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REVIEW

Artificial Intelligence in Health Education: Opportunities, Ethical Constraints and Pedagogical Challenges

Inteligencia Artificial en la Educación de Salud: Oportunidades, Limitaciones Éticas y Desafíos Pedagógicos

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ABSTRACT

Introduction: artificial intelligence (AI) has great potential to transform healthcare and health education. Therefore, we set out to analyze the scientific evidence on the implementation of artificial intelligence in the training of healthcare professionals, considering the ethical limitations of its application and opportunities for competence development.
Method: the research had a qualitative approach, with a descriptive design and a literature review. Eighty-six articles were analyzed, obtained from indexed databases such as Scopus, Web of Science, Redalyc, and Scielo, using keywords in English, Portuguese, and Spanish. The information was organized in an Excel matrix for analysis through critical reading using the CASPe method to evaluate the scientific quality of the studies.
Results: the implementation of AI in health education improves personalized learning, clinical simulations, and decision-making through data analysis. However, its use carries risks such as the dehumanization of the training process and excessive dependence on technology. Therefore, it is necessary to train teachers and establish ethical limits that ensure a balance between innovation and critical thinking.
Conclusion: artificial intelligence is revolutionizing health education by improving learning and clinical skills. However, it poses ethical challenges that require regulation and responsible use. Its successful integration requires balancing technology and the inclusion of human values.

Keywords: Learning; Ethics; Education; Artificial Intelligence.

RESUMEN

Introducción: la inteligencia artificial (IA) tiene un alto potencial para transformar la atención médica y la ducación en salud; por lo que se planteó analizar la evidencia científica sobre la implementación de la inteligencia artificial en la formación de profesionales de la salud, considerando las limitaciones éticas de su aplicación y oportunidades en el desarrollo de competencia.
Método: la investigación tuvo un enfoque cualitativo, con diseño descriptivo y de tipo revisión bibliográfica, se analizaron 86 artículos, obtenidos en bases indexadas como Scopus, Web of Science, Redalyc y Scielo, usando palabras clave en los idiomas de inglés, portugués y español. La información fue organizada en una matriz en Excel para su análisis realizado a través de la lectura crítica con el método CASPe para evaluar la calidad científica de los estudios.
Resultados: la implementación de la IA en la educación en salud mejora el aprendizaje personalizado, las simulaciones clínicas y la toma de decisiones mediante el análisis de datos. Sin embargo, su uso conlleva riesgos como la deshumanización del proceso formativo y la dependencia excesiva de la tecnología. Por ello, se requiere capacitar a los docentes y establecer límites éticos que aseguren un equilibrio entre

innovación y pensamiento crítico.
Conclusión: la inteligencia artificial está revolucionando la educación en salud al mejorar el aprendizaje y las competencias clínicas. Sin embargo, implica retos éticos que requieren de regulación y uso responsable. Su integración exitosa requiere equilibrar tecnología e inclusión de valores humanos.

Palabras clave: Aprendizaje; Ética; Educación; Inteligencia Artificial.

INTRODUCTION

(AI) has great potential to transform healthcare globally; however, its implementation poses challenges in terms of ethics and human rights. It should be noted that, according to the World Health Organization (WHO), AI can improve processes in diagnosis and research, facilitate access to health services, and strengthen the training of health professionals.[1]

However, the WHO calls for caution regarding the integration of artificial intelligence in health education, considering that these tools represent promising opportunities to improve teaching and learning processes; however, their use involves significant risks, such as misinformation, the use of personal data without consent, and the possible generation of clinical errors. Therefore, there is a need for rigorous evaluations prior to the widespread adoption of these technologies to ensure their safe and ethical use in health-related educational contexts.[2]

In this context, the digital transformation of the health sector involves significant cultural changes, which must be guided by principles that guarantee informed decisions and inclusive policies, considering that universal connectivity is essential and should be considered a social determinant of health, as well as digital goods, software, and open data, which must be scalable and adaptable to diverse realities.[3]

It should be noted that in higher education, artificial intelligence is integrated through tools such as self-learning platforms and robotics systems, which optimize communication and provide support to students outside the classroom, thereby facilitating their academic progress. These tools also promote autonomous and collaborative learning; however, it is essential to maintain a balance between technology and human interaction, especially in health training, where professionals provide care to people. For this reason, the incorporation of AI into curricula will foster confidence in its use within the health system, given its predictive and diagnostic potential.[4,5]

For this reason, artificial intelligence has great potential to modernize health professionals and health education; therefore, its progressive integration into healthcare practice requires that staff and students in training understand its uses, advantages, and limitations for ethical and safe application.[6,7]

It should be noted that digital evolution is profoundly changing the professional paradigm in the health sciences, impacting not only operational and administrative aspects, but also the educational sphere. This has created a need for academic training that adapts to the new demands of the digital environment, focusing on the use of educational technologies, the transformation of learning environments, and the integration of AI into the curriculum or study plans, defining the role of both teachers and students in the training process.[8,9]

In this sense, AI programs are complementary tools in operational, care, management, and research work, as well as at the educational level, facilitating the teaching-learning process, focused on autonomy and critical-reflective thinking, and how to use it at a professional level.[10,11]

That is why artificial intelligence is presented as an innovative, useful, and practical technological tool with high potential to transform the way healthcare is provided, with the aim of improving health outcomes. which is essential to promote its effective application as a valuable resource within the healthcare field, through promotion and incorporation in the generation of new knowledge from academic training, which will allow us to face the current challenges of the healthcare system. [12,13]

The literature reviewed above highlights the inherent need to explore how intelligence is integrated into education. Therefore, the objective of this study was to analyze the scientific evidence on the implementation of artificial intelligence in the training of healthcare professionals, considering the ethical limitations of its application and opportunities for the development of competence.

METHOD

A qualitative approach was used to facilitate reflective understanding and interpretation within a contextual framework of the implementation of artificial intelligence in the education of health professionals. Likewise, the descriptive design focuses on detailing the characteristics of a phenomenon in an organized and accurate manner. Similarly, a literature review facilitated the structuring, categorization, and summarization of the available information to provide a clear description of the object of study.[14]

In this sense, the study population consisted of all scientific articles found on the subject of intelligence in

health education; the selection of these articles was carried out through convenience sampling. This method facilitates a deep understanding of subjective elements such as artificial intelligence, education, and health.

Inclusion criteria:

- Original scientific articles.
- Published within the last 5 years.
- Research on topics related to work-related stress in healthcare personnel.

Exclusion criteria:

- Studies from institutional repositories.
- Essays.
- Review articles.

Therefore, data collection was carried out by a researcher who conducted systematic searches in various scientific databases such as Scopus, Science Direct, Web of Science, Redalyc, PubMed, and Scielo, integrating keywords in English (artificial intelligence, health, education), Spanish (Inteligencia, Artificial, Salud, educacion), and Portuguese (inteligência artificial, saúde, educação). To this end, structured search strategies were used, employing Boolean operators (AND and OR) and keywords relevant to the subject under study, which facilitated the identification of relevant and recent scientific documents, resulting in a sample of 30 studies.

In addition, the selection was made using non-probability convenience sampling and reviewed by another researcher to validate compliance with the selection criteria. The information obtained was systematized in an Excel matrix, which included elements such as the name of the authors, year of publication, summary, method used, results, conclusions, and references, which allowed the studies to be organized according to the questions posed.[15]

For the analysis, a critical reading was carried out using the CASPe method rubric, favoring a reflective assessment of the quality of the selected articles, focusing on their accessibility, availability, and scientific value. It should be noted that this was verified by another researcher.[15]

DEVELOPMENT

Opportunities presented by the integration of artificial intelligence in the education of health professionals

Artificial intelligence (AI) in health education has made it possible to personalize learning, adapting to the pace and level of each student through safe clinical simulations that reinforce practical skills without putting patients at risk, through the generalization of updated content based on scientific evidence, which offers immediate feedback to improve performance. It also promotes equity by adapting to different contexts, taking into account that its application strengthens the acquisition of digital skills essential for effective performance in the contemporary clinical environment.[16,17]

In this sense, it replaces traditional physical models, providing a more interactive and personalized experience. AI expands educational possibilities by enabling safe clinical simulations that are accessible at any time, improving assessment through objective analysis and preparing future professionals for an increasingly technological clinical environment.[18]

Likewise, the integration of AI into medical education represents a fundamental opportunity to improve both the quality and access to education, providing immediate feedback, streamlining the training process, and improving pedagogical decision-making, which contributes to democratizing medical knowledge, eliminating geographical barriers, and facilitating the digitization of knowledge.[19,20]

Furthermore, AI prepares students for digital clinical environments and promotes the development of critical thinking and innovation, which improves clinical decision-making with real-time data analysis and facilitates the research process in the field of health, transforming education and leadership in healthcare training.[21,22]

In turn, it automates assessments, ensuring objectivity and reducing the workload of teaching staff, promoting the development of digital and ethical skills essential for modern clinical practice. Similarly, it allows the creation of educational content tailored to the student's level, making learning more efficient. This contributes to the design of training programs focused on critical thinking and ethical-legal autonomy in its use.[23,24]

Therefore, artificial intelligence has the potential to improve access to information, refine diagnoses, and reduce clinical errors. It should be noted that its application under supervision processes enables the writing of scientific texts and the promotion of academic research in the field of health.[25]

Ethical limitations on the use of artificial intelligence in the training of healthcare professionals

The inappropriate use of chatbots in healthcare promotes the loss of clinical skills due to technological dependence, as well as a lack of transparency in data focused on personal information security, honesty in the

academic field, and equal opportunities to access these technological tools.[26]

It should be noted that the massive handling of health data raises concerns about informed consent and patient privacy, as well as responsible ethical attitudes on the part of students regarding the application of AI to reduce existing biases, affecting equity in healthcare, focusing on the difficulty of interpretation due to excessive dependence on these tools, which can limit the development of essential medical skills.[27]

Likewise, the incorporation of artificial intelligence into medical training presents barriers that can harm the relationship between the physician and the patient, due to the possible reduction in direct human interaction, considering a lack of preparation among students to communicate the associated ethical risks. In addition, the technological infrastructure and licenses required for implementation and administration represent an investment for higher education institutions.[28,29]

In this regard, the absence of clear regulations, protocols for their application, and the lack of adequate supervision complicate their safe implementation. Therefore, there is an urgent need to create ethical and legal frameworks to guide their use. At the same time, the lack of digital skills delays their application, as well as issues related to the risk of plagiarism in academic and research activities.[30,31]

On the other hand, it is necessary to strengthen mechanisms for anonymizing information in medical education, considering that this may violate the privacy of individuals or clinical cases used for professional training. Furthermore, the use of artificial intelligence can lead to excessive dependence, which weakens autonomous clinical judgment, considering these essential skills in high-demand and complex clinical settings, affecting critical reflection, clinical judgment, and decision-making.[32,33]

Similarly, AI also lacks the depth to generate ethical recommendations that are applicable in real-world contexts. Therefore, its use must be accompanied by constant human supervision. The presence of experts is key to validating and enriching the content generated. This ensures more comprehensive and responsible ethical training.[34,35]

Pedagogical challenges in the integration of artificial intelligence in the training of healthcare personnel

Artificial intelligence is transforming university education, highlighting its ability to personalize learning and improve administrative processes. However, its implementation faces challenges such as poor teacher training, resistance to change, and ethical dilemmas about the use of data. In healthcare training, these challenges are intensified by the lack of specific training, the need to adapt curricula, and the technological limitations of many institutions. In addition, there are concerns about equity in access to these tools and the protection of privacy. Overcoming these barriers requires comprehensive strategies that include teacher training, clear policies, and collaboration among educational stakeholders.[36]

Likewise, the implementation of artificial intelligence in medical education faces significant pedagogical challenges. One of the most relevant is preserving academic integrity, since inappropriate use of these tools can encourage plagiarism and limit critical thinking. Added to this is the absence of clear guidelines for their ethical integration into educational programs, which creates uncertainty in the teaching environment.[37,38]

In turn, the lack of academic preparation limits nurses' ability to adapt to technological advances in their daily practice. It is therefore urgent to design educational programs that integrate both the technical fundamentals and the ethical dilemmas of AI.[39] Similarly, resistance to change centered on doubts about the value or permanence of these tools, as well as the lack of technological infrastructure in some institutions, represents a significant barrier.[40] On the other hand, ethical concerns, especially regarding data privacy and equity, remain a challenge for analysis for their application by higher education institutions.[41]

It should be noted that incorporating artificial intelligence into the teaching of clinical anatomy has several challenges. One of the main ones is the limited ability of these tools to recognize anatomical variations, a crucial aspect of medical training. Other challenges include tensions related to clinical practice, equity, student support, and the development of critical thinking. These aspects reflect that AI is not yet fully adapted to the educational complexity of anatomy. In view of this, actions are proposed with greater transparency, diversity in AI development, and technology-free learning spaces. These measures seek a more ethical and conscious implementation in medical education.[42,43]

On the other hand, the integration of chatbots into artificial intelligence, such as ChatGPT, in nursing education, one of the main challenges identified is the excessive dependence on these tools, which could limit the development of critical thinking and encourage practices such as plagiarism if not used properly. Similarly, the inadequacy and usefulness of the recommendations generated by the system in clinical cases.[44,45]

CONCLUSIONS

Artificial intelligence (AI) is transforming health education by facilitating more personalized learning, advanced clinical simulations, and assisted diagnostics, which improves the development of skills in future professionals. However, this technological revolution also requires a rethinking of traditional teaching methods, integrating new forms of teaching focused on human-machine interaction. Scientific intelligence has a positive

impact in terms of its effective implementation in educational settings.

Therefore, despite its potential, the use of AI in health education raises important ethical dilemmas related to privacy, equity of access, and the dehumanization of learning. These challenges demand clear regulation and critical training in the responsible use of these tools. For this reason, the path to effective integration requires a balance between technological innovation and human values.

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