mobile-assisted learning management system flipped classroom. *Technology, Pedagogy and Education*, 31(1), 15-34. <http://dx.doi.org/10.1080/1475939X.2021.1940257>
- Kaufman, D. (2022). *Desmistificando a inteligência artificial*. Grupo Autêntica. <https://bit.ly/4boBKAW>
- Lasi, H., Fettke, P., Kemper, H. G., Feld, T. and Hoffmann, M. (2014). Industry 4.0. *Business e information systems engineering*, 6, 239-242. <https://doi.org/10.1007/s12599-014-0334-4>
- Lelepary, H. L., Rachmawati, R., Zani, B. N. and Maharjan, K. (2023). ChatGPT: Opportunities and challenges in the learning process of Arabic language in higher education. *Journal International of Lingua and Technology*, 2(1), 11-23. <https://doi.org/10.55849/jiltech.v2i1.439>
- Mikalef, P., Conboy, K., Lundström, J. E. and Popovič, A. (2022). Thinking responsibly about responsible AI and 'the dark side' of AI. *European Journal of Information Systems*, 31(3), 257-268. <https://doi.org/10.1080/0960085X.2022.2026621>
- Munn, Z., Peters, M. D., Stern, C., Tufanaru, C., McArthur, A. and Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC medical research methodology*, 18, 1-7. <https://doi.org/10.1186/s12874-018-0611-x>
- Neves, M. L. C., Jean Varvakis, G. and Fialho, F. A. P. (2018). People, Processes and Technology in Knowledge Management: A Literature Review/ Pessoas, Processos e Tecnologia na Gestão do Conhecimento: Uma Revisão da Literatura. *Revista de Ciências da Administração*, 20(51), 152-168. <https://doi.org/10.5007/2175-8077.2018v20n51p152>
- Pence, H. E. (2019). Artificial intelligence in higher education: New wine in old wineskins? *Journal of Educational Technology Systems*, 48(1), 5-13. <http://dx.doi.org/10.1177/0047239519865577>
- Rezaev, A. V. and Tregubova, N. D. (2023). ChatGPT and AI in the universities: an introduction to the near future. *Vysshee obrazovanie v Rossii= Higher Education in Russia*, 32(6), 19-37. <https://doi.org/10.31992/0869-3617-2023-32-6-19-37>
- Rudolph, J., Tan, S. and Tan, S. (2023). War of the chatbots: Bard, Bing Chat, ChatGPT, Ernie and beyond. The new AI gold rush and its impact on higher education. *Journal of Applied Learning and Teaching*, 6(1), 364-389. <https://doi.org/10.37074/jalt.2023.6.1.23>
- Ruggles, R. (1997). *Knowledge tools: using technology to manage knowledge better*. Working Paper. Ernst & Young Center for Business Innovation. <https://doi.org/10.4324/9780080509846>
- Russell, S. J. and Norvig, P. (2022). *Inteligência Artificial: Uma Abordagem Moderna* (4th ed.). Grupo GEN. <https://bit.ly/4inukjF>
- Saúde, S. Barros, J. P. and Almeida, I. (2024). Impactos da inteligência artificial generativa no ensino superior: tendências de investigação e percepções dos estudantes. *Soc Sci.*, 13. <https://doi.org/10.3390/socsci13080410>
- Vyas S. (2019) 'Application of artificial intelligence in public health: A systematic review'. *Journal of Advanced Scientific Research*, 10(4 Suppl 2), 224-227. <http://dx.doi.org/10.1093/bjsw/bcab168>
- Wiig, K. M. (1993). *Knowledge management foundations: thinking about thinking-how people and organizations represent, create, and use knowledge*. Schema Press, Limited. <https://bit.ly/4h57rAy>