WEAVING CONNECTIONS: THE TRANSFORMATIVE SYMBIOSIS BETWEEN LEARNING AND ARTIFICIAL INTELLIGENCE

TECER LIGAÇÕES: A SIMBIOSE TRANSFORMADORA ENTRE APRENDIZAGEM E INTELIGÊNCIA ARTIFICIAL

TEJIENDO CONEXIONES: LA SIMBIOSIS TRANSFORMADORA ENTRE APRENDIZAJE E INTELIGENCIA ARTIFICIAL

Oscar-Yecid Aparicio-Gómez
Correspondence author
Ed&TIC Research Center ,Colombia
https://orcid.org/0000-0003-3535-6288
oaparicio@editic.net

Carlos-Alfonso Aparicio-Gómez
Ed&TIC Research Center ,Colombia
https://orcid.org/0000-0002-3231-3699
caparicio@editic.net

Otto Federico von Feigenblatt
Keiser University, United States
https://orcid.org/0000-0001-6033-6495
vonfeigenblatt@hotmail.com

Abstract: This article examines the convergence between artificial intelligence (AI) and human learning, exploring how this convergence redefines not only education, but also the technological landscape. AI, in its quest to emulate human intelligence, ventures into the realm of cognitive tasks once exclusive to human minds, such as reasoning and problem-solving. Machine learning, as an essential pillar of AI, enables autonomous improvement in the face of new situations, revealing the adaptive capacity of these technologies. Inspired by the structure of the human brain, neural networks and deep learning significantly enhance data processing capacity. In education, AI manifests itself through intelligent tutoring systems and personalized platforms that shape learning environments uniquely for each student. The creative crossroads highlights how AI, by understanding patterns, acts as an amplifier of human creativity. This convergence envisions a new educational era, characterized by complete personalization, technologically rich environments, and advanced assessments, while raising challenges that define an educational and technological future full of possibilities.
Keywords: Human learning; Artificial Intelligence; Technological education; Pedagogical innovation.

Resumo: Este artigo examina a convergência entre a inteligência artificial (IA) e a aprendizagem humana, explorando como esta convergência está a redefinir não só a educação, mas também o panorama tecnológico. A IA, na sua tentativa de emular a inteligência humana, aventura-se no domínio das tarefas cognitivas que outrora eram exclusivas das mentes humanas, como o raciocínio e a resolução de problemas. A aprendizagem automática, enquanto pilar essencial da IA, permite o aperfeiçoamento autónomo face a novas situações, revelando a capacidade de

adaptação destas tecnologias. Inspiradas na estrutura do cérebro humano, as redes neuronais e a aprendizagem profunda aumentam significativamente a capacidade de processamento de dados. No domínio da educação, a IA manifesta-se mediante sistemas de tutoria inteligentes e de plataformas personalizadas que moldam os ambientes de aprendizagem de forma exclusiva para cada aluno. A encruzilhada criativa destaca como a IA, ao compreender padrões, atua como um amplificador da criatividade humana. Esta convergência prevê uma nova era educativa, caracterizada por uma personalização total, ambientes tecnologicamente ricos e avaliações avançadas, ao mesmo tempo que levanta desafios que definem um futuro educativo e tecnológico cheio de possibilidades.

Palavras-chave: Aprendizagem humana; Inteligência Artificial; Educação tecnológica; Inovação pedagógica.

Resumen: Este artículo examina la convergencia entre la inteligencia artificial (IA) y el aprendizaje humano, explorando cómo esta convergencia redefine no solo la educación, sino también el panorama tecnológico. La IA, en su búsqueda por emular la inteligencia humana, se aventura en el terreno de tareas cognitivas que una vez fueron exclusivas de las mentes humanas, como el razonamiento y la resolución de problemas. El aprendizaje de máquinas, como pilar esencial de la IA, posibilita una mejora autónoma frente a nuevas situaciones, revelando la capacidad adaptativa de estas tecnologías. Inspiradas en la estructura del cerebro humano, las redes neuronales y el aprendizaje profundo potencian la capacidad de procesamiento de datos de manera significativa. En el ámbito educativo, la IA se manifiesta a través de sistemas de tutoría inteligente y plataformas personalizadas que moldean los entornos de aprendizaje de manera única para cada estudiante. La encrucijada creativa destaca cómo la IA, al comprender patrones, actúa como un amplificador de la creatividad humana. Esta convergencia vislumbra una nueva era educativa, caracterizada por una personalización completa, entornos tecnológicamente ricos y evaluaciones avanzadas, al tiempo que plantea desafíos que definen un futuro educativo y tecnológico lleno de posibilidades.

Palabras claves: Aprendizaje humano; Inteligencia Artificial; Educación tecnológica; Innovación pedagógica.

1. INTRODUCTION

The convergence between artificial intelligence (AI) and human learning marks an unprecedented milestone in the educational and technological fields, triggering a transformative symbiosis that redefines the way we understand and apply knowledge. This phenomenon transcends mere coexistence to dive into a dynamic relationship where AI seeks to emulate human intelligence, and human learning intertwines with the analytical and adaptive capabilities of artificial intelligence.

At the very core of artificial intelligence, we find the ambitious mission to replicate the complexities of the human mind. This multidisciplinary field is immersed in the creation of computer systems and algorithms capable of performing cognitive tasks that, in previous times, were exclusive to human capacity (Domínguez, 2019). Reasoning, learning, problem-solving, and language comprehension are key goals in this quest to emulate human intelligence. Thus, AI is presented as a technological manifestation of the mind, a tool that not only processes data but interprets and understands its meaning in a manner strikingly like the human mind.

The intersection between AI and human learning comes to life in the transformation of education. In this dynamic environment, intelligent tutoring systems, personalized learning platforms, and virtual assistants emerge as the architects of a new educational paradigm. The ability of AI to analyze large-scale data enables the creation of personalized learning environments, tailored to the specific needs of each student. These systems not only identify areas of strength and weakness, providing instant feedback and personalized activities but also redefine the relationship between educator and learner, fostering a more inclusive and student-driven teaching process.

At the creative crossroads between AI and learning, we face a convergence that goes beyond conventional expectations. This meeting point integrates AI into the educational process and challenges to preserve and enhance the creative essence inherent in human learning (Fielding, 2016). At this crossroads, AI becomes a catalyst that amplifies the creative possibilities of human learning. The generation of creative content, supported by AI algorithms capable of understanding and replicating stylistic patterns, opens new avenues for artistic expression and educational creativity.

The convergence between AI and learning provides a glimpse of a future where personalization, immersion, and assessment will define the educational experience. AI, as an intuitive and analytical guide, is positioned as a key enabler to adapt education to the diversity of learning styles and to design stimulating educational environments. This crucible of innovation redefines not only how we learn but also how we explore creativity, anticipating a new chapter in the history of AI and human learning.

In the realm of personalized learning, AI's capacity to gather and process vast amounts of data about students' learning patterns and preferences offers unparalleled opportunities for tailoring educational experiences. By analyzing students' interactions with educational content, AI can identify areas where individuals struggle or excel, allowing educators to intervene more effectively and provide targeted support (Xie, 2023). Moreover, AI-powered adaptive learning platforms can dynamically adjust the difficulty and pace of instruction to match each student's abilities, ensuring that they are appropriately challenged without feeling overwhelmed.

Furthermore, AI-driven virtual assistants are revolutionizing the way students engage with course materials and seek academic assistance. These intelligent agents can answer students' questions in real-time, provide explanations, offer personalized recommendations for supplementary resources, and even facilitate collaborative learning experiences. By leveraging natural language processing and machine learning algorithms, these virtual assistants can understand and respond to students' queries with a level of sophistication that rivals human tutors, enhancing accessibility and convenience for learners.

Beyond individualized instruction and support, AI is also transforming the assessment landscape in education (Rheingold, 1985). Traditional forms of assessment, such as standardized tests and exams, often fail to capture the full range of students' abilities and knowledge. AI-powered assessment tools, on the other hand, can analyze diverse types of data, including written responses, multimedia projects, and interactive simulations, to provide more holistic and nuanced evaluations of students' learning outcomes. By leveraging techniques such as machine learning and data mining, these tools can identify patterns and insights that might otherwise go unnoticed, enabling educators to make more informed decisions about teaching and curriculum development.

AI-enabled assessment methods can offer immediate feedback to students, allowing them to reflect on their performance, identify areas for improvement, and take proactive steps to enhance their learning. By receiving timely and actionable feedback, students can engage more deeply with course materials, address misconceptions or gaps in their understanding, and ultimately achieve greater mastery of the subject. This iterative process of assessment and feedback fosters a growth mindset and empowers students to take ownership of their learning journey, laying the foundation for lifelong learning and continuous improvement.

In addition to its impact on teaching and learning, AI is also reshaping the landscape of educational research and innovation. By analyzing large-scale datasets and conducting sophisticated data mining operations, AI researchers can uncover valuable insights into the factors that influence learning outcomes, instructional effectiveness, and student engagement (Ferrer-Conill et al., 2020). These insights can inform the design of evidence-based interventions, instructional strategies, and educational technologies, leading to more efficient and impactful educational practices.

AI-driven simulations and modeling techniques are enabling researchers to explore complex educational phenomena in virtual environments, allowing them to conduct experiments, test hypotheses, and refine theories in ways that would be impractical or ethically challenging in traditional educational settings. By simulating the interactions between students, teachers, and instructional materials, these virtual environments provide researchers with valuable opportunities to study the dynamics of learning and instruction, leading to new discoveries and breakthroughs in the field of education.

2. METHODOLOGY

The methodology is based on a comprehensive review of the existing literature in the fields of artificial intelligence, human learning and education. A critical analysis of research, case studies and technological developments relevant to understanding the intersection between AI and human learning is undertaken. This review focuses on identifying the key synergies and convergences that are transforming the very nature of education and technology. In addition, a comparative analysis is made of different approaches and applications of AI in education, from intelligent tutoring systems to personalized learning platforms and interactive simulations. Through this analysis, we seek to understand how AI is being integrated into educational environments and how it is impacting the teaching and learning process. It also explores the ethical, social and pedagogical implications of this convergence between AI and human learning, considering aspects such as equity, inclusion and data privacy. To complement the theoretical analysis, concrete examples of successful implementations of AI in education are collected and analyzed, highlighting cases of good practices and lessons learned. Finally, reflections and recommendations are proposed to guide future research and developments in this emerging field, with the aim of promoting a responsible and effective integration of AI in the education of the future.

3. RESULTS
3.1. Basic principles

The convergence between AI and human learning redefines the foundations of education and technology, raising essential questions about how these two forces interact and evolve together (Nilsson, 1980). As we delve into the basic principles of AI and learning, we are plunged into a complex landscape where the transformative synergy between machines and human minds unleashes unprecedented innovations. At its core, AI seeks to emulate the complexity of human intelligence through computer systems and algorithms. This multidisciplinary field focuses on the development of machines capable of performing cognitive tasks that, until recently, were exclusive to the human mind. The ability to reason, learn, solve problems and understand language become fundamental objectives in the pursuit of AI (Aparicio-Gómez & Aparicio-Gómez, 2021).

One of the essential pillars of AI is machine learning, a concept that implies that computers improve their performance autonomously as they face new situations. This learning process involves the ability to adapt and evolve from experience, without the need for explicit programming. The three main types of machine learning are supervised, unsupervised and reinforcement learning (OpenAI, 2020). In supervised learning, the model is trained with labeled data; in unsupervised, unlabeled data is analyzed; and in reinforcement learning, the model makes decisions in a dynamic environment, receiving rewards or punishments based on its actions. These approaches allow machines to develop skills ranging from pattern prediction to complex decision-making.

Neural networks and deep learning are positioned as crucial elements in contemporary artificial intelligence. Inspired by the structure and functioning of the human brain, neural networks consist of layers of interconnected nodes, enabling machines to learn complex hierarchies of representations (Carr, 2015). Deep learning, a branch of artificial intelligence, has revolutionized the ability of machines to process large amounts of data and perform increasingly sophisticated tasks. From speech recognition to computer vision, deep learning has proven to be a powerful tool in creating intelligent systems capable of understanding and solving complex problems.

The intersection between AI and human learning is materializing in the transformation of the educational domain. Intelligent tutoring systems, personalized learning platforms, and virtual assistants are redefining the way individuals acquire knowledge (Aparicio Gómez et al., 2022). The adaptability of AI to individual learning styles and its ability to provide personalized feedback are opening new possibilities in teaching and skill development. This synergy not only enhances learning effectiveness, but also raises fundamental questions about the changing nature of education in a technology-driven world.

In this framework, the convergence between AI and human learning emerges as a bridge to a more personalized and adaptive educational future. The ability of AI to analyze large amounts of data and understand the subtleties of individual learning styles provides the opportunity to create educational experiences that are precisely tailored to the needs of each student (Hinojo-Lucena et al., 2019). Intelligent tutoring systems, supported by advanced algorithms, can identify specific areas for improvement and provide personalized guidance, thus optimizing the learning process.

As the convergence between AI and learning deepens, so does its impact on the creation of educational content. AI presents itself as a creative tool, capable of generating coherent and contextually relevant educational material. Generative language models, such as GPT, have demonstrated an impressive ability to create text in a fluent way and adapted to diverse educational needs (van Dis et al., 2023). This content generation

capability not only facilitates access to diversified educational resources, but also frees educators to focus on more interactive and personalized aspects of the teaching process. The convergence between AI and human learning is also manifesting itself in the creation of immersive and interactive educational environments.

3.2.Intersections and synergies

The confluence between AI and human learning has spawned an intricate network of intersections and synergies beyond conventional expectations, giving rise to a complex web of relationships that redefines the traditional boundaries of knowledge (Forbes-Riley & Litman, 2010). This intertwining shapes an unprecedented educational and technological paradigm. Diving into the crucial interactions between these two domains reveals a transformative symbiosis that drives significant advances in the understanding and application of learning, setting the direction for an innovative and dynamic educational future.

The confluences between AI and human learning are evident in the development of more personalized and adaptive educational systems. AI, through machine learning algorithms, deploys its ability to analyze large-scale data to understand individual learning styles. This approach enables the creation of personalized learning environments, tailored to meet the specific needs of individual learners. Paradigmatic exemplars include intelligent tutoring systems, capable of identifying areas of strength and weakness, providing instant feedback and personalized activities to boost academic performance (Drewniak & Posadzińska, 2020). The convergence of AI's analytical capabilities with the uniqueness of the human learning process represents an effective synergy that seeks to maximize individual educational potential.

Complementarity, AI emerges as a catalyst for pedagogical innovation, providing advanced tools for the creation of educational content and facilitating enriching learning experiences. Generative language models, such as GPT, have demonstrated the ability to generate coherent and contextually relevant text (Gill et al., 2024). This potential opens the possibility of automatic generation of educational material, ranging from lessons to assessments. AI also facilitates the creation of immersive learning environments, making use of virtual and augmented reality to immerse students in three-dimensional educational experiences. These innovations not only expand the accessibility of learning, but also transcend the boundaries of how information is presented and assimilated, taking education into new experiential dimensions.

The synergy between AI and learning manifests itself impactfully in the development of virtual assistants that play a role as companions in the educational process. These AI-powered assistants not only answer specific questions, but also provide detailed explanations of concepts and guide students through interactive learning activities (Fan & Chatterjee, 2018). Some virtual assistants incorporate elements of natural language processing, allowing them to understand and respond more naturally to learner queries. This dynamic interaction not only supports the learning process, but also fosters curiosity and engagement, key elements in holistic educational development.

The intersection between AI and learning is evidently reflected in the continuous improvement of feedback and assessment. Automated assessment systems, supported by machine learning algorithms, go beyond simply evaluating correct or incorrect answers. These systems provide detailed analyses of student responses, allowing patterns of thinking and specific areas of difficulty to be identified (Susnjak, 2022). This instant and

personalized feedback approach not only accelerates the learning process, but also empowers students to take a more active role in their educational development by understanding their own strengths and weaknesses.

3.3. The creative crossroads between artificial intelligence and learning.

In the vast web of connections between AI and human learning, a creative crossroads emerges that goes beyond mere technological convergence (Chai & Fan, 2018). This point of convergence redefines the boundaries of innovation and intellectual expression, establishing a crucible where the analytical and adaptive capabilities of AI merge with the innate creativity inherent in human learning. This crossroads manifests itself as a transformative space, challenging conventional perceptions about the nature of learning and creativity.

First, AI brings to this crossroads a unique ability to analyze vast data sets, identify complex patterns and generate efficient solutions. Deep learning algorithms, driven by complex neural networks, have demonstrated exceptional mastery in tasks that require intensive information processing, such as image recognition, natural language processing, and complex decision-making (Xie, 2023). This analytical component of AI serves as a solid foundation for boosting learning efficiency by providing accurate and personalized information to learners. Furthermore, the inherent adaptability of AI is manifested in its ability to dynamically adjust to individual learning styles, creating more relevant and effective educational experiences.

However, the creative crossroads goes beyond the analytical capabilities of artificial intelligence; it involves the challenge of preserving and enhancing the creative essence of human learning (Comesaña-Comesaña et al., 2022). Creativity, with its ability to synthesize information, find unexpected connections and generate innovative ideas, is an intrinsic attribute of humanity. In this context, learning is elevated to the category of an artistic act, where individuals not only absorb information, but also reinterpret and apply it in unique ways. The creative crossroads therefore demands a delicate harmonization between the analytical capabilities of AI and the unparalleled creativity of the human mind.

At this meeting point, AI becomes a technological inspiration that not only suggests, but also amplifies the creative possibilities of human learning (Tegmark, 2017). The generation of creative content, supported by AI algorithms capable of understanding and replicating stylistic patterns, opens new avenues for artistic expression and educational creativity. AI is not only limited to analyzing data but can also play a crucial role in identifying and developing creative skills in students. By providing personalized feedback and facilitating learning environments that foster innovation and divergent thinking, AI becomes a catalyst for creativity and individual expression.

This creative intersection also raises fundamental questions about the evolution of the educational process itself (Schmidhuber, 2015). The collaboration between AI and human learning not only redefines the nature of teaching, but also transforms the way students approach learning. The creative crossroads challenges educators to rethink and adapt their pedagogical methods to effectively incorporate the tools and analytical capabilities of AI. Teaching is no longer simply the transmission of information; it becomes a dynamic process of joint exploration, where AI acts as a collaborative partner in the pursuit of knowledge and creativity.

3.4.Convergence between artificial intelligence and learning

The convergence between AI and human learning, emerging as the epicenter of an unprecedented educational and technological transformation, transcends conventional barriers and shapes a new understanding in the way we acquire knowledge and relate to technology (Nilsson, 1959). This intersection between AI and learning is not simply a coexistence; rather, it is a symbiosis that promises to fundamentally alter the nature of pedagogy and human cognition in the coming years. A highlight of this convergence is the promise of complete personalization of education.

Machine learning algorithms, nurtured by detailed data on individual student performance and preferences, clear the way toward instantaneous tailoring of content and teaching methods to the unique needs of each student (Mnih et al., 2015). In this scenario, AI becomes an intuitive guide that not only understands but also dynamically responds to the diversity of learning styles and paces, thus forging a more inclusive and accessible education. This personalized approach represents an effective synergy between the analytical capabilities of AI and the uniqueness of the human learning process, marking a milestone in the way we conceive and approach education.

As we project into the educational horizon of the future, the convergence between AI and learning is envisioned to materialize in deeply immersive, technology-enriched educational environments. Online learning platforms, virtual assistants and interactive simulations, far from being exceptions, will become the norm (LeCun et al., 2015). These elements will trigger a shift towards dynamic and stimulating educational environments, where AI, acting as the driving force behind these environments, transcends conventional limitations. This shift not only improves the quality of education, but also redefines the learning experience, opening new frontiers for educational exploration.

In the coming years, the convergence between AI and learning will crystallize in the creation of advanced tools for the assessment and monitoring of academic performance. AI-based automated assessment systems, with the ability to quickly analyze large data sets, are emerging as key elements that will provide detailed insights into student performance (Chiappe & Lee, 2017). These tools, far from being simple instruments to ease the workload of educators, will foster accurate and detailed assessment of individual progress. The immediate feedback provided by these systems will stand as a fundamental pillar to drive self-regulation of learning, empowering students to take an active and autonomous role in their education.

In this context, the convergence between AI and learning is not only presented as a technological evolution, but as a revolution in the way we conceive education (von Feigenblatt & Aparicio-Gómez, 2023). This synergy promises a future where educational personalization is the norm, where technology amplifies our learning experiences, and where assessment and performance monitoring become precise and personalized tools. The intersection between AI and human learning brings with it the promise of a more inclusive, adaptive, and future-oriented education, ushering in a new era where technology and human cognition are uniquely and transformational intertwined.

4. CONCLUSIONS

The convergence between AI and human learning has woven an intricate web of intersections and synergies that redefines the very nature of education and technology.

This transformation is not simply a coexistence, but a symbiosis that unleashes unprecedented innovations. The intersections between AI and learning manifest themselves in educational personalization, where machine learning algorithms, based on detailed data on student performance and preferences, pave the way toward instant adaptation of content and teaching methods to individual needs. This approach represents an effective synergy between the analytical capabilities of AI and the uniqueness of the human learning process.

The creative crossroads between AI and learning emerges as a unique point of convergence where AI's analytical capabilities intertwine with human creativity. This intersection challenges conventional perceptions about the nature of learning and creativity. Here, AI acts as a technological muse, inspiring and amplifying the creative possibilities of human learning. The generation of creative content, supported by AI algorithms capable of understanding stylistic patterns, opens up new avenues for artistic expression and educational creativity.

The convergence between AI and learning not only drives educational personalization and creativity, but also redefines the educational environments of the future. Online platforms, virtual assistants and interactive simulations enrich the educational experience, triggering a shift towards dynamic and stimulating environments. AI, as the driving force behind these environments, overcomes traditional limitations, unlocking unlimited opportunities for experimentation and practical application of knowledge. This convergence will open new frontiers for educational exploration, transforming the way we conceive of teaching and learning.

Looking into the near future, the convergence between AI and learning will crystallize into advanced tools for assessing and monitoring academic performance. Automated AI-based systems will rapidly analyze large data sets, providing detailed insights into student performance. These tools, beyond alleviating the workload of educators, will foster accurate and detailed assessment of individual progress. The immediate feedback provided by these systems will become a fundamental pillar in driving self-regulation of learning, empowering students to take an active and autonomous role in their education.

AUTHORS' CONTRIBUTIONS: Oscar-Yecid Aparicio-Gómez (Development of ideas; formulation or evolution of the overall objectives and goals of the research), Carlos-Alfonso Aparicio-Gómez (Writing - original draft - Preparation, creation and/or presentation of the published work, specifically the writing of the initial draft) and Otto Federico von Feigenblatt: (Preparation, creation and/or presentation of published work by members of the original research group, specifically critical review)

BIBLIOGRAPHICAL REFERENCES
Aparicio Gómez, O. Y., Ostos Ortiz, O. L., & Mesa Angulo, J. G. (2022). La convergencia de aprendizajes en el metaverso. *Revista Interamericana de Investigación Educación y Pedagogía RIIEP*, *15*(2), 385–398. https://doi.org/10.15332/25005421.7879

Aparicio-Gómez, O.-Y., & Aparicio-Gómez, W.-O. (2021). Referentes filosóficos del proceso educativo. *Revista Internacional de Filosofía Teórica y Práctica*, *1*(2), 157–168. https://doi.org/10.51660/riftp.v1i2.37

Carr, N. (2015). *The glass cage: How our computers are changing the way we think, feel, and act*. W. W. Norton & Company.

Chai, J. X., & Fan, K. K. (2018). Constructing creativity: Social media and creative expression in design education. *Eurasia Journal of Mathematics, Science and Technology Education*, *14*(1), 33–43. https://doi.org/10.12973/ejmste/79321

Chiappe, A., & Lee, L. L. (2017). Open teaching: A new way on e-learning? *Electronic Journal of E-Learning*, *15*(5), 369–383.

Comesaña-Comesaña, P., Comesaña-Comesaña, P., Amorós-Pons, A., & Alexeeva-Alexeev, I. (2022). Technocreativity, Social Networks and Entrepreneurship: Diagnostics of Skills in University Students. *International Journal of Emerging Technologies in Learning (IJET)*, *17*(5), 180–195. https://doi.org/10.3991/ijet.v17i05.28183

Domínguez, L. M. M. (2019). The essentials in human learning to respond to continuous change. *Foro de Educacion*, *17*(27), 253–270. https://doi.org/10.14516/fde.638

Drewniak, Z., & Posadzińska, I. (2020). Learning and development tools in supporting of artificial intelligence companies innovativeness. *Proceedings of the 15th European Conference on Management, Leadership and Governance, ECMLG 2019*, 125–132. https://doi.org/10.34190/MLG.19.082

Fan, L., & Chatterjee, S. (2018). Application of situational stimuli for examining the effectiveness of financial education: A behavioral finance perspective. *Journal of Behavioral and Experimental Finance*, *17*, 68–75. https://doi.org/10.1016/j.jbef.2017.12.009

Ferrer-Conill, R., Foxman, M., Jones, J., Sihvonen, T., & Siitonen, M. (2020). Playful approaches to news engagement. *Convergence*, *26*(3), 457–469. https://doi.org/10.1177/1354856520923964

Fielding, M. (2016). Learning to be human: The educational legacy of John MacMurray. In *Learning to be Human: The Educational Legacy of John MacMurray*. Taylor and Francis Inc. https://doi.org/10.4324/9781315747934

Forbes-Riley, K., & Litman, D. (2010). Metacognition and learning in spoken dialogue computer tutoring. *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, *6094 LNCS*(PART 1), 379–388. https://doi.org/10.1007/978-3-642-13388-6_42

Gill, S. S., Xu, M., Patros, P., Wu, H., Kaur, R., Kaur, K., Fuller, S., Singh, M., Arora, P., Parlikad, A. K., Stankovski, V., Abraham, A., Ghosh, S. K., Lutfiyya, H., Kanhere, S. S., Bahsoon, R., Rana, O., Dustdar, S., Sakellariou, R., … Buyya, R. (2024). Transformative effects of ChatGPT on modern education: Emerging Era of AI Chatbots. *Internet of Things and Cyber-Physical Systems*, *4*, 19–23. https://doi.org/10.1016/J.IOTCPS.2023.06.002

Hinojo-Lucena, F. J., Aznar-Díaz, I., Cáceres-Reche, M. P., & Romero-Rodríguez, J. M. (2019). Artificial intelligence in higher education: A bibliometric study on its impact in the scientific literature. *Education Sciences*, *9*(1),1-9. https://doi.org/10.3390/educsci9010051

LeCun, Y., Bengio, Y., & Hinton, G. (2015). Deep learning. *Nature*, *521*(7553), 436–444.

Mnih, V., Kavukcuoglu, K., Silver, D., Rusu, A. A., Veness, J., Bellemare, M. G., & Petersen, S. (2015). Human-level control through deep reinforcement learning. *Nature*, *518*(7540), 529–533.

Nilsson, N. J. (1959). *Learning machines: Foundations of computational intelligence*. McGraw-Hill.

Nilsson, N. J. (1980). *Principles of artificial intelligence* (2nd ed.). Tioga Press.

OpenAI. (2020). *Five years of progress in artificial general intelligence*.

Rheingold, H. (1985). *Tools for thought*. MIT Press.

Schmidhuber, J. (2015). Deep learning in neural networks: An overview. *Neural Networks*, *61*, 85–117.

Susnjak, T. (2022). *ChatGPT: The End of Online Exam Integrity?* https://acortar.link/XcG5py

Tegmark, M. (2017). *Life 3.0: Being human in the age of artificial intelligence*. Knopf.

van Dis, E. A. M., Bollen, J., Zuidema, W., van Rooij, R., & Bockting, C. L. (2023). ChatGPT: five priorities for research. *Nature*, *614*(7947), 224–226. https://doi.org/10.1038/D41586-023-00288-7

von Feigenblatt, O., & Aparicio-Gómez, O.-Y. (2023). *Trascending the eternal debate between traditional and progressive education: A constructive scholary dialogue*. Octaedro.

Xie, H. (2023). The promising future of cognitive science and artificial intelligence. *Nature Reviews Psychology*, *2*(4), 202. https://doi.org/10.1038/S44159-023-00170-3