Generative Artificial Intelligence Systems and the Challenges in Latin American Education

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Abstract

This article examines the transformative role of Generative Artificial Intelligence (GAI) in education, exploring diverse disciplines such as engineering, medicine, programming, and information systems. GAI emerges as a revolutionary force, promising to fundamentally change educational practices. The PRISMA 2020 methodology (Page et al., 2021) was used to evaluate the relevant scientific literature. The systematic review identified research that applied specific criteria in the analysis of IAG in education. The selected papers covered a variety of disciplines, providing a comprehensive view of the impact of IAG in education. The results show a diversity of approaches and institutional responses to IAG in education. From significant changes in teaching practices to the identification of specific opportunities in disciplines such as computer science and engineering, GAI stands out as a catalyst for transformation. The adaptation of tertiary education, the need for specific skills to work with GAI, and ethical responses emerge as key themes. It focuses on the need for a deeper and more consensual understanding of the role of GAI in education. Concrete research-supported opportunities are highlighted, but ethical limitations and concerns are also underscored. Collaboration, reflection, and adaptation to open educational practices are proposed as approaches to address the challenges and fully exploit the benefits of IAG in education. This comprehensive analysis contributes to understanding the current and future landscape of GAI in education, providing valuable guidelines for educators, institutions, and educational technology developers.

Keywords: Artificial intelligence, generative, higher education, ChatGPT, Latin America.

1. Introduction

Generative AI, a significant evolution of artificial intelligence, stands out for its ability to autonomously create new content, from conversations and texts to images and music (Khennouche et al., 2024). In parallel, Natural Language Processing Systems have substantially improved the understanding and generation of human language (Sun et al., 2024), allowing machines to interpret and respond to linguistic expressions with increasing sophistication. This technological convergence poses unique challenges and opportunities, especially in the field of higher education (Khennouche et al., 2024).

In this context, the implementation of technologies such as NLP-based chatbots and generative AI systems in academic environments presents a number of benefits, from accelerating research to improving student experiences and optimizing educational processes (B et al., 2024). However, this progress is not without challenges, and one of the most critical aspects is its effective integration into higher education dynamics (Gao et al., 2024).

This study sets out to take a closer look at how generative AI systems can transform higher education while also identifying and addressing the challenges that arise in this process (Camilleri, 2024). By exploring specific applications, such as accelerating research (Liu et al., 2024), the personalization of the student experience (Nguyen-Mau et al., 2024) and the optimization of academic processes (Xu et al., 2024), will seek to offer a comprehensive vision of how these technologies can contribute to educational progress (Nithithanatchinnapat et al., 2024). In addition, the need to develop effective strategies to overcome barriers such as resistance to change, data privacy, and equity in access to these tools will be critically addressed (Lefebvre et al., 2024).

Development

The constant advancement of Artificial Intelligence (AI) research has marked an era of exponential growth, characterized by the creation of more sophisticated models, expansion of capabilities, and faster responses (Torous & Blease, 2024). This progress translates into generative AI that, when trained on vast data sets, unfolds unprecedented potential (Sahin et al., 2024). However, this power is not exempt from ethical and legal controversies, raising questions about the regulation and scope of its application, especially in the educational field (Cox, 2024).

The transformation in the field of education, particularly in higher education, has been undeniable (Ray et al., 2024). The personalization capacity of AI stands as a tool that can adapt to the pace and individual activities of students, redefining pedagogical strategies and providing a more enriching educational experience (Valova et al., 2024). This technological revolution, however, entails challenges that must be carefully considered, but it also opens up a range of opportunities to optimize and enrich the training process (Fang & Jiang, 2024).

Throughout this exploration, we will take a close look at Natural Language Processing systems and generative AI, focusing on their influence on higher education (Lee et al., 2024). We aim to

critically analyse the challenges inherent in the integration of these technologies in teaching and learning, as well as to identify the innovative opportunities they present to significantly improve the quality and efficiency of higher education in a context where adaptability and personalisation become key elements (Semeler et al., 2024).

Generative Artificial Intelligence

Artificial intelligence (AI) represents an area in computer science responsible for developing systems and programs that give machines human abilities, such as learning and the ability to plan actions, emulating the faculties of people (Mubin et al., 2024). This technological concept has gained prominence in both the personal and professional spheres, covering diverse sectors such as virtual assistants, cybersecurity, medicine and robotics (Bansal et al., 2024). Within the range of existing types of AI, generative artificial intelligence (IAG) stands out. AGI is defined as a type of artificial intelligence with the ability to generate new content, such as music, videos, text, audio or images. IAG models learn patterns and structures from training data and then generate new data with similar characteristics (Deck, 2024).

This type of artificial intelligence uses machine learning models to understand the patterns and relationships present in a human-created dataset, using this information to generate content (Gonçalves & Gonçalves, 2024). Unlike more conventional types of AI, such as analytical or discriminatory, GAI transcends cognitive abilities to delve into the realm of creative skills, generating original information rather than simply recognizing, analyzing, or classifying pre-existing content (Huang et al., 2024).

The accelerated evolution of AI models over the past decade is attributed to access to vast amounts of data available on the internet, allowing IAG to pass medical and legal access exams, write a significant portion of software engineers' code, and develop complex capabilities such as deception (Wu & Zhang, 2024). However, despite technological advances, Álvarez-Pallete highlights the need for cautious reflection and appropriate regulation, pointing out that an uncontrolled IAG represents an existential risk. It warns of the possibility of the IAG generating disinformation, deepfakes or fake news, threatening democracy through massive campaigns of systematic and undetectable disinformation (Mao et al., 2024).

Generative Artificial Intelligence in Education

Technological evolution is redefining teaching and learning paradigms at breakneck speed (Valova, Irena et al., 2024). In this context, generative artificial intelligence emerges as an innovative and revolutionary tool for educators. Advanced algorithms are not only capable of processing information, but also of generating high-quality content autonomously, marking a significant milestone in educational efficiency and productivity (Frick, 2024). IGNITE Serious Play's innovation team is immersed in several key aspects, providing AI-based solutions to address contemporary challenges in education (Umme et al., 2023).

First, the creation of Smart Lesson Units is a focus, where generative artificial intelligence analyzes extensive educational datasets to identify patterns and generate personalized lesson plans, allowing for effective adaptation to individual student needs (Wójcik et al., 2023). A palpable example of this approach is evidenced in a school in Singapore, where the

implementation of generative artificial intelligence systems has led to a significant increase in engagement and understanding of the material (Z. Li et al., 2023).

Likewise, the optimization of multimedia resources is positioned as a prevailing need in modern education (Behrmann et al., 2023). Generative artificial intelligence emerges as an effective solution by automatically selecting and adapting images, videos, and other multimedia resources, improving content understanding and retention. The individualization of learning is another key aspect addressed by generative artificial intelligence, allowing the creation of personalized learning paths adapted to the individual progress of each student (Patrinos et al., 2023). In one school in the United States, this implementation has improved the educational experience, evidencing faster progress and greater student satisfaction (J. Chen et al., 2023). Automatic feedback and intelligent evaluation are a substantial component in the optimization of teaching time (Ali et al., 2023). Generative artificial intelligence takes on this responsibility, providing instant feedback and detailed assessments. Implementation in a school in Canada has resulted in more efficient and accurate assessment, allowing educators to focus on more complex aspects of teaching (Kumar et al., 2024).

The generation of creative content, essential to stimulate students' creativity, benefits from the intervention of generative artificial intelligence (Rajala et al., 2023). At one institution in Spain, this technology has contributed to the creation of multimedia projects and interactive exercises, raising the level of student engagement and making learning more exciting and relevant (S. Chen et al., 2023).

Importance and challenges of Generative Artificial Intelligence

Generative artificial intelligence (AI) emerges as a fundamental tool in higher education, significantly transforming teaching and learning processes (Döring, 2023). Generative AI's ability to create original, personalized content drives a more effective, student-centered educational experience. This technological advance, by employing advanced algorithms and machine learning techniques, presents substantial opportunities for the continuous improvement of educational quality (Bakla, 2023).

In the higher education context, generative AI is proving to be a powerful means of personalizing teaching (Ilieva et al., 2023). By adapting to the individual needs of students, it can generate tailor-made educational content, providing exercises, lessons, and activities that are tailored to each student's knowledge and skill levels. Individualization of learning is crucial to address the diversity of learning styles present in higher education (Michel-Villarreal et al., 2023). In addition to personalizing the learning experience, generative AI facilitates the development of intelligent virtual assistants in academic environments (Bahroun et al., 2023). These assistants can interact conversationally with students, offering instant responses, feedback, and guidance on complex concepts. This approach not only improves accessibility to information, but also promotes autonomy and intrinsic motivation among university students (Alshahrani, 2023).

Despite the obvious benefits, the implementation of generative AI in higher education poses ethical and privacy challenges (Wang et al., 2023). It is imperative to address issues related to transparency and control over the data used by these systems, as well as to avoid biases that may

influence fairness and objectivity. The successful integration of generative AI into academic settings requires careful consideration of these ethical aspects (Metcalf et al., 2023).

Challenges of Generative Artificial Intelligence in Latin America

The introduction of generative artificial intelligence, exemplarily represented by the ChatGPT tool, has marked a transformative milestone in Latin American higher education, according to a study by the investment bank UBS (Gala & Makaryus, 2023). This innovative development, launched in November 2022, has experienced exceptional growth by replicating human conversations naturally and efficiently generating academic texts, captivating the educational community in the region (S. W. Li et al., 2023). ChatGPT's ability to analyze vast amounts of data and generate high-quality content has led to its rapid adoption, positioning itself as an agent of change in Latin American higher education (Dwivedi et al., 2023).

Generative artificial intelligence, in particular ChatGPT, stands out for its ability to amalgamate and analyze a diversity of data, which makes it an essential element in higher education. Technology has proven effective in personalizing the learning experience, generating well-structured educational content, and facilitating interactive virtual assistants (Lozano & Blanco Fontao, 2023). However, the study underscores the imperative need to address ethical and privacy issues to ensure responsible and equitable use of this technology in higher education (Marquez et al., 2023). From an educational perspective, generative artificial intelligence is anticipated to represent a significant advance for Latin America, as evidenced by the positive perception of technology as a transformative resource for teaching and learning (Dalalah & Dalalah, 2023). The active participation of Latin American researchers in understanding the potential of artificial intelligence for educational innovation accelerates the adoption of this technology in the university environment (Emenike & Emenike, 2023).

Practical examples, such as the collaboration between the Ecuadorian government and the World Bank to introduce an AI-based learning platform during the COVID-19 pandemic, highlight the tangible benefits of generative AI in higher education (Walczak & Cellary, 2023). Countries like Brazil are proactively revising their curricula to incorporate artificial intelligence and programming courses, responding strategically to technology-driven changes in education. Despite the enthusiastic adoption of generative artificial intelligence, the study highlights significant challenges, including the need to teach students how to use these tools consciously and ethically. In addition, it is mentioned that the upcoming UNESCO summit on artificial intelligence governance in Santiago could be crucial to establish legal protocols around generative artificial intelligence in Latin American higher education (Rudolph et al., 2023).

The adoption of generative artificial intelligence (Generative AI) in higher education in Latin America has experienced a notable growth, according to the study analyzed, reflected in significant percentage values. This technological resource is perceived positively in the region, with an impressive 76.8% of the people surveyed believing that "Generative AI will redefine the way we live and work in Latin America in the next 3 years" (Nuortimo et al., 2024). Generative AI is consolidated as a transformative resource for teaching and learning, with 57% of respondents from the business world stating that it will inevitably play a crucial role in future education. The active engagement of Latin American researchers is fundamental, as

demonstrated by the study, which highlights the vital role of these professionals in advancing the understanding of the potential of artificial intelligence in educational innovation. In this sense, 62.5% of respondents in Peru believe that Generative AI will play a vital role in the future, and 18.8% unconditionally support its adoption in the country's education system (Tsyganok et al., 2023).

In terms of optimism, Mexico and Chile lead, with 60% and 39.3%, respectively, believing that Generative AI should be used to educate the next generation as a priority. In addition, 80% of respondents in Mexico's education sector share this opinion. At the business level, 57% of respondents say that Generative AI will play an inevitable role in the education of the future. The study also reveals a strategic vision in Brazil, where the country's AI strategy commits to overhauling the national curriculum, including AI and programming courses. However, despite the enthusiasm and progress, challenges remain, such as the lack of specific skills and knowledge around Generative AI, ranking first (35.2%) as an impediment for educational institutions in the region (Tsao & Nogues, 2024).

2. Materials and methods

Within the research, a systematic review was carried out, following the recommendations of the (Higgins JPT, 2011), the recommendations of the PRISMA Report and the steps that have been proposed by various authors for the systematic reviews of scientific articles (Ferreira González et al., 2011; Perestelo-Pérez, 2013). In order to have a greater scope for scientific production on the topic of "natural language processing systems" and "Generative artificial intelligence systems", a survey of information was carried out in Scopus, Web Of Science, Redalyc, Scielo because they are the search engines that contain the largest amount of information on the subject analyzed.

The search process was carried out through keywords such as "NLP natural language processing systems", "Natural Language Processing Applications", "Generative artificial intelligence" and "Generative antagonistic networks", another inclusion criterion was access to scientific production of the last five years, of the same information from scientific articles, procedure books, conference proceedings, publications, book chapters to have a better delimitation of access to scientific production, in the same way the documents related to this type of technology with emphasis on higher education were analyzed, because the analysis is based on this level of education.

Results

By applying the criteria and recommendations established by the PRISMA 2020 declaration (Page et al., 2021), the following results were established as described in Figure 1:

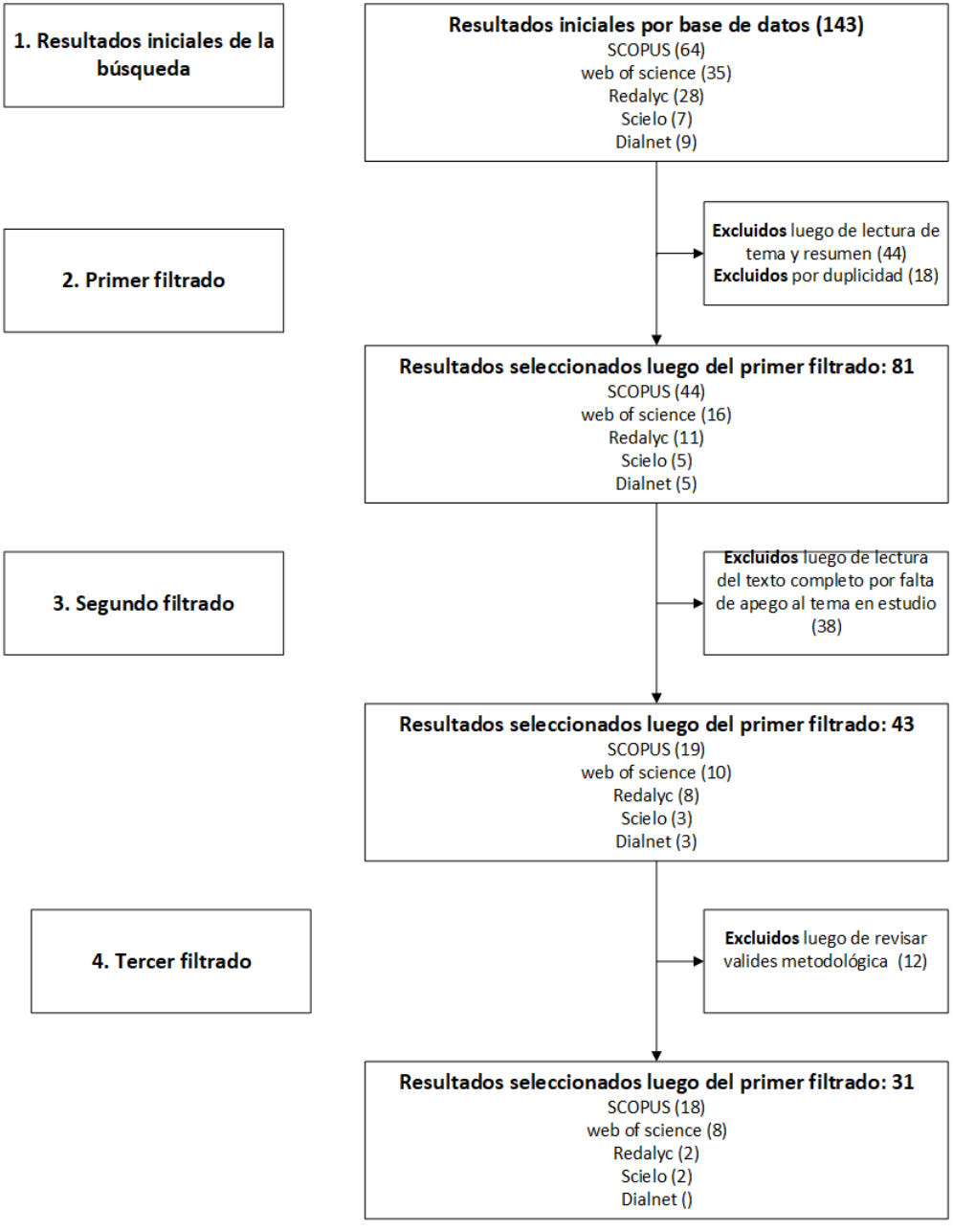

Figure 1 Search results for scientific articles . In original language Spanish

Board 1 Research Results Natural Language Processing Systems and Generative Artificial Intelligence Systems

Theme	Year	Summary	Method used	Conclusions	Practical implications
Generative artificial intelligence and engineering education	2024	The paper discusses the potential impact of generative AI (GAI) on engineering education, but does not specifically mention generative AI systems in education.	Generative Model (LT) Learning PathEducational materials and interactive activities for young learners	The GAI has the potential to affect engineering education. The use of the GAI can change teaching practices.	Potential Impact of GAI on Engineering EducationUsing GAI for Sustained, Self-Motivated Learning (World Bank, 2023)
Generative Artificial Intelligence and the Education Sector	2023	The paper discusses the different responses of academic institutions to large language models (LLMs) in education, but does not specifically mention generative AI systems in education.	No methodology has been defined	Different responses to LLMs in the education sector. Some institutions prohibit LLMs, others encourage them.	Different responses to LLMs in the education sector Some institutions prohibit LLMs, others encourage them (Ahmad et al., 2023)
Mapping out a research agenda for generative artificial intelligence in tertiary education	2023	The paper discusses the impact of generative artificial intelligence (AI) on tertiary education and outlines the need for research in this area. It mentions the use of AI in assessment, learning and teaching, and the technical and ethical aspects of AI in education. However, it does not provide specific details about generative AI systems in education.	No methodology has been defined	Tertiary education must adapt to generative AI. Students need skills to work with AI effectively.	Students need skills to work with generative AI effectively. It is crucial to monitor the alignment between education and the needs of employers. (Mapping out a research agenda for generative artificial intelligence in tertiary education | Australasian Journal of Educational Technology, 2023)
Artificial General Intelligence (AGI) for Education	2023	The document provided does not specifically mention "generative AI systems" in education. The paper focuses on artificial general intelligence (AGI) and its potential to revolutionize education.	No methodology has been defined	AGI has the potential to revolutionize education. Interdisciplinary collaborations are needed for the development of AGI.	AGI has the potential to revolutionize education. AGI can help set educational goals, design pedagogy and curriculum, and conduct assessments. (Latif et al., 2023)
Artificial General Intelligence (AGI) for Education	2023	The provided paper discusses the potential of Artificial General Intelligence (AGI) in education, including setting educational goals, designing pedagogy and curriculum, and conducting	Review of the concepts, capacities and potential of AGI in educationDiscussion of ethical issues and impact on human educators	AGI has the potential to revolutionize education. Interdisciplinary collaborations are needed for the development of AGI.	AGI can revolutionize education with personalized instruction and adaptive learning pathways. AGI algorithms can improve the design and usability of

		assessments. It does not specifically mention generative AI systems in education.			digital tools in education. (Latif et al., 2023)
Generative Artificial Intelligence in Education: Discussions and Forecasts	2023	The paper discusses the impact of generative artificial intelligence, specifically ChatGPT technologies, on education. It identifies the different opinions of experts and predicts trends such as the shift towards creativity-oriented education and the increased use of artificial intelligence technologies in education.	Qualitative analysis of expert opinions Meaningful analysis of scientific publications	The public discourse on the use of generative artificial intelligence in education is controversial. Generative artificial intelligence has the potential to solve educational tasks in the long term.	Controversial public discourse on the use of generative AI in educationPossible trends: creativity-oriented education, increased use of AI, new standards (Generative Artificial Intelligence in Education, 2023)
Examining Science Education in ChatGPT: An Exploratory Study of Generative Artificial Intelligence	2023	The paper discusses the use of generative artificial intelligence (AI) in education, focusing specifically on the AI platform called ChatGPT. It explores how ChatGPT can answer questions related to science education and suggests ways educators can use it in their pedagogy.	Self-learning methodologyUsing ChatGPT as a research tool	The production of ChatGPT is aligned with key research topics. ChatGPT should be used responsibly and critically evaluated.	ChatGPT can be used in science pedagogyEducators must critically evaluate AI-generated resources (Cooper, 2023)
Integrating Generative Artificial Intelligence in Intelligent Vehicle Systems	2023	The paper does not mention anything about generative artificial intelligence systems in education. The paper deals with the integration of generative artificial intelligence into intelligent vehicle systems.	It provides insights into the current state, potential applications, and future research directions for generative AI and basic models in smart vehicles. It outlines critical areas of future research, including domain adaptability, alignment, multimodal integration, and others.	Generative artificial intelligence can revolutionize user interactions in smart vehicles. Future research areas include domain adaptability, alignment, and multimodal integration.	Revolutionize user interactions in smart vehiclesDeliver more immersive, intuitive, and personalized experiences (Stapepen et al., 2023)
Chat Overflow: Artificially Intelligent Models for	2023	The paper discusses the potential impact of generative AI models on the practice of computer science	The paper discusses concrete, research-backed opportunities for computer science	Explore and seize opportunities to make a positive difference in computer science	The paper discusses opportunities for computer science teachers to use generative AI

Computing Education - renAIssance or apocAIypse?		education, exploring the opportunities and challenges they present.	teachers. The paper speculates on the long-term possibilities and on the rethinking of teaching practices.	classrooms. Dedicate efforts to identifying and taking advantage of new opportunities in computer education.	models. It suggests potential research questions and directions for future exploration. (Denny et al., 2023)
Generative artificial intelligence empowers educational reform: current status, issues, and prospects	2023	The paper discusses the current application of generative AI in education and identifies issues such as opacity, data privacy, personalization, and effectiveness. It also proposes solutions and future development trends in education.	Fair algorithms to identify and eliminate unfair factors in generative AI. Use of variational auto-encoders (VAEs) to generate images with specific conditions.	Generative AI should be seen as a transformative resource in education. Joint efforts are needed to address the problems and rebuild practices.	Generative AI can be a transformative resource for educators and students. Joint efforts are needed to address the problems and rebuild existing practices. (Frontiers | Generative artificial intelligence empowers educational reform: current status, issues, and prospects, n.d.)
Towards social generative AI for education: theory, practices and ethics	2023	The paper discusses the development of social generative AI systems for education, exploring their potential roles and the ethical considerations involved.	Conversations and Exploration as Educational InteractionsDeveloping Powerful AI Systems for Education	Designing social AI systems for education requires collaboration. Generative AI must have explicit goals and reasoning capabilities.	The design of new social AI systems for education requires collaboration between experts in neural and symbolic AI and experts in pedagogy and learning science. Generative social AI for education must respect fundamental human rights and respect the expertise of teachers. (Sharples, 2023)
Envisioning the future of learning and teaching engineering in the artificial intelligence era: Opportunities and challenges	2023	The paper discusses how generative AI technologies can enhance educational resources, develop new learning environments, and enhance learning experiences in engineering education.	Generative AI technologies, such as large language models and diffusion modelsIntegrating and using generative AI technologies in engineering education	Generative AI technologies can transform learning and teaching experiences. The integration of artificial intelligence technologies can improve engineering education.	Integrating generative AI technologies into engineering educationImproving learning experiences and student engagement (Menekse, 2023)
Generative AI for Programming Education:	2023	The paper discusses the use of generative AI models, specifically ChatGPT and GPT-4, in	Evaluation of ChatGPT (based on GPT-3.5) and GPT-4 Comparison of	GPT-4 surpasses ChatGPT and approaches the performance of	GPT-4 acts closely with human tutors in educational programming

Benchmarking ChatGPT, GPT-4, and Human Tutors		educational programming scenarios. It evaluates their performance compared to that of human tutors in various scenarios. However, it does not specifically mention generative AI systems in education outside the context of programming.	model performance with that of human tutors	human tutors in several scenarios. GPT-4 continues to struggle in certain environments.	scenarios. GPT-4 still struggles in certain environments. (Phung et al., 2023)
Generative AI: Implications and Applications for Education	2023	The paper discusses the implications and applications of generative AI in education, focusing specifically on the use of chatbots that respond to extensive language models for the review and evaluation of student work using AI.	Recalibrate a C-LLM for students to receive narrative feedbackUse rapid engineering for supplemental narrative reviews	AI reviews were found to be useful and different from human opinions. The paper explores the limits and potential applications of generative AI in education.	Application of the C-LLM for the review and evaluation of student work using AIPound range of emerging applications of generative AI in education (Olga et al., 2023)
Engineering Education in the Era of ChatGPT: Promise and Pitfalls of Generative AI for Education	2023	The paper discusses the use of generative AI technology, such as ChatGPT, in engineering education. It highlights the potential benefits and limitations of using such systems in education.	No methodology has been defined	ChatGPT has potential for personalized and effective learning. Generative AI in education raises ethical issues.	Personalized learning experiences through personalized feedback and explanations. Creation of realistic virtual simulations for hands-on learning. (Qadir, 2023)
The Rise of Generative Artificial Intelligence and Its Impact on Education: The Promises and Perils	2023	The paper discusses the impact of generative artificial intelligence (GAI) on education and how it will play an important role in all aspects of education.	No methodology has been defined	The GAI is promising and valuable, but it also has limits and concerns. Educational institutions must adapt to new artificial intelligence tools with guarantees.	GAI can revolutionize research practices and accelerate innovation. Educational institutions must adapt to new AI tools with updated policies. (Murugesan & Cherukuri, 2023)
Generative AI in Medical Education: Navigating the Promises and Perils for Tomorrow's Learners (Preprint)	2023	The paper discusses the potential benefits and limitations of generative AI technologies in medical education, but does not specifically mention their use in education in general.	No methodology has been defined	Generative AI has the potential to revolutionize medical educationMedical educators need to understand the uses and limitations	Generative AI has the potential to revolutionize medical education. Medical educators must understand the uses and limitations of these technologies. (Zhang & Kamel Boulos, 2023)

Shaping the Future of Education: Exploring the Potential and Consequences of AI and ChatGPT in Educational Settings	2023	The paper discusses the potential and consequences of using AI systems, specifically OpenAI's ChatGPT, in educational settings. It explores the impact of these systems on educational norms and raises concerns about reducing analytical skills and promoting misconduct.	The paper draws on existing literature to explore the potential and issues associated with the application of advanced AI models in education. The article contributes to understanding how these technologies reshape educational norms.	AI and ChatGPT have transformed educational practicesMixed reactions about their impact on education	AI and ChatGPT have transformed educational practicesMixed reactions about their impact on education (Grassini, 2023)
The Advent of Generative Language Models in Medical Education	2023	The article discusses the use of generative language models (GLMs) in medical education, but does not specifically mention the use of generative artificial intelligence systems in education.	A structured questionnaire was distributed to 1419 fertility professionals. In-person interactions were held at the ESHRE conference (2022) to encourage participation.	GLMs and AI present opportunities and challenges in medical education. Collaboration and transparency are necessary for responsible integration.	Opportunities to Improve Medical Education with AI and GLM Collaboration Needs and Guidelines to Address Challenges (Karabacak et al., 2023)
The rise of generative artificial intelligence (AI) language models - challenges and opportunities for geographical and environmental education	2023	The paper discusses the advantages and threats of generative AI language models in education, specifically in geographic and environmental education.	No methodology has been defined	Generative AI language models, such as ChatGPT, have potential in geographic and environmental education. Violations of intellectual property and academic integrity are of concern.	AI generative language models, such as ChatGPT, can transform geographic and environmental education. Violations of intellectual property and academic integrity are of concern. (Chang & Gillian, 2023)
Generative Artificial Intelligence based on large language models - tools for use in academic research	2023	The document provided does not mention anything about generative artificial intelligence systems in education.	No methodology has been defined	ChatGPT is a successful generative AI tool for academic research. Practical advice on the use of AI in academic research is provided.	ChatGPT and similar tools can help in various academic research tasks. Researchers can benefit from practical advice on using AI for literature review. (Ramos, 2023)
Generative Artificial Intelligence in Information Systems	2023	The paper discusses the potential impacts of generative AI tools, such as ChatGPT, on information systems education and offers	Discuss the challenges and consequences of generative AI tools in IS education. Provide	Discusses the challenges and consequences of generative AI toolsProvides recommendations	Discusses the challenges and consequences of generative AI toolsProvides recommendations for

Education: Challenges, Consequences, and Responses		recommendations for IS educators to respond effectively to the rise of AI tools.	recommendations for IS educators to respond effectively to AI tools.	for IS educators to respond to	an effective response to AI tools (Van Slyke et al., 2023)
How do we respond to generative AI in education? Open educational practices give us a framework for an ongoing process	2023	The paper analyzes the impact of generative AI on education and proposes open educational practices as a framework to respond to it.	Open Educational PracticesOnline Communities for Sharing and Collaboration	Open educational practices can help educators cope with generative AI in education. Collaboration and reflection are critical to responding to AI.	Open educational practices can help educators cope with generative AI in education. Collaboration with students enables student-centered approaches to AI. (Mills et al., 2023)

3. Discussion

This discussion focuses on the information provided by several papers that explore the role of Generative Artificial Intelligence (GAI) in the educational field (Ahmad et al., 2023). Although the papers address various areas, such as engineering, medicine, programming, and information systems, it is clear that GAI is emerging as a transformative force in education (Mao et al., 2024).

The analysis of the potential impact of the GAI on engineering education highlights the possibility of significant changes in teaching practices and learning trajectory (Van Slyke et al., 2023). It is suggested that GAI has the potential to deliver personalized and effective learning experiences, which could revolutionize the way students engage with educational material (Lozano & Blanco Fontao, 2023).

Paper on Institutional Responses to Mass Language Models Reveals Diversity of Approaches in the Education Sector (Khennouche et al., 2024). While some institutions prohibit these models, others encourage them. This divergence highlights the need for a deeper and more consensual understanding of the role of the IEG in education (S. Chen et al., 2023).

The discussion on research in tertiary education highlights the importance of equipping students with skills to work effectively with the GAI. The adaptation of tertiary education to the GAI is presented as crucial, along with the monitoring of the alignment between education and the demands of employment (Valova, Irena et al., 2024). Research on the use of IEG in computer science education highlights concrete research-backed opportunities for teachers. The suggestion to identify and seize new opportunities underscores the need for continued exploration of the practical applications of IEG in education (Murugesan & Cherukuri, 2023).

The analysis of GAI in medical education highlights both potential benefits and limitations. Medical educators must understand not only the opportunities but also the limitations of these technologies, pointing out the need for a balanced understanding for effective integration (Cooper, 2023). The paper on the impact of the GAI on geographic and environmental education

suggests transformative potential. However, concerns about intellectual property violations and academic integrity highlight the importance of addressing the ethical challenges associated with the GAI (Ahmad et al., 2023).

The proposal to use open educational practices as a framework to respond to the GAI highlights the importance of collaboration and reflection in this process. Adapting to student-centered approaches supports the idea that GAI can be a valuable resource when integrated collaboratively (Van Slyke et al., 2023). The discussion on the use of generative language models in medical education highlights opportunities and difficulties. The need for collaboration and transparency underscores the importance of an ethical and collaborative approach to fully reap the benefits of the IEG in this context (Metcalf et al., 2023). The general discussion on the impact of the GAI on education highlights the promise and limits of this technology. The acceleration of innovation and the need for updated policies to adapt to new AI tools highlight the importance of effective change management in educational institutions (Wang et al., 2023).

4. Conclusions

It is undeniable that the introduction of Generative Artificial Intelligence (AGI) represents a significant turning point in Latin American higher education. The rapid adoption of technologies such as ChatGPT has marked the beginning of an educational revolution, evidenced by the ability of personalization, content generation, and interactive virtual assistance offered by IAG. The mostly positive perception of this technology, supported by an active participation of researchers and proactive national strategies, suggests that IAG has the potential to redefine the way teaching and learning is done in the region. However, the ethical and privacy challenges highlighted indicate the urgent need to address fundamental issues to ensure responsible and equitable implementation in education.

The substantial opportunities and crucial challenges associated with the integration of Generative Artificial Intelligence (GAI) in Latin American higher education are undeniable. Personalization, content generation, and virtual attendance opportunities offer an optimistic vision of a more effective, student-centered educational experience. However, ethical challenges, especially in terms of privacy and data control, underscore the need for careful reflection and effective strategies to ensure ethical implementation. The region's ability to address these challenges will ultimately determine the positive and sustainable impact of GAI on Latin American higher education.

The information collected highlights the imminent transformation of the educational paradigm thanks to Generative Artificial Intelligence (GAI). From personalizing teaching to adapting tertiary education, GAI has revolutionary potential to improve the learning experience. The variety of responses from academic institutions to massive language models reveals a diverse picture in the adoption of GAI. While some institutions embrace these technologies, others are reluctant. This diversity highlights the need to establish clear guidelines and regulations for effective implementation.

Despite the GAI's promises, there were obvious ethical concerns and limitations. From privacy issues to the possibility of generating incorrect information, it's essential to address these challenges proactively. Ethical reflection and the development of safeguards are critical to responsible implementation. The research underscores the need for interdisciplinary collaboration to address the challenges and fully realize the benefits of IEG in education. Effective integration of the GAI requires collaboration between AI experts, pedagogues, and practitioners from different fields to ensure efficient and ethical implementation.

Evaluation of specific generative models, such as ChatGPT and GPT-4, reveals that, despite advances, challenges still exist in specific environments. This recognition of limitations underscores the continuous need for improvement and development of new technologies to overcome obstacles and ensure optimal performance in diverse educational contexts. Exploring GAI in specific fields, such as computer and medical education, reveals significant opportunities to improve the quality and efficiency of teaching. However, this positive impact is directly linked to a balanced understanding of the capacities and limitations of the IEG, as well as to the appropriate training of educators in its implementation.

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