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PURPOSES OF EDUCATION ALONG WITH ARTIFICIAL INTELLIGENCE DEVELOPMENTS

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Abstract

Artificial intelligence reconfigures social environments, educational practices and human lives, and its developments mobilize voices for advocates and detractors. The objective is to interpret possibilities, risks and opportunities of artificial intelligence for the purposes of education, through an analogical hermeneutic that establishes a balance between two interpretative extremes: univocity and equivocation. The results indicate impacts of artificial intelligence on the humanistic vision, autonomy, equity, comprehensive training and the same right to education. A balanced understanding mitigates risks and takes advantage of the possibilities of these developments for educational purposes, with the view that they are still in process and demand new inquiries.

EDUCATION • ARTIFICIAL INTELLIGENCE • TEACHING-LEARNING PROCESS • HUMANISM

PROPÓSITOS DE LA EDUCACIÓN FRENTE A DESARROLLOS DE INTELIGENCIA ARTIFICIAL

Resumen

La inteligencia artificial reconfigura entornos sociales, prácticas educativas y vidas humanas, y sus desarrollos movilizan voces defensoras y detractoras. El objetivo es interpretar posibilidades, riesgos y oportunidades de la inteligencia artificial para los propósitos de la educación, mediante una hermenéutica analógica que establezca un equilibrio entre dos extremos interpretativos: univocidad y equivocidad. Los resultados indican impactos de la inteligencia artificial en la visión humanista, la autonomía, la equidad, la formación integral y el mismo derecho a la educación. Una comprensión equilibrada mitiga riesgos y aprovecha posibilidades de estos desarrollos para los propósitos educativos, con la visión de que aún están en proceso y demandan nuevas indagaciones.

EDUCACIÓN • INTELIGENCIA ARTIFICIAL • PROCESO DE ENSEÑANZA-APRENDIZAJE • HUMANISMO

PROPÓSITOS DA EDUCAÇÃO PERANTE OS DESENVOLVIMENTOS DE INTELIGÊNCIA ARTIFICIAL

Resumo

A inteligência artificial reconfigura entornos sociais, práticas educacionais e vidas humanas, e seus desenvolvimentos mobilizam vozes defensoras e detratoras. O objetivo é interpretar possibilidades, riscos e oportunidades da inteligência artificial para os propósitos da educação, mediante uma hermenêutica analógica que estabeleça um equilíbrio entre dois extremos interpretativos: univocidade e equivocidade. Os resultados indicam impactos da inteligência artificial na visão humanista, a autonomia, a equidade, a formação integral e o próprio direito à educação. Uma compreensão equilibrada mitiga riscos e aproveita possibilidades desses desenvolvimentos para os propósitos educacionais, com a visão de que ainda estão em processamento e demandam novas indagações.

EDUCAÇÃO • INTELIGÊNCIA ARTIFICIAL • PROCESSO DE ENSINO-APRENDIZAGEM • HUMANISMO

LES OBJECTIFS DE L'ÉDUCATION ET LE DÉVELOPPEMENT DE L'INTELLIGENCE ARTIFICIELLE

Résumé

L'intelligence artificielle reconfigure les environnements sociaux, les pratiques éducatives et les vies humaines, et ses développements mobilisent à la fois défenseurs et détracteurs. L'objectif de ce travail est d'interpréter les possibilités, risques et opportunités que représente l'intelligence artificielle pour l'éducation, par moyen d'une herméneutique analogique qui établisse un équilibre entre deux extrêmes interprétatifs, ceux de l'univocité et de l'équivocité. Les résultats montrent les impacts de l'intelligence artificielle sur la vision humaniste, l'autonomie, l'équité, la formation intégrale et le droit à l'éducation. Une compréhension équilibrée de la question atténue les risques et profite des possibilités qu'offrent ces développements pour les appliquer au domaine de l'éducation, tout en gardant à l'esprit que ceux-ci sont encore en cours et appellent de nouvelles investigations.

ÉDUCATION • INTELLIGENCE ARTIFICIELLE • PROCESSUS ENSEIGNEMENT-APPRENTISSAGE • HUMANISME

ARTIFICIAL INTELLIGENCE (AI) SYSTEMS OVERCAME THE CONDITION OF INSTRUMENTS, burst into areas once exclusive to human action, emulate actions of the human being and walk in their reconfiguration and replacement (Barrios-Tao et al., 2020). AI is a "powerful force" that reshapes environments, cultures and human relationships (Floridi et al., 2018; Marín, 2018; Pedró, 2019) and continues with innovations: social robots, collaborative telepresence and data storage in DNA (World Economic Forum [WEF], 2019; Perez et al., 2017)

These developments pose challenges and bodies such as the United Nations Educational, Scientific and Cultural Organization (Unesco) indicate policies in relation to their risks and opportunities for sustainable development: guarantee inclusion and equity, prepare educational actors, understand educational practices and ensure ethics in data management (Pedró, 2019). Likewise, Unesco (2019a, 2019b) opened scenarios to deliberate on how AI could strengthen education, improve learning and promote the development of computational skills, and to ask questions about its limits and elements for its humanization. With this same goal, humanism-AI interaction, Stanford University created the Human Centered AI Center.

However, the results of the systematic review on AI applications in education by Zawacki et al. (2019) indicate an absence in this education-AI dialogue: "Where are the educators? This initial question translates into concerns about their lack of clarity about AI in their teaching-learning practices and its scope to strengthen education: among 145 articles (out of 2,656 between 2007-2018), 13 (8.9%) They were written by early authors with training in education.

The relationship AI developments and education moves between technophiles and technophobics, detractors and advocates. Possibilities and risks generate mixed evaluations: enthusiasm for its progress and fear for its results (Perez et al., 2017); dreams for a "utopian vision" in its processes and nightmares for a "dystopian end" in its achievement (Martorell & Alonso, 2019); "constructive" interactions that promote values to improve environments and "destructive" interactions that cause effects on incubated economic interests (Toboso & Aparicio, 2019); possibilities for their social environments and risks for sustainable development (Pedró, 2019); advances and potential risks (Sichman, 2021).

Faced with this disparity and antagonism, a balance is necessary through a comprehensive vision of its developments (Martorell & Alonso, 2019) and an orientation on its benefits and possible negative impacts (Perez et al., 2017). In order to offer a comprehensive vision of the relationship between AI and education, the objective of the article is to interpret the benefits, risks and opportunities of the developments of AI for the purposes of education.

AI and the purposes of education

The AI construct becomes more complex with the dynamics of its developments. From the initial question about the possibility of a machine being intelligent, the emulation of voices and emotions was followed, up to dreams of overcoming the human (Kaplan & Haenlein, 2019; Floridi et al., 2018; Postigo, 2018; García, 2017). The chronological horizon allows grouping diverse conceptions and ways to classify it.

The first conceptual group places it in a multidisciplinary area (mathematics, computer science, psychology, sociology, economics, engineering, neuroscience, biology, statistics) with the influence of other knowledge (philosophy, linguistics) (Vicari, 2021; Stone, 2016; Zawacki et al.,

2019). A second conception focuses on the systems-technologies relationship and defines it as a discipline "related to the theory of computation whose objective is to emulate some of the human intellectual faculties in artificial systems" (Benítez et al., 2014). The third concept determines the activity of creating intelligent machines, in the sense of a "quality" that allows them to function appropriately and with anticipation of their environment (Stone, 2016). A fourth group overcomes the unique AI and characterizes these systems. While Luckin et al. (2016) determine them as designs to interact with their environment through intelligent capabilities, the European Commission (2018, p. 2, own translation) characterizes them with capabilities to "... analyze their environment with a certain degree of autonomy and take action in order to achieve objectives".[1] This includes programs (voice assistants, image analysis and facial recognition, search engines) and software embedded in hardware devices (robots, drones or Internet of Things applications).

Regarding its classification, a difference is made between narrow and general AI (Baker & Smith, 2019), stages are indicated: narrow, general and super AI (Kaplan & Haenlein, 2019), and a distinction is made between weak and strong version (Strong AI) (Zawacki et al., 2019; Navas, 2016). The strong version locates systems that face "...strong philosophical challenges such as conscience, the development of an autonomous and unique character, or sensitivity, empathy or compassion"[2] (Colmenarejo, 2018, p. 123, own translation). Kaplan and Haenlein (2019) classify these systems according to their competencies: analytical AI with cognitive intelligence characteristics, human-inspired AI with emotions for decision-making, and humanized AI with social intelligence.

In the educational field, AI systems impact educational actors, practices and scenarios (Barrios-Tao et al., 2019). In addition, they offer interventions in students' academic processes: engagement, motivation, participation, retention, cognition (Zawacki et al., 2019; Marín, 2018; Huang, 2018). Likewise, they influence performance with tutors, applications, intelligent autonomous agents or virtual assistants (Sichman, 2021; Vicari, 2021; Alexander et al., 2019; Lodhi et al., 2018; Hussain et al., 2018; Howard et al., 2017; Sebastian & Richards, 2017; Huang & Chen, 2016) and reconfigure scenarios through Augmented Reality (AR) developments that enrich real physical spaces through sounds and images (Munnerley et al., 2014) and Mixed Reality (RM) in which digital and physical objects coexist (Adams et al., 2018). Finally, other systems automate teaching-learning practices with techniques such as Logistic Regression (LR), Random Forest (RF), Data Mining (DM) among others (Sreenivasa et al., 2018; Umer et al., 2017; Hoffait & Schyns, 2017).

The impacts of these developments are a fluctuating challenge between possibilities, risks and opportunities for educational purposes. In summary, education is considered as a right (Declaration of Human Rights, art. 26 and 27), whose centrality is the integral development of the human being through its pillars of being, knowing, doing and living together (Delors, 1996), that lead it along paths of autonomy and freedom, so that it contributes to processes of inclusion and equity with sociocultural transformation and sustainable human and social development (Unesco, 2015).

1 In the original: ". . . analizar su entorno y pasar a la acción –con cierto grado de autonomía– con el fin de alcanzar objetivos específicos".

2 In the original: ". . . desafíos filosóficos fuertes como la conciencia, el desarrollo de un carácter autónomo y único, o la sensibilidad, la empatía o la compasión".

Methodology

The methodology is located in Beuchot's analogical hermeneutics: ". . . theory of the interpretation of texts, which uses the concept of analogy to structure itself"[3] (2008, p. 491, own translation). This "interpretation policy" applicable to social problems allows establishing a balance between two interpretative extremes, univocity and equivocation (Beuchot, 2016), situation of interpreted texts, in relation to benefits, risks and opportunities of AI for education.

The methodological design is structured based on the three phases of analogical hermeneutics: syntactic, semantic and pragmatic (Beuchot, 2008), which guided the actions carried out: 1) Selection and revision of texts according to the objective, from keywords in Spanish, French and English ("artificial intelligence", "education", "humanism"), with the inclusion criteria (research articles located in databases and systems: Science Direct, SciELO, EBSCO, Dialnet, Proquest; reports, reports and statements on AI and education from universities and national and international entities; texts in English, French, Portuguese and Spanish; time frame: 2015-2020) and exclusion (gray material; master's works and doctoral theses; languages different); 2) Construction of a matrix to organize the selected texts, based on thematic units determined as "purposes" of education; 3) Characterization of univocal voices (benefits) and misunderstandings (risks) of AI for educational purposes. 4) The last action corresponds to the pragmatic phase, in which the analogical understanding (*A*) or the phronesis is determined between the univocal voices (*U*) and those equivocal (*E*). This interpretive moment allowed the determination of emerging themes in the relationship between AI and educational purposes, the basis for analogical interpretation: AI and the right to education (1D), AI and humanism (2H), AI and autonomy (3A), AI and equity (4I), AI and comprehensive training (5F).

Results

AI and the right of education (U1D): between mercantilism (E1D) and coverage (A1D)

In the first texts with univocal voices (*U*1D), some investigations implement AI systems to prevent problems such as dropout and low performance that would configure educational failures (Rovira et al., 2017; Umer et al., 2017), others create developments using data mining and machine learning algorithms that predict, based on the initial motivation of students, both their intention to drop out, as well as their chances of permanence and success. Hence, professional guidance and tutoring actions result to reduce dropout rates (Sreenivasa et al., 2018; Hoffait & Schyns, 2017). In relation to this student aid, Lynch (2018) refers to the "lifelong learning companions", which allow knowing their personal and school histories, as well as reinforcing skills and mastery of learning content.

On the other hand, models based on data mining such as logistic regression are presented, through decision trees and neural networks, to predict student retention and graduation possibilities (Raju & Schumacker, 2015). Likewise, interactive systems such as the Intelligent Student Assistant (StuA) that assists in student induction to the university environment (Lodhi et al., 2018), the Embodied Conversational Agents (ECA) as support in deciding and changing attitudes in the face of culturally constructed stigmatizing situations (Sebastian & Richards, 2017), and the Intelligent Tutoring Systems (ITS), based on learning models and neural networks, which indicate learning paths, provide a cognitive structure and involve the student with their learning (Zawacki et al., 2019).

3 In the original: ". . . teoría de la interpretación de textos, que usa el concepto de analogía para estructurarse".

Other systems favor the insertion of graduates into the labor market, such as the Linguistic Model that captures data from the curriculum, strengthens decision-making with multiple criteria, and improves internship applications in the labor market, according to their preferences (Nguyen et al., 2018). Likewise, expert systems allow the selection of personnel, based on their personal and social skills and their technical knowledge. These systems strengthen the integration between the competencies defined in the curricula and their graduation profiles, with the needs of the companies (Sánchez et al., 2016).

The latest authors consider expanding coverage in education through developments with AR and MRI, which allow reaching situations, environments and contexts, with physical access difficulties. These new realities allow the access of students in remote situations to academic, research and cultural settings, to strengthen their teaching-learning and research processes (Craig & Georgieva, 2018) and interact with virtual agents who act as facilitators and companions of the students. (Zawacki et al., 2019).

The first equivocal voice of AI developments in the face of education as a right (*E*1D) is related to commercial and lucrative factors, influenced by neoliberal policies, which impact educational actors and practices. While Saura and Bolívar (2019, p. 11) distinguish two neoliberal perspectives in education: one based on the "approaches to the structural condition of policies" and the other "focused on aspects of the new public management", Campos and Lastória (2020) take up the conversion of training (*bildung*) to a "semi-training" (*halbbildung*), conquered by the fetishism of merchandise, proposed by Adorno, and connect it with AI, instrumental rationality and learning.

This mercantilist situation feeds on the commercial value of data and knowledge, whose financial benefit is routed to third parties. The value of monitored data is increasing for companies that investigate user habits and preferences. In the academic field, Lupton (2016) points out the automatic compilations of software publications such as Web of Science and Google Scholar that design metrics on their performance and in which ". . . academics have no choice about whether or not they want their publication records to and quotes are publicly displayed on these platforms" (p. 110).

Other authors indicate that AI developments, while influencing trade in education, drove their practices through the ranking market, the metrics of their results and the productive measurement of educators. This trade in knowledge production, according to Feldman and Sandoval (2018), created two levels of research. One linked to the professional career, with institutional recognition, incentives and knowledge transfer, and another unrelated to commercial production and related to a relevant ethical action with the improvement of society and citizen training. A mercantilist, rewarded by the disciplines and another outstanding from the social and human point of view.

In this productive framework, the right to education is limited to those who have monetary possibilities and the biometrics of academic subjects are configured: "metrified" (Beer, 2016), "datified" (Cheney, 2017), "quantified" (Lupton, 2016), "digitized" (Moore & Robinson, 2016). Neoliberal policies that exercise soft governance through quantitative evaluations that deviate the purposes of education underlie each denomination (Saura & Bolívar, 2019). Studies indicate bibliometric impacts that measure the quality of research through digitized quantifications and establish commercial values for these knowledge products (Feldman & Sandoval, 2018; Lupton et al., 2018).

This metric, in addition to being a factor of capital and commerce, acts as a control that monitors the supposed value and behavior of people (Saura & Bolívar, 2019). Thus, human life became a product with monetary value, "the capitalization of the human body" (Lupton, 2016), through the price established for bio-digital knowledge generated by people. Consequently, educational actors become prosumers (producer-consumer at the same time) and their information, data and knowledge become merchandise (Feldman & Sandoval, 2018). Faced with technology and its productivity, the prosumer must produce-consume everything have been

produced-consumed. There the educational actor "dissolves in the contraction of the interval between production and consumption" and its recognition is limited to its "functional response" demanded by the productive apparatus (Marín, 2018, p. 189).

The first analogy (*A*1D) is based on quantitative criteria: the greater the development of AI systems, the greater the opportunities for coverage in education: "The broader the set of functions available in a society, the more inclusive it will be, and it will offer greater life possibilities to people, and a greater freedom of choice, favoring equal opportunities"[4] (Toboso & Aparicio, 2019, p. 172, own translation). Thus, more opportunities to face dropout problems and help students with personalized tutors who guide and manage learning, with the care that teachers with their presence and interaction contribute to the development of skills related to being and living together to a balanced economic and social life (Popenici & Kerr, 2017).

AI and humanism (U2H): between reconfiguration (E2H) and empowerment of the "what is human" (A2H)

A greater dedication to the cultivation of the physical, emotional, and intellectual dimensions on the way to an "excellence proper to our humanity" (Zovko & Dillon, 2018, p. 554) is a univocist perspective (*U*2H) that would benefit a humanist vision of education extended to life (Pedró, 2019). With these developments, people "must continue learning throughout their lives", "educational systems will have to adapt to this new paradigm" and "better training options for everyone" will be offered (Telefónica, 2018, p. 34). Automation will allow educators to be exempted from routine and administrative activities to dedicate themselves to their integral development, as well as to the personalized care and accompaniment of their students (Lynch, 2018; Popenici & Kerr, 2017).

Faced with the interaction between humans, fundamental for personal and social development (Rivera & Sánchez, 2018), some equivocal voices (*E*2H) point out the risk of transgressing it with the substitution of the human for intelligent machines. Automated practices would weaken both what it means to be human and the educational purpose of being "a means of becoming as human as possible, both as individuals of unique and inalienable value and as members of the universal human community" (Zovko & Dillon, 2018, p. 555).

From considering data and algorithms as "epistemological units made to have a form of representation" and "political, normative and ethical" phenomena (Prinsloo, 2017, p. 143) with the power to shape social life in various degrees and on the which individuals have, increasingly, less control (Monasterio, 2017), some authors expose the process of co-configuration and co-constitution between human beings and technologies as a horizon for human understanding, with the consequent formation of the mind and extension of the body (Ihde & Malafouris, 2019; Marín, 2018; Menéndez, 2018).

AI moves from the emulation of "natural language" (Wei & Zhao, 2019), to developing "rational agents" (Russell, 2017; Baker, 2019), recognizing and incorporating "emotions" (Imani & Montazer, 2019; Craig & Georgieva, 2018), until granting them "responsibilities" and "personalities" (Keating & Nourbakhsh, 2018) and developing "conscience" or "moral sense" in these systems (Monasterio, 2017; Perez et al., 2017). Consequently, they would influence the organic to modify, improve and re-create it (García, 2017) and change the "liquid, transformable and fluid" nature of the human, with the "physical, psychological, sociological and ecological consequences for life, health and integrity of people" (Postigo, 2018, p. 55). Changing the concept of what it means to be human

4 In the original: "Cuanto más amplio sea el conjunto de funcionamientos disponibles en una sociedad, más inclusiva será y ofrecerá mayores posibilidades de vida a las personas, y una libertad de elección mayor, favoreciendo la igualdad de oportunidades".

(Telefónica, 2018), transforming its condition and nature (Torcal, 2018) or eroding human self-determination (Floridi et al., 2018) open risks that humans can be redefined by technology (Popenici & Kerr, 2017).

Consequently, some systems seek to replace and substitute teachers with profitability criteria: "teaching is replaced by automated AI solutions" (Popenici & Kerr, 2017, p. 9). A risk for the employment stability of staff, with ethical implications in relation to confidential data and the privacy of educational actors (Zawacki et al., 2019) and with concerns about whether the "expensive AI research programs in education, intelligent tutoring systems and data mining" could be considered "a better investment option" than an education with more or better teachers (Bayne, 2015, p. 459; Kaplan & Haenlein, 2019). The very name teacherbot creates a "confusion of boundaries" (Bayne, 2015) and reduces the role of teachers to learning motivators or classroom facilitators (Lynch, 2018) or to the supervision, evaluation and management of online learning (Popenici & Kerr, 2017). Furthermore, the conception and practice of these systems emancipated from their instrumental condition configures and hyperlinks the human teacher as their "official" (Marín, 2018).

Finally, authors point out two forces exerting their power over human and social transformation: education seeks to improve its socio-cultural context with human values and AI systems with their data and algorithms, configured to influence, invade, and transform behavior human with other economic values (Torcal, 2018). Prinsloo (2017) indicates that despite the growing awareness of how algorithms transform the notion of human subjectivity, the purpose of forming political subjects faces subtle and automated forms and methods that invade educational actors.

The second analogy (*A*2H) refers to an automation that facilitates people's lives and can be "at the service of human self-determination", "promote social cohesion, without undermining human dignity" (Floridi et al., 2018, p. 694). Telefónica's Manifesto (2018) balances between the updating and flexibility of education systems to adapt to the change and uncertainty of AI, with the need for "a humanistic approach that encourages critical and creative thinking, as well as a philosophy of continuous learning" (p. 14).

Regarding the teacher bot-teacher relationship, Bayne (2015) points out some analogical aspects: exploring automated teaching practices that integrate humanistic dimension and technological appropriation; explore ways to integrate teacher presence with automation and to work together teacher-bots without ontological hierarchies and for the sake of productivity. In this sense, Pedró (2019) integrates the care of creative, empathic and socio-emotional aspects by teachers, with the support of AI in learning and in routine cognitive tasks. Likewise, the interaction between educational actors is accentuated with the irreplaceable presence of the teacher (Lynch, 2018; Popenici & Kerr, 2017), with the opportunity to extend their role in new settings through new systems, machine learning and new methodologies active learning (Adams et al., 2018).

AI and autonomy (U3A): versus governance (E3A) and personal responsibility (A3A)

Autonomy, critical thinking for responsible citizenship (Nussbaum, 2010) and public use of reason (Cortina, 2013) are purposes that could be strengthened (*U*3A) with the empowerment of people, the decentralization of power and citizen participation that enable digital platforms and the internet (Zafra, 2018). The hyper information and communication facilitated by AI reinforce autonomy and "the development of an intelligence resistant to the power of authority and blind traditions" (Nussbaum, 2010, p. 11), as well as flexible and multidisciplinary learning processes (Lobo, 2018).

In contrast, the equivocal third voice (*E*3A) indicates the risk to autonomy due to manipulation and governance through algorithmic programming of personal information and data. These configurations influence individual decisions in order to manipulate results, modify behaviors

and adopt certain types of behaviors unconsciously (Cotino, 2017), through the creation and extension of negative emotional currents (Zafra, 2018), and lead to its "gray area" where automated data extrapolates contexts and real events (Adams et al., 2018). On the other hand, these devices increase the "social disadvantage of marginalized groups" who have no control or knowledge over how their data is analyzed, used, and configure an "algorithmic authority" that exercises dominance over "automated subjects", whose decisions are made by coders as part of a "conservative political agenda" (Lupton, 2016, p. 118).

The move from manipulation to governance is as subtle as the techniques with which it is carried out. Saura and Bolívar (2019) point out self-monitoring, self-control, and the deceptive freedom of seduction, through soft control processes that monitor life itself, with the result of a "visible and visible subject, but empty" (p. 22). This governance traces a contradiction and paradox to individuals when it moves them between "zombies and intelligent", "clever animals and geniuses" and between "governed by causes of the brain and the environment that prevent freedom" and "lucid and creative in the extreme" (Espinosa, 2018, p. 119).

The false governance-autonomy paradox is located in the "digital panoptic" where the individual exhibits and exposes his interiority through his data, with which he manipulates and governs. There, each one is a "panoptic of himself" configured with his own data and manipulated through neoliberal psycho-politics, which seeks to please rather than subdue, through the willing seduction exercised with positive emotions (Han, 2014). Thus, death is declared to the "historical type of Sapiens" that, based on the awareness of its own individual dimension, is considered autonomous, independent and self--determined (Marín, 2018).

With the fallacious autonomy, the construction of a political subject, an educational purpose, is risked, with the consequent cancellation of democratic participation. Hence, the Montreal Declaration (2018) prevents that AI systems should not be developed, nor used "to impose a particular lifestyle on people, either directly or indirectly, through the implementation of oppressive monitoring and evaluation mechanisms. or incentives".

The next risk is the blurring of individual responsibility: "Who is responsible for the decisions of an AI system? The designer of the algorithm, its creator, its distributor, the ultimate owner?"[5] (Telefónica, 2018, p. 69, own translation). Both responsibility and autonomy are eroded by the force of social pressure configured in social networks: "The force of what others think has shown to have sufficient capacity to modify the behavior of subjects" (Lanier, 2018). The Montréal Declaration (2018) warns about the possibility that AI developments diminish "the responsibility of human beings when decisions must be made".

The third analogy (*A*3A) indicates a balance between the tasks delegated to AI systems and the care of personal autonomy, by supervising and guiding the programming of these systems (Floridi et al., 2018; Lynch, 2018). For its part, the Montréal Declaration (2018) indicates a balance between the use of AI systems and respect for autonomy, with the possibility of "fulfilling their own moral objectives and their conception of a life worth living". Likewise, it considers appropriate to maintain "social and cultural diversity" and personal human development in the educational field when these systems avoid restricting "personal lifestyle choices" and "the homogenization of society through the standardization of behaviors and opinions".

5 In the original: "¿Quién es responsable de las decisiones de un sistema de IA? ¿El diseñador del algoritmo, su creador, su distribuidor, el propietario final?".

AI and equity (U4I): facing exclusionary systems (E4I) and social inclusion (A4I)

The fourth univocal voice (*U*4I) indicates contributions of AI for equity in education through the introduction of interactive devices that multiply automated environments and include more students located in remote places (Toboso & Aparicio, 2019). Connectivity would allow new modes of presence with the forms of reality (AR and RM) supported by 5G networks in which man-machine interact and ways in which people experience the world are recreated (Adams et al., 2018). With this "extended reality", in addition to eliminating physical distances, developments such as the simulation of a 360-degree view of the environment are taken advantage of through 3D images that allow us to virtually experience global problems and generate actions against them (Craig & Georgieva, 2018).

Likewise, the possibility of supporting learning in developing countries is indicated, through collaborative telepresence and with the support of intelligent tutoring systems such as Computer Assisted Learning (Pedró, 2019; Nye, 2015), improving the capacities of educational actors, through "human intelligence augmented by AI", and "finding new solutions to old and new problems", based on a fairer and more efficient distribution of resources (Floridi et al., 2018, p. 693).

Finally, a "constructive interaction" is indicated with cultural transformation through "interactive robotics" aimed at fostering and promoting values of the environment, desirable and shared by its actors for the improvement of their social context (Toboso & Aparicio, 2019). Thus, the equity of educational systems is favored with the use of data (Pedró, 2019) and the adoption of principles of responsibility, choice and transparency in the development of equitable platforms and responsible algorithms (Telefónica, 2018). Hence, Stewart (2018) highlights ". . . excellent opportunities for developing countries to reduce the digital divide and create more inclusive societies" (p. 23).

The first contrast indicates new gaps of social, digital and robotics exclusion (*E*4I), which reflect inequalities of "access and use", as well as of "opportunities" (Toboso & Aparicio, 2019). In developing countries, these cracks widen due to their deficiencies in the number of devices and connectivity: in these countries more than half of their population is not connected (Telefónica, 2018). The risks are indicated both in lags in the teaching-learning processes (Zurutuza, 2018), and in the deprivation of new scenarios through extended realities (Munnerley et al., 2014).

Nye's review (2015) synthesizes obstacles to introducing AI systems in developing countries: availability of ICT hardware; electrical availability; internet reliability; data costs; training in basic ICT skills; language barrier; lack of culturally appropriate content. In addition, Zurutuza (2018) indicates that systemic problems of inequality in the distribution of sources and information are due to lack of infrastructure, inadequate content and prejudices motivated by ethnic and cultural origin, and also Adams et al. (2018) point out other barriers such as disproportion in socio-economic status, gender inequality and legislative decisions that hinder the arrival of innovations.

Consequently, the gap between educational institutions (Pedró, 2019; Beer, 2016) is also widening as a "key product of neoliberal production systems" under the parameters of utility (Feldman & Sandoval, 2018, p. 218) and with undifferentiated parameterization and classification policies. Likewise, the practices of data generation, collection and analysis subscribe to different classes and gaps between people, according to their means and functions: some with means to collect data, others with artifacts and experience to analyze them and set the rules for their access, and utility, and the latter who generate them and with minimal possibilities: "Thus new political, economic and social hierarchies are created . . . a rich big data and a poor big data" (Cotino, 2017, p. 138). The convergence of exclusion and inequity is focused on the "new outcasts" (Lerman, 2013) identified with millions of people who remain on the periphery of big data.

Finally, research shows discrimination and inequity in the configuration of algorithms for access to education, with gender biases in the creation of profiles (Sebastian & Richards, 2017) and with forms of harassment by their creators that impact personal emotions (Craig & Georgieva, 2018). In this area, Stewart (2018, p. 23) refers to the data and algorithms to select characteristics and configure models with codes that can integrate "implicit and unconscious prejudices of their human creators".

The Montreal Declaration (2018) and Floridi et al. (2018) open the fourth (*A*4I) analogy: contribute to the strengthening of a just and equitable society by guaranteeing access for all to knowledge, fundamental resources, and AI developments. Another balance is drawn between the integration of these developments into education and the opportunity they offer to transform culture with educational values such as inclusion and justice. This transformation indicates a design of the so-called "info sphere" with developments whose priority values are formative and are aimed at improving society (Floridi, 2018).

The closure of this analogy indicates an equitable and inclusive access to developments such as telepresence robotics that would allow students with special needs to attend the classroom, maintain the continuity of their learning (Pedró, 2019), as well as opportunities for learning and learning. research through augmented and mixed realities, which allow educational actors to be involved in "a conversation about a very different world, one that moves from the information age to the experience era" (Craig & Georgieva, 2018).

AI and comprehensive training: (U5F) versus superficiality (E5F) and skills (A5F)

The latest univocal sources indicate possibilities to strengthen other pillars: knowing, doing and living together (U5F). Some authors focus on the potential of AI to innovate cognitive theories and approaches with the centrality of active learning (Popenici & Kerr, 2017), as well as to increase and enrich the classroom, with the consequent opportunities for multiple and flexible learning (Munnerley et al., 2014). Pedró (2019) refers to benefits for collaborative learning through machine learning and word processing systems, which make it possible to create asynchronous discussion groups, interconnect educational actors and monitor the information about their discussions and the guidance of their participation and learning. This is the case of the collaborator, Computer Science, which monitors the collaborative behavior of students, leads them towards a more productive attitude by detecting moments in which their participation decreased and uses tactics to integrate them again (Howard et al., 2017).

For autonomous learning, extended reality allows the student to play the role of co-creator of mixed environments and strengthen their learning, through stimuli and interactions with virtual reality experiences, which induce brain responses similar to those produced with events in the physical world (Adams et al., 2018). Likewise, personalized learning is strengthened with adaptive experiences through systems that monitor their progress, personalize and modify their learning paths, based on data and with analytical technologies.

These adaptive learning systems are adjusted to the level and type of content, according to the student's achievement of skills (Adams et al., 2018), as well as to the various learning styles and multiple intelligences, with the increase of factors of interest, attraction and flexibility in times and places (Munnerley et al., 2014). Within the framework of developments to personalize teaching processes (Campos & Lastória, 2020), one of these systems, Intelligence Computer Assisted Instruction, is based on constructive learning theory and establishes a personalized cognitive model that determines the progress and mastery of contents, in addition to analyzing, deciding and building a learning strategy adapted to the student (Huang & Chen, 2016).

Another development of "symbiosis" between human-machine is the cooperative system of

Walsh et al. (2017) in which "human-learner" and "machine-learner" benefit from an effective and efficient learning environment, with cognitive and affective results, through machine learning adapted to both. In problematic cases, "apprentice-machine" presents corrective material for human progress. Other systems strengthen argumentative skills for writing: While the automated punctuation system analyzes linguistic and structural aspects of writing (Perin & Lauterbach, 2018), the System for the evaluation of arguments identifies the level of argumentation in paragraphs and suggests recommendations to improve the argumentation in the formulations and final reports of the projects (García et al., 2018).

Finally, other sources converge on benefits for knowing and doing in a 4.0 world or computational thinking. Yadav et al. (2016, p. 1052) refer that while for the Royal Society (2012) computational thinking is a "process of recognizing aspects of computing" and "applying computer tools and techniques to understand and reason about natural and artificial processes and systems", Barr and Stephenson (2011) concretize it in nine aspects: data collection, analysis and representation, problem decomposition, abstraction, algorithms and procedures, automation, parallelization, and simulation. For its strengthening, Learning Analytics are developed, determined as disciplines aimed at improving teaching-learning processes, through data analysis and generation of patterns to characterize habits, predict responses and provide comments (Pedró, 2019), or as computational techniques for pedagogical interventions to support learning, through data: capture, report, prediction, action and refinement (Umer et al., 2017).

In contrast, misleading voices indicate risks for knowing, doing and living together (*E*5F): with the automation of information and content, teaching-learning practices could be reduced to automatic forms of delivery, control and evaluation of content that comply with formats and standards (Popenici & Kerr, 2017), condition learning skills inside and outside the classroom (Campos & Lastória, 2020), to the detriment of the construction of knowledge that links environments and experiences of educational actors. Likewise, risks are indicated if teaching practices are promoted without "rigorous evaluations" (Pedró, 2019, p. 28) and academic and research tasks based on superficial, automatic and immediate information offered by some systems.

In addition, automation can undermine creativity, a cornerstone of know-how. This risk is proportional between the roles delegated to the systems and those diminished to the educational actors, who should be subject to supervision and human choice (Floridi et al., 2018). The automation of these functions would cloud the development of "creativity, initiative and entrepreneurial spirit" (Popenici & Kerr, 2017, p. 4), it would interfere, redefine and dilute the artist's intentions in the creative process (Venancio, 2019), it would reduce the training to automated, measurable and exploitable skills by the market, and the education to the production and increase of labor: a task, a profession and a means oriented to a fiscal purpose "where the acquisition of knowledge is a way for the reproduction and economic advance "(Feldman & Sandoval, 2018, p. 218), contrary to an education focused on what it means to be, human (Zovko & Dillon, 2018).

Finally, experiences without interpersonal ties incubated by technological developments that hinder the formation of knowing how to live, the strengthening of community values and the development of common spaces of experience are indicated (Marín, 2018). The dialectic between crowd-loneliness, in which individuals wander, generated the *hikikomori* phenomenon, characterized by the abandonment of social interactions to take refuge in technologies, through which a virtual relationship with the outside world is established (De la Calle Real & Muñoz Algar, 2018; Sánchez, 2017). In this case, interaction, growth and coexistence between educational actors is at risk, since now there is only a coexistence between "phantasmagoric entities" (Lanier, 2018) or between fictitious profiles, created to show what one is not, which redounds on the platforms. Isolation and loneliness grows, to the detriment of learning communities, necessary for development in educational settings.

The last analogy draws a balance between strengthening computational thinking and automating educational practices (*A*5H). Walsh et al. (2017) point out the machine-human interaction with multidisciplinary approaches, which allow a balance between human learning and the impacts of machine learning on the student. This "symphony of the system" needs a simultaneous integration and evaluation between theories of cognitive science, education and computer science. Thus, for a balanced machine-human interaction or smart-intelligence, it is a priority to strengthen human intelligence in decision-making and computational skills, with the potential of AI systems (Baker, 2019).

Discussion

The first aspect to discuss is the commitment to a humanistic education that integrates AI developments, not reduced to a "technology-focused solution", but rather considers its usefulness to make us more human (Popenici & Kerr, 2017), which consolidate its wisdom dimension to deepen the sense of the human (Floridi, 2018; Postigo, 2018) and to take care of human and social sustainability with a guarantee of access and equity.

A second point is drawn as a necessity: mutual understanding between education and AI developments. It should start with the mutual recognition of possibilities, continue with the aspects that should be strengthened to improve their relationship and the risks that could affect them, and culminate with the potentialities that should converge in the integral well-being, the quality of life of the people and their environments. This understanding would determine mutual benefits: the contribution of AI systems with the improvement of education and computational skills would strengthen the creation of innovative AI developments.

The third aspect is a challenge. For those who develop AI systems: a greater knowledge of the human and educational practices oriented to integral development, which exceed information, data collection and analysis. To educational actors: overcome the "character of mass consumption in the midst of academic capitalism" (Brunner et al., 2019, p. 132), get out of the bubble and rethink some of their timid and past anchored theories and practices with the call for innovation (Freire, 2017), strengthen skills that cannot be replaced by machines and take better advantage of AI developments.

Lastly, the integration of education-AI, humanism-AI is considered: articulating practices and potentialities. A "robot-proof" education (Aoun, 2017) should not fill minds with scientific advances, but rather enhance the creative mindset and mental elasticity in order to innovate in favor of society, for which new literacies must be integrated: of data, to manage them; technological, to know how machines work; human, humanics, to understand what it means to be, human. The purpose of AI-education should be the integral well-being of the human, a revolutionary process in the daily life of educational actors supporting their objectives and practices (Roll & Wylie, 2016) with the ability not to "engulf", but to "integrate" with the human to become part of it, seek its growth and dignify its bodily, spiritual and social dimensions (Torcal, 2018).

Conclusions

The findings indicate possibilities for AI systems to strengthen educational purposes, starting with a greater guarantee of access and equity, made possible by their innovative developments. In addition, with automation, integration and interaction with AI systems, there are opportunities to improve some educational practices. However, they warn about risks for the objectives of education, associated with a commercialization of education and its consequences in terms of exclusion and inequity,

the possible manipulation and governance that would hinder processes of autonomy and freedom, and the risk of reconfiguration of the human with dark values, by those who configure these systems.

The possibility of an analog hermeneutic in relation to the impacts of AI systems on educational practices and actors, still remains open because a fully developed AI does not yet exist (Perez et al., 2017), since the scope These developments cannot yet be fully measured in terms of charity or slander for the human. Hence, many authors and institutions rather pose challenges, some of which can be taken as conclusions: a comprehensive public policy on AI for sustainable development; ensure inclusion and equity in AI in education; prepare teachers for AI-based education and prepare AI to understand education; develop inclusive and quality data systems; make research on AI in education meaningful (Pedró, 2019, p. 26).

Some of the sources are aimed both at those who develop AI systems and at educational actors to interact and take advantage of the opportunities of these developments, while minimizing their risks in order to improve human life and social environments (Telefónica, 2018; Floridi et al., 2018). Likewise, promote these systems for the benefit of the human and professional development of educational actors and avoid the extremes of over or under using them, of under or overvaluing them.

Challenges are opened to the objectives of education as innovations in AI developments advance, which open the article to new inquiries: soft skills and abilities and AI systems; educational theories and AI developments; AI systems adapted to particular educational settings; configuration of humanistic values in AI systems.

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Note on authorship

Hernando Barrios-Tao: article idea; analog revision and interpretation; writing; discussion and final editing. Vianney Díaz: revision and univocal themes; thematic base; writing; discussion. Yolanda M. Guerra: revision and misleading topics; writing; discussion and final editing.

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The data underlying the research text are reported in the article.

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