ARTÍCULOS DE INVESTIGACIÓN
Research Article

Impact of artificial intelligence on educational actors (2015-2023)[1]

Impactos de la inteligencia artificial en actores educativos (2015-2023)

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Abstract

Introduction: Artificial intelligence systems impact the practices and lives of both students and teachers. Research reviews on artificial intelligence in education have been oriented towards automation, collaboration and use in classroom practices, with a gap in its impact on educational actors. Method: The article, under the PRISMA model, is aimed at interpreting the impacts, in terms of benefits, risks and opportunities of artificial intelligence systems on students and teachers, the main educational actors (2015-2023). The methodology to interpret the texts is analogical hermeneutics, which allows for establishing an analogy between univocal and equivocal visions. Results: Artificial intelligence impacts identity, integral development, relationships, functions, and the very being of educational actors. Conclusions: The voices of educators remain indebted,

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in relation to the impacts of artificial intelligence on the subjects, of the educational act. It is necessary to strengthen trust, human centrality, and a sapiential integration of these systems in the practices and lives of educational actors.

Keywords

Education; Artificial Intelligence; Teacher; Student; Robots; Teaching; Learning.

Resumen

Introducción: los sistemas de inteligencia artificial (IA) impactan las prácticas y la vida tanto de estudiantes como de profesores. Las revisiones investigativas sobre la IA en la educación se han orientado a la automatización, colaboración y uso en las prácticas de aula, con un vacío en su impacto sobre los actores educativos. Método: el artículo, bajo el modelo *Preferred Reporting Items for Systematic Review and Meta Analyses* (PRISMA), se orienta a interpretar impactos, en términos de beneficios, riesgos y oportunidades, de los sistemas de la IA en estudiantes y profesores, principales actores educativos (2015-2023). La metodología, para interpretar los textos, es la hermenéutica analógica, que permite establecer una analogía entre visiones unívocas y equívocas. Resultados: la IA impacta en la identidad, desarrollo integral, relaciones, funciones y en el mismo ser de los actores educativos. Conclusiones: las voces de los educadores permanecen en deuda con respecto a los impactos de la inteligencia artificial en los sujetos del acto educativo. Es necesario fortalecer la confianza, centralidad en lo humano y una integración sapiencial de estos sistemas en las prácticas y vidas de los actores educativos.

Palabras clave

Educación; Inteligencia artificial; Profesor; Estudiante; Robots; Enseñanza; Aprendizaje.

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Introduction

Several perspectives on education orient their vision toward sustainable human and social development, extended to all life through lifelong learning (United Nations Educational, Scientific and Cultural Organization [UNESCO], 2015). These views aim to build educated minds and responsible citizens with humanistic values and socio-emotional skills (Chernyshenko et al., 2018; World Economic Forum, 2016). Human-centered education, which is not a technology-centered solution (Popenici & Kerr, 2017), is being challenged by developments in the AI field, which is advancing faster than the wisdom with which it should be managed (Tegmark, 2017).

Research on AI and education has focused on reviewing its use in automating and reconfiguring processes in educational scenarios, improving teaching-learning practices, and predicting the performance and difficulties of students. Regarding the reconfiguration of educational environments, Augmented Reality (AR) is used to enrich physical spaces through images and sounds (Munnerley et al., 2014), while Mixed Reality (MR) is used to integrate physical and digital objects (Adams et al., 2018).

Some systems intervene in the students' academic practices and experiences to predict and generate actions that strengthen their motivation, cognition, engagement, participation, and retention (Zawacki-Richter et al., 2019; Marín-Casanova, 2018; Huang, 2018) and prevent underachievement and dropout (García-Peña et al., 2020; Guan et al., 2020). In addition to addressing the abovementioned situations, AI is used to improve learning (Ouyang et al., 2022; Xu & Ouyang, 2022; Vicari, 2021) through applications (Hwang et al., 2020) and various techniques such as logistic regression (LR), random forest (RF), data mining (DM), among others (Chen et al., 2022; Sreenivasa et al., 2018; Umer et al., 2017; Hoffait & Schyns, 2017).

These systems are configured to accompany and intervene in academic performance with tutors, applications, and intelligent autonomous agents or virtual assistants that challenge the roles of teachers and students (Sichman, 2021; Lodhi et al., 2018; Hussain et al., 2018; Howard et al., 2017; Sebastian & Richards, 2017; Huang & Chen, 2016). One of the latest advancements is ChatGPT (Generative Pretrained Transformer), which was developed from natural language emulation and is equipped with hyper-information that enables it to analyze, synthesize, interpret, write, provide answers, perform complex tasks, and generate text (Tirado-Olivares et al., 2023; Van den Berg & Du Plessis, 2023).

However, two gaps in the field demand attention. On the one hand, the voice of educators is still underrepresented in research on AI developments (Zawacki-Richter et al., 2019). On the other hand, information on the impact of AI on students and teachers as individuals is still not in the same proportion as research on its use in educational practices (Lameras & Arnab, 2022;

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Zhai et al., 2021). These contrasts raise the need to research the impacts in terms of benefits, risks, and opportunities of AI for students and teachers. The impact of AI on educational actors can be inferred from the literature on the impact of AI on automation, on the collaboration and intervention of AI systems in education, and on the teaching-learning practices, scenarios, and methodologies.

Another angle on this topic is the disparity of visions regarding AI and its impact on life itself and on the ways of being and relating to the point of questioning *the human* and its nature and condition (Barrios-Tao et al., 2020). These perspectives move between advocates and detractors or technophobes and technophiles; "digital utopians" and "technoskeptics" (Tegmark, 2017, p. 36); enthusiasts of its advances and those fearful of its results (Pérez et al., 2017); utopian dreamers about its processes and dystopian pessimists about its achievements (Martorell-Campos & Alonso-Puelles, 2019); "constructive" interactions to improve environments and "destructive" interactions due to its consequences (Toboso-Martín & Aparicio-Payá, 2019); beneficial advances and potential risks (Sichman, 2021).

In the face of these views, it is necessary to weigh benefits and challenges (UNESCO, 2020), seize opportunities, address its challenges (European Commission [EC], 2020), "and influence the conversation about how to build beneficial AI" (Tegmark, 2017, p. 48). Moreover, it is fundamental to interpret the challenges, risks, and opportunities of AI for the main educational actors (students and teachers) to provide a comprehensive perspective and contribute to the construction of educational policies and strategies that guarantee its benefits and mitigate its negative impacts (Pérez et al., 2017).

Theoretical references: artificial intelligence and educational actors

Advancements in AI dynamize its various concepts and classifications. From a multidisciplinary set of computer, social, and human sciences (Stone, 2016; Zawacki-Richter et al., 2019), AI, which was a field oriented to emulating human faculties in artificial systems (Benítez et al., 2014) or an activity to create intelligent machines predictive of their environment (Stone, 2016), shifted to the plural concept of AIs that combines technologies, data, algorithms, and computing. The results are systems that act in the physical or digital dimensions, perceive their environment through data, interpret them, and make decisions in accordance with their objectives (EC, 2020) and the criteria established with certain ethical and contextual values (EC, 2018; Monasterio-Astobiza, 2017; Hill, 2016).

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The typification of "narrow", "general", and "super" AI (Baker & Smith, 2019; Kaplan & Haenlein, 2019) or "weak" and "strong" AI (Zawacki-Richter et al., 2019; Navas, 2016) lies in its ability to emulate human actions. These "super" or "strong" AIs autonomously face philosophical challenges related to reason and consciousness and incorporate aspects of sensitivity or emotionality (Colmenarejo-Fernandez, 2018): analytical AI with cognitive intelligence characteristics; emotional AI inspired by humans; humanized AI with an addition of social intelligence (Kaplan & Haenlein, 2019).

Concerning the actors involved in the educational process, its consideration has been extended to include the social, family, and institutional domains in addition to the student and the teacher. Institutions, social groups, families, directors, and education officers play a role and influence teaching-learning practices. Particularly, the multiple definitions of teachers are energized by several factors, but they agree that their work goes beyond the practices and relationships located in a classroom environment. In this sense, it is proposed that accompanying, motivating, empowering, or involving students in their affective, cognitive, and behavioral learning process through knowledge, practices, and values, determines the identity of the human teacher (Kim et al., 2020). The article limits the educational actors to students and teachers, but it is open to new subjects configured in AI systems with student or teacher roles.

The development of AI in education has evolved from instruments or devices for automation to collaborative systems that accompany educational practices and has now reached the point of social robots. These strong AI systems pretend to be subjects, new educational actors with the ability to know, learn, analyze, adapt, and make decisions like human beings, posing challenges to the roles of students and teachers (Xu & Ouyang, 2022). The basic aspect of the configuration of these "c-instructors" or new teachers (teacherbot) is the communication that mimics human dialogue through Spoken Dialogue Systems (SDS) and allows them to instruct and interact with students (Edwards et al., 2018).

Edwards et al. (2018) have determined factors that contribute to the suitability of these teacherbots in terms of the configuration of their communicative process: psychological connection or closeness, appropriate mood, clarity of information, recognized accents and high tones, possibility of feedback, and learning environment, among others. In this sense, both the appearance and the behavior of the robot influence the learning outcomes (Belpaeme, 2018).

Research such as that of Kim et al. (2020) has defined and classified these types of systems (teacherbot, machine teacher) as: "a technology that plays a meaningful role during an interaction with humans in helping them engage in affective, cognitive, and behavioral learning through various ways" (p. 1904). In terms of forms or types, there are virtual agents (assistants, chatbots),

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social robots, and telepresence robots, which can be physically embodied agents (made of materials such as metal or plastic) or disembodied agents with no visible or physical instance (interfaces or software).

Depending on their configuration, these machines mobilize their progress to assume roles as teachers, assistants, tutors, peers, or learners of students (Chen et al., 2020; Sharkey, 2016). Likewise, it has been evidenced that the response and treatment of humans to these types of machines are similar to the social ways in which humans relate to each other. In this sense, the way one interacts with human teachers influences the expectations and the development of attitudes toward the machine teacher (Kim et al., 2022).

Methodology

The article is designed with the steps of the PRISMA model (Page et al., 2021): identification, screening (or filtering), eligibility, and inclusion (González de Dios et al., 2011). In the first stage, articles (N = 539) were identified by using the descriptors in Spanish, English, and Portuguese ("artificial intelligence", "education", "teachers", "students", "robots") in their various combinations, according to the interfaces of the databases (Science Direct, Scopus, EBSCO, SciELO) and with the time frame 2015-2023.

Next, the screening step applied the criterion of type of document: research article, statement or report from international entities, universities or institutions, book by relevant authors, doctoral dissertations with the exclusion of texts that did not correspond to the above: gray material, bachelor's and master's degree works (excluded n = 256). As a result, the first partial selection of articles was made (N = 283). Subsequently, there was a selection of texts applying a new criterion: accessibility (excluded n = 88). This second partial selection resulted in a new number of eligible articles (N = 195).

Finally, in the inclusion phase, the selected texts were placed in a collection matrix (title, location, abstract, keywords, main findings) and their relevance to the objective of the article was considered with the aim of establishing the challenges, risks, and opportunities of AI for students and teachers (excluded n = 79). Due to their relevance, some texts outside the time frame were included. The final texts chosen for further interpretation were N = 116 texts. The steps performed are presented in the following diagram:

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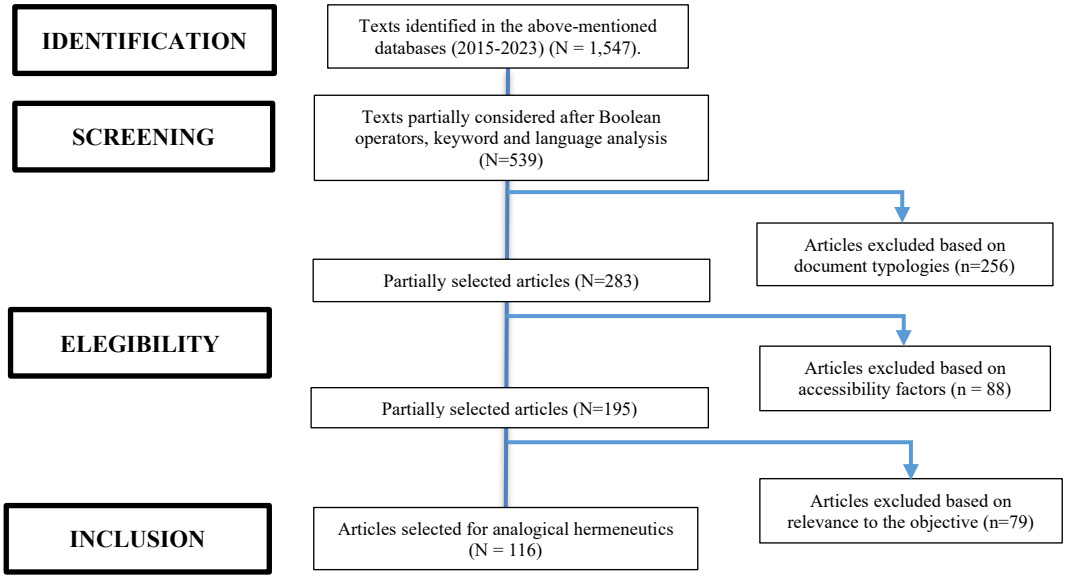
Figure 1. *Flow chart according to PRISMA*



The methodology for interpreting the texts was analogical hermeneutics (Beuchot, 2016) because of its relevance for understanding texts and social phenomena that move between interpretative extremes, detractors and defenders, as in the case of AI and its impact on teachers and students. Analogical hermeneutics focuses on analogy (balanced or *phronetic* vision) when two extreme positions are confronted: "univocity" and "equivocity", and it is structured in syntactic, semantic, and pragmatic phases (Beuchot, 2016).

The syntactic phase was conducted between the "univocal" **(U)** reduction that considers the benefits and the "equivocal" **(E)** amplitude on the risks regarding the impact of AI on educational actors. It was structured in an analysis matrix using the emerging categories in the texts included: identity **(i)**, integral development **(d),** interrelationships **(r),** functions **(f),** and new actors **(n).** Next, in the semantic phase, "univocal" **(U 1-5)** and "equivocal" **(E 1-5)** conceptions of the five topics included in the categories were analyzed. Finally, in the pragmatic phase, the analogies **(A 1-5)** or *phronesis* between the univocal and the equivocal of the five topics were established.

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Table 1

Interpretation matrix structure

Topics	Analogies (A)	Univocity (U)	Equivocity (E)
1. Identity (i)	AI and identity of educational actors.	autonomy	manipulation
2. Integral development (d)	AI and integral development of educational actors.	skills	superficiality
3. Interrelationships (i)	AI and relationships between educational actors.	new presences	fictitious links
4. Functions (f)	AI and the functions of educational actors.	collaboration	automation
5. New actors (n)	AI and new "educational actors."	Collaborative robots	teacherbot

Results

Artificial intelligence (AI) and identity (A-i): between autonomy (U-i) and manipulation (E-i)

The first utopian perspectives **(U)** are based on the potential of AI platforms to contribute to the educational equity and inclusion of students through access to information and knowledge (Pedró, 2019; Stewart, 2018). These systems reinforce autonomy, decision making, capacity for choice, responsibility **(U-i)** (Telefónica, 2018; EC, 2018), and critical, computational, and systemic thinking skills, which contribute to the development of the identity of educational actors (Van den Berg & Du Plessis, 2023 Benvenuti et al., 2023; Martín-Núñez et al., 2023; Organisation for Economic Co-operation and Development, 2020; Yadav et al., 2016).

However, there are risks to identity: quantification, manipulation and governance **(**E-i). From quantification, through the link between big data and algorithms comes the labeling, manipulation, exploitation, governance, and loss of identity of the educational actors. The first moment is variously called: bibliometrics of the self (Lim, 2021), dataism (Han, 2014), digitization (Lupton et al., 2018; Moore & Robinson, 2016), quantification (Lupton, 2016), datification (Cheney-Lippold, 2017), metric culture or metrics of power (Feldman & Sandoval, 2018). In all cases, data including cognitive and socio-emotional processes is collected, used, and stored, with the risk of categorizing and profiling people to the point of biasing their data through algorithms **(**UNESCO, 2020) to exercise soft governance; subjectivities are turned into capital and subjected to control through their behavior (Saura & Bolívar, 2019).

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In this dynamic, biopower, once contextualized in the industrial society as a disciplinary form of capitalism associated with the biological and the bodily and enforced through norms, prohibitions, and devices (Galparsoro & Pérez-Pérez, 2018), shifts to the realm of the *psyche.* There, it operates as a strategy of neoliberal power, accessing internal needs through new instruments of governance: motivation and competition (Han, 2014). This psychopolitics exerts its power through immaterial forms of production; big data reaches, enlightens, and exploits the depth of the *psyche.*

The configurations increase productivity with the optimization of psychic processes, in which the subjects exploit themselves voluntarily under the conviction of supposed freedom. The efficiency of this self-exploitation lies in the seduction, dependence, open expression, happiness, and supposed freedom in which it is performed (Galparsoro & Pérez-Pérez, 2018; Han, 2014).

Data analytics, applied to learning, can label students, intervene in their freedom, turn them into users with a certain profile (Wolf, 2015), and reproduce their lives with fidelity or not (Galparsoro, 2017). These statistical configurations blind the human and mark an apocalyptic horizon. "Big data announces the end of the person and free will" (Han, 2014, p. 26). In this sense, the EC (2018) warns about profiles configured for purposes different from their original context, unknown to the individuals themselves, and, possibly, inaccurate, incomplete, and detrimental to their identity. Moreover, the boundaries between automated decisions and human decisions resulting from reflection are blurred. Automated decisions are the result of rules and instructions calculated by third parties (Popenici & Kerr, 2017), with the consequent dangers to autonomy, freedom, and the possibility of creating, configuring aspirations, and projecting the future (Wolf, 2015).

In terms of psychopower strategies, algorithms configured with massive patterns that influence the negative or positive spheres of emotions are used (Lanier, 2018). They have values and representations oriented to modify behaviors and make unconscious decisions, to the point of representing an “unleashed intelligence” to replace teachers (Prinsloo, 2017), without the possibility of arguing and establishing value judgments based on reflections and real information (Cotino-Hueso, 2017).

On the contrary, there are social epistemic phenomena (epistemic bubbles and echo chambers) configured with post-truth practices in social networks (EC, 2018). Nguyen (2020) states that these echo chambers make exposure or argumentation impossible because they exclude and discredit dissonant perspectives. While on Facebook there is evidence of increasing ideological positions and their exposure to political material different from their stance (Flaxman et al., 2016), content suggestions flood Google’s biased filters and YouTube’s automated bubbles (O’Callaghan et al.,

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2015). At the individual level, Cardon (2018) highlights the way algorithms lock people "in the bubble of their own choices, fold their fate into the funnel of the probable, and feed the precision of the selection of a disproportionate capture of personal information" (p. 24).

The result is a “techno” or “cyberperson,” whose identity, relationships, functions, and interactions are produced and developed thanks to some socially consolidated technological system (Echeverría, 2016) or a *“zoon elektronikon”.* This system is timeless and relationships are mediated by devices. There, the person’s thumbs are protagonists and their habitat is the *“*electronic *polis”* (Huici-Urmeneta & Davila-Legerén, 2016). The Internet is where people exist, their new mask is digital, and their identity is a diverse and dynamic profile marked with their smartphone number and passwords. This is where the *hikikomori* phenomenon would be located, which is characterized by social isolation and finding refuge in technological devices; the only means of virtual relationship with the social world (De La Calle & Muñoz, 2018; Sánchez-Rojo, 2017).

These “phantasmagoric entities” with fallacious identities, reviews, friendships, followers, and publications challenge professional profiles, the monitoring of learning, and civic education due to stimuli, social pressure, behavior modification (Lanier, 2018), and coercion towards an “ideal ego” founded on a self-subjectification, whose status is defined by the “external quantified gaze” (Saura & Bolívar, 2019, p. 22) and by the number of “Like” tags, the new “digital amen” (Han, 2014). Thus, masses of profiles, solitudes, users, and individuals objectified and stimulated to consume are created (Cardon, 2018). The functional response to the demand of the devices is what remains of the individual. The notions of individual, identity, freedom, culture, and soul are decentralized (Marín-Casanova, 2018).

The balanced perspective **(F-i)** suggests horizons of trust in AI based on the guarantee of security and the preservation of human rights. This preservation should be addressed by those involved in the development of AI (Organization for Economic Cooperation and Development [OECD], 2020) through human supervision: validation, monitoring, intervention, restriction, real-time deactivation of systems (EC, 2020), and the adoption of policies to preserve the identity, transparency, and security of the rights over collected data (UNESCO, 2020). A balance between the actions entrusted to the AI and those reserved to individuals is possible, allowing the strengthening of their freedom and autonomy (Floridi et al., 2018).

The Montréal Declaration (2018) highlights the care and protection of identity, privacy of thoughts and emotions, and control of preferences. Additionally, it emphasizes the protection of sociocultural diversity, the possibility of choosing one’s lifestyle and personal experiences in favor of identity, and the possibility of fulfilling one’s moral choices within the framework of one’s personal conception and meaning of life.

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Artificial intelligence (AI) and integral development (A-d): between new skills (U-d) and superficiality (E-d)

The utopian perspectives **(U)** of the second topic are based on the possibility of greater inclusion of students in comprehensive education processes, better computational skills, and the customization of learning when using AI systems **(U-d).** In this sense, the Internet, digital platforms, and access to AI systems would enable more information and the empowerment of people (Lanier, 2018). Moreover, it can also improve the design of learning practices and decision making by providing customized and automated content with personalized support and tasks, and individualized assessments and feedback (Marzal, 2023; Vashista et al., 2023; Lameras & Arnab, 2022).

In the same vein, the initial training of teachers could be strengthened with support and training on AI systems to develop skills that allow them to design their own educational resources (Ayuso-Del Puerto & Gutiérrez-Esteban, 2022). Educational practices with AI systems can strengthen the teachers' development of competencies and skills and improve lifelong and personalized learning (Benvenuti et al., 2023).

The new scenarios of AR (physical spaces enhanced by images and sounds) (Marzal, 2023; Munnerley et al., 2014), and MR (coexistence of digital and physical objects) (Adams et al., 2018) benefit the creation, flexibility, and multidisciplinarity of the learning practices (Lobo, 2018). Additionally, they enhance the adaptation to specific circumstances and different learning styles and incorporate multiple intelligences. This also motivates students to create virtual worlds, rather than simply consume them, to incorporate, interact with, and evaluate their own experiences (Craig & Georgieva, 2018).

Personalized learning systems can also accompany students in their learning rhythms and indicate moments to intervene in their educational process (Xu & Ouyang, 2022; Hwang et al., 2020; Hoffait & Schyns, 2017). They monitor their progress, provide feedback on their development, contribute to problem solving and academic decision making (Hwang et al., 2020; Nguyen et al., 2018; Long et al., 2015; Nye 2015), predict permanence or dropout, and guide professional decisions (Hussain et al., 2018; Rovira et al., 2017). Similarly, the analysis of learning processes improves teaching and learning by critically evaluating data, generating patterns about the students' habits, predicting their responses to help them make decisions, tracking their individual progress, and marking their learning paths (Pedró, 2019; Adams et al., 2018).

Interaction with AI systems has the potential to expand human intelligence (Floridi et al., 2018) and improve computational thinking, which is oriented toward abstraction, automation, and problem solving through algorithms (Celik, 2023; Benvenuti et al., 2023; Martín-Núñez et al., 2023; Yadav et al., 2016), moving beyond data literacy and computational techniques toward

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analytical skills, interaction, reasoning, and understanding of natural and artificial systems. Moreover, learning environments based on digital games (Serious Games) strengthen motivation, effort, persistence, socio-emotional intelligence, student engagement, problem solving, and metacognition (Marzal, 2023; Ortiz-Colon et al., 2018).

In contrast, dystopian positions **(E-d)** propose greater exclusion and inequity due to the digital divide between those who can or cannot access systems to improve their professional skills, build knowledge, and strengthen their learning and research (Lameras & Arnab, 2022; Pedró, 2019). Without connectivity to access devices due to factors such as electrical availability, data costs, language barrier, and lack of infrastructure, among others, new outcasts are configured (Cotino-Hueso, 2017; Nye, 2015). Moreover, there is a risk of discrimination by configuring data with "the implicit and unconscious biases of its human creators" (Stewart, 2018, p. 23), harassment and racist practices (Craig & Georgieva, 2018), and stereotypes and biases toward certain dominant groups **(**EC, 2018). The systems that interact with students may be biased based on certain configured skills and performances and could use personalized data that risk their privacy and security (Lameras & Arnab, 2022).

Furthermore, the hyper-information of systems, different from knowledge, poses a risk to learning due to the information fatigue syndrome, which paralyzes the analytical capacity and contributes to the atrophy of thinking (Han 2014), since logical reasoning processes are avoided in favor of calculation or quantification procedures. The language of wisdom based on silence and reflection is disturbed and vanishes in the chaotic noise of “hyper” information and communication. Information is accumulated, not knowledge or truth; uninformed masses are created, not critical masses (Galparsoro, 2017).

Additionally, creativity is interfered with, redefined, and diluted (Venancio-Júnior, 2019), and the hands become atrophied since they are underutilized due to the overuse of the thumbs when handling smartphones (Han, 2014; Galparsoro & Pérez-Pérez, 2018). In short, a “semi-training” (*halbbildung)* of educational actors is made possible and emerges from the connection between AI, instrumental rationality, and learning (Arruda-Campos & Nabuco-Lastória 2020).

From quantified and governed educational actors, there is a move toward actors that are superficial, do not have critical thinking, and are pressured to compete and generate profitable academic products to respond to rankings manipulated by algorithms (Lupton et al., 2018; Feldman & Sandoval, 2018). Therefore, comprehensive education is undermined by quantifiable and economically exploitable results and competencies (Zovko & Dillon, 2018). Moreover, critical and creative thinking and linguistic and logical-mathematical intelligence are affected by the indiscriminate use of social applications (Castillejos-López, 2022).

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The analogical interpretation **(A-d)** draws the balance of contributing to the comprehensive development of educational actors depending on the extension of the systems available in a society, but with guarantees of access and responsibility in its configuration to preserve freedom and equal opportunities (Toboso-Martín & Aparicio-Payá, 2019). In this regard, the Montréal Declaration (2018) sees an opportunity to strengthen an equitable society through the guarantee of access to tools, resources, and knowledge, which allows for combating dominant relationships among people.

Regarding the governed "zombie" users, who are at the same time intelligent, genius, lucid, and creative (Espinosa, 2018), they have the opportunity to increase their social capabilities with the responsibility and preservation of human control over the systems and consider them as tools to support teaching-learning practices, which avoids replacing the skills and the development of critical thinking of educational actors (Van den Berg & Du Plessis, 2023). Finally, the Crawford et al. (2019) report calls on AI systems developers to combat racism, homophobia, and misogyny, and to guarantee the individual rights of minorities.

Artificial intelligence (AI) and relationships (A-r): between new presences (U-r) and fictitious links (E-r)

Interpersonal relationships **(r)** are reshaped by algorithmic configurations with the gradual loss of individual control (Prinsloo, 2017). Utopian perspectives suggest that there are benefits **(U-r)** from the new forms of presence, which are enabled by 5G networks and advanced sensors (WEF, 2019) such as augmented and mixed reality. These environments involve educational actors and contribute to strengthening their interaction, cooperation, and collaboration in learning processes, as well as to the expansion of the classroom and school time (Craig & Georgieva, 2018; Roll & Wylie, 2016).

Dystopian perspectives point out risks **(E-r):** conflict and rupture in the interaction between teachers and students when their identities are altered in these systems. The creation of masks and profiles transforms interpersonal relations through massified and fictitious connections that are governed by different rules than the bonds between physical persons (Echeverría, 2016), jeopardizing the real bonds necessary to monitor educational practices. Furthermore, biometric practices induce impersonal educational relationships characterized by economic values, competitiveness, profit, and mercantilist interests (Marín-Casanova, 2018), and are algorithmically configured by voluntary exploitation and competition generated by the subjects themselves (Han, 2014). Likewise, the deterioration of relationships is influenced by automation, loss of autonomy, behavioral manipulation and modification, addictions, hypnosis, and direct or indirect imposition of particular lifestyles (Declaration of Montréal, 2018; Lanier, 2018).

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The power of some systems to hijack the senses, stereotype based on race or gender, orient toward false realities, and promote escapism, violence, and consumption, pose other risks (Craig & Georgieva, 2018). Hyperinformation, the opacity of truth, and the physical distance between people blur trust (Galparsoro, 2017). In addition, given that these systems are moving towards societies without spaces to develop common experiences (Marín-Casanova, 2018), educational practices that require interaction and collaboration to build knowledge are at risk.

The analogy **(A-r)** is posed as the balance between strengthening personal and academic relationships by taking advantage of the mixed and augmented realities of AI, without allowing their blurring and forgetting that human beings interact there, not masked digital profiles. The analogy therefore questions the horizon of use and relationships in these environments: Will they be used for social good, to foster empathy, and as a powerful new medium for learning? (Craig & Georgieva, 2018).

Artificial intelligence (AI) and functions (A-f): between collaboration (U-f) and automation (E-f)

Operational and formative functions **(f)** receive contributions from machine learning to predict and make decisions through massive data analysis and natural language processing. Moreover, research and learning benefit **(U-f)** when educational actors are relieved of automatable tasks and administrative burdens, (Lameras & Arnab, 2022; Xu & Ouyang, 2022; Guan et al., 2020; Adams et al., 2018) which allows them to focus on the teaching-learning process and develop skills that help them thrive in globally competitive economies (Popenici & Kerr, 2017) with improved teacher effectiveness in the educational process (Al Darayseh, 2023).

García-Vélez (2019) points out the benefits for institutional educational management (optimization of information use, queries, analysis, activity scheduling, resource management, decision making, information integration, interconnection of repositories, big data analysis, information input to turn it into knowledge) and for supporting learning (modeling of academic knowledge, intelligent tutoring systems, prediction of academic performance, conformation of collaborative work groups and games as learning support).

Lemaignan et al. (2017) highlight individual and collaborative robot-human cognitive skills, such as geometric reasoning (combination among the spatial, symbolic, and geometric domains); situation assessment; acquisition and representation of knowledge models for multiple agents; situated, natural, and multimodal dialogue; human-aware task planning; and human-robot joint task achievement. In this sense, Bialik and Fadel (2018) identify areas in which machines outperform humans, (repetitive and predictive tasks, classification of numerous data, decision

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making based on concrete rules) and others in which humans outperform systems (experiencing emotions, building relationships, formulating questions and explanations, deciding on resource use in different dimensions, using and communicating products and results, making decisions about abstract values).

The use of student data (data mining) about their educational process for the configuration of AI systems by using techniques such as Random Forest, Decision Trees, Naïve Bayes, Support Vector Machines, K-Nearest Neighbor, Logistic Regression, among others, allows predicting academic performance through variables such as family and socioeconomic factors and habits, in order to deploy accompanying actions (Gil-Vera & Quintero-López, 2021; Castrillón et al., 2020). It also predicts the risk and success of students in their academic performance and their chances of permanence or dropout (Alves-Bitencourt et al., 2022; Lottering et al., 2020; Wakelam et al., 2020; Beaulac & Rosenthal, 2019), which allows agile decisions to be made and strengthens student retention (García-Peña et al., 2020; Guan et al., 2020; Gray & Perkins, 2019; Burgos et al., 2018).

In contrast, the risks **(E-f)** challenge the formative configurations of systems and human teachers: interpreting robot-human interaction, control strategies, natural and multimodal communications, mental models, modeling of human cognition, acquisition, representation and manipulation of knowledge, the passage from knowledge to decision making (Lemaignan et al., 2017). Changing the role of teachers, who are now learning motivators or classroom facilitators, or replacing them with cost-effective AI solutions would reduce education to a teaching-learning activity, neglecting the pillars of being and living together (Zawacki-Richter et al., 2019).

On the contrary, delegating functions to robots blurs individual responsibility: Who is responsible when human rights are infringed because of algorithmic decisions? Who programmed, operated, or implemented the decision? (EC, 2018). Al Darayseh's (2023) research presented findings on the risks of teacher behavior and attitudes due to stress and anxiety caused by the use of AI in some educational practices.

The analogy (**A-f**) balances the opportunities of automation with the operational functions delegated and delimited to machines and the collaborative interaction and personalized accompaniment in research and learning processes by human teachers (Adams et al., 2018). The latter have the opportunity to strengthen their imagination, creativity, and innovation, skills that cannot be replicated by machines (Benvenuti et al., 2023; Aoun, 2017; Popenici & Kerr, 2017), and students can choose non-automatable professions in the near future (Tegmark, 2017).

The functions delegated to robots imply rethinking the roles and responsibilities of teachers and students and implementing new pedagogical models for mixed and augmented environments; the new learning laboratories (Adams et al., 2018). Balance would mean that a cognitive robot shares

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space and tasks with humans and preserves and cares for the roles of both machines and humans, who must ensure their care and not transfer their control or delegate human judgment in high-value decisions (Russell et al., 2015). In summary, teachers should be regulators or catalysts of the use of AI by establishing designs, dynamics, and sequences of teaching-learning processes when they are incorporated into educational practices (Lameras & Arnab, 2022), as well as regulating the reliance on systems and applications for classroom activities (Xu & Ouyang, 2022).

Artificial intelligence (AI) and new "actors" (A-n): From collaborative robots (U-n) to teacherbots (E-n)

The last topic moves from collaborative systems for learning to new subjects or actors, social robots with the pretension of replacing teachers: teacherbots (**n**). The utopian claim (**U-n**) begins with systems or applications that collaborate with the learning process (Cerny, 2023) and strengthen the development of students' skills in STEM fields (Restrepo-Echeverri et al., 2022). It continues with systems configured to learn from experience and outperform human performance on cognitive tasks (Russell et al., 2015), and it is followed by others that simulate natural language and recognize and mimic emotions (Chen at al., 2022; Wei & Zhao, 2019; Imani & Montazer, 2019). There are now avatars that simulate teacher behavior (Pedró, 2019), and we have reached a human-machine symbiosis with robots that develop mutual learning (Walsh et al., 2017), provide personalized instruction, and monitor and support students' academic performance (Edwards et al., 2018).

Some utopian views on the use of conversational agents or chatbots point to their potential to provide immediate support by answering questions, offering explanations, and providing additional resources, as well as saving time and helping to strengthen the teachers' pedagogical strategies such as motivation, achievement, and personalized learning (Labadze et al., 2023; Iku-Silan, Hwang, & Chen, 2023). Particularly, initial results on ChatGPT suggest that it could support teaching-learning practices, plan lessons, prepare assessments on problem solving, provide specific materials, support the writing process, and strengthen case analysis (Tirado-Olivares et al., 2023; Barrett, A. & Pack, 2023; Duong et al., 2023). Moreover, the responsible interaction with this generative AI could strengthen the critical thinking of the educational actors regarding the products generated by the chatbot (Chauncey & McKenna, 2023; Van den Berg & Du Plessis, 2023).

Other rational agents having the ability to perceive and act on their environment guide, motivate, and engage students in their learning pathways. Additionally, they help with abstract or complex topics (Zawacki-Richter et al., 2019), model pedagogical strategies (Baker & Smith, 2019), and provide personalized learning, support, and stimulating experiences in the cognitive

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processes (Xu & Ouyang, 2022). Some robots recognize emotions from physiological data, facial expressions, and texts, which allows them to understand the emotions and cognition of the student and provide affective intervention, motivation, and support in the cognitive process (Chen et al., 2022).

Regarding the students' relationship with themselves and their peers, some AI systems could act as learners, with students acting as the system's instructors, which would enable the consolidation of the students' learning outcomes (Chen et al., 2020). Other robots could be configured as student peers, providing cognitive interaction, stimulation, and emotional support when learning difficulties arise (Xu & Ouyang, 2022).

Meanwhile, teacherbot refers to complex algorithmic interfaces arranged to provide tailored and supervised content, assume roles of assistants in tasks of organizing information, responding to requirements, and facilitating, managing, and evaluating student learning (Popenici & Kerr, 2017; Bayne, 2015). Their configurations allow them to recognize voices, faces, and emotions; interpret speech patterns and gestures; respond to complex verbal cues; and adapt to people's needs by learning from their feedback, rewards, and criticisms (Chen at al., 2022; Wei & Zhao, 2019; Imani & Montazer, 2019).

Some research evidences benefits such as the tutoring system (Huang & Chen, 2016), which strengthens constructive student learning based on Web-based research or the cooperative human-machine symbiosis system of Walsh et al. (2017) of mutual learning in an environment adapted to the cognitive and affective domains of the human learner with the mediation of devices, books, and interaction in diverse realities. Popenici and Kerr (2017) consider that the human-machine interface has the potential to change how information is accessed and memorized for the creation of learning, having as future vision cyborgs that enhance human memory and cognition.

The systematic review by Hou et al. (2023) addresses the influence of educational robots in enhancing the students' creativity, in terms of developing practical and innovative skills and teaching through the creation of prototypes.

As for students in isolation, confinement, and even special learning situations, social robots can interact with them and integrate them into the physical classroom environment, allowing them to interact with educational communities (Kim et al., 2020), achieve positive outcomes for the development of their cognitive and affective skills, and facilitate their learning process (Belpaeme et al., 2018).

In contrast, dystopian perspectives **(E-n)** are based on robot-human interaction scales that begin with human dominance over systems and end with the risk of annulling the human actor: human-in-the-loop, robots select targets and act after human order; human-on-the-loop, robots act,

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but with human dependence and supervision; human-out-of-the-loop, robots act independently and autonomously (Prinsloo, 2017). Thus, there is a shift from assistance and collaboration to reconfiguration and replacement of *the human* (Barrios-Tao et al., 2020).

As for chatbots, concerns are raised about their reliability and accuracy (Labadze, Grigolia, & Machaidze, 2023). Notably, initial research on the development of ChatGPT 3-4 and its chances of passing tests in medicine, law, and engineering (Koh et al., 2023) indicated risks such as the possibility of compromising the integrity of the data it was trained with, generating imprecise, inaccurate, and biased information. Moreover, it would undermine critical development, creativity, academic integrity, and copyright (Van den Berg & Du Plessis, 2023; Tirado-Olivares et al., 2023; Zamir, Afzal, & Sultana, 2023; Saraiva Rodrigues & Santos Rodrigues, 2023). In addition, the chatbot can contribute to misinformation by using incorrect content and presenting it as convincing and credible, and it would be difficult to know the underlying sources it used. Hallucinations could also occur in this generative AI (Chauncey & McKenna, 2023).

These social robots pose risks for inclusion and socio-emotional factors in educational practices (UNESCO, 2020; The World Economic Forum [WEF], 2016; Pedró, 2019) and mental health when the teacher is replaced by a robot-human interaction. Risks include sociological, physical, and psychological consequences for human health and integrity, as well as threats to individual autonomy and responsibility, and to social interaction, which is delegated to supposedly human characteristics attributed to the systems. It would not be enough to seek solutions in legal aspects such as granting "personality" to these systems, with arguments of human characteristics, in order to protect developer corporations and the engineers that configure the systems (Keating & Nourbakhsh, 2018).

Similarly, there are risks to student privacy when emotional data is collected and used to customize the learning processes with this information (Chen et al., 2022; Lameras & Arnab, 2022). Other risks are the possibility of developing an attachment to the configuration of a device, the deception of certain fictitious functions such as the understanding and caring of a system, the inappropriate control of the system that may induce decisions about a student's behavior, and the loss of human contact when the companionship of the device is preferred, affecting the student's social development (Sharkey, 2016).

The risk factors in the student-teacherbot interaction are determined, first, by the so-called "anthropocentric expectation of communication", born from the fact that people need natural peers to communicate. In this sense, there could be a level of uncertainty in students to the extent that communicative emulation is more effective and is developed in learning contexts (Edwards et al., 2018, p. 475). Second, the risk factors are also determined by the "psychological closeness",

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which is established by the effectiveness of the verbal or non-verbal communication that would induce closeness, connection, or distancing between robot and student, with the consequent establishment of the credibility or not of the learner (Edwards et al., 2018, p. 476).

The last analogy **(A-n)** arises from the mutual reconfiguration between humanism and technologies (Barrios-Tao et al., 2020), which makes it possible to improve human skills and equitable configurations for sustainability and inclusive social development (UNESCO, 2020). In all cases, humans are needed to control, monitor, and ensure the quality of the data through which the robots that interact with educational actors are configured (Van den Berg & Du Plessis, 2023).

Another perspective of the analogy aims to strengthen the educational practices with AI systems and the irreplaceable replacement of the teacher and their presence and interaction (Bayne, 2015). It also seeks to recognize the teachers' ability to adapt to the students' state, motivate them, and involve them in the educational practice. This work could be enhanced by AI systems to redesign interdisciplinary learning tools, collaborate with learning tasks (Walsh et al., 2017), and strengthen the interpersonal, emotional, ethical, aesthetic, reality understanding, and leadership competencies of teachers, which are irreplaceable in the relationships among educational actors (Parreira et al., 2021). In short, it is about overcoming the vision of AI as an "enemy" and finding ways to work with it to improve learning outcomes and transform teaching and the relationships and learning experiences between AI, teachers, and students (Koh et al., 2023).

Discussion

The first aspect of discussion is a call for mutual trust between creators, AI systems designers, and those who use them in educational contexts. An integration between educators, institutions, and AI systems developers is proposed (Vashista et al., 2023). All of those involved should focus on one goal: the integral training of educational actors. Programming a friendly AI based on the understanding of the meaning of life and its ethical imperative (Tegmark, 2017) would generate trust, a prerequisite for adopting AI in the spheres of life (EC, 2020).

This trust implies wisdom and understanding of how both humans and robotics work in terms of ethics and language (Holmes et al., 2022). It is necessary to integrate the systems into an "ecosystem of trust," where they meet the standards of protection of fundamental rights and those of consumers, and are human-centered (EC, 2020, p. 3). Moreover, the systems would have

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ethical guidelines embodied in values and principles such as benefits for the people and the planet, sustainable development and well-being, transparency and responsible disclosure, safe operation throughout their life cycles, and assessment and management of potential risks (OECD, 2019).

Trust should create awareness and strengthen critical education to avoid the tyranny that would seek to homogenize or standardize the world and prevent what Virilio (1996/1999) determines as possible accidents of the technological failures. Furthermore, it should be recognized that quality and educational results are not achieved only by the implementation of advanced AI systems and that the complexity of the human, pedagogical, social, and cultural dimensions of the educational process must be considered.

A second point of discussion is to associate the benefits of AI with integral development and strengthening of the interactions of educational actors. Students and teachers should be beneficiaries of the updating and flexibilization of educational systems through AI and the possibilities they offer for fostering lifelong learning and critical and creative thinking. Moreover, educational actors should be involved in discussions about these systems; "it would be more helpful to ensure more critical engagement in public debates about algorithms than to attempt to change them" (CE, 2018, p. 37).

The third aspect concerns the humanization of educational actors who read, create, imagine, seek to understand, and listen to the echo about the potential of these systems in the framework of everyday questions (Keating & Nourbakhsh, 2018). The significant impact of AI on humans and the process of co-construction or mutual configuration between AI and educational actors evidences the need to understand and focus systems on people and configure them towards that which humanizes, integrally improves life, and contributes to a more humane society (Yang et al., 2021): solidarity, responsibility, equity, creativity (Telefónica, 2018).

The humanizing aspects must be strengthened. Communication, interpersonal and social relationships, philosophical thinking, and ethics should be revitalized through the physical presence of teachers, as opposed to immaterial and artificial systems (Vashista et al., 2023; Yang et al., 2021).

The inclusion of social robots or teacherbots merits a fourth point of discussion about these supposed replacements of human subjects, where the meaning of being a teacher should be rethought. Beyond imparting knowledge, being a teacher means interacting as a human in life, developing and enhancing the student's learning, cultivating the love and desire to learn, and knowing and understanding their social realities, pedagogical routes, and own styles (Xu & Ouyang, 2022). In this sense, educational robots should be considered as complementary machines

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to human actors, to avoid reducing education to automatic learning processes, and to consider that it demands the integral cultivation of the physical, intellectual, and emotional dimensions of the educational actors (Zovko & Dillon, 2018).

In short, trust and humanization converge in the integration of humans and AI. The positive or negative aspects of the unstoppable systems are no longer the question, but the understanding of their function and safety, their correct use towards a happy ending (Tegmark, 2017), with a clear sense of mutual construction and feedback between device and subject (Cardon, 2018). In educational ecosystems, human and artificial intelligence (humans and robots) should not be substitutes but complements. Their centrality should not be machines or data, but synergy, integration, mutual growth, cooperation, creativity, and empowerment. They should be oriented toward the integral training of the educational actors (Torcal, 2018; Aoun, 2017).

Moreover, this integration should foster *the human* and its potential, avoiding the "over", "under", or "misuse" of these developments (Floridi et al., 2018) and considering that technological developments contribute to well-being, but do not solve social problems by themselves (García-Ramírez & Valle-Jiménez, 2020).

Conclusions

The balance of an analogical hermeneutic allows for addressing the risks, benefits, and opportunities of AI for students and teachers, from the research developed. However, the general perspectives on AI and education, and the research analyzed in the time frame (2015-2022) are oriented more toward the impact of AI on educational tasks and practices than on the teachers and students as human beings. This situation not only limits the research conducted, but also motivates the need to open new studies in educational contexts to continue establishing the impacts of new and accelerated advances (ChatGPT, the metaverse, among others) on the lives of educational actors.

The article aimed at strengthening the humanistic vision of education and the centrality of people, considering the impact of technological advances on the lives of students and teachers. The reflection on the AI systems considers technological, legal, and ethical aspects, among others, but should focus on their influence on people's lives. It is necessary to strengthen trust, human centrality, and the sapiential integration of these systems into the practices and lives of educational actors. In this sense, the implications of the study for the educational systems and the developers, users, and trainers of AI seek to reflect on the integration of these technologies in their practices while favoring the sustainable human and social development of students and teachers (UNESCO, 2015).

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Beyond the results, some findings raise concerns. On the one hand, the scarce presence of educators in this conversation, since they would highlight opportunities and risks for the pedagogical practices and, above all, provide clarity about these systems and their influence on human attitudes, which is the center and purpose of education (Belda-Medina & Kokošková, 2023; Zawacki-Richter et al., 2019). On the other hand, the lack of integrated research that brings together professional communities from different areas (engineering, technology, law, philosophy, ethics, bioethics, among others) and the lack of debates in which they can integrate the experiences and concerns of society, in general, is also worrying.

In addition, Latin American perspectives are still scarce, perhaps because these developments have been slow to reach these contexts, or because the factors of connectivity, structure, and access to equipment are still lacking. In all three cases, it is essential to acknowledge both Virilio's (1996/1999) argument for increasing the number of active and critical perspectives to counter the tyranny of technoscience and Cardon's (2018) call for opening pathways to engage with these new systems, explore their components, and uncover their underlying worldviews.

The research limitations are evident when compared to the extensive literature on advancements in AI within educational practices, particularly in engineering and technology fields. However, within the analyzed time frame, studies addressing the impact of AI on educational actors and research conducted by educators within their respective fields remain limited. Similarly, there is a scarcity of research examining the individual responsibilities of creators, developers, distributors, managers, and users who integrate AI into education.

In conclusion, several topics remain open for further research on the developments of AI in education such as AI and new forms of algorithmic citizenship; the innovations of the metaverse for students and teachers; the educational objectives and student profiles shaped by AI systems; the impact of strong AI on human rights, freedom, and the overall well-being of educational actors; and the ethical responsibilities of those involved in AI development, among others.

Conflict of interest

The authors declare that they have no personal conflicts of interest, nor any conflicts of interest with any institution or commercial association of any kind.

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Author's note

Vianney Díaz-Pérez: Principal investigator, data collection, theoretical framework, writing.

Hernando Barrios-Tao: Co-investigator, data collection, data analysis, methodological design, writing, and final revision of the manuscript.

References

Adams, S., Brown, M., Dahlstrom, E., Davis, A., Depaul, K., Diaz, V., & Pomerantz, J. (2018). *NMC horizon report: 2018 higher education edition*. EDUCAUSE.

Al Darayseh, A. (2023). Acceptance of artificial intelligence in teaching science: science teachers' perspective. *Computers and Education: Artificial Intelligence*, *4*, 100132. https://doi.org/10.1016/j.caeai.2023.100132

Alves-Bitencourt, W., Mello-Silva, D., & Do Carmo-Xavier, G. (2022). Pode a inteligência artificial apoiar ações contra evasão escolar universitária? [May artificial intelligence support actions against school dropout?] *Ensaio: aval. pol. públ. Educ., Rio de Janeiro*, *30*(116), 669-694. https://doi.org/10.1590/S0104-403620220003002854

Aoun, J. (2017). *Robot-proof. Higher education in the age of artificial intelligence*. MIT Press.

Arruda-Campos, L. F., & Nabuco-Lastória, L. A. (2020). Semiformation and artificial intelligence in teaching. *Pro-Posições*, *31*, e-20180105. https://www.scielo.br/j/pp/a/RMMLt3y3cwPs9f4cztTtMSv/?lang=en

Ayuso-Del Puerto, D., & Gutiérrez-Esteban, P. (2022). La Inteligencia Artificial como Recurso Educativo durante la Formación Inicial del Profesorado [Artificial intelligence as an educational resource during preservice teacher training]. *RIED-Revista Iberoamericana de Educación a Distancia*, *25*(2), 347-362. https://doi.org/10.5944/ried.25.2.32332

Baker, T., & Smith, L. (2019). *Educ-AI-tion rebooted? Exploring the future of artificial intelligence in schools and colleges*. Nesta. https://media.nesta.org.uk/documents/Future_of_AI_and_education_v5_WEB.pdf

DOI: https://doi.org/10.21501/22161201.4803

Barrett, A., & Pack, A. (2023). Not quite eye to A.I.: student and teacher perspectives on the use of generative artificial intelligence in the writing process. *International Journal of Educational Technology High Education*, *20*(59). https://doi.org/10.1186/s41239-023-00427-0

Barrios-Tao, H., Díaz, V., & Guerra, Y. (2020). Subjetividades e inteligencia artificial: desafíos para 'lo humano' [Subjectivities and artificial intelligence: challenges for the 'human']. *Veritas*, *47*(4), 81-107. http://dx.doi.org/10.4067/S0718-92732020000300081

Bayne, S. (2015). Teacherbot: interventions in automated teaching. *Teaching in Higher Education*, *20*(4), 455-467. https://doi.org/10.1080/13562517.2015.1020783

BeldaMedina, J., & Kokošková, V. (2023). Integrating chatbots in education: insights from the ChatbotHuman Interaction Satisfaction Model (CHISM). *International Journal of Educational Technology in Higher Education*, *20*(62). https://doi.org/10.1186/s41239-023-00432-3

Beaulac, C., & Rosenthal, J. S. (2019). Predicting university Students' academic success and major using random forests. *Research in Higher Education*, *60*(7), 1048-1064. https://doi.org/10.1007/s11162-019-09546-y

Belpaeme, T., Kennedy, J., Ramachandran, A., Scassellati, B., & Tanaka, F. (2018). Social robots for education: A Review. *Robotics, 3*(21), eaat5954. https://doi.org/10.1126/scirobotics.aat5954

Benvenuti, M., Cangelosi, A., Weinberger, A., Mazzoni, E. Benassi, M., Barbaresi, M., & Orsoni, M. (2023). Artificial intelligence and human behavioral development: a perspective on new skills and competences acquisition for the educational context. *Computers in Human Behavior*, *148,* 107903. https://doi.org/10.1016/j.chb.2023.107903

Benítez, R., Escudero, G., & Kanaan, S. (2014). *Inteligencia Artificial Avanzada* [Advanced artificial intelligence]. Universidad de Cataluña: UOC.

Beuchot, M. (2016). *Hechos e interpretaciones. Hacia una hermenéutica analógica* [Facts and interpretations. Toward an analogical hermeneutics]. FCE.

Bialik, M., & Fadel, C. (2018). *Knowledge for the age of artificial intelligence: what should students learn?* Center For Curriculum Design. https://curriculumredesign.org/wp-content/uploads/CCR_Knowledge_FINAL_January_2018.pdf

DOI: https://doi.org/10.21501/22161201.4803

Burgos, C., Campanario, M. L., De la Peña, D., Lara, J. A., Lizcano, D., & Martínez, M. A. (2018). Data mining for modeling students' performance: a tutoring action plan to prevent academic dropout. *Computers and Electrical Engineering*, (66), e-541556. http://dx.doi.org/10.1016/j.compeleceng.2017.03.005

Cardon, D. (2018). *Con qué sueñan los algoritmos. Nuestra vida en el tiempo de los big data* [What do algorithms dream of. Our life in the big data era]. Dado Ediciones.

Castillejos-López, B. (2022). Inteligencia artificial y entornos personales de aprendizaje: atentos al uso adecuado de los recursos tecnológicos de los estudiantes universitarios [Artificial intelligence and personal learning environments: attentive to the proper use of technological resources by university students]. *Educación* , *31*(60), 9-24. https://doi.org/10.18800/educacion.202201.001

Castrillón, O., Sarache, W., & Ruiz-Herrera, S. (2020). Predicción del rendimiento académico por medio de técnicas de inteligencia artificial [Prediction of academic performance using artificial intelligence techniques]. *Formación Universitaria*, *13*(1), 93-102. http://dx.doi.org/10.4067/S0718-50062020000100093

Celik, I. (2023). Exploring the determinants of artificial intelligence (AI) literacy: digital divide, computational thinking, cognitive absorption. *Telematics and Informatics*, (83), e-102026. https://doi.org/10.1016/j.tele.2023.102026

Cerny, M. (2023). Perceptions of the design and use chatbots for educational purposes: a dialogue partner. *Journal of Educators Online*, *20*(4). https://doi.org/10.9743/JEO.2023.20.4.3

Chauncey, S. A., & McKenna, P. (2023). A framework and exemplars for ethical and responsible use of AI Chatbot technology to support teaching and learning. *Computers and Education: Artificial Intelligence*, (5), e-100182. https://doi.org/10.1016/j.caeai.2023.100182

Chen, H., Park, H., & Breazeal, C. (2020). Teaching and learning with children: impact of reciprocal peer learning with a social robot on children's learning and emotive engagement. *Computers & Education*, *150*, e-103836. https://doi.org/10.1016/j.compedu.2020.103836

Chen, X., Zou, D., Xie, H., Cheng, G., & Liu, C. (2022). Two decades of artificial intelligence in education: contributors, collaborations, research topics, challenges, and future directions. *Educational Technology and Society*, *25*(1), 28-47.

Cheney-Lippold, J. (2017). *We are data: algorithms and the making of our digital selves*. University Press.

DOI: https://doi.org/10.21501/22161201.4803

Chernyshenko, O., Kankaraš, M., & Drasgow, F. (2018). *Social and emotional skills for student success and wellbeing: conceptual framework for the OECD study on social and emotional skills*. Organisation for Economic Co-operation and Development.

Colmenarejo-Fernández, R. (2018). Ética aplicada a la gestión de datos masivos [Applied ethics to big data]. *Anales de la Cátedra Francisco Suárez*, *52*, 113-129.

Cotino-Hueso, L. (2017). Big data e inteligencia artificial. Una aproximación a su tratamiento jurídico desde los derechos fundamentales [Big data and artificial intelligence. An approach from a legal point of view about fundamental rights]. *Dilemata*, *9*(24), 131-150.

Craig, E., & Georgieva, M. (2018). VR and AR: the ethical challenges ahead. *EDUCAUSE Review*, 2018. https://er.educause.edu/blogs/2018/4/vr-and-ar-the-ethical-challenges-ahead

Crawford, K., Roel, D., Dryer, T., Fried, G., Green, B., Kaziunas, E., Kak, A., Varoon, M., McElroy, E., Sánchez, A., Raji, D., Rankin, J., Richardson, R., Schultz, J., West, S., & Whittaker, M. (2019). *AI now 2019 report*. AI Now Institute. https://ainowinstitute.org/AI_Now_2019_Report.pdf

De La Calle-Real, M. & Muñoz-Algar, M. J. (2018). Hikikomori: el síndrome de aislamiento social y juvenil [Hikikomori: the youth social isolation syndrome]. *Revista de la Asociación Española de Neuropsiquiatría*, *38*(133), 115-129. https://dx.doi.org/10.4321/s0211-57352018000100006

Duong, C. D., Vu, T. N., & Ngo, Th. V. (2023). Applying a modified technology acceptance model to explain higher education students' usage of ChatGPT: a serial multiple mediation model with knowledge sharing as a moderator. *The International Journal of Management Education*, *21*, 100883. https://doi.org/10.1016/j.ijme.2023.100883

Echeverría, J. (2016). *Ciberpersonas y cibermasas en las cibersociedades* [Cyberpersons and cybermasses in cybersocieties]. https://acento.com.do/opinion/ciberpersonas-cibermasas-las-cibersociedades-8408618.html

Edwards, Ch., Edwards, A., Spence, P., & Lin, X. (2018). I, teacher: using artificial intelligence (AI) and social robots in communication and instruction. *Communication Education*, *67*(4), 473-480. https://doi.org/10.1080/03634523.2018.1502459

DOI: https://doi.org/10.21501/22161201.4803

Espinosa, L. (2018). La mano y el algoritmo. Una antropología compleja ante los desafíos tecnológicos del presente [The hand and the algorithm. A complex anthropology for the technological challenges of the present]. *Araucaria, Revista Iberoamericana de Filosofía, Política, Humanidades y Relaciones Internacionales*, *20*(40), 109-136. https://doi.org/10.12795/araucaria.2018.i40.05

European Commission. (2020). *White paper on artificial intelligence: a European approach to excellence and trust, 2020*. https://commission.europa.eu/publications/white-paper-artificial-intelligence-european-approach-excellence-and-trust_en

European Commission. (2018). *Algorithms and human rights, 2018*. https://rm.coe.int/algorithms-and-human-rights-en-rev/16807956b5

Feldman, Z., & Sandoval, M. (2018). Metric power and the academic self. *TripleC, 16*(1), 214-233.

Flaxman, S., Goel, S., & Rao, J. M. (2016). Filter bubbles, echo chambers, and online news consumption. *Public Opinion Quarterly*, *80*(1), 298-320. https://doi.org/10.1093/poq/nfw006

Floridi, L., Cowls, J., Beltrametti, M., Chatila, R., Chazerand, P., Dignum, V., Luetge, Ch., Madelin, R., Pagallo, U., Rossi, F., Schafer, B., Valcke, P., & Vayena, E. (2018). AI4People – An ethical framework for a good AI society: opportunities, risks, principles, and recommendations. *Minds and Machines*, *28*, 689-707. https://doi.org/10.1007/s11023-018-9482-5

Galparsoro, J. I. (2017). *Big data* y Psicopolítica. Vía de escape: de la vida calculable a la vida como obra de arte [Big data and psychopolitics. Escape route: from calculable life to life as a work of art]. *Dilemata*, *9*(24), 25-43.

Galparsoro, J. I., & Pérez-Pérez, R. M. (2018). Revolución digital y psicopolítica. Algunas consideraciones críticas a partir de Byung-Chul Han, Foucault, Deleuze y Nietzsche [Digital and psychopolitical revolution. Some critical considerations in the wake of Byung-Chul Han, Foucault, Deleuze and Nietzsche]. SCIO. Revista de Filosofía, 14, 251-275. https://revistas.ucv.es/scio/index.php/scio/article/view/493/491

García-Peña, V. R., Mora-Marcillo, A. B., & Ávila-Ramírez, J. A. (2020). La inteligencia artificial en la educación [Artificial intelligence in education]. *Dominio de las Ciencias, 6*(3). 648-666. https://dialnet.unirioja.es/servlet/articulo?codigo=8231632

DOI: https://doi.org/10.21501/22161201.4803

García-Ramírez, D., & Valle-Jiménez, D. (2020). Los impactos de la ideología técnica y la cultura algorítmica en la sociedad: Una aproximación crítica [The impacts of technical ideology and algorithmic culture on society: a critical approach]. *Revista de Estudios sociales*, *71,* 15-27. https://doi.org/10.7440/res71.2020.02

García-Vélez, R. A. (2019). *Contribuciones a la gestión del conocimiento en el ámbito de la educación superior mediante técnicas de inteligencia artificial* [Contributions to knowledge management in the field of higher education using artificial intelligence techniques] [Doctoral dissertation, Universidad de Vigo]. Investigo. http://hdl.handle.net/11093/1322

Gil-Vera, V. D., & Quintero-López, C. (2021). Predicción del rendimiento académico estudiantil con redes neuronales artificiales [Development of an artificial neural network for predicting student academic success]. *Información Tecnológica*, *32*(6), 221-228. http://dx.doi.org/10.4067/S0718-07642021000600221

González de Dios, J., Buñuel-Álvarez, J. C., & Aparicio-Rodrigo, M. (2011). Listas guía de comprobación de revisiones sistemáticas y metaanálisis: declaración PRISMA [Checklists for systematic reviews and meta-analyses: PRISMA statement]. *Evidencias en Pediatría*, *7*(97), 1-6.

Gray, C., & Perkins, D. (2019). Utilizing early engagement and machine learning to predict student outcomes. *Computers & Education*, *131*, 22-32. https://doi.org/10.1016/j.compedu.2018.12.006

Guan, Ch., Mou, J., & Jiang, Z. (2020). Artificial intelligence innovation in education: A twenty-year data-driven historical analysis. *International Journal of Innovation Studies*, *4*, 134-147. https://doi.org/10.1016/j.ijis.2020.09.001

Han, B-Ch. (2014). *Psychopolitics: neoliberalism and new technologies of power* (E. Butler, Trans.) . Verso. (Original work published 2014)

Hill, R. K. (2016). What an algorithm is? *Philosophy and Technology*, *29*(1), 35-59. https://doi.org/10.1007/s13347-014-0184-5

Hoffait, A-S., & Schyns, M. (2017). Early detection of university students with potential difficulties. *Decision Support Systems*, *101*, 1-11. http://dx.doi.org/10.1016/j.dss.2017.05.003

Holmes, W., Porayska, K., Holstein, K., Sutherland, E., Baker, T., Buckingham, S., Santos, O., Rodrigo, M., Cukurova, M., Ig, B., & Koedinger, K. (2022). Ethics of AI in education: towards a community-wide framework. *International Journal of Artificial Intelligence in Education*, *32*, 504-526. https://doi.org/10.1007/s40593-021-00239-1

DOI: https://doi.org/10.21501/22161201.4803

Hou, H., Zhang, X., & Wang, D. (2023). Can educational robots improve student creativity? A meta-analysis based on 48 experimental and quasi-experimental studies. *Frontiers of Education in China, 18*(3), 223-244. https://doi.org/10.3868/s110-008-023-0020-1

Howard, C., Jordan, P., Di Eugenio, B., & Katz, S. (2017). Shifting the load: a peer dialogue agent that encourages its human collaborator to contribute more to problem solving. *International Journal of Artificial Intelligence in Education*, *27*(1), 101-129. https://doi.org/10.1007/s40593-015-0071-y

Huang, S-P. (2018). Effects of using artificial intelligence teaching system for environmental education on environmental knowledge and attitude. *EURASIA Journal of Mathematics, Science and Technology Education, 14*(7), 3277-3284. https://doi.org/10.29333/ejmste/91248

Huang, J., & Chen, Z. (2016). The research and design of web-based intelligent tutoring system. *International Journal of Multimedia and Ubiquitous Engineering, 11*(6), 337-348. http://dx.doi.org/10.14257/ijmue.2016.11.6.30

Huici-Urmeneta, V., & Davila-Legerén, A. (2016). Del *Zoon Politikón* al *Zoon Elektronikón*. Una reflexión sobre las condiciones de la socialidad a partir de Aristóteles [From *zoon politikón* to *zoon elektronikón*. A reflection on the conditions of sociability from Aristotle]. *Política y Sociedad, 53*(3), 757-772. http://dx.doi.org/10.5209/rev_POSO.2016.v53.n3.50776

Hussain, M., Zhu, W., Zhang, W., & Abidi, S. M. (2018). Student engagement predictions in an e-Learning system and their impact on student course assessment scores. *Computational Intelligence and Neuroscience*, ID 6347186. https://doi.org/10.1155/2018/6347186

Hwang, G-J., Xie, H., Wah, B., & Gasevic, D. (2020). Vision, challenges, roles and research issues of artificial intelligence in education. *Computers and Education: Artificial Intelligence, 1,* 100001. https://doi.org/10.1016/j.caeai.2020.100001

Iku-Silan, A., Hwang, G-J., & Chen, Ch-H. (2023). Decision-guided chatbots and cognitive styles in interdisciplinary learning. *Computers & Education*, *201*, e-104812. https://doi.org/10.1016/j.compedu.2023.104812

Imani, M., & Montazer, G. (2019). A survey of emotion recognition methods with emphasis on E-Learning environments. *Journal of Network and Computer Applications*, *147*, e-102423. https://doi.org/10.1016/j.jnca.2019.102423

DOI: https://doi.org/10.21501/22161201.4803

Kaplan, A., & Haenlein, M. (2019). Siri, Siri, in my hand: who's the fairest in the land? On the interpretations, illustrations, and implications of artificial intelligence. *Business Horizons*, *62*(1), 15-25. https://doi.org/10.1016/j.bushor.2018.08.004

Keating, J., & Nourbakhsh, I. (2018). Teaching artificial intelligence and humanity. *Communications of the ACM*, *61*(2), 29-32. https://doi.org/10.1145/3104986

Kim, J., Merrill, K., Xu, K., & Sellnow, D. (2022). Embracing AI-based education: perceived social presence of human teachers and expectations about machine teachers in online education. *Human-Machine Communication*, *4*, 169-185. https://doi.org/10.30658/hmc.4.9

Kim, J., Merrill, K., Xu, K., & Sellnow, D. (2020). My teacher is a machine: understanding students' perceptions of AI teaching assistants in online education. *International Journal Human Computer Interaction*, *36*(20), 1902-1911. https://doi.org/10.1080/10447318.2020.1801227

Koh, J., Cowling, M., Jha, M., & Sim, K. N. (2023). The human teacher, the AI teacher and the AIed-teacher relationship. *Journal of Higher Education Theory and Practice*, *23*(17), 200-212. https://doi.org/10.33423/jhetp.v23i17.6543

Labadze, L., Grigolia, M., & Machaidze, L. (2023). Role of AI chatbots in education: systematic literature review. *International Journal of Educational Technology in Higher Education*, *20*(56). https://doi.org/10.1186/s41239-023-00426-1

Lameras, P., & Arnab, S. (2022). Power to the teachers: an exploratory review on artificial intelligence in education. *Information*, *13*(14). https://doi.org/10.3390/info13010014

Lanier, J. (2018). *Ten arguments for deleting your social media accounts right now*. Henry Holt & Co.

Lemaignan, S., Warnier, M., Sisbot, A., Clodic, A., & Alami, R. (2017). Artificial cognition for social human-robot interaction. *Artificial Intelligent*, *247*, 45-69. http://dx.doi.org/10.1016/j.artint.2016.07.002

Lim, M. A. (2021). Governing higher education: the pure data system and the management of the bibliometric self. *Higher Education Policy*, *34*(1), 238-253. https://doi.org/10.1057/s41307-018-00130-0

DOI: https://doi.org/10.21501/22161201.4803

Lobo, L. C. (2018). Inteligência artificial, o Futuro da Medicina e a Educação Médica [Artificial intelligence, the future of medicine and medical education]. *Revista Brasileira de Educação Médica*, *42*(3), 3-8. https://doi.org/10.1590/1981-52712015v42n3RB20180115EDITORIAL1

Lodhi, P., Mishra, O., Jain, S., & Bajaj, V. (2018). StuA: an intelligent student assistant. *International Journal of Interactive Multimedia and Artificial Intelligence*, *5*(2), 17-25. https://doi.org/10.9781/ijimai.2018.02.008

Long, Y., Aman, Z., & Aleven, Z. (2015). Motivational design in an intelligent tutoring system that helps students make good task selection decisions. In Conati, C., Heffernan, N., Mitrovic, A., and Verdejo, F. (Eds.), *Artificial Intelligence in Education* (pp. 226-236). Springer.

Lottering, R., Hans, R., & Lall, M. (2020). A machine learning approach to identifying students at risk of dropout: a case study. *(IJACSA) International Journal of Advanced Computer Science and Applications, 11*(10), 417-422. http://dx.doi.org/10.14569/IJACSA.2020.0111052

Lupton, D., Mewburn, I., & Thomson, P. (2018). *The digital academic: critical perspectives on digital technologies in higher education*. Milton Keynes: Routledge.

Lupton, D. (2016). The diverse domains of quantified selves: self-tracking modes and dataveillance. *Economy and Society*, *45*(1), 101-122. http://dx.doi.org/10.1080/03085147.2016.1143726

Marín-Casanova, J. (2018). La resemantización TIC de la cultura humanista [The ICT resemantization of the humanist culture]. index.comunicación, *8*(1), 179-195.

Martín-Núñez, J. L., Ar, A., Pérez Fernández, R., Abbas, A., & Radovanovic, A. (2023). Does intrinsic motivation mediate perceived artificial intelligence (AI) learning and computational thinking of students during the COVID-19 pandemic? *Computers and Education: Artificial Intelligence*, *4,* e-100128. https://doi.org/10.1016/j.caeai.2023.100128

Martorell-Campos, F., & Alonso-Puelles, A. (2019). Asistidos por el soberano electrónico. Utopías y distopías de la inteligencia artificial [Assisted by the electronic sovereign. utopias and dystopias of artificial intelligence]. *Dilemata*, *11*(30), 111-127. https://www.dilemata.net/revista/index.php/dilemata/article/view/412000294/644

Marzal, M. A. (2023). La formación en competencias digitales para la virtualidad y la inteligencia artificial: una nueva frontera de las multialfabetizaciones [Training for digital competencies for virtuality and artificial intelligence]. *Informatio 28*(2), a5. https://doi.org/10.35643/Info.28.2.1

DOI: https://doi.org/10.21501/22161201.4803

Monasterio-Astobiza, A. (2017). Ética algorítmica: Implicaciones éticas de una sociedad cada vez más gobernada por algoritmos [Algorithmic ethics: ethical implications of a society increasingly governed by algorithms]. *Dilemata*, *9*(24), 185-217. https://www.dilemata.net/revista/index.php/dilemata/article/view/412000107/497

Montréal Declaration. (2018). *For a responsible development of artificial intelligence*. https://recherche.umontreal.ca/english/strategic-initiatives/montreal-declaration-for-a-responsible-ai/

Moore, P., & Robinson, A. (2016). The quantified self: what counts in the neoliberal workplace. *New Media & Society*, *18*(11), 1-19. https://doi.org/10.1177/146/4448/5604328

Munnerley, D., Bacon, M., Fitzgerald, R., Wilson, A., Hedberg, J., Steele, J., & Standley, A. (2014). *Augmented reality: application in higher education*. Australian Government. Office for Learning & Teaching.

Navas, S. (2016). Smart robots y otras máquinas inteligentes en nuestra vida cotidiana [Smart robots and other machines in our daily life]. *Revista CESCO de Derecho de Consumo*, (20), 82-109.

Nguyen, C. (2020). Echo chambers and epistemic bubbles. *Episteme*, *17*(2), 141-161. https://doi.org/10.1017/epi.2018.32

Nguyen, J., Sánchez-Hernández, G., Armisen, A., Agell, N., Rovira, X., & Angulo, C. (2018). A linguistic multi-criteria decision-aiding system to support university career services. *Applied Soft Computing Journal*, *67*, 933-940. https://doi.org/10.1016/j.asoc.2017.06.052

Nye, B. (2015). Intelligent tutoring systems by and for the developing world: a review of trends and approaches for educational technology in a global context. *International Journal of Artificial Intelligence in Education, 25*(2), 177-203. https://doi.org/10.1007/s40593-014-0028-6

O'Callaghan, D., Greene, D., Conway, M., Carthy, J., & Cunningham. (2015). Down the (White) Rabbit hole: the extreme right and online recommender systems. *Social Science Computer Review*, *33*(4), 459-78. https://doi.org/10.1177/0894439314555329

Organisation for Economic Co-operation and Development. (2020). *Trustworthy AI in education*. https://www.oecd.org/education/trustworthy-artificial-intelligence-in-education.pdf

Organisation for Economic Co-operation and Development. (2019). *Principles on AI*. https://www.oecd.org/going-digital/ai/principles

DOI: https://doi.org/10.21501/22161201.4803

United Nations Educational, Scientific and Cultural Organization. (2020). *Humanistic futures of learning: perspectives from UNESCO chairs and UNITWIN networks*. https://unesdoc.unesco.org/ark:/48223/pf0000372577

United Nations Educational, Scientific and Cultural Organization. (2015). *Rethinking education: towards a global common good?* Paris. https://unesdoc.unesco.org/ark:/48223/pf0000232555

Ortiz-Colón, A-M., Jordán, J., & Agredal, M. (2018). Gamificación en educación [Gamification in education: an overview on the state of the art]. *Educação e Pesquisa*, (44), e-173773. https://doi.org/10.1590/s1678-4634201844173773

Ouyang, F., Zheng, L., & Jiao, P. (2022). Artificial intelligence in online higher education: a systematic review of empirical research from 2011 to 2020. *Education and Information Technologies*, *27*(6), 7893-7925. https://doi.org/10.1007/s10639-022-10925-9

Page, M., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshawk, J. M., Hróbjartsson, A., Lalu, M. M., Lin, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., McGuinness, L. A., Stewar, L. A., Thomas, J., Tricco, A. C., Welch, V. A., Whiting, P., & Moher, D. (2021). Declaración PRISMA 2020: una guía actualizada para la publicación de revisiones sistemáticas [The PRISMA 2020 statement: an updated guideline for reporting systematic reviews]. *Revista Española de Cardiología*, *74*(9), 790-799. https://doi.org/10.1016/j.recesp.2021.06.016

Parreira, A., Lehmann, L., & Oliveira, M. (2021). O desafio das tecnologias de inteligência artificial na Educação: percepção e avaliação dos professores [The challenge of artificial intelligence technologies in Education: teachers' perception and evaluation]. *Ensaio: Avaliação e Políticas Públicas em Educação*. *29*(113). https://doi.org/10.1590/s0104-40362020002803115

Pedró, F. (Dir.). (2019). *Artificial intelligence in education: challenges and opportunities for sustainable development*. United Nations Educational, Scientific and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000366994

Pérez, J., Deligianni, F., Ravi, D., & Yang, G. (2017). *Artificial Intelligence and Robotics*. EPSRC UKRAS Network. https://doi.org/10.31256/WP2017.1

Popenici, S., & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education. *Research and Practice in Technology Enhanced Learning*, *12*(22). https://doi.org/10.1186/s41039-017-0062-8

DOI: https://doi.org/10.21501/22161201.4803

Prinsloo, P. (2017). Fleeing from Frankenstein's monster and meeting Kafka on the way: algorithmic decision-making in higher education. *E-Learning and Digital Media*, *14*(3), 138-163. https://doi.org/10.1177/2042753017731355

Restrepo-Echeverri, D., Jiménez-Builes, J. A., & Branch-Bedoya, J. W. (2022). Educación 4.0: integración de robótica educativa y dispositivos móviles inteligentes como estrategia didáctica para la formación de ingenieros en STEM [Education 4.0: integration of educational robotics and smart mobile devices as a didactic strategy for the training of engineers in STEM]. *DYNA*, *89*, 124-135. https://doi.org/10.15446/dyna.v89n222.100232

Roll, I., & Wylie, R. (2016). Evolution and revolution in artificial intelligence in education. *International Journal of Artificial Intelligence in Education, 26*(2), 582-599.

Rovira, S., Puertas, E., & Igual, L. (2017). Data-driven system to predict academic grades and dropout. *PLoS One, 12*(2), 1-21. https://doi.org/10.1371/journal.pone.0171207

Russell, S., Dewey, D., & Tegmark, M. (2015). Research priorities for robust and beneficial artificial intelligence. *AI Magazine*, *36*(4), 105-114.

Sánchez-Rojo, A. (2017). El fenómeno *hikikomori*: tradición, educación y TIC [The hikikomori phenomenon: tradition, education and information and communication technologies (ICT)]. *ARBOR, Ciencia, Pensamiento y Cultura, 193*(785), a405. http://dx.doi.org/10.3989/arbor.2017.785n3010

Saraiva Rodrigues, O., & Santos Rodrigues, K. (2023). A inteligência artificial na educação: os desafios do ChatGPT [Artificial intelligence in education: the challenges of ChatGPT]. *Texto Livre*, *16*, e-45997. https://doi.org/10.1590/1983-3652.2023.45997

Saura, G., & Bolívar, A. (2019). Sujeto académico neoliberal: Cuantificado, digitalizado y bibliometrificado [Neoliberal academic subject: quantified, digitised and bibliometrified]. *REICE, Revista Iberoamericana sobre Calidad, Eficacia y Cambio en Educación*, *17*(4), 9-26. https://doi.org/10.15366/reice2019.17.4.001

Sebastian, J., & Richards, D. (2017). Changing stigmatizing attitudes to mental health via education and contact with embodied conversational agents. *Computers in Human Behavior*, *73*, 479-488. http://dx.doi.org/10.1016/j.chb.2017.03.071

Sharkey, A. J. (2016). Should we welcome robot teachers? *Ethics and Information Technology*, *18*(4), 283-297. https://doi.org/10.1007/s10676-016-9387-z

DOI: https://doi.org/10.21501/22161201.4803

Sichman, J. S. (2021). Inteligência Artificial e sociedade [Artificial intelligence and society]. *Estudos Avançados*, *35*(101), 37-50. https://doi.org/10.1590/s0103-4014.2021.35101.004

Sreenivasa-Rao, K., Swapna, N., & Praveen-Kumar, P. (2018). Educational data mining for student placement prediction using machine learning algorithms. *International Journal of Engineering & Technology*, *7*(1.2), 43-46. https://doi.org/10.14419/ijet.v7i1.2.8988

Stewart, U. (2018). AI can help to bridge the digital divide and create an inclusive society. *ITU News*, *1*, 19-23. https://historicjournals.itu.int/viewer/3150/?return=1&css-name=include&window_close=1&offset=7#page=3&viewer=picture&o=&n=0&q=

Stone, P. (Dir.). (2016). *Artificial intelligence and life in 2030.* Stanford University. https://ai100.stanford.edu/sites/g/files/sbiybj18871/files/media/file/ai100report10032016fnl_singles.pdf

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

Telefónica. (2018). *Manifiesto por un nuevo pacto digital. Una digitalización centrada en las personas* [Manifesto for a new digital pact. Digitization centered on people]. https://www.telefonica.com/manifiesto-digital/assets/manifiesto_por_un_nuevo_pacto_digital.pdf

Tirado-Olivares, S., Navío-Inglés, M., O'Connor-Jiménez, P., & Cózar-Gutiérrez, R. (2023). From human to machine: investigating the effectiveness of the conversational AI ChatGPT in historical thinking. *Education Sciences*, *13*(8), 803. https://doi.org/10.3390/educsci13080803

Toboso-Martín, M., & Aparicio-Payá, M. (2019). Entornos de funcionamientos robotizados. ¿Es posible una robótica inclusiva? [Robotized functionings environments. Is it possible an inclusive robotics?] *Dilemata*, *11*(30), 171-185. https://www.dilemata.net/revista/index.php/dilemata/article/view/412000297/647

Torcal, L. (2018). Integración versus superación. El corazón del problema tecnoético [Integration versus conquest. The heart of the technoethical problem]. *Telos, 109*, 60-69. https://telos.fundaciontelefonica.com/telos-109-cuaderno-central-tecnoetica-lluc-torcal-corazon-problema-tecnoetico/

Umer, R., Susnjak, T., Mathrani, A., & Suriadi, S. (2017). On predicting academic performance with process mining in learning analytics. *Journal of Research in Innovative Teaching*, *10*(2), 160-176. https://doi.org/10.1108/JRIT-09-2017-0022

DOI: https://doi.org/10.21501/22161201.4803

Van den Berg, G., & Du Plessis, E. (2023). ChatGPT and generative AI: possibilities for its contribution to lesson planning, critical thinking and openness in teacher education. *Education Sciences*, *13*, 998. https://doi.org/10.3390/educsci13100998

Vashista, N., Gugnani, P., Bala, M., & Kumar, A. (2023). The educator's lens: understanding the impact of AI on management education. Panipat Institute of Engineering and Technology. *India International Journal of Education and Development using Information and Communication Technology*, *19*(3), 9-27.

Venancio-Júnior, S. J. (2019). Arte e inteligências artificiais: implicações para a criatividade [Art and artificial intelligences: implications for creativity]. *ARS (São Paulo)*, *17*(35), 183-201. https://doi.org/10.11606/issn.2178-0447.ars.2019.152262

Vicari, R. M. (2021). Influências das tecnologias da inteligência artificial no ensino [Impact of artificial intelligence technologies on teaching]. *Estudos Avançados*, *35*(101), 73-84. https://doi.org/10.1590/s0103-4014.2021.35101.006

Virilio, P. (1999). *Politics of the very worst* (M. Cavaliere, Trans.). Semiotext(e). (Original work published 1996)

Wakelam, E., Jefferies, A., Davey, N., & Sun, Y. (2020). The potential for student performance prediction in small cohorts with minimal available attributes. *British Journal of Educational Technology*, *51*(2), 347-370. https://doi.org/10.1111/bjet.12836

Walsh, K. R., Tamjidul, H., & Williams, K. H. (2017). Human machine learning symbiosis. *Journal of Learning in Higher Education, 13*(1), 55-62.

World Economic Forum. (2019). *Top 10 emerging tecnologies*. http://www3.weforum.org/docs/WEF_Top_10_Emerging_Technologies_2019_Report.pdf

World Economic Forum. (2016). *New vision for education: fostering social and emotional learning through technology*. http://www3.weforum.org/docs/WEF_New_Vision_for_Education.pdf

Wei, P., & Zhao, Y. (2019). A novel speech emotion recognition algorithm based on wavelet kernel sparse classifier in stacked deep auto-encoder model. *Personal and Ubiquitous Computing*, *23*(3), 521-529. https://doi.org/10.1007/s00779-019-01246-9

Wolf, B. (2015). Big data, small freedom? Informational surveillance and the political. *Radical Philosophy*, *191*, 13-20.

DOI: https://doi.org/10.21501/22161201.4803

Xu, W., & Ouyang, F. (2022). A systematic review of AI role in the educational system based on a proposed conceptual framework. *Education and Information Technologies*, *27*(3), 4195-4223. https://doi.org/10.1007/s10639-021-10774-y

Yadav, A., Good, J., Voogt, J., & Fisser, P. (2016). Computational thinking as an emerging competence domain. In M. Mulder (Ed.), *Competence-based vocational and professional education: bridging the worlds of work and education* (pp. 1051-1067). Springer International Publishing AG.

Yang, S. J., Ogata, H., Matsui, T., & Chen, N-S. (2021). Human-centered artificial intelligence in education: seeing the invisible through the visible. *Computers and Education: Artificial Intelligence, 2*, e-100008. https://doi.org/10.1016/j.caeai.2021.100008

Zamir, S., Afzal, S., & Sultana, N. (2023). ChatGPT and artificial intelligence in higher education institutions: benefits, challenges and ethical concerns. *Biannual Uswa Journal of Research*, *3*(2), 1-23. https://uswa.com.pk/?p=1455

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*(39). https://doi.org/10.1186/s41239-019-0171-0

Zhai, X., Chu, X., Chai, Ch., Jong, M., Istenic, A., Spector, M., Liu, J-B., Yuan, J., & Li, Y. (2021). A Review of artificial intelligence (AI) in education from 2010 to 2020. *Complexity*, e-8812542. https://doi.org/10.1155/2021/8812542

Zovko, M-E., & Dillon, J. (2018). Humanism vs. competency: traditional and contemporary models of education. *Educational Philosophy and Theory*, *50*(6), 554-564. https://doi.org/10.1080/00131857.2017.1375757