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REVIEW

Artificial intelligence, education and digital inclusion

Inteligencia artificial, educación e inclusión digital

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ABSTRACT

Introduction: the rapid development of human scientific endeavor has enabled the implementation of increasingly automated systems that facilitate certain functions and processes in all spheres of life.
Objective: to describe the application of artificial intelligence in education as a strategy to ensure digital inclusion.
Method: a comprehensive literature review was conducted. The search was conducted in: SciELO, PubMed, and SCOPUS, repositories, and the Google Scholar search engine. The search strategy consisted of descriptors. 32 papers were used to develop this article.
Development: AI provides significant tools, from the graphic representation of content in educational contexts to the creation of conceptual maps and the development of tests to validate acquired knowledge. However, its use must be urgent without losing the guiding and methodological thread, always recognizing that the goal is the acquisition of knowledge. Universities require projection at different scales to present their results for the sake of sociocultural and academic scientific development. With the implementation of AI, this outreach function can be fulfilled, guaranteeing direct and personalized access and promoting digital inclusion.
Conclusions: the use of AI in educational subjects offers new platforms and work scenarios. Each of its capabilities adapts to the specifics of the educational environment, while also enhancing easy, affordable, and universal access to educational content.

Keywords: Education; Educational Environments; Digital Inclusion; Artificial Intelligence.

RESUMEN

Introducción: el vertiginoso desarrollo logrado por el quehacer científico del hombre ha permitido la

implementación de sistemas cada vez más automatizados que facilitan determinadas funciones y procesos en todas las esferas de la vida.
Objetivo: describir la aplicación de la inteligencia artificial en el ámbito educacional como estrategia para garantizar la inclusión digital.
Método: se desarrolló una revisión bibliográfica exhaustiva. La búsqueda fue realizada en: SciELO, PubMed y SCOPUS, repositorios y el motor de búsqueda de *Google Scholar*. La estrategia de búsqueda quedo integrada por descriptores. Para el desarrollo del presente artículo se emplearon 32 trabajos.
Desarrollo: la IA aporta notables herramientas desde la representación gráfica de contenidos de forma didácticas hasta la elaboración de mapas conceptuales y la elaboración de test para la validación de conocimiento adquirido. Sin embargo, su uso debe ser con premura sin perder el hilo conductor y metodológico; siempre reconociendo que la finalidad es la adquisición del conocimiento. Las Universidades requieren de una proyección a diferentes escalas con el objetivo de la presentación de sus resultados en pos del desarrollo socio-cultural y académico científico. Con la implementación de las IA puede cumplimentarse esta función extensionista; garantizar el acceso de forma directa y personalizada promoviendo la inclusión digital.
Conclusiones: el uso de la IA en materias educacionales ofrece nuevas plataformas y escenarios de trabajos. Cada una de sus facilidades se adapta a las particularidades del entorno educativo; a la vez que potencian el acceso a los contenidos educativos de forma fácil, asequible y universal.

Palabras clave: Educación; Entornos Educativos; Inclusión Digital; Inteligencia Artificial.

INTRODUCTION

The vertiginous development achieved by the scientific work of man has allowed the implementation of increasingly automated systems that facilitate certain functions and processes in all spheres of life. In this sense, artificial intelligence (AI) has gained ground and has become the protagonist of multiple scenarios previously considered difficult to access. Medicine, research, and education are just some scenarios in which it has achieved its most significant prominence.

Digital inclusion in educational environments comprises various aspects that must be managed and classified by groups or categories. These include digital infrastructure, economic infrastructure, knowledge and skills in using information and communication technologies (ICTs), and the application of new developments in digital matters.[1]

Educational environments and universal access for all are key aspects of the Sustainable Development Goals (SDGs) as they include the universal application and access to ICTs affordably and universally. However, there are still situations where the limitation gaps are marked, as in the case of Latin America, with an Internet access rate of 70 % and an average annual growth rate of 8 %.[2] This situation poses limitations for developing inclusive educational environments.

The use of AI in educational spaces dates back to the 1970s and 1980s when computer-assisted educational schemes began to be developed. In these years, AI (albeit in its infancy) created educational environments and applied intelligent tutoring methods to ensure education for all students through accessible language. Since then, and today, man has witnessed the ever-increasing development of AI and its countless applications.[3]

In education, using information and communication technologies (ICTs) has opened up new scenarios for developing a broad educational environment for all. It guaranteed the implementation of new forms of education, such as distance or blended learning. It also allowed the training and increase of the professional preparation of teachers and the autonomy of students in managing their knowledge.[4]

In addition to this aspect, the use of AI in educational environments has allowed (in turn demonstrated) an improvement in each of the educational processes by ensuring adaptive educational environments according to the needs of each student; it facilitates the acquisition of knowledge by the student in an environment with better inclusive opportunities and the generation of a greater sense of commitment of the parties involved in academic training as referred to by Zainab Rasheed et al.[5] in their research entitled Harnessing Artificial Intelligence for Personalized Learning: A Systematic Review. Criteria supported by other studies such as Zouheir Boussouf et al.[6], Palomino Quispe et al.[7], and Gómez Cano et al.[8]

The different educational processes require constant updating to guarantee the quality of academic training. The use of technology and information opens up new tools for learning and the development of student autonomy. In this sense, AI is a valuable and easy-to-use tool for and by all. However, its use should complement training strategies for its improvement and as a form of universal access to different educational environments. Based on the above, the objective of describing the application of artificial intelligence in the academic environment as a strategy to ensure digital inclusion was proposed.

METHOD

To fulfill the proposed objective, an exhaustive bibliographic review of research of different types on the application of artificial intelligence in education as a way of guaranteeing digital inclusion was carried out. The search was carried out in the main databases: SciELO, PubMed, and SCOPUS, in addition to other sources such as directories and repositories (Dialnet, DOAJ, and Latindex) and the Google Scholar search engine.

The search strategy was integrated by the following descriptors (with their equivalents in English): Education, Educational environments, Digital inclusion, and Artificial Intelligence (to achieve greater efficiency in the search). They were linked using the Boulenaean operators. Articles whose abstracts and titles were related to the central theme of the research were selected. Forty-seven research papers were identified; 32 were used to develop this article. The analysis of each was carried out based on theoretical methods.

DEVELOPMENT

With the rapid development of new technologies, especially AI, a new concept has emerged called machine learning. This knowledge management system is based on using technological tools to create new educational systems based on virtual environments. In this sense, AI tools have emerged as new alternatives to the teaching process through the application of digital and intelligent tutoring systems, teaching robots, and others that have ensured an improvement of traditional learning systems with a greater adaptive and inclusive approach for students and teachers.[9]

Alongside this development, digital competencies are presented as a necessity (and, at the same time, a new opportunity) as elements to adapt to automated management systems. In this sense, the use of AI opens up new opportunities for the development and enhancement of digital competencies, skills that are considered key elements for achieving universal digital inclusion in all human spheres: educational, social, and others.[10]

Undoubtedly, the application of artificial intelligence opens up new horizons for the socialization of knowledge (both academic and scientific). Each individual is guaranteed open, equitable, and differentiated access. They are given autonomy for the management of knowledge.

Digital inclusion and education. Conceptual bases from an AI perspective

The term e-inclusion arises from the agreements from the World Information Summit held in 2003. It arose as the participating governments needed to guarantee an approach that includes public education for all through the use of technologies. However, since 2003, its conceptual definition has changed; its purpose has been changed.[11]

E-inclusion, from its pedagogical or educational approach, aims to ensure accessible education and learning processes for all based on digital tools and the development of virtual competencies of all its participants.[12] It is presented as a growing need and alternative to achieve a rational and beneficial use of digital tools, always based on policies and good practice guidelines.

The growing interest of researchers in using digital AI tools in educational environments to achieve digital inclusion is evidenced by projects focused on evaluating the applications of these tools in different areas. One example is the Education Sector Fund's projects based on digital inclusion.[13] In its 2024 report, a large number of projects are listed, including the following:

- Networks and digital inclusion: incidences and characterizations for creating communities promoting deep learning in Uruguay and Chile's public teacher training centers.
- Learning Mathematics through interaction with peers and intelligent machines.
- Learning social skills in people with intellectual disabilities and people with normative development through digital technology.
- Deep learning in the Exact Sciences through inclusive digital networked challenges
- Development of language teaching support tools using Artificial Intelligence techniques
- Using teacher- and learner-centered artificial intelligence to analyze inclusive and resilient teaching and learning processes
- Digital barriers: the challenges of adults facing the AcreditaCB test
- Co-designing teaching and learning strategies that include digital technologies in STEM.

Each of these projects is based on the premise of digital inclusion linked to training processes by applying new technologies, including AI. The new digital tools open up spaces that can be used to guarantee education and the socialization of knowledge in all educational plans. At the same time, they should not only be framed in academic training but also in educational strategies for all social sectors to respond to specific problems: health (educational talks, among others), with an environmental focus, and more.

Countries such as Ecuador analyze the importance and need for the application of AI in educational processes to guarantee digital and educational inclusion in all scenarios. At the same time, its transformative and affordable role is highlighted if it is used for educational purposes and based on scientific evidence.[14]

Contribution of AI to e-Inclusion in the educational process

Evidence shows that AI's input and contribution can be seen from the macro-structural point of view (at the level of training institutions or centers) and at the micro-structural level (training processes exemplified by programs or projects).

From the framework level, AI offers new tools not only for managing and organizing educational projects and plans. It also contributes to the generation of competitive skills in the framework of institutional communication and digital marketing strategies.[15,16,17]

As educational and research centers, universities require projection at different scales (social, international, and specific groups) to present their results in pursuit of socio-cultural and scientific academic development. With the implementation of AI, this extensionist function can be fulfilled by guaranteeing direct, sectorial, and personalized access to each group. Digital inclusion is promoted and developed.

One indispensable function of education (at any level) is to train and improve learners' skills. In this sense, developing specialized human capital in the various sectors of society is key to ensuring scientific and technical development. AI has revolutionized training processes as a tool for perfecting talent and developing human capital.[18,19]

However, according to the results shown by researchers such as Estrada-Araoz et al.[20], the evaluation of knowledge in relation to the use of AI and its applications in educational processes in higher education is not satisfactory. In this sense, ignorance and divergent opinions on the innumerable benefits of AI prevailed. On the other hand, other studies have shown encouraging results regarding teachers' knowledge and preparation for AI's benefits.[21]

Functions include data management and analysis, project management, and marketing strategies. Others, such as optimization and personalization of the knowledge system and active learning, are just some of the benefits of AI in educational matters. On the other hand, some scientists and educators are understandably concerned about the implications or risks of excessive and disproportionate implementation of these tools, which is mainly based on bad ethical practices.[22,23,24] Therefore, the workaround for these tools should be bimodal: promotion with caution.

New tools must nourish educational processes for the perfection of each curricular strategy. AI provides remarkable tools, from the graphic representation of contents in a didactic way to elaborating concept maps and tests to validate acquired knowledge. However, its use must be done with haste without losing the guiding and methodological thread, always recognizing that the aim is gaining knowledge.

Education and research must go hand in hand to guarantee the development of students and learners. Universities have the mission of training based on the historical precepts of knowledge in coordination with the advances achieved in the area of expertise where they are developed.

Intelligent tutors are AI tools that open new academic and research training scenarios. Their inception dates back to the 1960s, and their refinement has allowed the conjunction of cognitive psychology, educational research, and computing, enhanced by the development of ICT, perfected with AI. They offer all students an equitable and inclusive academic environment.[25]

Not only university education has witnessed the rapid rise of AI tools. Different special education forms apply and refine their educational methods by implementing these tools. According to the research developed by Rodríguez Torres et al.[26], through the application of AI, tools adapted to the needs and/or disabilities of each student are offered. Educational processes have been improved by integrating (primarily didactic) ways of learning and assessment. All these tools are based on a personalized approach that guarantees digital education and inclusion.

These criteria are supported by studies such as the one developed by Muñoz Morán[27] and Ruiz Muñoz et al.[28] Their research collects the positive assessments and opinions of teachers and educators in special education centers. Teachers recognize the importance of new technological tools in preparing feasible and accessible educational environments for people with disabilities and emphasize their right to digital inclusion.

In relation to scientific research, AI tools offer opportunities for the analysis of large sources of information and data; a stage of the research process that in human hands can take considerable time. They also offer new theories or predictive models that can be used as simulators or experimental means for hypothesis testing and validation of surveys without the involvement of humans or animals in invasive procedures.[29,30]

AI-generated or AI-mediated virtual environments for education provide digitally inclusive spaces. According to a study by Bernedo-Moreira et al.[31], their results show that AI offers enriching spaces for learning where knowledge is inclusive, accessible, and effective. It positively influences learning autonomy through learner-mediated control over the educational process.

While AI can optimize the educational process, it must be valued and applied to develop students' critical thinking and ensure quality academic training. On the other hand, its use must be monitored periodically to validate that it does not incur practices that are reprehensible from an ethical point of view.[32] Conditions that can generate negative opinions and rejection from the scientific and academic community in the continued use

of these tools can undoubtedly facilitate each of the processes in which man interacts.

CONCLUSIONS

The use of AI in educational subjects offers new platforms and work scenarios. Each of its facilities adapts to the particularities of the academic environment; at the same time, they enhance access to educational content in an easy, affordable, and universal way. AI-based digital inclusion is growing exponentially; it requires greater facilities while analyzing its results (positive or negative) to achieve a rational and facilitating use of education at all levels.

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