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El impacto de la IA en el aprendizaje y la educación: eficacia, beneficios y desafíos

The Impact of AI on Learning and Education: effectiveness, benefits, and challenges

O impacto da IA na aprendizagem e na educação: eficácia, benefícios e desafios

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Resumen

La inteligencia artificial (IA) ha transformado significativamente el ámbito educativo, proporcionando herramientas y aplicaciones que personalizan el aprendizaje, mejoran la eficiencia y facilitan la gestión académica. El objetivo de este estudio es analizar el impacto de la IA en el proceso de enseñanza-aprendizaje, determinando su efectividad, beneficios y desafíos en los resultados educativos. Metodológicamente se realizó una revisión sistemática de diferentes tesis y revistas científicas utilizando criterios PICO y la lista de verificación PRISMA, en un período de diez años. Los hallazgos indican que la IA personaliza el aprendizaje a través de algoritmos y sistemas adaptativos, ofrece retroalimentación instantánea y facilita la creación de entornos educativos motivadores. Sin embargo, también presenta desafíos éticos y prácticos, como una dependencia excesiva que puede afectar el desarrollo de habilidades críticas y la capacidad de aprendizaje autónomo. La integración de la IA en la educación requiere de un equilibrio para maximizar sus beneficios sin comprometer el desarrollo integral de los estudiantes. Se debe capacitar a los educadores para utilizar estas herramientas de manera efectiva, promoviendo un uso moderado y complementario a los métodos tradicionales.

Palabras clave: inteligencia artificial; aprendiendo; educación.

Abstract

Artificial intelligence (AI) has significantly transformed the educational field, providing tools and applications that personalize learning, improve efficiency, and facilitate academic management. The objective of this study is to analyze the impact of AI on the teaching-learning process, determining its effectiveness, benefits, and challenges in educational outcomes. Methodologically, a systematic review of differ-ent theses and scientific journals was carried out using PICO criteria and the PRISMA checklist, within a period of ten years. The findings indicate that AI per-sonalizes learning through algorithms and adaptive systems, offers instant feedback, and facilitates the creation of motivating educational environments. However, it also presents ethical and practical challenges, such as excessive dependence that can affect the development of critical skills and the capacity for autonomous learning. The integration of AI in education requires a balance to maximize its benefits with-out compromising the integral development of students. Educators must

be trained to use these tools effectively, promoting moderate and complementary use along with traditional methods.

Keywords: artificial intelligence; learning; education.

Resumo

A inteligência artificial (IA) transformou significativamente o campo educacional, fornecendo ferramentas e aplicativos que personalizam a aprendizagem, melhoram a eficiência e facilitam a gestão acadêmica. O objetivo deste estudo é analisar o impacto da IA no processo de ensino-aprendizagem, determinando sua eficácia, benefícios e desafios nos resultados educacionais. Metodologicamente, foi realizada uma revisão sistemática de diferentes teses e revistas científicas utilizando os critérios PICO e o checklist PRISMA, num período de dez anos. As descobertas indicam que a IA personaliza a aprendizagem através de algoritmos e sistemas adaptativos, oferece feedback instantâneo e facilita a criação de ambientes educacionais motivadores. No entanto, também apresenta desafios éticos e práticos, como a dependência excessiva que pode afetar o desenvolvimento de competências críticas e a capacidade de aprendizagem autónoma. A integração da IA na educação requer um equilíbrio para maximizar os seus benefícios sem comprometer o desenvolvimento integral dos alunos. Os educadores devem ser treinados para utilizar estas ferramentas de forma eficaz, promovendo o uso moderado e complementar juntamente com os métodos tradicionais.

Palavras-chave: inteligência artificial; aprendizado; educação.

Introduction

Artificial intelligence (AI) has emerged as a transformative resource in various fields and disciplines, and education is not the exception. During the last few years, the immersion of technology created with AI in learning and teaching has substantially modified the educational process. This technological change offers a variety of tools and applications that enable the personalization of the educational process, improve learning efficiency, and facilitate academic management. However, the impact of AI in education also presents ethical and practical challenges that must be considered.

The problem of this study is related to the need to understand and evaluate the results of the impact of AI applied in classrooms. Despite the growing use of AI technologies in educational

environments, there is a significant lack of empirical studies that analyze their real effectiveness in the teaching and learning process. Thus, it intends to provide data and analysis on how this resource interacts with the educational dynamics, the interaction between teachers and students, and academic achievement in different school environments.

The rationale lies in the growing demand to evaluate the impact of AI on learning and education, especially when applied directly in classrooms. As educational institutions adopt these resources, it is critical to understand how they change the educational process and student outcomes. This analysis not only provides valuable information for educators and educational administrators about effectiveness and potential benefits, but also identifies areas for improvement and potential challenges. Similarly, it will contribute to the formulation of educational guidelines that optimize this resource in teaching environments. The overall objective is related to analyzing the impact of AI on the teaching and learning process to determine its effectiveness, benefits and challenges on students' educational outcomes.

The research background considers what is exposed by (Salmerón Moreira, 2023) in his study on the future of artificial intelligence for education in higher education institutions which claims that the use of AI in the educational environment offers the opportunity to modernize the sector according to the new emerging technologies. Both educators and learners must update their competencies to cope with the new challenges and take advantage of the available tools that optimize the teaching and learning experience. In addition, AI will change how knowledge and skills are acquired by students, allowing teachers to personalize instruction more effectively through intelligent algorithms and machine learning systems that are adjusted to individual needs. Alfaro Salas and Díaz Porras (2024), in their study on perceptions and applications of AI among high school students, report that several students would like to use AI to solve problems, recognizing its potential as a valuable tool to face the challenges of the environment. Additionally, they refer that this resource will allow them to execute electronic and programming projects, decorative works, among others. On the other hand, some students expressed their desire to use AI to boost their school experiences that consider academic as well as organizational aspects. Another group of students mentioned that they would like to use AI to overcome specific difficulties in learning, such as mathematics. Finally, they showed interest in using AI for self-learning and acquiring knowledge in various areas.

According to Añapa (2024) in his study on the impact of the use of AI on autonomous learning and challenges in Higher Education Institutions concludes that artificial intelligence transforms the way students learn by personalizing learning, providing instant feedback, providing virtual assistance function, analyzing data and facilitating access to educational resources. These technological advances have the potential to increase the effectiveness and efficiency of autonomous learning, driving knowledge acquisition and skill development more effectively. The impact of AI on autonomous learning is remarkable, with benefits including personalized educational experiences, adaptive learning programs, and improved academic outcomes.

Regarding the impact of artificial intelligence (AI) on learning and education, Williams (2019) developed a specific research aimed at Early Childhood Education students, demonstrating that it is feasible to introduce the use of AI from these early stages. The results of their study highlight that, despite the young age of the children, they are able to understand the basic concepts related to AI and interact effectively with this technology. The authors highlight the receptivity of young children to learn and handle AI tools, suggesting great potential for incorporating this knowledge into the curriculum from an early age. Moreover, they highlight the importance of adapting teaching methods to the cognitive abilities of children, allowing them to become familiar with the technology in a playful and educational way. This innovative approach not only facilitates the understanding of AI, but also promotes the development of critical and creative skills from the beginning of formal education.

Rodriguez et al. (2021) conducted a study to determine whether an AI tool was suitable for teaching Machine Learning to children between the ages of 10 and 16, evaluating both its instructional validity and its ease of use and appeal. The findings of this study support both premises, demonstrating that the participating students not only gained an understanding of basic Machine Learning principles using the tool, but also found it entertaining and accessible. Also, the results indicate that students were able to apply the acquired knowledge to develop their own Machine Learning projects. This underscores the effectiveness of the tool as a valuable educational resource, capable of making learning complex concepts such as Machine Learning both understandable and fun for young people. The students' ability to create their own projects also highlights the tool's potential to foster creativity and practical application of knowledge in a real-world context, which can contribute significantly to their educational and technological development.

Ayuso del Puerto and Gutiérrez Esteban (2022) conducted a research in which students worked in groups of 3 to 5 people to design two AI projects, one textual and one image-based, based on didactic content suggested by Early Childhood Education teachers. In the first phase, students entered images or text related to the topic in question and then used a programming environment similar to Scratch to develop their projects. One resulting game allowed the character to identify cards with images, while another asked questions about the content explained, requiring students to respond with the correct card. These activities are useful for working on vocabulary in Early Childhood Education, providing continuous feedback. This tool is especially relevant in virtual education promoted by COVID-19, as it is accessible and open, helping to reduce inequalities.

During the activity, doubts were resolved in a Moodle forum, supported by video tutorials and other resources shared on Wakelet and Twitter. However, 42.1% of the students felt insecure using the tool, although 57.9% did not feel intimidated and 18.4% showed indifference. 55.3% plan to use this tool in their future teaching work. On the other hand, 61.8% considered that the virtual modality facilitated learning, although 52.6% felt overwhelmed by the amount of information provided.

Similarly, in a study by Del Cisne Loján et al. (2024), a significant negative correlation ($F(1, 63) = 5.12$, $p < .001$) was identified between reliance on artificial intelligence and the development of critical skills in students. This finding indicates that overuse of AI tools to complete academic tasks may hinder critical thinking, analytical skills, and problem solving. In the same vein, regression analysis confirmed that reliance on AI negatively predicts students' academic performance. This suggests that inappropriate use of these tools may adversely affect students' ability to learn autonomously, research, and ground their knowledge. Consequently, although AI offers numerous educational advantages, it is crucial to balance its use so as not to compromise the development of skills essential for independent learning and critical thinking. Educators should encourage a moderate and well-targeted use of AI, integrating it as a complement to the traditional educational process, rather than as a substitute, to maximize the benefits without sacrificing the holistic development of students.

Likewise, Lara Andino et al (2024), refers that the integration of AI in the educational environment has proven to be a powerful tool to improve the learning experience and educational management. Personalization of learning is one of the main benefits it offers, allowing content to be adapted to the individual needs of each student. This is done by collecting and analyzing data on performance,

preferences and learning styles, which facilitates the creation of effective and motivating educational environments.

Similarly personalization, AI has driven the development of virtual tutoring and automated feedback systems. These systems, such as chatbots and virtual assistants, can provide instant answers to students' questions, resolve doubts and offer detailed explanations of complex concepts Bolaño García and Duarte Acosta (2024). These resources represent a versatile tool that can play a variety of roles, such as teacher, student or tutor, in virtual training environments. The development of this type of software has emerged as an effective solution to address the needs in the field of education, which demands flexibility and adaptability. On the other hand, the use of chatbot contributes to improve knowledge management and the development of activities both inside and outside the classroom, providing a classroom practice without boundaries or time constraints Paredes Rizo (2021)

Automated assessment is another crucial area where AI has shown its potential. These systems can perform quick and accurate assessments of students' work, providing immediate and detailed feedback. This not only minimizes the workload of teachers, but also allows students to correct their mistakes and improve their understanding more efficiently Calderón Cruz et al (2024). Google Forms, Mentimeter, Kahoot, Quizziz are platforms that allow the generation of surveys, quizzes, lessons, exams and individual or group activities Baltazar, (2023)

Baltazar (2023) points out that AI has been used in various environments for several years, providing resources that have facilitated both individual and cooperative learning. Among the main uses of AI, the following stand out:

Cooperative whiteboards: these tools allow the joint participation of two or more students in the creation of online products, especially useful for solving problems or other activities that require collaboration and shared visualization.

Collaborative presentations: Resources that allow the visualization of screens with different types of data, facilitating the exchange of information among groups of students. Tools such as Google Docs allow sharing and editing presentations, spreadsheets and texts among users from different environments.

Groupware applications: Tools for communication management, including audio conferences, videoconferences and chat. Applications such as WhatsApp, Zoom and Google Meet are key to promote collaborative learning, being oriented to a pedagogical and didactic use.

The integration of AI in education is not only limited to teaching and student assessment, but also encompasses educational management. AI-powered learning management systems (LMSs) can optimize course management, student progress tracking, and large-scale educational data analysis. This enables educational institutions to make data-driven decisions, improving operational efficiency and overall educational quality Lara Andino et al. (2024).

Similarly, AI can play a crucial role in the early identification of at-risk students. By analyzing patterns of behavior and academic performance, AI systems can alert educators to students who may need additional support, enabling timely interventions that can prevent school failure and improve academic outcomes (Bolaño-García & Duarte-Acosta, 2024).

The use of AI is also transforming the design of educational materials. Tools such as AI-based content generators can create personalized teaching resources, Calderón-Cruz et al. (2024). According to Canfran Duque (2023), ChatGPT provides access to a wide range of online educational resources. The application of this platform in learning facilitates the delivery of information, the resolution of queries and the guidance of students in their mastery process in this field. This tool allows students to get clear and precise explanations of basic concepts, solve complex problems and explore new ideas. Additionally, ChatGPT can function as a support tool for practical projects, providing suggestions, advice, and creative solutions. Its ability to understand and generate text allows it to adapt to the specific needs of each student, offering personalized and effective learning. Its impact on learning is related to the generation of examples and practical exercises, the exploration of advanced topics, support in projects and practical work, among other aspects. Despite the potential benefits, the implementation of AI in education should be approached with caution. It is essential to involve teachers in the technological integration process, providing them with the training and support necessary to use these tools effectively. Resistance to change and lack of technological skills can be significant barriers that must be overcome for successful implementation Esteves Fajardo et al. (2024)

Methodology

This study adopted a qualitative and descriptive methodological approach. To conduct the research, a thorough systematic review of master's and doctoral theses, as well as scientific journal repositories, was carried out following PRISMA-SCR guidelines. The search terms employed included "artificial intelligence", "education", "impact"; "learning" and "education". The sources

consulted covered repositories such as Prometeo, Reincisol, Social Fronteriza, among others, covering a period of the last ten years.

In addition, the PICO criteria and the PRISMA checklist were used as essential tools in the research process. The PICO criteria helped formulate four key research questions, while the PRISMA checklist ensures the quality and clarity of the systematic analysis. This process included a thorough exploration of the available literature, selection of relevant studies, detailed data collection, synthesis of the information obtained and presentation of the results. In this way, these methodological tools provided a rigorous and objective approach, facilitating an accurate and informed assessment of the data analyzed.

Illustrations, tables, figures

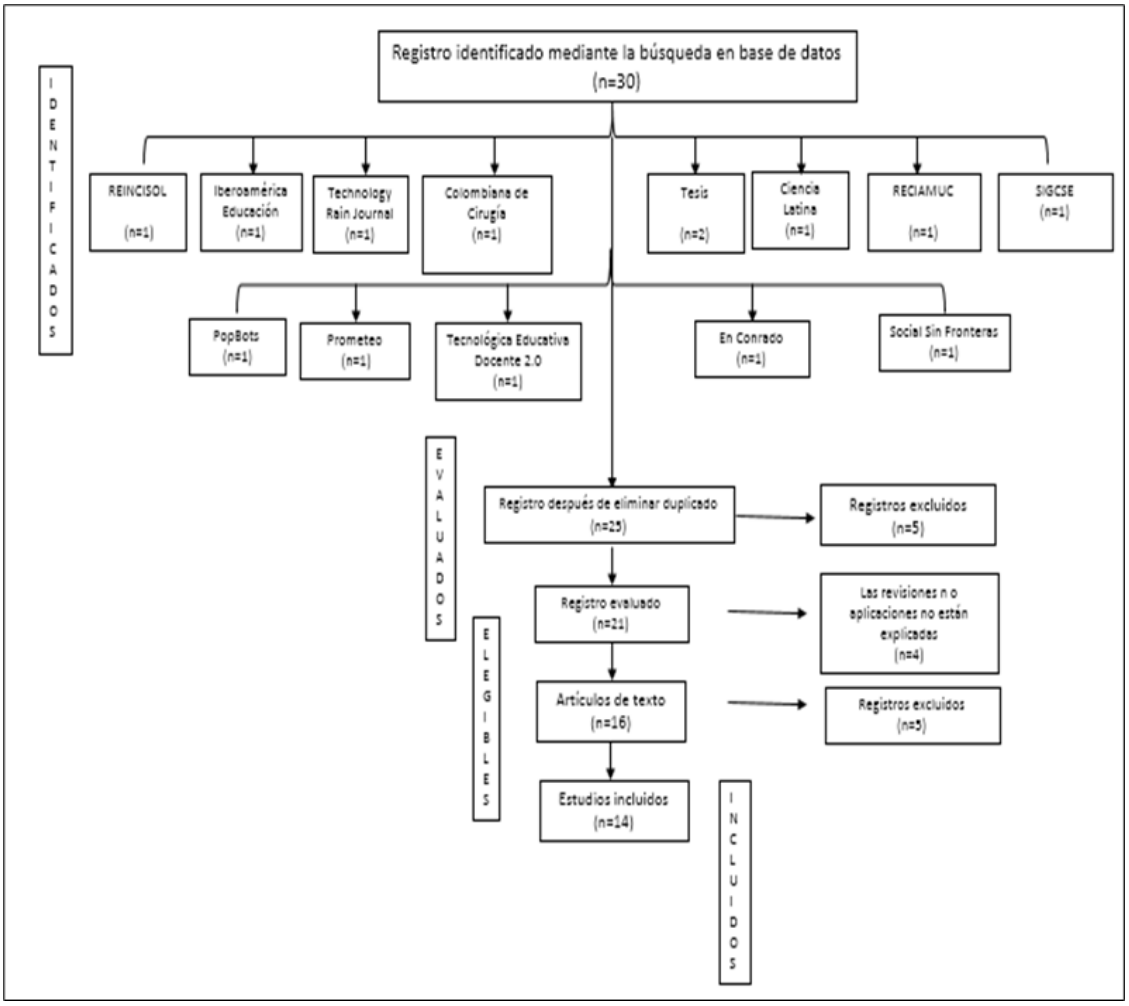

Illustration 1. Record identified by database search

Note: Own elaboration (2024)

Table 1. *Document quality assessment checklist*

QA1	QA1: Does the paper evaluate the effectiveness of AI in the teaching and learning process through empirical studies?	(+1) Yes/ (+0) No
QA2	QA2: Does the paper address personalization of learning through intelligent algorithms and machine learning systems?	(+1) Yes/ (+0) No
QA3	QA3: Does the study identify ethical and practical challenges associated with the use of AI in education?	(+1) Yes/ (+0) No
QA4	QA4: Is quantitative evidence presented on the impact of AI on improving educational effectiveness and academic outcomes?	(+1) Yes/ (+0) No

Note: Own elaboration (2024)

Conclusions

From the study we conclude that:

- AI in education modernizes teaching, offering personalization and instant feedback, but its use must be balanced to avoid dependency and encourage critical thinking.
- Students perceive AI positively, seeing it as a valuable tool to enhance the academic experience and solve problems, although they may initially feel insecure.
- Integrating AI as a complement to the traditional educational process is essential to maximize its benefits without compromising students' holistic development and critical skills.

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