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PAPER

Artificial Intelligence Tools Applied to Education: A Systematic Literature Review

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ABSTRACT

Today, the world is in a process of continuous change, and the digital era has positively influenced education by revolutionizing the traditional approach through the adoption of artificial intelligence (AI) tools. The aim of this paper is to analyze how AI is transforming teaching and learning processes. To this end, a systematic literature review was conducted, selecting 33 articles that addressed the research topic from various perspectives. To summarize the information, the PRISMA methodology was used, which involved an exhaustive search in academic databases, the application of inclusion and exclusion criteria to select relevant studies, and a detailed analysis of the chosen articles, developed between 2019 and 2024, which contained relevant characteristics for the study. In parallel, specific research questions were established to guide the review, addressing pedagogical, practical, ethical, and social aspects related to the integration of AI in education. The results highlighted the potential benefits of AI in learning personalization, teaching efficiency, and access to advanced educational resources. In addition, challenges in AI implementation were identified, such as the generation of incorrect information and biases in training data. It is concluded that AI can improve personalization of learning, teaching efficiency, and access to advanced resources, but it is crucial to address ethical challenges such as data privacy, equity in access to technology, transparency of algorithms, and impact on students' autonomy and critical thinking.

KEYWORDS

education, teaching, tools, artificial intelligence (AI), technology

1 INTRODUCTION

Today, the world is undergoing constant change, and the digital age has had a positive impact on education by transforming the traditionalist approach through the implementation of artificial intelligence (AI) tools [1] where its goal is to make machines think like a human being would [2]. Al-Raimi [3] noted that the rapid advance of technology has had a significant influence on people's lifestyles, bringing about notable changes in the field of teaching and learning. The influence of AI has

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contributed to the emergence of new instructional methodologies, the creation of techniques to personalize experiences, and above all, the consolidation of pedagogical strategies that focus on the professional and integral development of students [4].

Khalid [5] mentions that AI is defined as a system that seeks to simulate the processes executed by humans. Since its first appearance in 1955, the term AI has undergone a remarkable evolution [6]. Initially conceived as a system to improve human performance, its development has progressed towards the use of big data as a means to address tasks of greater complexity [7], [8]. However, it is important to understand that AI tools are not intended to replace the role of teachers. Rather, it is a strategic combination that prioritizes automation along with human guidance to ensure educational quality [9].

In the current educational landscape, adaptive learning is positioned as one of the most innovative trends, driving a revolution in the way we teach and learn [10], [11]. The rapid advancement of AI has generated great interest in its application in various fields, and education is no exception. Research on the impact of AI tools in education highlights their potential to improve learning experiences and outcomes [12], [13], [14], [15]. These tools, such as cognitive tutors and language learning platforms, have been found to improve learning outcomes and provide personalized learning pathways [14]. However, their integration also presents challenges, such as the need for appropriate training, ethical guidelines, and a balance between AI capabilities and human-centered pedagogy [12], [15]. Despite these challenges, AI tools have been shown to have a positive impact on the learning experience, especially in higher education, by equipping graduates with new skills and transforming teaching methods [13].

Learning analytics and virtual tutors are emerging as key tools to enhance teaching and learning [10]. The potential of AI to improve educational pedagogy and advance progressive teaching practices is a key area of interest [16]. AI can improve the learning environment by personalizing content and tutoring, in addition to providing expert systems and online learning. However, the challenges of integrating AI into educational institutions, including student support and administration, need to be addressed [17]. AI can also personalize learning based on student characteristics with systems such as intelligent tutoring systems and exploratory learning environments [18]. While previous literature has explored the impact of AI in education, this study is distinguished by its methodological approach and timeliness. Unlike previous reviews that focused primarily on quantitative approaches, we adopt a rigorous qualitative methodology to analyze in depth the characteristics, benefits, and challenges of AI tools in higher education. Thus, a unique perspective on the most recent trends in this rapidly evolving field is offered, filling a crucial gap in the existing literature.

In addition, the integration of augmented reality (AR) and virtual reality (VR) along with automated assessment is enriching the educational experience, while AI tools are facilitating inclusion and accessibility in education [19]. This perspective should be limited to how AI should be taught, but not taught with AI [20]. Given the vast panorama of research focused on understanding the mechanisms of operation of artificial intelligence, this study focuses on analyzing AI tools used in education, adopting a qualitative approach to understand their characteristics, benefits, and limitations [21]. For this purpose, a systematic review of the scientific literature was carried out, searching for information in reliable sources such as Scopus, Taylor & Francis, and Springer, among others. The objective of the study is to analyze the various AI tools applied to education and, based on the results obtained, to contribute the updated knowledge in this branch of knowledge, as well as to serve as a base

document to point out possible areas of future research to enrich the experience of interaction between the user and the digital era.

2 METHODOLOGY

2.1 Search strategy

Systematic reviews represent an important tool in the field of research, as they allow the meticulous collection of information from documentary sources relevant to a specific domain. This methodology directs the trajectory of the research, allowing the exploration of questions that otherwise could not be fully addressed, i.e., the answer to these questions contributes significantly to support the resolution of a particular study. Similarly, it is important to understand that scientific research does not operate in a vacuum; therefore, the literature review acts as a mechanism upon which knowledge is built, evaluating and developing explanatory theories that determine the occurrence of a specific phenomenon within the readers' field of interest.

To ensure the suitability of the systematic review for readers, it is important to develop a document in which information relevant to the field of research is captured based on the transparency and quality of the underlying studies. Therefore, to consider these characteristics, the PRISMA methodology is developed in this study with the objective of determining the incidence of different artificial intelligence tools in the educational field. The initial phase of the PRISMA statement consists of the formulation of research questions, which are focused on answering the problem posed, i.e., they help to focus the search for evidence, establishing the parameters and criteria for inclusion or exclusion.

Subsequently, search methods are established using Boolean operators and key terms that correlate with the research questions. The selected documents are also subjected to an exhaustive analysis according to the previously defined research criteria, thus ensuring the quality of the study and consistency in the response to the questions posed. Finally, a consolidated synthesis of each of the selected documents is presented, prioritizing the presentation of the most relevant information of each study.

2.2 Research questions

Table 1 schematically presents the research questions, meticulously formulated to maintain close thematic coherence and a direct connection with the object of study. The questions are aligned with the research objective, synthesizing the most important findings and providing a solid conceptual framework for the analysis and discussion of the results, ensuring their relevance in the academic and scientific field. The study considered the analysis of three dimensions: 1) The pedagogical dimension focused on describing how AI tools have the capacity to impact teaching and learning processes. 2) The practical dimension focuses on understanding the perception of AI tools by the actors of the educational system, such as teachers and students. In this dimension, the advantages and limitations of AI in the educational environment are analyzed. 3) Finally, the ethical and social dimension regarding the implications that exist in the use of AI tools in education, which includes challenges related to student data privacy and equity in access to education.

Table 1. Research questions

N.	Question	Motivation
RQ1	What are the main AI tools used in education?	Identify the most relevant AI tools in the teaching process.
RQ2	How are these AI tools applied in the teaching-learning process?	Understand the practical applications and methods of integrating AI tools in educational settings.
RQ3	What are the advantages and challenges in implementing AI in education?	Identify the advantages and disadvantages of using AI tools in education.
RQ4	What are the main ethical challenges related to the use of AI tools in education?	Recognize the ethical implications arising from the integration of AI tools in education.

2.3 Systematization of the search and data collection

The search for documentary information was conducted covering publications issued between 2019 and 2024 in databases and platforms oriented to knowledge and research, such as Scopus, Springer, Google Scholar, Taylor & Francis, Sage Publishing, among others. The selection of these bibliographic managers allowed access to a wide range of studies related to the branch of the study, including systematic studies, meta-analyses, trials, case studies, etc.

Table 2 details the exclusion and inclusion criteria proposed for the purpose of filtering the documents collected from the various databases. The purpose of implementing these criteria is to be able to select studies that meet the study objective, ensuring that only those that provide valid and reliable information to answer the study questions posed are included. To study the pedagogical dimension through question RQ1, key terms such as [“artificial intelligence” AND “learning retention”], [“AI” AND “traditional teaching”] were used. For the practical dimension focused through question RQ2 [“advantages” AND “artificial intelligence” AND “education”] OR [“challenges” AND “artificial intelligence” AND “education”]. Finally, for the third ethical and social dimension through question RQ3 [“ethical challenges” OR “ethical issues” AND “artificial intelligence”], [“ethical dilemmas” AND “education” OR “artificial intelligence”].

Table 2. Inclusion and exclusion criteria

N.	Inclusion	Exclusion
C1	Articles whose research focus is centered on AI tools applied to education.	To improve the quality of data synthesis, documents containing redundant or highly similar information are excluded, thus avoiding unnecessary repetition.
C2	Publications produced between 2019 and 2024.	Articles whose focus is not related to the research topic.
C3	Studies published entirely in Spanish or translated into English.	Documents with low information substantiation on the subject.
C4	Research presenting empirical information or data analysis focused on AI tools in education.	Documents whose area of study differs from the subject of study.

2.4 Selection of information

During the systematic review, careful criteria have been defined and applied to code and select relevant studies. These criteria range from initial identification, through assessment and eligibility determination, to the final inclusion of studies. For a more detailed explanation (see Figure 1).

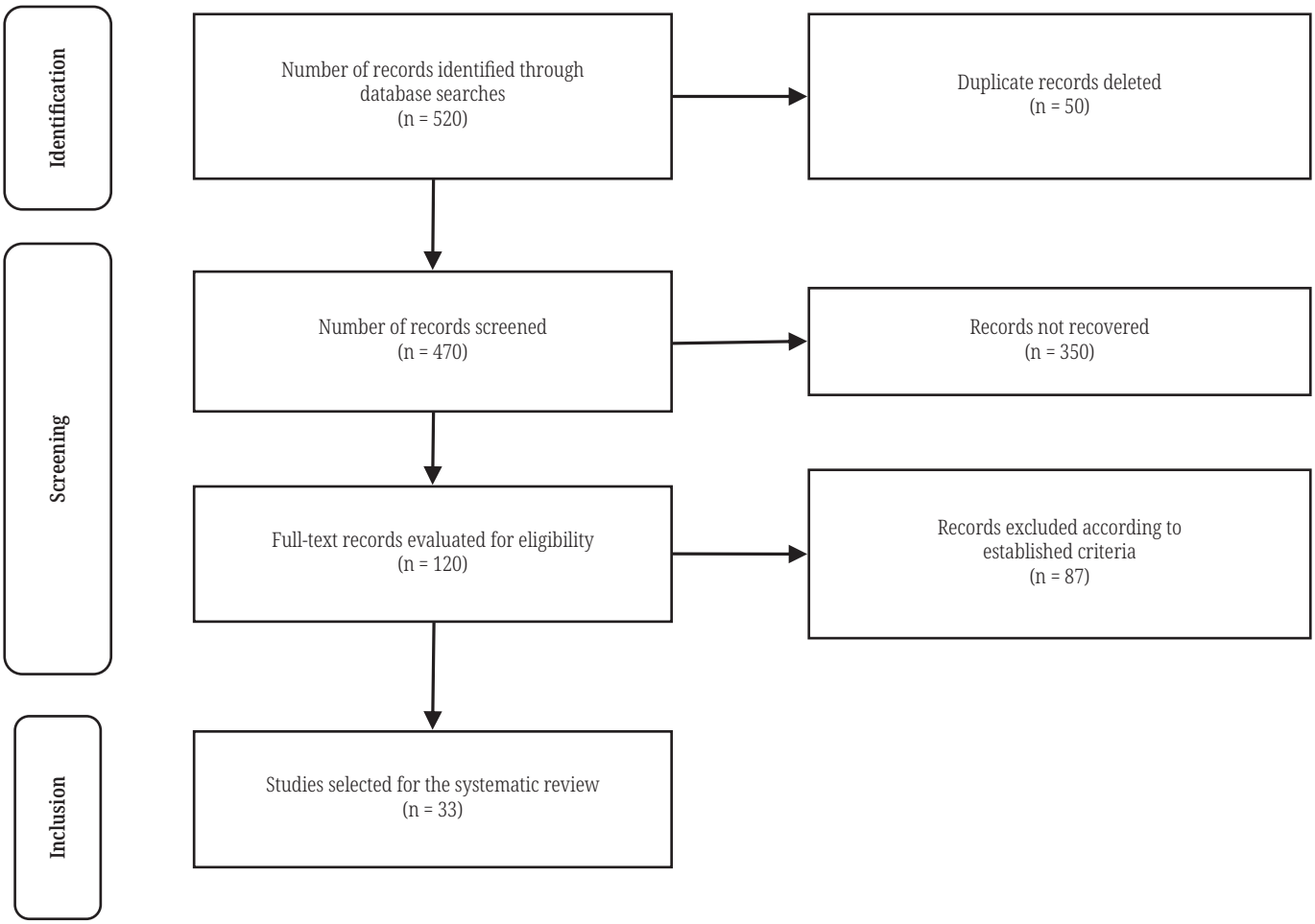

Fig. 1. PRISMA flow diagram

2.5 Data extraction

Table 3 shows the 33 articles selected from the literature search. The information extracted from each paper was based on answering the research questions. Various aspects of information, such as case studies and systematic reviews that met the inclusion and exclusion criteria were considered. The recapitulated summary of the papers is presented in Table 3.

Table 3. Selected articles

No.	Title	Author(es)	Objective/Caso
1	Education in the Era of Generative Artificial Intelligence (AI): Understanding the Potential Benefits of ChatGPT in Promoting Teaching and Learning **Year:** 2023 **Journal:** *Journal of AI*	D. Baidoo and L. Owusu	The aim of this article is to analyze the impact of ChatGPT in education, highlighting its potential benefits, such as personalization of learning and continuous feedback, as well as its limitations, such as misinformation generation and biases in training data.
2	AI tools applicable to Education **Year:** 2023 **Journal:** *Technology Rain Journal*	C. Baltazar	The objective of this article is to analyze the impact of AI in education, highlighting specific tools such as ChatGPT, Intelligent Tutoring Systems (ITS) and miMente AI, and how their strategic integration can enhance the educational experience and prepare students for the technological future.
3	To use or not to use ChatGPT and assistive artificial intelligence tools in higher education institutions? The modern-day conundrum – students' and faculty's perspectives **Year:** 2023 **Journal:** *Equity in Education & Society*	C. Bissessar	The objective of this study was to explore student and teacher perspectives on the benefits and challenges of using AI tools, such as ChatGPT, to complete academic assignments.
4	La Inteligencia Artificial en el contexto de la formación educativa **Year:** 2023 **Journal:** *EPISTEME KOINONIA*	C. Carbonell, S. Burgos, D. Calderón de los Ríos, and O. Paredes	The objective of this article is to describe the significant contributions that AI has generated in educational training, in a context of change towards innovative and productive teaching methods.
5	Case study: exploring the role of current and potential usage of generative artificial intelligence tools in higher education **Year:** 2023 **Journal:** *Issues in Information Systems*	V. Chergarova, V. Tomeo, L. Provost, G. De la Peña, A. Ulloa, and D. Miranda	The objective of this study essay is to examine the impact of AI on the education of international students, exploring its applications and associated concerns to enhance their academic experience.
6	ChatGPT y comunicación científica: hacia un uso de la Inteligencia Artificial que sea tan útil como responsable **Year:** 2023 **Journal:** *Hipertext.Net*	C. Lopezosa	The objective of this paper is to present considerations for the useful and responsible use of AI in scientific communication, highlighting the potential impact of OpenAI's ChatGPT.
7	The use of ChatGPT as a learning tool to improve foreign language writing in a multilingual and multicultural classroom **Year:** 2023 **Jornal:** *Advances in Mobile Learning Educational Research*	S. Athanassopoulos, P. Manoli, M. Gouvi, K. Lavidas, and V. Komis,	The study aimed to examine the effectiveness of ChatGPT as a feedback tool on foreign language writing, especially for socially vulnerable populations, such as refugees/migrants, who face extra language difficulties.
8	Enhancing PDF interaction for a more engaging user experience in library: Introducing ChatPDF **Year:** 2023 **Revista:** *IP Indian Journal of Library Science and Information Technology*	S. Panda	The objective of the paper is to present ChatPDF as a solution to improve the limited interaction of traditional PDF readers in library systems, highlighting its benefits for user satisfaction and pointing out areas of implementation and opportunities for future research.
9	Empowering Education with Generative Artificial Intelligence Tools: Approach with an Instructional Design Matrix. **Year:** 2023 **Journal:** *Sustainability (Switzerland)*	L. Ruiz, P. Acosta, J. De Moreta, and M. Gonzalez	The objective of the study was to evaluate how generative artificial intelligence (Gen-AI) tools, in combination with the 4PADAFE instructional design matrix, can improve education and the teaching-learning process at ESPE Armed Forces University.
10	Research on the application of Artificial Intelligence tools in higher vocational education. **Year:** 2023 **Journal:** *Applied and Computational Engineering*	Y. Xu	The objective of this study is to analyze how AI tools can improve the quality of teaching, assist teachers, and enhance the learning experience of students in higher vocational education.

(Continued)

Table 3. Selected articles *(Continued)*

No.	Title	Author(es)	Objective/Caso
11	The adoption of artificial intelligence applications in education. **Year:** 2023 **Journal:** *International Journal of Data and Network Science*	K. Alhumaid, S. Al Naqbi, D. Elsori, and M. Al Mansoori	The objective of this study is to investigate the perception of users in the UAE on the use of AI in education, using data collected from a survey of 387 university students.
12	The Advantages and Disadvantages of Using Artificial Intelligence in Education **Year:** 2023 **Revista:** *Journal of Educational and Social Research*	K. Al-Tkhayneh, E. Alghazo, and D. Tahat	The aim of this study was to identify the advantages and disadvantages of using AI in education from the perspective of students at Al Ain University.
13	Artificial intelligence and education Challenges and disadvantages for the teacher **Year:** 2019 **Journal:** *ARCTIC Journal*	H. Barrios, V. Diaz, and Y. Guerra	The objective of the study was to identify teachers' perceptions of the application of robotics and AI in education through analytical empirical research.
14	Advantages and Challenges of Using Artificial Intelligence in Primary and Secondary School Education **Year:** 2023 **Journal:** *Journal of Education, Humanities and Social Sciences*	H. Guan	The objective of this study is to analyze the advantages and challenges of the application of AI in primary and secondary education through a comprehensive literature review and survey data.
15	An E-commerce Personalized Recommendation Algorithm based on Fuzzy Clustering **Year:** 2022 **Journal:** *International Journal of Economics and Statistics*	Y. Hou and S. Yang	The objective of this study is to improve the quality of recommendations in recommender systems by using the fuzzy clustering algorithm, addressing problems such as lack of diversity and degradation of recommendation quality.
16	Implementing Artificial Intelligence in Higher Education: Pros and Cons from the Perspectives of Academics **Year:** 2023 **Journal:** *Societies*	A. Pisica, T. Edu, R. Zaharia, and R. Zaharia	This article investigates the perspectives of Romanian academics on the implementation of AI in Higher Education. It analyzes its advantages and disadvantages in the teaching-learning process and administrative management.
17	Integrating artificial intelligence into education **Year:** 2023 **Journal:** *International Journal of Advanced Academic Studies*	S. Sharma and D. Sharma	This article examines the current application of AI in education, exploring its advantages and disadvantages, and proposing an approach for the development of AI-enabled educational platforms.
18	Application of Artificial Intelligence in Education. Problems and Opportunities for Sustainable Development **Year:** 2022 **Journal:** *BRAIN. Broad Research in Artificial Intelligence and Neuroscience*	V. Yuskovych, T. Poplavska, O. Diachenko, T. Mishenina et al.	The article focuses on the application of AI in education, highlighting opportunities and problems in the context of sustainable development, analyzing its current status and potential benefits.
19	Application of artificial intelligence in medical education: A review of benefits, challenges, and solutions **Year:** 2024 **Journal:** *Medicina Clínica Práctica*	M. Zarei, H. Eftekhari, A. Abbasi, and M. Hosseini	This study aims to comprehensively evaluate the advantages, challenges and main strategies for using AI in medical education to improve its effective integration.
20	Ethical principles for artificial intelligence in K-12 education. **Year:** 2023 **Journal:** *Computers and Education: Artificial Intelligence*	C. Adams, P. Pente, G. Lemermeyer, and G. Rockwell	This study examines the ethical principles guiding the development of AI policies for K-12 education, identifying unique principles and adaptations of general principles.

(Continued)

Table 3. Selected articles *(Continued)*

No.	Title	Author(es)	Objective/Caso
21	Ethics of AI in Education: Towards a Community-Wide Framework **Year:** 2022 **Journal:** *International Journal of Artificial Intelligence in Education*	W. Holmes, K. Porayska-Pomsta, K. Holstein, E. Sutherland et al.	The aim of this study is to explore the ethical implications of AI in education, identifying challenges and proposing a multidisciplinary framework to address these issues effectively.
22	Ethics of Artificial Intelligence in Education: Student Privacy and Data Protection **Year:** 2023 **Journal:** *Science Insights Education Frontiers*	L. Huang	This study examines the ethical risks that AI technology poses to students' personal information and offers recommendations for addressing student data security concerns.
23	A Study on Ethical Awareness Changes and Education in Artificial Intelligence Society. **Year:** 2023 **Journal:** *Revue d'Intelligence Artificielle*	J. Kwon	The aim of this study is to present a direction for AI ethics education, examining its educational values and limitations, and highlighting its necessity for moral development in AI society.
24	Ethical use of Artificial Intelligence in Health Professions Education: AMEE Guide No. 158 **Year:** 2023 **Journal:** *Medical Teacher*	K. Masters	The objective of this study is to identify, anticipate and address the ethical implications of the use of AI in Health Professions Education, ensuring respect for fundamental ethical principles.
25	Fairness, Accountability, Transparency, and Ethics (FATE) in Artificial Intelligence (AI) and higher education: A systematic review **Year:** 2023 **Journal:** *Computers and Education: Artificial Intelligence*	B. Memarian and T. Doleck	The purpose of this study is to analyze the definitions and studies on Justice, Responsibility, Transparency, and Ethics (JRET) in the AI and higher education literature. The developments of JRET are summarized and the challenges of each reviewed study are synthesized.
26	Ethical principles for artificial intelligence in education **Year:** 2023 **Journal:** *Education and Information Technologies*	A. Nguyen, H. N. Ngo, Y. Hong, B. Dang, and B. P. T. Nguyen	This article seeks to explore whether there is a global consensus on ethics in AI applied to education (AIED) by analyzing international policies and guidelines.
27	Qualitative and quantitative analyses of artificial intelligence ethics in education using VOSviewer and CitNetExplorer **Year:** 2023 **Journal:** *Frontiers in Psychology, 14*	L. Yu and Z. Yu	This study examined the essence and principles of the ethics of AI in education, as well as a bibliometric analysis of its application in this field.
28	The Role of Artificial Intelligence Autonomy in Higher Education: A Uses and Gratification Perspective **Year:** 2024 **Journal:** *Sustainability (Switzerland)*	W. Niu, W. Zhang, C. Zhang, and X. Chen	This study investigates how AI educators' autonomy design influences students' usage intentions by exploring how it meets students' needs.
29	A Primer on Generative Artificial Intelligence **Year:** 2024 **Journal:** *Education Sciences*	F. Kalota	This article aims to introduce basic concepts of AI and Gen-AI for educators and practitioners. It addresses fundamentals, applications and current challenges of Gen-AI.
30	Assessing student-perceived impact of using artificial intelligence tools: Construction of a synthetic index of application in higher education **Year:** 2023 **Journal:** *Cogent Education*	A. Grájeda, J. Burgos, P. Córdova, and A. Sanjinés	The objective of this research is to determine the adoption of AI tools in academic areas, specifically at Sampoerna University.

(Continued)

Table 3. Selected articles *(Continued)*

No.	Title	Author(es)	Objective/Caso
31	Educational Applications of the ChatGPT AI System: A Systematic Review Research. **Year:** 2023 **Journal:** Educational Process: International Journal	Ziyaeddin Halid, Ali Ibrahim, Stamatios Papadakis, and Michai Kallogiannakis	The aim of the research is to analyze the existing literature to identify the potential effects of ChatGPT in education, revealing both positive implications and concerns about its use in educational settings.
32	The use of ChatGPT as a learning tool to improve foreign language writing in amultilingual and multicultural classroom. **Year:** 2023 **Journal:** Advances in Mobile Learning Educational Research	Stavros Athanassopoulos, Polyxeni Manoli, Maria Gouvi, Konstantinos Lavidas, and Vassilis Komis,	The aim of the research is to examine the effectiveness of ChatGPT as a feedback tool for foreign language writing, specifically among high school students with a refugee/migrant background, in improving their vocabulary and grammar in learning German.
33	A Conversation with ChatGPT about the Impact of the COVID-19 Pandemic on Education: Comparative Review Based on Human–AI Collaboration. **Year:** 2023 **Journal:** Educational Process: International Journal	Turgut Karakose, Murat Demirkol, Nurcihan Aslan, Huseyin Kose, and Huseyin Kose	The aim of the research is to analyze the effects of the COVID-19 pandemic on education through a collaborative analysis between humans and AI, evaluating ChatGPT-3.5 and 4 responses in terms of accuracy, clarity, conciseness and breadth of information provided.

3 RESULTS AND DISCUSSION

RQ1: What are the main AI tools used in education?

Artificial intelligence has experienced a remarkable advance in the 21st century, extending to several areas, including higher education. In this field, the use of AI tools has evolved from simple auxiliary tools to complex systems. The main areas of development include machine learning, deep learning and natural language processing. [22]. These technologies enable computers to make data-driven decisions, identify patterns in large sets of information, and understand human language [23].

Over-reliance on AI models carry significant risks, such as perpetuating stereotypes and spreading misinformation. Therefore, it is critical to teach students to critically evaluate the information generated by these AI models [24]. On the other hand, although their usefulness is recognized, most teachers are not proposing to replace traditional teaching methods with tools such as ChatGPT, but to integrate them as a complement to enhance classroom learning [25]. Similarly, educators can use AI tools to create interactive material, lesson plans and educational resources [26].

The growing importance of AI in digital life, especially in education, is marking a significant shift in academia. AI tools, whose functions vary from generating personalized questions to creating interactive activities, are being increasingly used by educators and academics [19]. This allows education professionals to explore and exploit their potential to improve pedagogical practices, as they point out [1], [26]. For this reason, these tools span several categories according to their functions and uses, from chatbots and virtual assistants to image recognition systems and speech-to-text transcription software, as summarized in refer to Table 4.

Table 4. Examples of AI tools

Type of AI Tool	Function	Tools
Text Generation System	Research system	ChatPDF, Copilot, Scite Assistant
	Chat system	ChatGPT, Claude
	Content system	Jasper, Notion
	Language learning system	Twee, Duolingo
	Resource generating system	Conker, Monic
	Search system	Microsoft Bing, Perplexity, You.
	Editorial system	Quillbot
Image Generation System	Illustration or figure generation system	Bing Image Creator, Visual ChatGPT.
	Presentation generation system	ChatBA, Slides AI, Gamma
Video Generation System	Image and video analysis system	Leonardo AI.
Code Generation System	Code debugging system	Code GPT
	Code generation system	Code Whisper, Github Copilot

RQ2: How are these AI tools applied in the teaching-learning process?

In education, AI tools are revolutionizing content creation and access, improving research, interaction, personalization of learning and efficiency in the production of educational resources. The use of these tools has transformed the dynamics of teaching and access to education at the university level. Below are some key tools and their importance in teaching [27].

ChatGPT: The AI-based text generation model, also known as LLM (large-scale language model), is trained by analyzing patterns in large amounts of web text, looking for statistical regularities to predict the following words in a sentence [28], [29], [30]. This tool, used by teachers as a virtual assistant, interacts and answers questions in a conversational manner, providing personalized support in real time to students [1], [31].

You.com: Innovative educational platform that fuses advanced technology and modern pedagogy to promote active student participation and collaboration [1]. It offers a variety of resources, such as interactive e-books, educational videos and formative assessments, facilitating the tracking of student progress and providing immediate feedback for educators. Recent research confirms the benefits of these platforms, highlighting improvements in motivation, engagement and academic performance, as well as the development of critical and problem-solving skills [28], [32].

Chat Pdf: Advanced AI platform that enables users to retrieve information from large PDF files, including various types of documents such as research articles, books, and legal contracts [33]. Through natural language interactions, users can explore PDFs as if they were conversing with another person, allowing them to analyze and extract relevant data. These tools stand out for their ability to synthesize the main ideas of PDFs, regardless of language, which facilitates the proposal of co-curricular activities according to recent research [1].

Leonardo AI: AI tool that uses computer vision and machine learning to analyze images and videos, being useful to improve the teaching experience in the identification of objects in scientific experiments or the interpretation of medical images [1].

Humata.ai: AI tool GPT-3.5, whose function is to analyze PDF documents, excelling in the automation of literature review in specific repositories [34]. Uses machine

learning algorithms to examine course content and provide personalized recommendations to students [1].

All of these tools are transforming education by offering new opportunities to personalize learning, improve the quality of content and facilitate interaction between students and teachers, promoting a more practical and personalized approach to teaching and learning [1]. In education, AI falls into two categories: those that support student learning and those that assist teachers in their tasks. In this way, AI benefits both parties by providing up-to-date information to create educational content and offering personalized tutoring to improve student performance [35]; as in the article by Kaftan [36] who conducted research on data interpretation in medical education, which makes a comparison between Chat GPT, Gemini and COPILOT. Table 5 describes the main applications of AI tools in educational learning.

Table 5. Applications of AI tools in the educational field

Type of Application	Description
Individualized Learning	Artificial intelligence in education promises to personalize learning experiences, increase teacher productivity and student engagement. Through data analytics, it can create learning plans tailored to each student, enabling personalized instruction. Examples of software that enable this activity include DreamBox and Knewton [35], [37].
Intelligent Tutoring Systems	Intelligent tutoring systems (ITS), powered by AI, offer personalized support to students, such as Carnegie Learning's system for mathematics, adapting to individual learning styles and providing immediate feedback. Their ease of use makes them valuable resources both in and out of the classroom, acting as virtual guides that facilitate learning in a variety of areas [37], [38].
Automatic Grading System	Automating assessment with AI simplifies the correction of written work, allowing teachers to focus on tasks or activities within the classroom. Examples such as Turnitin use NLP to detect errors and plagiarism, streamlining assessment. This not only reduces the teaching load, but also promotes the development of students' writing skills [37].
Predicting Student Dropout Data	The use of AI for predictive analytics has become indispensable in education, especially in the fight against school dropout. By evaluating student attendance, engagement and performance data, institutions can identify those at risk and provide them with the necessary support. This technology makes it possible to anticipate problems and offer targeted solutions to reduce dropout, which is crucial for improving student success [35], [37].
Virtual Assistance	Artificial intelligence-powered virtual assistants are valuable tools for students by providing support for administrative tasks such as scheduling and task management. For example, Brainly provides instant answers to academic queries using machine learning. Personalized tutoring, such as Stanford University's system, assesses student performance in real time and provides feedback to improve performance. In addition, virtual advising without human intervention, such as chatbots, is transforming the teaching process by providing personalized responses to student queries [35], [37].

Artificial intelligence tools are transforming education by personalizing learning, providing intelligent tutoring and automating assessment, which improves the educational experience and reduces the teaching load. In addition, predictive dropout analytics help identify and support at-risk students, while virtual assistants streamline administrative management and provide personalized tutoring. These applications demonstrate that AI integration is essential for pedagogical and administrative advancement in the digital age.

RQ3: What are the advantages and challenges in the implementation of AI in education?

The integration of AI has become a topic of growing interest, especially among students and teachers, who recognize its potential to improve teaching processes, enrich knowledge, and generate didactic resources that foster an inclusive environment conducive to effective communication [39]. However, the use of AI poses significant challenges when not handled properly. In particular, understanding data processing algorithms is becoming increasingly complex. For this reason, addressing these complexities and analyzing the benefits of AI tools ensures the transparency, fairness, and effectiveness of this methodology as a new technique used in the educational environment [40].

Similarly, the proper management of AI contributes to improving the quality of education and promotes an inclusive educational environment, where the skills and competencies of each actor involved in the teaching process are recognized. The following highlights the advantages of the use of AI in education.

Personalized education: Personalized education with AI represents an innovative educational approach that uses AI technologies to tailor the teaching and learning process to the individual needs of each student. Unlike the traditional model of a uniform curriculum for all students, this approach leverages data on each student's academic performance, learning preferences, interests, and abilities to deliver personalized learning experiences specific to everyone [41], [42]. With data analysis algorithms, AI can identify certain patterns about the behavior and performance of students, thus personalizing the content of the curriculum according to the characteristics of each student and encouraging them to continue studying.

Teachers use digital resources to analyze student data and create innovative content by AI, facilitating the identification of student strengths and weaknesses [43]. This personalized adaptation involves assigning tasks according to each student's level of mastery of knowledge. By gathering relevant information, teachers can provide personalized education that eliminates learning gaps and ensures quality and transparency in the use of AI tools. In addition, the integration of AI in education offers additional support to students through intelligent tutoring systems, which provide interactive learning materials customized to their individual learning styles [41].

Innovative educational resources: AI tools offer a variety of customizable resources for each student, representing an innovative approach to global information sharing. The use of virtual platforms maintains student interaction regardless of time or location, allowing communication with both local and international teachers. This dynamic eliminates the geographical barriers imposed by traditional learning methods [41], [44]. On the other hand, teachers can share AI-generated teaching resources, which are available online to students everywhere. This free access strengthens students' research capacity and encourages inquiry.

Innovative educational resources based on AI tools offer a variety of applications and platforms that are transforming teaching and learning methods. For example, mobile apps such as Duolingo and Babbel use AI algorithms to adapt content and exercises based on each user's individual language learning progress. Similarly, online platforms such as Khan Academy and Coursera employ AI-based recommender systems to suggest courses and educational materials that match users' interests and learning objectives [41].

In addition, programs such as 101 Education PPT and Beike Net provide teachers with AI-based resources to generate 3D instructional content and simulate

immersive scenarios, helping students engage in more realistic learning. These tools also provide access to educational material and quizzes that can be tailored to the user's personalized curriculum. In short, the integration of AI tools in education is revolutionizing the way teaching and learning takes place, offering more personalized and effective experiences for both students and teachers [41].

Teacher feedback: The implementation of AI allows a detailed and timely analysis of students' learning progress, providing feedback to teachers and allowing them to learn about their students' performance and detect possible difficulties or deficiencies early on. In the virtual environment, the analysis of large volumes of data helps to collect information as the teacher interacts with students, generating detailed reports that evidence this connection [40], [41].

One prominent example is PowerSchool, an AI-based solution that manages academic data and provides tools to monitor student progress. This platform uses AI algorithms to perform predictive analytics based on large historical data sets, the results of which anticipate future trends in academic performance, enabling early and personalized interventions to address potential difficulties [19]. In addition, PowerSchool identifies individual learning patterns, adapting teaching methods to meet the specific needs of each student and improving the effectiveness of the educational process. Similarly, the platform generates detailed and personalized reports on academic performance, including grades, attendance, class participation, and progress on learning objectives [45].

On the other hand, as AI tools are introduced into the educational environment, Crompton [46] mentions that there are also challenges and limitations that need to be addressed in higher education and education in general. While these tools have the potential to transform the way students acquire knowledge, there are obstacles that must be overcome to take full advantage of their capabilities. Some of the challenges include implementation costs, lack of integration, data privacy, stakeholder acceptance, and technological implications on the educational process [43]. As the use of AI in learning is explored, it is critical to address these limitations to ensure an effective and beneficial educational environment for all learners. The following are the main challenges of AI tools.

Cost of adaptation: The main challenge in implementing AI in education is cost. Developing and maintaining intelligent educational tools requires considerable investment in specialized technical equipment, research, and development. In addition, AI systems need constant upgrades to adapt to changing educational needs, which entails additional training costs for staff. Teachers also need training to use these tools effectively, which entails additional time and resource costs [47]. Schools, especially in economically disadvantaged regions, often lack the necessary funds to acquire and maintain advanced AI equipment. Despite the great potential of smart educational tools, cost remains a significant barrier to their widespread adoption and the full exploitation of their benefits for sustainable development [41].

Lack of integration: The development of AI in education faces obstacles to adapting to the diversity and complexity of educational environments. The lack of specific regulations, as in a study conducted by Dashkevych [48], means the generation of responses by AI motors in the field of education must be controlled. Legal uncertainty and the absence of concrete policies limit the progress of the integration of AI in education. At the national level, AI education is not yet fully integrated into educational development plans [49]. Teachers advocate for greater government investment in school digital infrastructure and the issuance of guiding policies. Establishing policy frameworks can provide consistent guidance for the implementation of AI education in different educational contexts [41].

Lack of privacy: The incursion of AI into education raises legitimate concerns about data security. Systems collect and analyze sensitive information, such as students' identities and learning patterns [43]. The absence of adequate protection could expose this data to unauthorized access, representing a significant privacy risk. In addition, educational institutions could be targeted by threats such as cyberattacks and data breaches. To counter these dangers, it is imperative that technical staff implement robust security measures and promote data protection awareness among faculty and students. Only in this way can AI play an effective role in education and gain the trust of the school community [41], [50].

Acceptance by those involved: Successful implementation of AI in education faces several challenges, including the understanding gap between AI researchers and educators. Teachers, especially those less familiar with modern technologies, may find it difficult to fully utilize AI tools in their teaching [19]. Factors such as perception, understanding, and value attributed to AI in education influence its acceptance. Survey results reveal that many teachers express concerns, such as the potential substitution of teaching roles and the reliability of AI in assignments. Addressing these concerns and promoting AI literacy among primary and secondary teachers is essential to increasing educational awareness of this topic and improving its acceptance. In addition, using AI as a teaching tool can increase the effectiveness of teaching and the learning experience of students [39], [41].

Technological implications: The advancement and application of AI in education face technological limitations, especially in the tools available for its teaching, which lack specific software and do not fully meet the needs of educators. Although AI enriches education by providing high-quality content and teaching resources, it neglects the emotional connection with students, which limits their integral development. In addition, areas such as image and voice recognition still fall short of the necessary accuracy and require continuous improvement [41], [50]. This constant need for improvement is essential to ensuring that AI can accurately interpret and understand visual and auditory stimuli, providing more effective educational assistance.

RQ4: What are the main ethical challenges related to the use of AI tools in education?

The advancement of AI has brought with it numerous opportunities in the educational field, but it has also raised significant ethical challenges [51]. The use of AI tools in education raises questions about the privacy of student data, equity of access to the technology, transparency of the algorithms used, and the impact on student autonomy and critical thinking. These ethical challenges are critical to ensuring that the use of AI in education is ethical and beneficial to all involved.

Among its characteristics, AI could capture information and generate educational scenarios where knowledge is replicated in an automated way, simulating the mechanisms of the human brain through natural language [52]. It is argued that AI significantly improves education; however, due to its rapid advancement, more and more risks associated with the use of these tools emerge. Students and users in general are exposed to data leakage, disclosure of personal information, and even data trafficking. Problems such as those mentioned above have become increasingly serious threats. Therefore, it is important to study the ethical risks that AI presents to learning [53].

Privacy principle: Privacy is described as a universal right inherent to human dignity. Since AI collects data, which is subdivided into subcategories and provided

by users, it is necessary that all information is collected, used, shared, stored, and deleted once the questions for which this tool has been used have been answered [54]. On the other hand, when talking about personal information, the AI must safeguard the legal frameworks and ethical standards of information disclosure, i.e., have informed consents specifying the use of personal data with the user's prior approval [55].

Privacy is linked to data protection and security; therefore, designers of AI tools must ensure that information provided by users, in this case students, is not accessible to everyone. A clear example is to avoid sharing phone numbers, dates of birth, and even age to prevent situations such as bullying or cyberbullying [56]. In this regard, it is essential to understand that the privacy of information will remain protected to the extent that students and teachers refrain from disclosing as much personal data as possible. Currently, there is software that analyzes the data provided and can identify the user, which raises the question of whether the use of AI is a valuable tool for education or simply a means of overexposure [55].

Principle of justice and equity: Justice and equity in education focus on guaranteeing an equitable and impartial distribution of technological resources for both students and teachers. In this sense, the development of AI focuses on eliminating barriers in schools, promoting equity and fairness [57]. However, it is important to note that the decision to adopt AI in school training rests with the users, who must be able to recognize the potential risks or disadvantages associated with its inappropriate use [58].

Principle of autonomy: The sense of autonomy is recognized as a person's ability to make decisions or judgments based on reflection, i.e., the full capacity to choose wisely. In education, the promotion of autonomy in the use of AI tools is noteworthy, as it fosters the development of critical thinking skills and self-regulation in students. In addition, it ensures that the actors involved in the learning process become more active in their professional training [55].

Principle of responsibility and accountability: In the educational field, the principle of responsibility is understood as the autonomy that students or teachers have in the use of AI algorithms [55]. This characteristic determines that AI users must be responsible for the possible consequences derived from the use of technology, i.e., they must be aware of how their actions affect themselves and others. This implies not only using the technology in an ethical and legal manner but also being prepared to assume the consequences of their decisions and actions. Responsibility relates to the obligation to justify and explain decisions made, as well as to accept responsibility for any negative impact they may have. In the educational context, this means that both students and teachers must be willing to reflect on the use of AI in learning and be transparent about how and why certain algorithms are used [59].

4 CONCLUSIONS

The integration of AI in education poses significant challenges and opportunities. AI can improve personalization of learning, teaching efficiency, and access to advanced educational resources. However, it is crucial to address ethical challenges such as data privacy, equity in access to technology, transparency of algorithms, and impact on students' autonomy and critical thinking. Awareness of these ethical issues ensures an ethical and beneficial AI implementation for all involved.

Teacher buy-in is key to the success of AI in education. Therefore, it is essential to address their concerns and promote AI literacy among educators by improving their

acceptance and understanding. In addition, it is necessary to continuously improve AI tools to ensure their effectiveness. A balanced approach that combines the benefits of AI with constant ethical reflection and appropriate training for educators can create a more inclusive, efficient, and ethical educational environment in the digital age.

The results of the study can be applied beyond educational courses, as ethical challenges and equity in access to the technology are relevant in other sectors such as health, finance, and the public sector. The need for user acceptance and training is also applicable in different fields adopting AI, ensuring effective implementation. In addition, continuous improvement of AI tools is crucial to maintaining their relevance in any sector.

5 AUTHOR CONTRIBUTIONS

All authors made significant contributions to each section of the article.

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