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Integration of Artificial Intelligence in Higher Education: Relevance for Inclusion and Learning

Integración de la Inteligencia Artificial en la Educación Superior: Relevancia para la Inclusión y el Aprendizaje

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ABSTRACT

Artificial intelligence (AI) is revolutionizing the way teachers design and deliver their classes, especially in creating environments that prioritize inclusion. Integrating AI into educational environments is not just about adopting new technologies; it's about reimagining pedagogical strategies to make learning more accessible and personalized for each student. This transformation is supported by a growing body of research that highlights both the potential benefits and challenges of AI in higher education. In this review article we critically evaluate the evolving landscape of Artificial Intelligence (AI) in higher education, focusing on training methodologies and the deployment of AI tools to improve the learning process. Findings from the literature review on the integration of Artificial Intelligence (AI) in higher education suggest that the way forward requires a nuanced approach that balances innovation with ethical considerations, inclusivity and practicality.

Keywords : Artificial Intelligence in Education; Inclusive Learning; AI-driven Pedagogy; Educational Technology Trends; Personalized Learning Experiences

RESUMEN

La Inteligencia Artificial (IA) está revolucionando las estrategias educativas, particularmente en la promoción de entornos que enfatizan la inclusividad y las experiencias de aprendizaje personalizadas. La integración de la IA en los entornos educativos va más allá de la adopción de nuevas tecnologías; implica la reinvención de estrategias pedagógicas para mejorar la accesibilidad y la personalización del aprendizaje para cada estudiante. Esta transformación está respaldada por un creciente cuerpo de investigación que ilumina la naturaleza dual de los beneficios potenciales y los desafíos de la IA dentro del ámbito de la educación superior. Este artículo de revisión profundiza en el panorama evolutivo de la Inteligencia Artificial en la Educación, con un enfoque específico en metodologías de formación y la implementación de la pedagogía y herramientas impulsadas por IA destinadas a mejorar el proceso de aprendizaje. Nuestros hallazgos, basados en una revisión exhaustiva de la literatura, indican que avanzar en la Inteligencia Artificial en la Educación requiere un enfoque equilibrado que armonice la innovación con consideraciones éticas, inclusividad y aplicación práctica. Esta síntesis pretende contribuir a las tendencias

tecnológicas educativas destacando la imperativa de adoptar la IA para cultivar experiencias de aprendizaje más inclusivas y efectivamente personalizadas.

Palabras Clave: Inteligencia Artificial en la Educación; Aprendizaje Inclusivo; Pedagogía impulsada por IA; Tendencias de Tecnología Educativa; Experiencias de aprendizaje personalizadas

Introduction

The integration of Artificial Intelligence (AI) into higher education marks a transformative phase in the educational landscape, presenting new opportunities for personalized learning experiences while sparking critical discussions about its implications for inclusion and learning. The field of AI in higher education has been examined in various dimensions, including personalization, psychology, machine learning, and its influence on inclusion. Scholars recognize the revolutionary potential of AI to reshape higher education, but at the same time, emphasize the importance of rigorous analysis and ethical deliberation to realize its beneficial impacts on pedagogy. A systematic review by Zawacki-Richter, Marín, Bond, and Gouverneur (2019) describes the growing presence of AI in higher education through descriptive and pilot studies, underscoring an urgent call for innovative research and practice in AI in Education (AIEd) that can significantly improve learning outcomes. This reveals uncharted territory for educators to investigate the effectiveness of AI in improving educational achievement. Li and Wong (2023) expand the discourse by highlighting the critical role of personalization in AI-enabled learning, advocating for specific research to advance personalized learning experiences through AI, thereby promoting inclusion in education settings. The search for equity and inclusion in higher education through the application of AI faces notable challenges, as highlighted by Lainjo and Tsmouche (2023). Their insights reveal a gap in current AI applications in tertiary education, which lacks essential features to foster equity and inclusion, highlighting potential barriers to inclusion with AI integration. Chai, Wang, and Xu (2020) contribute to the narrative by noting that AI research in education focuses predominantly on higher education, especially in the development of intelligent tutoring systems, indicating the need for further exploration of AI's impact on inclusion and diversity in this area. Collaborative synergy between teaching stakeholders, developers, AI educators, and researchers is crucial to incorporating comprehensive learning science analysis and insights into AI technologies in education, as emphasized by Fornasier (2021). Such collaborations are vital to overcoming potential obstacles to AI-supported teaching and learning in higher education. Chiu, Meng, Chai, King, Wong, and Yam (2022) highlight the importance of diversity and inclusion in AI education, proposing additional research on how AI curricula adapt to diverse academic abilities and gender differences, thus highlighting the need for inclusive AI educational frameworks. In this way, the current discourse on AI in higher education reflects a dynamic interplay of optimism and critical scrutiny, emphasizing the need for a balanced evaluation of the benefits, limitations, and ethical dimensions of AI to ensure its responsible and effective incorporation into the educational sector (Gazquez, Pérez-Fuentes y Suazo, 2023). This review article aims to critically assess the evolving landscape of Artificial Intelligence (AI) in higher education, focusing on training methodologies and the deployment of AI tools to

enhance the learning process. This exploration is timely and relevant given the increasing incorporation of AI into educational frameworks and its potential implications for pedagogical effectiveness and student outcomes.

Methodology

In conducting this review on the integration of artificial intelligence (AI) in higher education to promote inclusive learning, a rigorous methodology was followed. The selection of studies was based on well-defined inclusion and exclusion criteria:

The search was limited to studies published between 2019 and the present. This allowed a focus on recent developments in the application of AI in higher education and its impact on inclusion. Various types of research were included, such as peer-reviewed primary research studies, clinical trials, observational studies, systematic reviews, and meta-analyses. These were to address the implementation and effects of AI in higher education, with a focus on inclusion. The selected studies had to focus explicitly on the application of AI technologies in the context of higher education and evaluate their impact on inclusion and accessibility for students. Priority was given to studies with methodological rigor, clear methodologies, and statistically significant findings. This ensured that research that significantly contributed to the field was included. The search strategy was designed to comprehensively identify relevant studies. Several academic databases were searched, including PubMed, Google Scholar, IEEE Xplore, Web of Science and Scopus. The search terms used included a combination of keywords such as "higher education," "inclusive learning," "artificial intelligence," "adaptive learning," and "intelligent tutoring systems." Boolean operators (AND, OR) were used to refine the results. No language restrictions were imposed on the search. Additionally, a manual review of bibliographic references of key articles and reviews was performed to identify additional relevant studies that may have been missed in the initial search. To evaluate the quality of the included studies, appropriate evaluation tools and criteria were used depending on the type of study. Randomized controlled trials were assessed using the Cochrane Collaboration risk of bias tool, while for observational studies the Newcastle-Ottawa scale was applied to assess their quality and risk of bias. This evaluation process ensured that studies with the highest level of evidence and methodological rigor received appropriate consideration in the review, ensuring the reliability and relevance of the findings and recommendations.

Results

Key concepts

The incorporation of Artificial Intelligence (AI) in higher education interweaves a wide range of concepts essential for the advancement of learning and inclusion. These range from technological innovations and pedagogical strategies to ethical considerations and inclusion frameworks, each contributing significantly to the complex impact of AI on educational paradigms. At the core of AI are technological foundations and their applications, such as machine learning and neural networks, which are essential in allowing computers to learn and make predictions from data. AI platforms, such as adaptive and intelligent tuto-

ring systems, personalize the learning experience based on individual student profiles, thus improving personalization in education. However, phenomena such as overfitting and underfitting must be considered in machine learning models, which affect the accuracy of predictions and the personalization of educational content. Big data management and data mining are essential for analyzing data sets generated within educational systems, essential for the analysis of student performance and curriculum development. Additionally, technologies such as augmented reality and virtual reality offer immersive learning experiences, pushing the boundaries of traditional classroom environments. From a pedagogical perspective, personalization and adaptive learning stand out for tailoring learning experiences to individual needs, preferences, and learning styles. MOOCs and hybrid teaching models, which use AI for scalability and personalization, reach diverse student populations. Educational games and gamification, as well as instructional strategies such as the flipped classroom and experiential learning, encourage active learning and the application of knowledge in real contexts. Ethical and inclusion considerations are fundamental in the integration of AI in education. The principles of ethics and equity in AI guide the development and implementation of educational technologies, ensuring that they promote equity and do not perpetuate bias. The commitment to diversity and inclusion focuses on serving a broad spectrum of students, addressing the needs and challenges of underrepresented groups. It is crucial to safeguard academic integrity and transparency, ensuring that AI-driven decisions are understandable and explainable, and protect the privacy of learners and the security of educational data.

Looking ahead, emerging trends include ICT-enabled and mobile learning, and collaborative learning on social media, powered by AI algorithms for content curation and interaction analysis. The application of AI in fields such as precision medicine and the promotion of computational thinking opens new possibilities for the personalization of educational content and the development of problem-solving skills. Understanding and applying these key concepts is essential for actors in higher education to effectively harness the potential of AI in enriching the learning experience, addressing the individual needs of students, and ensuring that educational environments are inclusive, equitable, and conducive to academic integrity. The nuanced appreciation and application of these concepts allows AI to truly transform higher education, making it more personalized, engaging and inclusive.

Evolution of educational technology

The evolution of technology for inclusion in higher education has been a progressive and multifaceted trajectory that began with the early adoption of computers in educational settings, marking a shift toward digitized learning environments. This initial period focused on improving access to information and fostering computer literacy among students and educators, laying the foundation for future technological advances in education. As technology advanced, attention shifted to developing inclusive educational technologies, designed to meet the diverse learning needs of all students, including those with disabilities. This focus on inclusion coincided with a pedagogical shift toward equity and social justice, where technology began to be seen as a potential tool to promote equitable pedagogies and inclusive practices in learning environments.

With the arrival of artificial intelligence (AI) and adaptive learning systems, a significant advance in technology for inclusion in higher education was marked. AI applications enabled personalized learning experiences, adaptive assessments, and targeted support for diverse student populations, greatly improving inclusive educational practices. Along with these technological advances came ethical considerations and a focus on diversity, underscoring the importance of ensuring that technological advances aligned with ethical standards and promoted diversity and inclusion in higher education. Technological evolution also brought with it broader implications, including technological spillovers and their role in promoting inclusive growth. This period recognized the importance of the broader impacts of technological integration for social inclusion and economic development. Furthermore, the integration of technology in higher education encouraged interdisciplinary approaches and the promotion of computational thinking, highlighting the importance of overcoming traditional disciplinary barriers and equipping students with skills relevant to a digitalized world. International policies and agreements have also played a crucial role in the evolution of technology for inclusion, reflecting a global commitment to inclusive educational practices. Educational leadership has been instrumental in promoting sustainable inclusive education through technological integration, promoting initiatives that leverage technology to support inclusive practices and ensure their sustainability. Looking to the future, the evolution of technology in higher education is set to continue, with a focus on aligning technological advances with societal objectives, embracing a socio-technological orientation where technological solutions are developed and implemented with a keen awareness of its social implications and its potential to contribute to a more inclusive educational landscape.

Potential benefits and challenges associated with implementing AI in this context

Implementing artificial intelligence (AI) in higher education to foster inclusive learning presents a wide range of potential benefits but also poses significant challenges that require careful attention. The integration of AI in this context offers personalization and flexibility in educational delivery, enhancing learning outcomes and supporting inclusive educational practices. However, implementing AI also involves ethical considerations, limitations in addressing critical issues, and challenges in critical reflection.

Among the benefits, personalization and flexibility are prominent, where AI adapts learning experiences to meet individual student needs and styles, thus improving educational delivery's flexibility. Sadiku et al. (2021) emphasize how AI integration can provide personalized learning experiences tailored to individual student needs. Additionally, AI technology has the potential to enhance learning outcomes by offering intelligent support and facilitating the learning process, especially in laboratory settings, as observed by Sousa et al. (2021).

AI also aids in enhancing decision support and data management in educational and healthcare contexts by integrating statistical and AI techniques for efficient data and information management, as Kulikowski (2022) suggests. Moreover, AI's integration into educational evaluation and other domains can lead to technological advancements that enhance the efficiency of educatio-

nal development and evaluation, as discussed by Liao (2022).

However, the implementation of AI is not without its challenges. The ethical implications of AI integration in higher education necessitate critical examination of the challenges and risks, alongside exploring ethical and educational strategies for AI integration, as Zawacki-Richter et al. (2019) highlight. Issues such as teacher employability, technological training, and the ethical implications of using AI in education demand more attention, according to Durso & Arruda (2022). The literature indicates a deficiency in critical reflection on the challenges and risks associated with AI in education, underscoring the need for an in-depth investigation of ethical and educational approaches to AI integration. Therefore, while the integration of AI into higher education for inclusive learning brings significant benefits like personalization, improved learning outcomes, and support for inclusive practices, it also introduces considerable challenges, including ethical concerns and the necessity for critical reflection and attention to crucial issues. Addressing these challenges while leveraging the potential benefits is essential for a responsible and effective implementation of AI in higher education.

Applications of artificial intelligence in higher education for inclusive learning

The integration of Artificial Intelligence (AI) in higher education has unveiled a vast array of applications aimed at fostering inclusive learning environments. These applications cover a diverse range of areas from personalization and adaptive learning systems to intelligent tutoring systems and formative assessments, to user-interactive components and leveraging AI for campus efficiency. The core of these applications is their collective contribution to promoting educational practices that support and accommodate the diverse needs of students. Central to AI's role in higher education is the drive for personalization and the deployment of adaptive systems, designed to meet individual learning requirements and provide specialized support to students, thus enhancing the overall learning experience. This approach is underscored by the use of AI for detailed profiling and predictive analytics, and the creation of adaptive learning environments that dynamically adjust to students' evolving needs, as highlighted by Zawacki-Richter et al. (2019).

AI-powered formative assessments and intelligent tutoring systems further enrich the educational landscape. These tools deliver assistance and personalized learning experiences, significantly enhancing educational environments and learning outcomes, as demonstrated by Calatayud et al. (2021). Additionally, user-interactive components and AI technologies introduce interactivity and participation into the learning process, fostering student interest and engagement, as observed by Jantakun et al. (2021).

Aligning AI with inclusive pedagogy and social justice principles is another critical aspect of its application in higher education. This alignment emphasizes AI's capability to accommodate diverse learning styles, support students with disabilities, and promote inclusive growth within educational settings, as discussed by Luan et al. (2020). The integration of AI tools with smartphones has also enhanced smart learning experiences, utilizing advanced AI methodologies to improve learning outcomes, a trend noted among Moroccan students at Hassan II University of Casablanca.

The realm of collaborative learning and virtual reality has benefited from AI, with technologies providing intelligent support for collaborative efforts and creating immersive educational environments, explored by Zheng & Badarch (2022). Furthermore, AI extends to enhancing student support services and campus operational efficiency, using AI-powered algorithms and systems to refine administrative functions and bolster institutional support mechanisms, a development addressed by Lainjo & Tsmouche (2023).

The systematic review by Zawacki-Richter et al. (2019) is noteworthy for its exploration of AI applications in higher education, illuminating the current state of AI integration and emphasizing the need for innovative research in AI in Education (AIEd) for significant impact. Bozkurt et al. (2021) conducted a comprehensive review of AI studies in education over half a century (1970-2020), using social network analysis and text mining to trace AI's evolution and influence in education.

Rienties et al. (2020) provided a concise overview of four distinct research areas: Artificial Intelligence in Education (AIED), Computer-Supported Collaborative Learning (CSCL), Educational Data Mining (EDM), and Learning Analytics (LA), highlighting the necessity for coherence and integration among these fields. Li and Yang (2023) explored the concerns and reactions in higher education in the AI era, underlining AI's transformative potential and its implications for pedagogy and learning processes.

Ethical considerations around AI-supported mentoring in higher education were examined by Köbis & Mehner (2021), who stressed the importance of establishing ethical standards and guidelines to tackle unresolved issues in AI integration. Hannan (2021) identified successful AI applications in crucial operational areas of universities, including student learning experiences, support services, and enrollment management, offering practical insights into AI's applicability in higher education contexts.

Lainjo & Tsmouche (2023) assessed AI's impact on higher education institutions, offering a thorough analysis of the benefits and challenges that modern digital and automated technologies introduce to higher education. Crompton & Song (2021), drawing on the Horizon Report (2020), examined AI's potential in higher education and discussed major trends in educational technology shaping the global higher education landscape.

Pedró (2020) reviewed AI applications in higher education, providing an overview of the opportunities, evidence, and challenges associated with AI integration. Lastly, Goksel & Bozkurt (2019) identified key themes in AI education, such as adaptive learning, personalization, expert systems, and intelligent tutoring systems, offering a comprehensive outlook on AI's potential to revolutionize educational processes.

These foundational studies and projects have significantly advanced the understanding of AI's role in higher education, shedding light on the potential benefits, challenges, and ethical considerations associated with its integration into educational frameworks.

Artificial intelligence to improve the learning process of students in a context that favors inclusion

The integration of Artificial Intelligence (AI) in higher education to enhance the learning process and foster inclusivity has attracted attention through various influential studies and projects.

These initiatives underscore the complex role of AI in evolving educational practices to meet the diverse needs of students and cultivate a more inclusive learning atmosphere.

Zawacki-Richter et al. (2019) underscore the necessity for pioneering research and the practical application of AI in Education (AIEd) to realize a significant impact within the educational realm. Bearman & Ajjawi (2023) concentrate on directing students toward AI quality standards and nurturing meaningful interactions with AI systems, a crucial approach for refining pedagogical strategies in an AI-influenced world and fostering inclusive learning experiences. Khan et al. (2022) spotlight AI's capability to boost student motivation and diminish dropout rates, proposing that AI plays a vital role in crafting more engaging and inclusive learning experiences, notably for students at risk of demotivation or dropout. The research by Abgaryan et al. (2023) highlights AI's potential in enhancing knowledge acquisition and student engagement, demonstrating the benefits of AI in providing captivating educational experiences for a diverse student body. Su & Yang (2023) explore the specific advantages of employing tools like ChatGPT in education, recognizing the benefits of more personalized and efficient learning experiences for students and the enhancement of feedback processes for educators, thereby streamlining educational interactions and learning activities. Crompton & Song (2021) acknowledge the transformative influence of AI on teaching and learning in higher education, suggesting AI's capacity to substantially broaden and enhance educational practices to accommodate various needs and learning preferences.

Collectively, these studies illuminate the potential advantages of AI in higher education, including personalized learning experiences, enhanced learning outcomes, and heightened student motivation and engagement. Nonetheless, they also bring to light challenges that necessitate resolution, such as ethical considerations, the imperative to concentrate on critical issues, and tackling vulnerabilities linked to cyber threats.

Discussion

Artificial intelligence (AI) is revolutionizing the way teachers design and deliver their classes, especially in creating environments that prioritize inclusion. Integrating AI into educational environments is not just about adopting new technologies; it's about reimagining pedagogical strategies to make learning more accessible and personalized for each student. This transformation is supported by a growing body of research that highlights both the potential benefits and challenges of AI in higher education. The use of AI in education goes beyond simple automation to facilitate dynamic learning experiences that can adapt to the diverse needs of students. AI-enabled personalized learning experiences can adapt to individual learning styles and paces, thereby improving student engagement and understanding (Suazo, 2023). Tools like intelligent tutoring systems and adaptive learning platforms can provide personalized support and feedback, helping students overcome learning obstacles more effectively. This AI-powered personalization not only improves learning outcomes, but also fosters a more inclusive educational environment where every student has the opportunity to succeed. However, integrating AI into teaching and learning also presents several challenges that educators must address. Ethical considerations, such as data privacy, bias in AI algorithms, and

potential dehumanization of the learning process, are critical issues that require careful attention. Ensuring that AI tools are designed and implemented in ways that meet ethical standards and promote equity is paramount. Furthermore, the successful integration of AI into education requires a change in the way teachers are trained and supported. Educators must be equipped with the skills necessary to effectively incorporate AI tools into their teaching practices. This includes understanding how to interpret the ideas generated by AI and how to use these tools to complement traditional teaching methods. The vulnerability of educational institutions to cyberattacks, especially with the increasing reliance on digital platforms, underscores the importance of robust cybersecurity measures. Protecting student data and ensuring the reliability of AI systems are crucial to maintaining trust in technology-enhanced education.

Conclusions

In light of the findings of the literature review on the integration of Artificial Intelligence (AI) in higher education, it is clear that the way forward requires a nuanced approach that balances innovation with ethical considerations, inclusivity and practicality. The future of research and practice in this area must focus on a few key areas.

First, there is an imperative need to develop comprehensive ethical and privacy guidelines designed specifically for the educational context. This effort must address complexities around data transparency, algorithmic bias, and equity, while ensuring that informed consent is not just a procedural formality, but a fundamental aspect of integrating AI into education. Such guidelines would not only protect the interests and rights of students and educators, but also serve as a beacon for the responsible use of AI in higher education.

Simultaneously, exploring the potential of AI to enhance inclusive pedagogy requires deeper analysis. This exploration must go beyond superficial applications to investigate how AI can be designed and implemented to address the diversity of student needs, learning styles, and backgrounds, thereby fostering an equitable and accessible educational environment for all.

Equally critical is addressing the factors that influence educators' adoption of AI tools. The focus should be on understanding the barriers and motivations educators face and developing targeted training programs. These programs must not only impart the skills and knowledge necessary for AI integration, but also build confidence among educators to effectively navigate the new environment.

The path forward also requires fostering interdisciplinary collaborations. By bridging the gap between educational technology, computer science, ethics, psychology and other relevant fields, research can shed a more complete view of the multifaceted impact of AI in higher education. These collaborative efforts can unravel the complexities of AI integration and pave the way for innovative solutions that improve teaching and learning.

Additionally, the long-term effects of integrating AI into educational settings remain a vital area of research. Longitudinal studies are essential to capture the evolving dynamics of AI initiatives, their sustainability, impact on learning outcomes, and emerging challenges and needs over time. These insights can inform continuous improvement and adaptation of AI in education.

Another aspect that requires attention is the role of AI in assessment practices. Investigating how AI can contribute to the development of more authentic, adaptive and personalized assessment methods can revolutionize the way student learning and progress are measured, moving towards more holistic and meaningful assessment practices.

Addressing the digital divide is crucial to ensuring equitable access to AI-enhanced learning opportunities. Research should explore strategies to overcome barriers related to socioeconomic status, geographic location, and access to technology, ensuring that the benefits of AI in education are accessible to all students.

Incorporating student perspectives into the design and development of AI applications is another important consideration. Engaging students as co -designers can ensure that AI tools are aligned with their needs and preferences, thereby improving the relevance and effectiveness of these technologies in higher education.

The cost-effectiveness of AI solutions also deserves evaluation, especially in the context of the budget constraints faced by educational institutions. Evaluating the return on investment in terms of educational outcomes and operational efficiency can provide valuable information for decision makers in higher education.

Finally, as AI becomes more integrated into research methodologies in higher education, its ethical use in this context must be critically examined. Ensuring transparency, accountability, and respect for the privacy and consent of participants in AI-powered research is paramount.

Navigating the future of AI in higher education therefore requires a balanced approach that embraces the transformative potential of AI, while meticulously addressing the ethical, inclusion, and practicality challenges that accompany its integration.

References

Abgaryan, H., Asatryan, S., & Matevosyan, A. (2023). Revolutionary changes in higher education with artificial intelligence. *Main Issues of Pedagogy and Psychology, 10*(1), 76-86. https://doi.org/10.24234/miopap.v10i1.454

Bearman, M., & Ajjawi, R. (2023). Learning to work with the black box: Pedagogy for a world with artificial intelligence. *British Journal of Educational Technology, 54*(5), 1160-1173. https://doi.org/10.1111/bjet.13337

Bozkurt, A., Karadeniz, A., Bañeres, D., & Rodríguez, M. (2021). Artificial intelligence and reflections from educational landscape: A review of ai studies in half a century. *Sustainability, 13*(2), 800. https://doi.org/10.3390/su13020800

Calatayud, V., Espinosa, M., & Vila, R. (2021). Artificial intelligence for student assessment: A systematic review. *Applied Sciences, 11*(12), 5467. https://doi.org/10.3390/app11125467

Chai, C., Wang, X., & Xu, C. (2020). An extended theory of planned behavior for the modelling of chinese secondary school students' intention to learn artificial intelligence. *Mathematics, 8*(11), 2089. https://doi.org/10.3390/math8112089

Chiu, T., Meng, H., Chai, C., King, I., Wong, S., & Yam, Y. (2022). Creation and evaluation of a pretertiary artificial intelligence (ai) curriculum. *IEEE Transactions on Education, 65*(1), 30-39. https://doi.org/10.1109/te.2021.3085878

Crompton, H., & Song, D. (2021). The potential of artificial intelligence in higher education. *Revista Virtual Universidad Católica Del Norte, 62*, 1-4. https://doi.org/10.35575/rvucn.n62a1

Durso, S., & Arruda, E. (2022). Artificial intelligence in distance education: A systematic literature review of brazilian studies. *Problems of Education in the 21st Century, 80*(5), 679-692. https://doi.org/10.33225/pec/22.80.679

Fornasier, M. (2021). Legal education in the 21st century and the artificial intelligence. *Revista Opinião Jurídica (Fortaleza), 19*(31), 1-32. https://doi.org/10.12662/2447-6641oj.v19i31.p1-32.2021

Gazquez Linares, J. J., Pérez Fuentes, M. del C., & Suazo Galdames, I. (2023). Embracing the Potential of Artificial Intelligence in Education: Balancing Benefits and Risks. *European Journal of Education and Psychology*, *16*(1), 1–8. https://doi.org/10.32457/ejep.v16i1.2205

Goksel, N., & Bozkurt, A. (2019). Artificial intelligence in education. In *2019: 224-236*. https://doi.org/10.4018/978-1-5225-8431-5.ch014

Hannan, E. (2021). Ai: New source of competitiveness in higher education. *Competitiveness Review: An International Business Journal Incorporating Journal of Global Competitiveness, 33*(2), 265-279. https://doi.org/10.1108/cr-03-2021-0045

Jantakun, T., Jantakun, K., & Jantakoon, T. (2021). A common framework for artificial intelligence in higher education (aai-he model). *International Education Studies, 14*(11), 94. https://doi.org/10.5539/ies.v14n11p94

Khan, M., & Khojah, M. (2022). Artificial intelligence and big data: The advent of new pedagogy in the adaptive e-learning system in the higher educational institutions of Saudi Arabia. *Education Research International, 2022*, 1-10. https://doi.org/10.1155/2022/1263555

Köbis, L., & Mehner, C. (2021). Ethical questions raised by ai-supported mentoring in higher education. *Frontiers in Artificial Intelligence, 4*. https://doi.org/10.3389/frai.2021.624050

Kulikowski, C. (2022). 50 years of achievements and persistent challenges for biomedical and health informatics and john mantas' educational and nursing informatics contributions. https://doi.org/10.3233/shti220936

Lainjo, B., & Tsmouche, H. (2023). Impact of artificial intelligence on higher learning institutions. *International Journal of Education Teaching and Social Sciences, 3*(2), 96-113. https://doi.org/10.47747/ijets.v3i2.1028

Lainjo, B., & Tsmouche, H. (2023). Impact of artificial intelligence on higher learning institutions. *International Journal of Education Teaching and Social Sciences, 3*(2), 96-113. https://doi.org/10.47747/ijets.v3i2.1028

Li, K., & Wong, B. (2023). Artificial intelligence in personalised learning: A bibliometric analysis. *Interactive Technology and Smart Education, 20*(3), 422-445. https://doi.org/10.1108/itse-01-2023-0007

Li, Y., & Yang, P. (2023). Higher education worries and response in the era of artificial intelligence. *Education*. https://doi.org/10.54647/education880398

Liao, Y. (2022). Educational evaluation of piano performance by the deep learning neural network model. *Mobile Information Systems, 2022*, 1-12. https://doi.org/10.1155/2022/6975824

Luan, H., Géczy, P., Lai, H., Gobert, J., Yang, S., Ogata, H., et al. (2020). Challenges and

future directions of big data and artificial intelligence in education. *Frontiers in Psychology, 11*. https://doi.org/10.3389/fpsyg.2020.580820

Pedró, F. (2020). Applications of artificial intelligence to higher education: Possibilities, evidence, and challenges. *Iul Research, 1*(1), 61-76. https://doi.org/10.57568/iulres.v1i1.43

Rienties, B., Simonsen, H., & Herodotou, C. (2020). Defining the boundaries between artificial intelligence in education, computer-supported collaborative learning, educational data mining, and learning analytics: A need for coherence. *Frontiers in Education, 5*. https://doi.org/10.3389/feduc.2020.00128

Sadiku, M., Ashaolu, T., Ajayi-Majebi, A., & Musa, S. (2021). Artificial intelligence in education. *International Journal of Scientific Advances, 2*(1). https://doi.org/10.51542/ijscia.v2i1.2

Sousa, M., Mas, F., Pesqueira, A., Lemos, C., Verde, J., & Cobianchi, L. (2021). The potential of ai in health higher education to increase the students' learning outcomes. *Tem Journal,* 488-497. https://doi.org/10.18421/tem102-02

Su, J., & Yang, W. (2023). Unlocking the power of ChatGPT: A framework for applying generative AI in education. *ECNU Review of Education, 6*(3), 355-366. https://doi.org/10.1177/20965311231168423

Suazo Galdames, I. (2023). Chatbots for Promoting Healthy Habits and Scientific Culture. *International Journal of Medical and Surgical Sciences*, *10*(4), 1–4. https://doi.org/10.32457/ijmss.v10i4.2413

Zawacki-Richter, O., Marín, V., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – where are the educators?. *International Journal of Educational Technology in Higher Education, 16*(1). https://doi.org/10.1186/s41239-019-0171-0

Zheng, R., & Badarch, T. (2022). Research on applications of artificial intelligence in education. *American Journal of Computer Science and Technology, 5*(2), 72. https://doi.org/10.11648/j.ajcst.20220502.17