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ARTICLE

AI AND BILINGUAL EDUCATION FRAMED WITHIN SIGNIFICANT LEARNING: A CRITICAL REFLECTION[1]

IA E A EDUCAÇÃO BILÍNGUE NO MODELO DE APRENDIZAGEM SIGNIFICATIVA: UMA REFLEXÃO CRÍTICA

IA Y EDUCACIÓN BILINGÜE EN EL MARCO DEL APRENDIZAJE SIGNIFICATIVO: UNA REFLEXIÓN CRÍTICA

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ABSTRACT:
Artificial Intelligence (AI) plays an increasingly significant role in education, particularly in the Bilingual Education Teaching Program (UBETP). This literature-based reflection reviews and analyzes the role that AI plays in education through the lens of the Significant Learning model proposed by Dee Fink. This model, in turn, is part of the institutional pedagogical philosophy. The review was conducted across five databases: Redalyc, Scielo, Proquest, Science Direct, and Eric, identifying three key areas where AI has an influence: autonomous learning, administrative processes, and instructional support. However, it also addresses concerns regarding equity, transparency, and teacher autonomy, as AI systems can perpetuate biases and limit educators' autonomy. While AI effectively contributes to information assimilation and cognitive interaction, it is less effective in facilitating reflective and emotional processes, essential for comprehensive education. Therefore, AI should be considered a complement to traditional methods, not its replacement.
Keywords: artificial intelligence; bilingualism; bilingual education; higher education; instruction; learning.
RESUMO:
A Inteligência Artificial (IA) desempenha um papel cada vez mais relevante na educação, particularmente no Programa de Ensino de Educação Bilíngue (UBETP). Esta reflexão, baseada em uma revisão de literatura, analisa o impacto da IA na educação através do modelo de Aprendizagem Significativa proposto por Dee Fink, o qual faz parte da filosofia pedagógica institucional. A revisão foi realizada em cinco bases de dados: Redalyc, Scielo, Proquest, Science Direct e Eric, identificando três áreas-chave de influência da IA: aprendizagem autônoma, processos administrativos e apoio à instrução. No entanto, surgem preocupações

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relacionadas à equidade, transparência e autonomia docente, pois os sistemas de IA podem perpetuar vieses e limitar a autonomia dos educadores. Embora a IA contribua de maneira eficaz para a assimilação de informações e a interação cognitiva, ela é menos eficiente na mediação de processos reflexivos e emocionais, que são fundamentais para uma educação integral. Por isso, a IA deve ser considerada um complemento aos métodos tradicionais, e não um substituto.
Palavras-chave: inteligência artificial; bilinguismo; educação bilíngue; ensino superior; instrução; aprendizagem.
RESUMEN:
La Inteligencia Artificial (IA) desempeña un papel cada vez más relevante en la educación, particularmente en el Programa de Enseñanza de Educación Bilingüe (UBETP). Esta reflexión, basada en una revisión de la literatura, analiza el impacto de la IA en la educación a través del modelo de Aprendizaje Significativo propuesto por Dee Fink, el cual forma parte de la filosofía pedagógica institucional. La revisión se realizó en cinco bases de datos: Redalyc, Scielo, Proquest, Science Direct y Eric, identificando tres áreas clave de influencia de la IA: el aprendizaje autónomo, los procesos administrativos y el apoyo a la instrucción. No obstante, surgen preocupaciones relacionadas con la equidad, la transparencia y la autonomía docente, dado que los sistemas de IA pueden perpetuar sesgos y limitar la autonomía de los docentes. Si bien la IA aporta de manera eficaz a la asimilación de información y la interacción cognitiva, no es tan eficaz en la mediación de procesos reflexivos y emocionales, fundamentales para una educación integral. Por ello, la IA debe considerarse como un complemento a los métodos tradicionales, y no como un reemplazo.
Palabras clave: inteligencia artificial; bilingüismo; educación bilingüe; educación superior; instrucción; aprendizaje

Introduction

Artificial Intelligence (AI) has captivated as much interest as it has raised concerns across various domains of human life (Jantakun, Jantakun and Jantakoon, 2021; Poola, 2017). While AI offers promising benefits such as automation, behavioral prediction, personalization of products and services, and enhanced data management and analysis, it simultaneously raises significant ethical issues related to data privacy, authorship, and the reliability and trustworthiness of information (Dignum, 2021; Tapalova and Zhiyenbayeva, 2022). The implications of these issues are heavily contingent upon the conceptualization and application of AI. In the realm of social media, for instance, platforms such as TikTok, Instagram, and YouTube, AI algorithms analyze extensive patterns of user behavior to predict, personalize, and tailor content delivery (Kuehn, 2020). Even when such functions are entertaining and of interest to users, the private aspects of human life could unwillingly enter the public domain.

Landing on the specific field of education, AI applications range from the basic automation of teaching, evaluation, and learning processes through platforms like Moodle, Blackboard, and BrightSpace (Aldiab *et al*., 2019; Keleş and Özel, 2016; Yamani, Alharthi and Smirani, 2022) to more sophisticated adaptive and responsive systems such as ALEKS,

Knewton, and ClassCraft (Annuš, 2024; Flogie and Aberšek, 2022; Ouyang and Jiao, 2021). It is argued that the aforementioned functionalities are made possible as a result of the evolution that machines and technology have undergone so as to acquire *learning capabilitie*s, transforming and being transformed by human knowledge, communities, and strategies for knowledge construction and exchange (Kaur, 2021). This, in turn, adds new levels of complexity to the concepts of 'knowledge' and 'knowing' within the learning processes that machines undergo and what they, subsequently, contribute to human learning (Markauskaite *et al.*, 2022; McIver *et al*., 2013). In such a light, we embark in a literature-based reflection on what AI has been and could potentially come to mean for the educational context in which we are immersed. Specifically, these reflections are contextualized within the field of foreign and second language education in the Undergraduate Bilingual Education Teaching Program (UBETP) in accordance with the significant learning dimensions outlined by Fink (2013) which constitute the core principles of our pedagogical philosophy. This article holds that knowledge construction, learning, and knowing inherently involve a multiplicity of interconnected human dimensions and social domains. In this context, AI has the potential to enhance those aspects of learning that are more closely aligned with objective, formulaic tasks. However, it may prove less effective in addressing tasks grounded in subjectivity, where human interpretation and emotional nuance play a central role.

Methodology

The review of the literature for this reflection took Ridley (2012) as referent, and it was systematically conducted across five databases. The initial two databases, Redalyc and Scielo, were selected due to their focus on disseminating research pertinent to the Iberian and Latin American contexts. The subsequent three databases—Eric, Science Direct, and ProQuest—were chosen for their specialized content in educational research.

The search strategies encompassed a range of word combinations involving AI and education, including AI and learning, AI and instruction, and AI and bilingualism, among others. In contrast to conventional literature reviews, this study sought to identify key arguments to integrate them with the lived experiences within our UBETP, as well as to examine the potential effect of AI on our teaching practices. Out of three literature review categories outlined in Ridley (2012), this closely resembles a descriptive and topic-based review that illustrates the main arguments regarding the use of AI bringing them into dialogue

with our most immediate context. We included articles in Spanish and English as those are the languages that we speak and can academically comprehend. Additionally, we only used peer-reviewed articles published in academic and scientific journals within the past ten years. We also used theory that does not come from research within the aforementioned parameters, but that represents fundamental conceptualizations or ground underpinnings at the heart of this paper.

In so doing, we identified three principal domains where AI has been significantly influential in education. We then categorized, organized, and analyzed the arguments presented in the literature, including both explicit and implicit arguments, to construct our own perspectives within these domains. Adopting a critical approach, we addressed various concerns related to AI in the educational sphere.

Subsequently, we discussed the teaching and learning philosophy of the University to evaluate the affordances and limitations of AI within the context of the UBETP. This analysis aimed to contribute to the ongoing debate on AI in education while situating it within the specific context and practices in the program, exploring advantages, disadvantages, and potential in the field.

Three Significant Domains of AI in Education

In the wide-ranging educational endeavors, AI can generally be categorized in three broad areas it commonly serves. The first one is the software and/or technological devices that offer students support in independent learning tasks or self-directed learning activities. The second is related to those that provide support to administrative processes in education, and that could very well be at the classroom or the institution level. Finally, the third one is related to all those technological features that facilitate teaching-related actions such as instruction, evaluation, and feedback (Fahimirad and Kotamjani, 2018; Jantakun, Jantakun and Jantakoon, 2021).

The first group can be exemplified with the Duolingo application, which offers personalized activities, sequences of didactic units, and opportunities for students to grapple with English language content in order to develop communicative competence at their own rate and in their own time and manner. In direct association to such an example, we could definitely mention an initial step that the UBETP took toward the use of basic forms of AI, where the faculty guided the students through the use of the Corpus of Contemporary American English (COCA) to support the students' own learning and acquisition of the foreign language in its

multiplicity of domains. COCA offered a vast inventory of English language samples, grouped into patterns according to the genre where a word, word combination, expression, and language in general, could most commonly be found. In other words, the platform categorized patterns of language into their most common social context of use. For example, this resource could show that the expression 'you know…' has a significantly higher frequency of use in spoken conversational English than in academic texts. The students, then, used the platform to inquire about the appropriateness of language chunks in order to accomplish different functions in their spoken and written production. This also allowed them to implement metacognitive strategies for their own grammatical, lexical, and even pragmatic competences, as well as to design and apply strategies for self monitoring, self evaluation, and self correction (Escobar-Alméciga, 2015a; 2015b).

In the second group and at the classroom level, we can find the illustrative case of the Turnitin software. This resource is commonly used to identify instances in which text is found in multiple locations, facilitating an analysis on plagiarism. The software may be employed by itself as a stand-alone tool, and it can also be embedded in virtual learning spaces to provide an immediate report on the probability that a paper that is being submitted may contain information from other authors and allow students and professors to run the corresponding analysis and take the necessary correcting measures. Another example of this group may be the software used for the automation of the construction of bibliographical information which, fifteen years ago, a writer had to do manually, but today, writers can rely on reference manager systems to produced, in an automatized manner, reference lists simultaneously as the author advances in their writing process for things like the thesis manuscript and article writing. At the institutional level, an example can be the facial recognition software that automates the clearance for access of people to the buildings and improves the incoming and ongoing flow of persons into the institution, keeping a high-standard level of security.

The third and, probably, the most relevant group for the educational process, can be exemplified with the virtual platforms that the UBETP uses for the English component as well as the one used to support the content courses. The platform used for the English levels enables the creation of immersive learning experiences, where users engage interactively with materials through speaking, grammar, reading, and listening comprehension activities that offer automated feedback. Even further, there is an integrated, standardized exam which is focused on assessing the proficiency level according to the Common European Framework of Reference (CEFR). As the exam unfolds, it offers detailed, real-time feedback on each of the mentioned abilities, aiding test-takers in effectively evaluating their own performance. It provides

recommendations for students to advance their processes stimulating their self monitoring, metacognitive awareness, adaptability, and agency in the learning endeavor (Arora, 2021; Baleja, 2024; García-Peñalvo, Llorens-Largo and Vidal, 2023; Tapalova and Zhiyenbayeva, 2022).

AI can adjust educational content and learning activities to the specific needs of individual learners, delivering a personalized approach to learning based on data patterns identified about the user (Bonami, Piazentin and Dala-Possa, 2020). It can even create exciting scenarios for students to immerse themselves and act and interact with simulated places, peoples and environments that resemble or create a content-related reality (García-Peñalvo, Llorens-Largo and Vidal, 2023). Such an adaptability also extends to different learning paces, in which AI-driven platforms can customize teaching materials and strategies based on each student's background, traceable performance, and interests to individual speeds (Flores *et al*., 2022). As AI provides data-driven and real-time feedback, it contributes to the creation of responsive teaching-learning environments which are essential in monitoring student's performance and in dynamically adjust teaching strategies to meet students' emerging needs (Flores *et al*., 2022; Liu, Zhang and Biebricher, 2024; Verma *et al*., 2023).

Today, digital learning environments incorporate AI that simulate human intelligence and enable complex decision-making scenarios through predictive analytics, adaptive, creative, and interactive developments. Intelligent tutoring systems and adaptive learning platforms exemplify the potential of AI in leveraging comprehensive student and course-related data to personalize educational content, activities, strategies, and learning outcomes. Such systems enable the creation and/or support of individualized learning pathways (Baleja, 2024; Tapalova and Zhiyenbayeva, 2022). In the pursuit of such personalized teaching-learning paths, our University implemented a sophisticated software system that collects extensive data from companies, institutions, and organizations across diverse sectors. This data collection focuses on identifying specific professional, personal, and specialized traits that are desirable for particular positions in organizations. The software processes this data to generate organized profiles that not only reflect current job market trends but also highlight the key attributes essential for attaining desired positions and to perform at high quality standards in them. Furthermore, the software integrates a tutoring system designed to assist students and alumni in developing competencies that will optimally prepare them for professional success. In this quest, AI is transforming the educational environment by personalizing the learning experience in direct connection with real-life tendencies (Bonami, Piazentin and Dala-Possa, 2020; Saleh, 2019). AI, in this case, also proves to be highly valuable in the development and refinement of

educational programs and the internal organization of courses. It enhances the collection and analysis of data and facilitates the design and implementation of AI-driven educational technologies, which are aimed at aligning student learning outcomes with actual demands of society at large.

AI-driven simulations and personalized learning experiences offer students the opportunity to engage with complex problems and devise or grapple with potential effective solutions (Benvenuti *et al*., 2023; Ocaña-Fernández, Valenzuela-Fernández and Garro-Aburto, 2019). Recognizing the role of AI in fostering these competencies is crucial, as it empowers students to confront and overcome various challenges in ways that are situated, recreated, and meaningful and that, at the same time, assist the teacher with didactic-related work. That is, the integration of AI into educational practices supports educators in nurturing environments that extend beyond immediate learning opportunities. Such environments not only provide on-the-spot emerging educational experiences, but also inspire students to take ownership of an ongoing learning journey throughout their lives.

The integration of AI into education warrants critical examination, however, as it is not without its concerns. There are significant issues related to the potential that AI has in perpetuating inequities, fostering overgeneralizations, and creating ambiguity. It also presents concerns regarding the commercialization of education, a decline in teacher autonomy, and privacy implications (Davies, Eynon and Salveson, 2021; Gillani *et al*., 2023; Woolf; Lane; Chaudhri; Kolodner, 2013). Given that AI systems rely on extensive datasets derived from the general public, there is a risk that these technologies may exacerbate common beliefs and stereotypes, for instance, disproportionately misrepresenting the realities of certain demographic groups and, even, the demographic groups themselves.

Khan (2023) contends that the use of AI in education can lead to discriminatory outcomes, disproportionately impacting marginalized groups such as students from low-income families, ethnic minorities, and individuals with disabilities. Gillani *et al*. (2023) further illustrate that predictive models designed to evaluate student performance may unjustly categorize disadvantaged students as "at risk," potentially resulting in inappropriate or detrimental interventions. Such models often replicate historical data patterns reinforcing and legitimizing existing inequities within educational systems rather than addressing and amending them. This issue is particularly concerning given that AI systems are frequently implemented at scale, meaning that algorithms affecting thousands of students simultaneously could lead to inequitable grading practices and unequal resource distribution. This underscores

the need for ongoing scrutiny of AI systems to ensure they do not exacerbate social unfairness in education

In terms of transparency, Gillani, Eynon, Chiabaut and Finkel (2023) coined the term "black box" problem to explain that AI systems, particularly those based on neural networks, operate in ways that are difficult to understand, making it unclear how they process information and arrive at particular decisions. This lack of transparency may cause educators to blindly trust AI outcomes, which could fail and lead to flawed interventions. Moreover, AI frequently encounters difficulties in generalizing across diverse educational contexts. As Davies, Eynon and Salveson (2021) highlight, models developed in well-resourced urban schools may exhibit suboptimal performance when applied to rural or underfunded educational settings complicating the reliability of AI systems across varying contexts. This lack of adaptability has the potential of aggravating educational disparities, benefiting certain students while disadvantaging others. The issue of transparency also extends to the users of AI systems and their claims regarding the technology's outputs in relation to their own. In our educational setting, for example, we faced the challenge of determining whether a text was authored by a student or generated by AI. This complexity prompted a revision of our practices, leading us to revert to traditional methods, such as requiring students to produce handwritten texts on-site using paper and pencil. This adjustment was made to address the challenges posed by AI-generated content and ensure the authenticity of students' work. The issues of transparency highlight the need for AI systems in education to be designed with clarity and contextual sensitivity to avoid reinforcing inequalities or to compromise academic integrity.

Privacy is, yet, an additional concern regarding the use of AI systems in educational settings. Educational institutions may, under a profit-driven model, engage in data collection practices that compromise both educational integrity and personal information security. As discussed in Davies, Eynon and Salveson (2021), market-driven approaches often emphasize cost-efficiency over the well-being and equitable treatment of students and teachers. AI-driven surveillance in educational environments, for instance, can lead to intrusive monitoring of students, educators, and the broader community, potentially inducing anxiety and stress. To further muddy the waters, the use of AI for creative tasks such as writing assignments undermines the educational purpose of fostering independent work and creativity and could progressively deteriorate the abilities underlying such production (Gillani *et al*., 2023).

The increasing integration of AI into educational practices may also have implications for teachers' professional performance over time. As AI assumes an expanding range of instructional responsibilities, including grading, providing feedback, and designing standard

learning activities, it could potentially reduce teachers' autonomy, creativity, and academic authority. Zhai *et al*. (2021) caution that excessive reliance on AI may lead educators to shift from their role as pedagogical experts to that of mere facilitators managing the procedural aspects of instruction. This transition could undermine teachers' capacity to develop pedagogical strategies that address the specific needs of their students and the unique characteristics of the educational context. Furthermore, overly depending on AI might centralize the control of didactic and assessment resource design, resulting in standardized methods that overshadow individual learning styles. This shift could compromise the flexibility, adaptability, and creativity essential for effective instructional design, and consequently, impact the ability of catering to diverse educational needs. That is, excessive dependence on AI could compromise the effectiveness of autonomous teaching and learning approaches, which are crucial for accommodating diversity and uniqueness in education.

At the institutional level, while AI is frequently promoted as a tool to alleviate teacher workloads or to enhance student outcomes through innovative approaches to class instruction and to learning, its underlying objective may instead be to project a marketable image or to reduce operational costs, rather than genuinely advancing educational quality (Davies, Eynon and Salveson, 2021). With that being said, Zhai *et al*. (2021) argue that AI is often promoted as a fast technological fix for diverse educational challenges, but this approach risks oversimplifying complex issues and prioritizing financial savings for institutions over genuine improvements in education. In addition, Davies, Eynon and Salveson (2021) points that companies that produce AI educational tools, focused on profit, often influence policy decisions, prioritizing cost-effective solutions over those that improve student learning. Such an approach may hinder the improvement of teaching and learning experiences where these technologies could contribute to educational enhancement. In other words, while AI can potentially enrich education, its current state often focuses on financial and institutional concerns over significant improvements in teaching and learning experiences, which limits the true educational potential of AI.

In summary, AI has great potential to transform education by enhancing learning experiences, supporting administrative tasks and teaching processes. However, its implementation must be approached with caution; the aforementioned benefits of AI may help create more responsive and dynamic educational environments for students and teachers. There may be significant concerns regarding fairness, transparency, privacy, and the potential of relinquishing teacher autonomy, nonetheless. As AI continues to develop in education, it is important to maintain a critical perspective and ensure that its integration prioritizes meaningful

improvements in education, rather than commercial or institutional interests. The true value of AI in education will depend on how such issues are addressed.

Framing AI within our Institution's Pedagogical Philosophy

Nearly two decades ago, our university recognized the necessity of grounding its pedagogical decisions and practices within a comprehensive teaching-learning paradigm. Following extensive deliberation and considerable effort, the institution chose to frame its pedagogical approach within the Significant Learning Model as articulated by Fink (2013). Fink's model, which builds upon and extends Bloom *et al*. (1956) taxonomy, encompasses a broader spectrum of human experiences that influence teaching and learning, and is better aligned with the University's organizational culture and identity.

Originally, Bloom's taxonomy presented a hierarchical framework for cognitive processes departing from fundamental activities like retention and comprehension of information, to, then, extend it to more complex cognitive tasks like application, analysis, synthesis, and evaluation. This hierarchical structure was designed in a way that each level builds upon the previous ones, illustrating progression to higher-order cognitive skills (Forehand, 2010).

In harmony with Bloom's, the model proposed by Fink (2013) extends the framework by incorporating additional human dimensions of learning and, thus, providing a more contextually nuanced and socially relevant pedagogical approach for the institution conducive to significant learning. This model does not focus exclusively on the levels of complexity in learning but rather adopts a multidimensional methodology that allows the University to recognize students' learning as a process that involves their social, emotional, as well as their intellectual attributes. It also incorporates the development of critical thinking, socially edifying attitudes, and value-centric teaching practices viewing learning as a network of interconnected synergies, which are meant to respond to individual and contextual needs. This approach aims to enhance students' effectiveness in their actions, interactions, and responses to social demands.

With this in mind, Fink incorporated factors of learning like the human dimension, integration, application, foundational knowledge, caring, and learning to learn. These, in turn, introduced other working elements like "metacognition, ethics, leadership and interpersonal skills, communication skills, tolerance, character and adapting to change" (Irvine, 2021, p. 10). The contrast between the two frameworks highlights the additions with which Fink's model

extended Bloom's conceptualization integrating new items related to the Human Dimension and to Caring. Additionally, from a significant learning perspective, Fink (2013) recognized cognition as a multidimensional, interactive, and socially-dependent process where change in the individual–-in one or more of their dimensions–was expected to occur.

Fink's model falls within the constructivist paradigm, which posits that knowledge is neither fixed nor static, but it is continuously evolving through social processes. According to this perspective, knowledge results from dynamic interactions within educational environments, where it is perpetually shaped and reshaped through social engagements and the opportunities afforded to the learner to take an active part of social exchange. Constructivism asserts that knowledge emerges through dialectical interactions involving a diverse array of thoughts, emotions, ideologies, identities, and cultures, each exerting influence on those of others around.

Consistently, Tsulaia (2023) explains that constructivism views learning as an active process where learners build knowledge through social engagement, rather than merely the acquisition of data. This process involves discussion, inquiry, and practical application, collectively grappling with information with meaningful relevance. Contrary to other approaches where knowledge is frequently associated solely with rational cognition, Scheg (2015), within the constructivist paradigm, places reason and emotion in a complementary interplay and at the core of individual and collective learning.

Having offered our epistemological commitment to knowledge, learning, and knowing, we can now venture into a discussion on the ways in which AI might have a place within the teaching and learning processes as collectively conceived in our institution. (For additional details on the dimensions addressed in Fink's framework (see figure 1).

Table 1 - Dimensions of Fink's significant learning

Dimension	**Explanation**
Learning to Learn	This refers to the capacity for self-directed learning and effective management of knowledge and information to engage in self-taught learning.
Fundamental Knowledge	This dimension involves processes such as understanding and recalling concepts.
Application	This pertains to the development of critical and creative thinking skills necessary for problem-solving and the opportunities given for the students to apply it.
Integration	This dimension focuses on establishing of interdisciplinary connections that relate academic knowledge to real-world contexts.

Caring	This involves enhancing the personal learning process to foster successful engagement and achievement
Human dimension	This refers to the process of learning about oneself and others and ways of coexisting in faction of the collective pursuits

Source: Prepared by the authors, based on Fink (2013, p. 35) and Branzetti *et al*. (2019, p. 469).

These dimensions are not to be understood as isolated entities; rather, they are conceived as components that stimulate an interplay of interconnections creating a fluid network of synergies among them, which may be conducive to the negotiation, creation, and appropriation of knowledge and its application, and hence, to learning –figure 1.

Figure 1 - Interconnected dimension as per Fink's taxonomy.

Source: Fink (2013)

In Fink's framework, learning is conceived as a subjective process that engages the individual holistically, integrating the various domains of knowledge construction. This approach requires diverse forms of interaction with information to populate it with meaning and applicability, ultimately transforming it into knowledge. In contrast, AI primarily relies on extensive objective datasets, which may lack the capacity to in-and-of-itself establish "a set of instances and processes of meaning production, through which individuals and social collectives construct and act upon reality" (Torres-Carrillo, 2000, p.8). Bearing in mind that learning emerges from both objectivity and subjectivity, AI might potentially serve as a valuable tool for accessing and interacting with information (objectivity). However, for this information to contribute to meaningful learning, it must be grounded in human cognitive processes, which involve (inter)reasoning, (inter)feeling, (inter)acting, and (inter)representing (Escobar-Alméciga and Brutt-Griffler, 2022; Fink, 2013). These processes consolidate meaningful learning, engaging the individual in addition to the objective processes, in

subjective experiences. Thus, AI alone does not generate the type of subjective experiences that embody the human dimensions proposed by Fink for meaning-making, which should not suggest that they cannot support them.

In other words, some dimensions in Fink's Taxonomy can benefit significantly from AI, while those more closely tied to subjective experiences would still need to rely at a greater extent on human involvement. For example, the "fundamental knowledge" dimension, which focuses on the acquisition of concepts, can be effectively supported by AI through tasks such as information retrieval. However, the "human dimension", which has to do with self-awareness and empathy towards others, being intrinsically linked to human interaction, presents significant challenges for AI in generating reliable information and providing adequate support for such endeavors.

In the "Learning to Learn" dimension—which focuses on empowering learners to take ownership of their learning process—AI proves beneficial as it facilitates the personalization of resources and activities. Such customization supports both educators and students in creating educational practices tailored to individual needs, contexts, and interests, and ultimately enhancing their engagement in as well as outside the classroom and increasing their motivation (Del Puerto and Esteban, 2022; Norman-Acevedo, 2023).

In the context of the "Fundamental Knowledge" dimension, which refers to the processes of accessing and acquiring information, a relevant example includes virtual libraries such as Open Library and the Miguel de Cervantes Virtual Library. These platforms offer free access to extensive collections of information and online resources, often guided by AI-powered assistance. Additionally, virtually mediated courses provided by platforms such as Coursera, Platzi, and MasterClass illustrate how technological mediation facilitates learners' acquisition of fundamental knowledge across diverse disciplines. These emerging technologies serve as valuable tools that support individuals in both accessing and internalizing information, enhancing the overall learning experience.

In relation to the "Application" dimension, which focuses on the practical implementation of acquired knowledge, AI can facilitate the translation of theoretical knowledge into experiential practice. Tools such as AutoCAD and Revit, commonly used in design and architecture, enable the modeling of structures in two and three dimensions, providing reliable simulations for prototype creation, despite the absence of physical reality. In this way, AI enhances the application of knowledge by offering resources that simulate real-world phenomena, thereby enabling students to internalize and apply their learning in a practical context.

The "Integration" dimension deals with processes of emphasis, synthesis and, most importantly, connecting knowledge across disciplines. Here, AI plays a central role in creating and or facilitating opportunities for the learner to establish connections between prior and new knowledge and across different fields. Technological tools such as hypertexts, which link various texts through technological mediation (Landow, 2006), promote an interconnected perspective on information, and, in so doing, they foster interdisciplinarity and intertextuality. This technological mediation aids in drawing complex relationships among different topics and subjects, ensuring a more holistic appropriation of knowledge. In Narrative Hypermedia, for instance, users engage with a literary story that can simultaneously connect with fields such as history, economics, politics, and geography, illustrating how knowledge comes about from complex associations of the work of the learner.

In contrast, when addressing the "Human and Care" dimensions, AI's impact is significantly limited. According to Fink, the human dimension involves self-awareness and introspection, both of which are grounded in human metacognitive processes. Similarly, the care dimension is concerned with the development of new emotions, interests, and values, and requires experiential processes that are inherently human and cannot be effectively mediated by AI. These dimensions rely deeply on personal experiences and social exchange that AI falls short in replicating or facilitating.

To further complicate matters, when examining the relationship between AI and learning, significant distinctions between two critical concepts emerge 'information' versus 'knowledge'. Although these terms are frequently used interchangeably, scholarly discussions have emphasized the important differences between them. Information refers to raw, unprocessed data and it is typically associated with objectivity. Knowledge, while incorporating information, goes beyond that by involving, understanding, processing, and appropriating such information (Escobar-Alméciga Caviedes-Cadena; Benavides, 2024). This process of transforming information into knowledge is inherently subjective and populated with the learner's subjectivities in pursuit of relevant applications. As Ahenkorah-Marfo (2012) explains, "Information is what you get from different sources and later turned into knowledge" (p. 3).

Put differently, while AI functions as a valuable tool in supporting various dimensions of the significant learning taxonomy, it cannot substitute the reflective, applicative, emotional, and rational processes inherent to human cognition. Consequently, AI's role is more prominent in dimensions related to the acquisition, interaction, and integration of information within metacognitive activities. However, its impact is notably less pronounced in the dimensions of

human and care, which are associated with personal and social processes that are uniquely developed by individuals and social groups in time and through interactions.

Conclusions

Knowledge construction, learning, and knowing are inherently social practices that engage various human dimensions and social domains. These practices span a spectrum, with one end more closely aligned with objective, tangible aspects, while the other is more concerned with subjective, interpretative elements. In that sense, AI's affordances are more solidly associated to the objective and tangible end of the spectrum, requiring more human intervention in subjective, interpretative, metacognitive, and creative processes.

The integration of AI in education offers significant potential to transform the learning landscape by enhancing personalization, efficiency, and accessibility. AI-powered adaptive learning platforms support student autonomy by tailoring educational experiences to individual needs, fostering more engaged and self-directed learning. Through personalized designs, AI enables students to engage with activities suited to their learning paths, guiding them through tailored journeys that encourage greater ownership of their education. At the same time, AI-driven systems streamline administrative and instructional tasks, allowing educators to focus on higher-order functions such as critical thinking, emotional development, and creativity. This dynamic frees teachers to address more complex pedagogical challenges while AI handles routine processes, ultimately enhancing the overall educational experience by empowering learners and supporting educators in fostering deeper, more meaningful learning outcomes.

Despite the many advantages of AI in education, it is crucial to approach its use with a critical perspective. While AI excels in data-driven, objective tasks, it faces significant limitations in addressing the subjective and interpretive social dimensions of education, such as empathy, creativity, sensitivity, collaboration and ethical discernment. Furthermore, AI lacks the human qualities at the core of creation of inviting social climates that are conducive to collaboration, emotional engagement, and the holistic development of students (Escobar-Alméciga and Brutt-Griffler, 2022).

AI systems, which rely on large datasets, also risk perpetuating biases, raising concerns about equity, transparency, and teacher autonomy. These limitations underscore the need for a balanced approach, where AI serves as a complement to human judgment and interaction, rather than a replacement, ensuring that the educational experience remains rooted in the personal and social dimensions essential for meaningful learning.

Looking ahead, it is paramount to the integrity of education to prioritize the ethical considerations surrounding the integration of AI in teaching and learning, ensuring that these systems promote fairness, transparency, and empower both students and teachers in their educational contexts. As AI becomes more prevalent in educational settings, attention must be given to addressing issues of equity, bias, and privacy. These systems should not perpetuate existing asymmetrical access or diminish teacher autonomy, but rather serve to enhance educational practices by offering equitable, high-quality, and personalized learning opportunities. More significantly, AI should be viewed as a means to support educational goals, not as an end in itself. Its value lies in its ability to facilitate inclusive, human-centered learning environments that integrate both objective data-driven processes and the subjective, interpretive dimensions of education, such as creativity, empathy, and critical thinking. By focusing on AI as a tool to enhance rather than replace human interaction, we can ensure that it enriches the educational experience, contributing to a more holistic approach that supports meaningful engagement, personal growth, and social responsibility.

References

AHENKORAH-MARFO, Michael. Clarifying concepts of knowledge and information-literature review. **Journal of Knowledge Management Practice**, 2012. Available at https://journals.klalliance.org/index.php/JKMP/article/view/117. Access on: 03 Aug. 2024.

ALDIAB, Abdulaziz, CHOWDHURY, Harum.; KOOTSOUKOS, Alex, ALAM, Firoz, ALLHIBI, Hamed. Utilization of Learning Management Systems (LMSs) in higher education system: A case review for Saudi Arabia. **Energy Procedia**, v. 160, p. 731-737, 2019. DOI: 10.1016/j.egypro.2019.02.186.

ANNUŠ, Norbert. Educational software and artificial intelligence: students' experiences and innovative solutions. **Information Technologies and Learning Tools**, v. 101, n. 3, p. 200-226, 2024. DOI: 10.33407/itlt.v101i3.5479.

ARORA, Mani. Artificial Intelligence: New pathways and challenges in higher education. *In:* **Impact of AI Technologies on Teaching, Learning, and Research in Higher Education**. IGI Global, 2021. p. 30-48.

BALEJA, Katie. Exploring the Efficacy of Personalized Learning Pathways Utilizing Artificial Intelligence in Education. *In:* **Proceedings EdMedia+ Innovate Learning**. Association for the Advancement of Computing in Education (AACE), 2024. p. 157-161.

BENVENUTI, Martina; WRIGHT, Michelle; NASLUND, John; MIERS, Anne. How technology use is changing adolescents' behaviors and their social, physical, and cognitive development. **Curr Psychol**, v. 42, n.1 p. 16466–16469. 2023. DOI: https://doi.org/10.1007/s12144-023-04254-4

BLOOM, Benjamin; ENGELHART, Max; FURST, Edward; HILL, Walker; KRATHWOHL, David. (Eds.). **Taxonomy of educational objectives, The classification of educational goals, Handbook I:** Cognitive domain. New York: Longmans, 1956.

BONAMI, Beatrice; PIAZENTIN, Luiz; DALA-POSSA, André. Educación, Big Data e Inteligencia Artificial: metodologías mixtas en plataformas digitales. **Comunicar**: Revista Científica de Comunicación y Educación, n. 65, p. 43-52, 2020. Available at: https://www.revistacomunicar.com/index.php?contenido=detalles&numero=65&articulo=65-2020-04

BRANZETTI, Jeremy.; GISONDI, Michael.; HOPSON, Laura.; REGAN, Linda. Aiming beyond competent: the application of the taxonomy of significant learning to medical education. **Teaching and Learning in Medicine**, v. 31, n. 4, p. 466-478, 2019. DOI: https://doi.org/10.1080/10401334.2018.1561368

DAVIES, Huw; EYNON, Rebecca; SALVESON, Cory. **The Mobilisation of AI in Education:** A Bourdieusean Field Analysis. Sociology, v. 55, n. 3, p. 539-560, 2021. DOI: 10.1177/0038038520967888

DEL PUERTO, Desirée; ESTEBAN, Prudencia. La Inteligencia Artificial como recurso educativo durante la formación inicial del profesorado. **RIED-Revista Iberoamericana de Educación a Distancia**, v. 25, n. 2, p. 347-358, 2022. DOI: 10.5944/ried.25.2.32332

DIGNUM, Virginia. The role and challenges of education for responsible AI. London Review of Education, v. 19, n. 1, p. 1-11, 2021. DOI: 10.14324/lre.19.1.01

ESCOBAR-ALMÉCIGA, Wilder Exploring pragma-grammatical roles of 'Do' in EFL students' spoken production**.** *In:* ESCOBAR-ALMÉCIGA, Wilder; CASTAÑEDA-PEÑA, Harold (ed.). **Discourse analysis applied to English language teaching in Colombian contexts:** Theory and methods. Bogotá: Editorial Universidad El Bosque, 2015a.

ESCOBAR-ALMÉCIGA, Wilder. Language configurations of degree-related denotations in the spoken production of a group of Colombian EFL university students: A corpus-based study. **Colombian Applied Linguistics Journal**, v. 17, n. 1, p. 114-129, 2015b. DOI: 10.14483/udistrital.jour.calj.2015.1.a08

ESCOBAR-ALMÉCIGA, Wilder.; CAVIEDES-CADENA, Lorena.; BENAVIDES, Fabián. Navigating Complexity: Fostering inclusive social environments in bilingual education through multimodal communication. *In:* CARDOZO-GAIBISSO, Lourdes.; HARMAN, Ruth.; VAZQUEZ DOMINGUEZ, Max.; BUXTON, Cory. OREGON (ed.). **Pedagogies for Equitable Access.** Reimagining Multilingual Education for an Uncertain World. Information Age Publishing, 2024. p. 77-94.

ESCOBAR-ALMÉCIGA, Wilder; BRUTT-GRIFFLER, Janina. Multimodal Communication in an Early Childhood Bilingual Education Setting: A Social Semiotic Interaction Analysis**.** Íkala, **Revista De Lenguaje Y Cultura**, v. 27, n. 1, p. 84–104, 2022. DOI: 10.17533/udea.ikala.v27n1a05.

;FAHIMIRAD, Mehrnaz; KOTAMJANI, Sedigheh. A review on application of artificial intelligence in teaching and learning in educational contexts. **International Journal of Learning and Development**, v. 8, n. 4, p. 106-118, 2018. DOI: 10.5296/ijld.v8i4.14057

FINK, Dee. **Creating significant learning experiences:** An integrated approach to designing college courses. John Wiley & Sons, 2013.

FLOGIE, Andrej; ABERŠEK, Boris. **Artificial intelligence in education**. Active Learning-Theory and Practice, 2022.

FLORES, Fernando; CAPUÑAY SANCHEZ, Dulce; ESTELA URBINA, Ronald; VALLES CORAL, Miguel; VERGARA MEDRANO, Segundo; ELERA GONZALES, Durbeli. Inteligencia artificial en educación: una revisión de la literatura en revistas científicas internacionales. **Apuntes universitarios**, v. 12, n. 1, p. 353-372, 2022. DOI: 10.17162/au.v12i1.974.

FOREHAND, Mary. Bloom's taxonomy. **Emerging Perspectives on Learning, Teaching, and Technology**, v. 41, n. 4, p. 47-56, 2010. Available at: https://www.d41.org/cms/lib/IL01904672/Centricity/Domain/422/BloomsTaxonomy.pdf

GARCÍA-PEÑALVO, Francisco; LLORENS-LARGO, Faraón; VIDAL, Javier. La nueva realidad de la educación ante los avances de la inteligencia artificial generativa. **Revista Iberoamericana de Educación a Distancia (RIED)**, v. 27, n. 1, p. 9-39. 2024. DOI: 10.5944/ried.27.1

GILLANI, Nabeel; EYNON, Rebecca; CHIABAUT, Catherine; FINKEL, Kelsey. Unpacking the "Black Box" of AI in Education. **Educational Technology & Society**, v. 26, n. 1, p. 99–111, 2023. DOI: 10.48550/arXiv.2301.01602

IRVINE, Jeff. Taxonomies in education: Overview, comparison, and future directions. **Journal of Education and Development**, v. 5, n. 2, p. 1-25, 2021. DOI: https://doi.org/10.20849/jed.v5i2.898

JANTAKUN, Thiti; JANTAKUN, Kitsadaporn; JANTAKOON, Thada. A Common Framework for Artificial Intelligence in Higher Education (AAI-HE Mode). **International Education Studies**, v. 14, n. 11, p. 94-103, 2021. DOI: 10.5539/ies.v14n11p94

KAUR, Kashveenjit. Role of artificial intelligence in education: Peninsula College Central Malaysia. **International Journal of Academic Research in Progressive Education and Development**, v. 10, n. 2, p. 1006-1016, 2021.

KELEŞ, Mümine; ÖZEL, Selma. A Review of Distance Learning and Learning Management Systems. InTech, 2016. DOI: 10.5772/65222

KHAN, Suleman. The Ethical Imperative: Addressing Bias and Discrimination in AI Education. **International Journal of Education**, v. 13, n. 1, p. 47-58, 2023.

KUEHN, Katharina. Personalization 3.0: How Personality Can Predict Consumer Behavior. *In:* **Anthropological Approaches To Understanding Consumption Patterns And Consumer Behavior**. IGI Global. 2020, p. 22-50. DOI: 10.4018/978-1-7998-3115-0.ch002

LANDOW, George. **Hypertext 3.0: critical theory and new media in an era of globalization.** UK: Johns Hopkins UP, 2006.

LIU, Meilu; ZHANG, Lawrence; BIEBRICHER, Christine. Investigating students' cognitive processes in generative AI-assisted digital multimodal composing and traditional writing. **Computers & Education**, v. 211, n. 1, p. 1-21. 2024. DOI: 10.1016/j.compedu.2023.104977

MARKAUSKAITE, Lina; MARRONE, Rebecca; POQUET, Oleksandra; KNIGHT, Simon; MARTINEZ-MALDONADO, Roberto; HOWARD, Sarah; JO, Tondeur; DE LAAT Maarten; BUCKINGHAM SHUM, Simon; SIEMENS, George. Rethinking the entwinement between artificial intelligence and human learning: What capabilities do learners need for a world with AI? **Computers and Education:** Artificial Intelligence, v. 3, n. 1, p.1-16, 2022. DOI: 10.1016/j.caeai.2022.100056.

MCIVER, Derrick; LENGNICK-HALL, Cynthia; LENGNICK-HALL, Mark; RAMACHANDRAN, Indu. Integrating knowledge and knowing: A framework for understanding knowledge-in-practice. **Human Resource Management Review**, v. 22, n. 2, p. 86-99. 2013. DOI: 10.5465/amr.2011.0266.

NORMAN-ACEVEDO, Eduardo. La inteligencia artificial en la educación: una herramienta valiosa para los tutores virtuales universitarios y profesores universitarios. **Panorama**, v. 17, n. 32. p.1-11. 2023. DOI: 10.15765/pnrm.v17i32.3681.

OCAÑA-FERNÁNDEZ, Yolvi; VALENZUELA-FERNÁNDEZ, Luis; GARRO-ABURTO, Luzmila. Inteligencia artificial y sus implicaciones en la educación superior**. Propósitos y Representaciones**, v. 7, n. 2, p. 536-568. 2019. DOI: 10.20511/pyr2019.v7n2.274

OUYANG, Fan; JIAO, Pengcheng. Artificial intelligence in education: The three paradigms. **Computers and Education:** Artificial Intelligence, v. 2, n. 1, p.1-6, 2021. DOI: 10.1016/j.caeai.2021.100020.

POOLA, Indrasen. How artificial intelligence in impacting real life everyday**. International Journal for Advance Research and Development**, v. 2, n. 10, p. 96-100, 2017

RIDLEY, Diana. **The literature review:** A step-by-step guide for students**.** 2 ed. UK: SAGE Publications, 2012.

SALEH, Ziyad. Artificial intelligence definition, ethics and standards. **Journal of Artificial Intelligence**, v. 1, n. 1, 2019.

SCHEG, Abigail. **Implementation and critical assessment of the flipped classroom experience.** USA: Igi Global. 2015.

TAPALOVA, Olga; ZHIYENBAYEVA, Nadezhda. Artificial intelligence in education: AIEd for personalised learning pathways**. Electronic Journal of e-Learning**, v. 20, n 5, p. 639-653, 2022. DOI: 10.34190/ejel.20.5.2597.

TORRES-CARRILLO, Alfonso. Educación popular, subjetividad y sujetos sociales. **Pedagogía Y Saberes**, v. 15, n. 1, p.5-14. 2000. DOI: 10.17227/01212494.15pys5.14

TSULAIA, Nino. **Constructivism as a theory of learning:** Foundations and significance. Basics of Learning the latest theories and method, Boston. 2023.

VERMA, Navdeep; GETENET, Seyum; DANN, Christopher; SHAIK, Thanveer. Designing an artificial intelligence tool to understand student engagement based on teacher's behaviours and movements in video conferencing. **Computers and Education:** Artificial Intelligence, v. 5, n. 1, p. 1-13. 2023. DOI: 10.1016/j.caeai.2023.100187

WOOLF, Beverly; LANE, Chad; CHAUDHRI, Vinay; KOLODNER, Janet. AI Grand Challenges for Education. **AI Magazine**, v. 34, n. 4, p. 66-84. 2013. DOI: 10.1609/aimag.v34i4.2490.

YAMANI, Hana; ALHARTHI, Ahmed; SMIRANI, Lassaad. Evaluation of Learning Management Systems: A Comparative Study Between Blackboard and Brightspace. **International Journal of Emerging Technologies in Learning** (iJET), v. 17, n. 7, p. 125-144. 2022. DOI: 10.3991/ijet.v17i07.28881

ZHAI, Xuesong; CHU, Xiaoyan; CHAI, Ching; JONG, Morris; ISTENIC, Andreja; SPECTOR, Michael; LIU, Jia-Bao; LI, Yan. A Review of Artificial Intelligence (AI) in Education from 2010 to 2020. **Complexity**, v. 2021, n.1, p.1-18. 2021. DOI: 10.1155/2021/8812542

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