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Review Article

Artificial Intelligence, Health and Education

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Abstract

The field of Artificial Intelligence (AI) has gained significant interest recently due to increased public awareness of its potential as a pivotal instrument across a wide range of disciplines, including industry, telecommunications, engineering, health, and education. AI algorithms require careful consideration of the training process, which necessitates an amount of data that has been evaluated and, in some cases, curated by the developers themselves to generate accurate and efficient models. The influence of AI on various sectors, including healthcare and education, has been substantial.

In the domain of healthcare, algorithms have been developed that possess the capacity to detect and diagnose various medical anomalies. A notable illustration of this is its utilization in the early diagnosis of chronic diseases, such as cancer. In this context, the employment of machine learning models has been shown to exhibit a high degree of accuracy in the analysis of medical images, clinical histories, and physiological patterns. This, in turn, has the potential to enhance the quality of medical care and reduce response times.

Conversely, within the domain of education, AI has facilitated the development of customized teaching and evaluation systems that can adapt to the pace and learning style of each student. These technologies not only facilitate teaching in virtual environments, but also promote autonomous learning, strengthen student motivation, and provide immediate feedback, making the educational process more efficient.

Introduction

Artificial Intelligence (AI) is a field of science and engineering that focuses on the creation of algorithms, machines, robots, search engines and information processing systems to perform tasks that normally require an understanding of several variables in a similar way as a human expert would visualize them, incorporating features like learning, reasoning, and perception [1].

Data-driven tools enable decision-making comparable to expert judgment, thereby generating a growth in the diversification of applications. This growth can be attributed to the development of sophisticated algorithms, including Support Vector Machines (SVM), random forests, and clustering algorithms such as KNN, as well as Artificial Neural Networks (ANN), among others [2].

A fundamental component of any Artificial Intelligence algorithm is the process of training. The process entails the loading of a set of data, intending to adjust the values and points of intersection of information within the algorithms themselves to a defined response (supervised algorithms) or to determine the detection of patterns if the outputs are not defined (unsupervised algorithms) [3]. As illustrated in Figure 1, the training process of a neural network algorithm is depicted.

In this sense, generative AI employs deep neural networks and transformational models capable of learning complex representations of language, image, or clinical data, generating original results from such data [1].

Artificial intelligence in education

The integration of generative artificial intelligence within educational frameworks has precipitated substantial progress in the realm of personalized learning. This technology extends beyond mere information replication; its algorithmic architecture makes it possible to generate original content that

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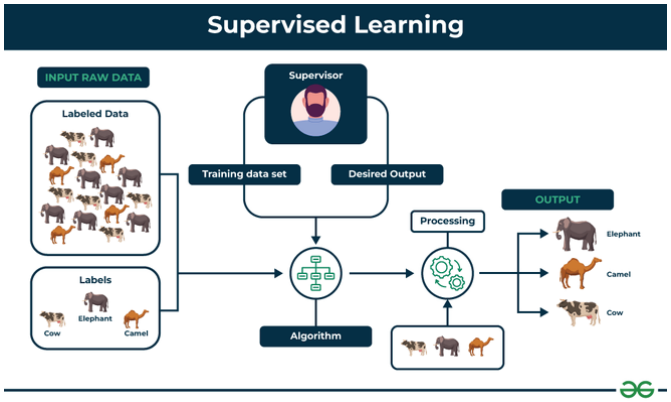

Figure 1: Representative diagram of the supervised training of a neural network [4].

responds to the specific needs of the user. In this regard, virtual tutoring systems have been developed that employ AI to adjust the level, format, and pace of educational content according to the student's profile [5,6].

At the operational level, these systems integrate automatic learning models that analyze the student's performance history and predict which content or activities represent greater effectiveness in their training process. This predictive capacity is made possible by the training of the algorithms with historical, behavioral, and academic performance data, which generates a dynamic model of pedagogical support. This results in a more efficient, student-centered educational experience that acknowledges both the strengths and areas of opportunity of the students.

Conversely, the integration of artificial intelligence within institutional management has been instrumental in the development of analytical tools that facilitate the identification of patterns within student performance, attendance, participation and progression data. Consequently, managers are empowered to make informed decisions regarding evaluation policies, curriculum modification or resource allocation [7]. This form of administrative intelligence has been shown to have considerable value in elementary, middle and higher education.

In addition, generative AI has opened up new possibilities in the design of educational materials. Through its use, it is possible to generate explanatory texts, mathematical examples, interactive assessments and even personalized scientific simulations. These resources not only enrich the student experience, but also free teachers from repetitive tasks, allowing them to focus on more creative and reflective pedagogical strategies.

Some of the artificial intelligences with a focus on education are described in Table 1, in which, the name of the AI, its main use, school characteristics and the web page to explore are indicated.

Table 1: Artificial intelligences for the area of education.

AI name	Primary use	Description	Website
Magic School AI	Productivity tool for educators	Assists teachers in generating lesson plans, rubrics, differentiation, activity ideas, communicating with parents and creating assessments, saving time on administrative tasks.	magicschool.ai
ChatGPT / Google Gemini	Generative language models	Teachers can use them to generate ideas, draft texts (announcements, mailings), summarize complex articles, create customized study materials and generate test questions	chat.openai.com / gemini.google.com
Classroomscreen.com	Classroom management and visualization tool.	Helps teachers manage time, display clear instructions, organize activities, generate random groups, use timers and draw directly on the screen, facilitating classroom dynamics.	classroomscreen.com
Quizlet	Interactive study platform.	Allows teachers and students to create and share flashcards, quizzes and interactive games to effectively learn vocabulary, review concepts and prepare for exams.	quizlet.com
Turniti	Turniti Plagiarism detection and writing assistance	Used by educators to check the originality of students' work and provide feedback on the grammar, style, and structure of their writing, encouraging academic integrity.	turnitin.com

AI tools in education, supported by recent literature [6,7].

Artificial intelligence in healthcare

The healthcare sector has been one of the most significantly impacted by the integration of Artificial Intelligence (AI) technologies, particularly those designed to generate personalized diagnoses, prognoses, and treatments. Generative AI, as it pertains to education, is not confined to data classification; it is capable of producing inferences, and original clinical content from large volumes of both structured, and unstructured medical data.

One of the fields in which its impact is most visible is that of medical imaging. Machine learning algorithms, trained on large datasets of diagnostic images, such as X-rays, MRI scans, and CT scans, have been demonstrated to enhance diagnostic accuracy [8]. These tools have the capacity to detect subtle patterns that may not be perceived by even the most specialized personnel. Consequently, they offer an automated second opinion in real time.

Furthermore, the advent of generative models has facilitated the development of bespoke treatment regimens, meticulously tailored to the clinical profile of each patient. The analysis of variables such as genetics, comorbidities, treatment history, and drug response enables AI to propose personalized therapeutic strategies that optimize clinical outcomes [9,10]. This personalization capability is pivotal in addressing complex and chronic diseases, where conventional approaches have considerable limitations.

However, the use of artificial intelligence in medicine is not without its challenges. One of the main concerns is the quality of the data used to train the models. Incomplete, biased, or mislabeled data can lead to erroneous decisions with serious consequences for the patient. Therefore, model validation, human supervision, and transparency in training processes are critical elements to ensure clinical safety [11].

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Some of the artificial intelligences with a focus on health are described in Table 2, in which the name of the AI, its main use, school characteristics, and the web page to explore are indicated.

Results

A review of recent literature, and current developments in Artificial Intelligence (AI) reveals that machine, and generative learning models are being adopted more quickly in the healthcare, and education sectors. This advance has optimized traditional processes, and significantly transformed user-system interactions, promoting more personalized, adaptive, efficient decision-making environments.

In education, systems based on generative AI have produced positive results in personalizing educational content according to students' individual characteristics. Supervised, and unsupervised algorithms enable adaptive systems that respond to user needs in education, and healthcare [3]. Similarly, these tools have demonstrated predictive capacity with respect to academic performance, enabling more timely and informed pedagogical interventions. However, these technical benefits have also raised ethical concerns, such as the potential for biases present in historical data to be replicated, which could affect certain student groups disproportionately.

Conversely, the integration of AI within educational management has facilitated enhanced decision-making through automated analysis of variables such as attendance, performance, and participation. This approach has contributed to improved institutional policies, more efficient resource allocation, and more strategic management. However, it is important to note that over-reliance on these systems has the potential to displace professional teaching judgment, particularly in cases where critical evaluation of AI-generated outcomes is not incorporated.

Table 2: Artificial intelligences with a health focus.

AI name	Primary use	Description	Website
IBM Watson Health	Analysis of clinical, and imaging data for diagnostic support in oncology, radiology, and cardiology.	Helps clinicians review large volumes of patient data, including records, medical literature, and imaging results, to identify patterns, and suggest possible diagnoses or treatments, especially in complex cases.	ibm.com/watson-health (Nota: IBM ha reestructurado Watson Health, sus soluciones están ahora más integradas en áreas específicas de salud).
Google Health / DeepMind Health	Early detection of eye diseases (e.g. diabetic retinopathy), and support in the interpretation of medical images.	Deep learning algorithms to analyze retinal scans, MRI, or CT scans, identifying subtle signs of disease that might be difficult for the human eye to detect with the naked eye.	health.google
PathAI	Diagnosis, and prognosis in pathology through the analysis of biopsy images.	AI to analyze digitized pathology slides, assisting pathologists in identifying, and quantifying cancer cells, classifying tumors, and predicting disease progression.	pathai.com
Viz.ai	Detection and classification of cerebrovascular accidents (CVA) and other vascular pathologies in tomography images.	Alerts medical teams quickly to potential stroke cases on CT scans, optimizing crucial treatment times by identifying occlusions in cerebral blood vessels.	viz.ai

Table 2 presents AI applications in healthcare, drawing on recent studies [8,9].

In the field of healthcare, these advances are of equal significance. The implementation of deep neural networks has led to a significant enhancement in the accuracy of early diagnosis of complex diseases, including cancer, cardiovascular conditions, and neurological disorders. AI systems, trained on large datasets, identify subtle patterns in clinical and educational data, enhancing diagnostic and predictive capabilities. Nevertheless, however, the 'black box' nature of many models raises concerns about decision traceability, particularly in contexts where diagnostic explanation is essential for both patient confidence and medical validation.

Conversely, generative models have facilitated the construction of personalized therapeutic plans that integrate multiple clinical variables, such as genetic profile, medical history, and response to previous treatments. This adaptive capacity has resulted in tangible improvements in the quality of medical care and health outcomes. However, the increasing automation of processes has also exposed risks related to the loss of clinical skills in healthcare professionals, as well as the urgent need to establish clear regulatory frameworks that delineate responsibilities in case of errors attributable to AI.

The findings, when considered collectively, underscore the transformative potential of AI in sensitive, and complex contexts. Notwithstanding its numerous technical advantages, the ethical, and effective implementation of AI remains contingent on human oversight, algorithmic transparency, and the establishment of regulatory frameworks that guarantee fairness, privacy, and accountability. In such cases, technology should not be regarded as a substitute for human judgment; rather, it should be considered a complement that enhances human capabilities when utilized in a critical, and contextualized manner.

Conclusion

The integration of artificial intelligence within the health, and education sectors signifies a disruptive advance with considerable transformative potential. The results of the analysis demonstrate significant enhancements in efficiency, personalization, and predictive capacity, both in the domain of medical care, and in the context of teaching-learning processes. Nevertheless, it is imperative to judiciously balance these technical benefits with ethical, social, and regulatory considerations.

In particular, the application of generative models, and deep learning algorithms poses challenges that cannot be addressed solely from a technological perspective. The opacity of some systems, the potential reproduction of structural biases, and the increasing reliance on automated decisions underscore the need for informed human oversight, as well as robust public policies that ensure transparency, fairness, and accountability.

A number of international organizations have initiated the

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formulation of frameworks for action in this domain. The World Health Organization (WHO) has underscored the significance of ethical principles in the utilization of Artificial Intelligence (AI) within the healthcare sector. The organization has asserted that AI systems must be designed to safeguard patient autonomy, promote equity, and ensure clinical safety. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) has established global recommendations on the ethics of artificial intelligence, proposing regulatory frameworks that integrate human rights, social justice, and sustainability as central axes.

Nevertheless, the effective implementation of these recommendations is still faced with significant barriers, particularly in contexts characterized by limited institutional capacities or scarce critical digital culture. Thus, inclusive, participatory, and contextualized AI governance is essential, capable of incorporating not only the voice of technical experts, but also that of educators, health professionals, policy makers, and user communities.

In summary, the development and integration of artificial intelligence in strategic sectors such as health and education cannot be conceived apart from ethics and regulation. It is asserted that the effective contribution of technological innovation to collective well-being and the reduction of inequalities is contingent upon a balanced approach that articulates technological innovation with humanistic principles and appropriate regulatory frameworks.

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