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FROM CONNECTIVISM TO EDUCATION 5.0: PHILOSOPHICAL, SOCIAL AND CULTURAL FOUNDATIONS

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ABSTRACT

This study investigates the evolution of educational conceptions in the face of contemporary technological and sociocultural transformations. It analyzes Education 4.0, characterized by the intense incorporation of digital technologies into teaching, and Education 5.0, which proposes the integration of these resources into humanized and learner-centered pedagogical practices. Using a framework that combines philosophical, historical, social, and cultural foundations, the study also examines the influence of Connectivism Theory as a theoretical support for both models. The research, qualitative and descriptive in nature, was based on a bibliographic survey of national and international databases, encompassing classic and contemporary authors. The analysis was conducted through a comparison between the two educational proposals and the ways in which Connectivism articulates with each, highlighting points of convergence and divergence. The results indicate that, while Education 4.0 emphasizes technological efficiency and preparation for the digitized job market, Education 5.0 seeks to balance innovation and integral human development. It is concluded that incorporating connectivist perspectives offers the potential to build more collaborative, adaptive, and culturally sensitive educational experiences.

Keywords: Education 4.0. Education 5.0. Connectivism. Pedagogical Innovation. Humanization of Education.

INTRODUCTION

The social and technological transformations of recent decades have directly impacted educational systems, demanding new ways of teaching and learning. Advances in artificial intelligence, large-scale data analysis, and digital networks have created a scenario in which Education 4.0 has emerged as a proposal focused on the intensive incorporation of technology into pedagogical processes, responding to the demands of a globalized and highly automated market.

More recently, Education 5.0 has gained prominence, presenting itself as a movement that seeks to integrate digital innovation with humanistic, socio-emotional, and cultural dimensions, aiming at the formation of critical, creative, and socially responsible individuals. In this context, Connectivism emerges as a theoretical framework that recognizes learning as a networked process, supported by multiple connections between people, information, and technologies.

Given this scenario, the following research problem arises: how does Connectivism Theory relate to the foundations of Education 4.0 and Education 5.0, highlighting convergences and divergences between these two educational models?

This research is justified, firstly, by its scientific relevance, as it contributes to broadening the academic debate on the impacts of the Fourth Industrial Revolution and new educational perspectives in the field of pedagogy. Secondly, its social importance lies in the fact that understanding these models can support managers, teachers, and public policy makers in making decisions involving the balanced and humanized integration of technologies into education. In a scenario where schools and universities still face challenges in adapting to contemporary demands, research that problematizes the relationship between technological innovation and the humanization of the educational process becomes fundamental.

Thus, the objective of this study is to comparatively analyze the philosophical, historical, social, and cultural foundations that structure Education 4.0 and Education 5.0, discussing how Connectivism relates to each of these proposals and what implications arise from this articulation for 21st-century education.

METHODOLOGY

This is a basic study , with a qualitative approach and descriptive-analytical character , based on bibliographic research. The purpose was to gather, examine, and compare scientific productions that address Education 4.0, Education 5.0, and Connectivism Theory, seeking to identify their convergences, divergences, and possibilities for articulation.

The search for materials was conducted in the following databases : Google Scholar, SciELO, Harvard Education Press, and Harvard University Press. The following descriptors were used as a search strategy , combined in different forms and associations: “Education 4.0”, “Education 5.0”, “Connectivism” , “networked learning” , and “learning theories in the digital age”.

The survey was conducted between August 2024 and March 2025. Preference was given to up-to-date references that reflect recent changes in the field of education, as well as fundamental texts for the historical or theoretical understanding of the subject.

Portuguese, English, and Spanish were selected in order to broaden the scope of the discussions and incorporate national and international perspectives.

The inclusion criteria involved: (i) thematic relevance to Education 4.0, 5.0 or Connectivism; (ii) publications in peer-reviewed journals or recognized academic publishers; (iii) availability of full access to the text; and (iv) explicit alignment with the research objectives.

The exclusion criteria included: (i) strictly opinion-based materials without scientific backing; (ii) duplicate publications in different databases; and (iii) texts whose content did not directly address the research problem.

The initial screening process involved reading the titles and abstracts , during which works that did not meet the established criteria were discarded. Following this, the selected articles and books were read in full, with entries recorded in index cards organized by thematic categories. This systematization allowed for the identification of convergences and divergences between the materials, supporting the comparative analysis conducted in the results.

The results of the collected data were interpreted in light of the theoretical framework of Farias Filho and Arruda Filho (2013).

PRESENTATION AND DISCUSSION OF RESULTS

Connectivism: learning from connections

The term "connection," often associated only with the digital world, comes from the Latin "*conexione*", meaning link or nexus. Since antiquity, human beings have sought ways to connect, such as smoke signals used for long-distance communication. In the biological realm, the first form of connection occurs through the umbilical cord and, after birth, expands into the physical and emotional interactions established with the people around them. Over time, these connections have evolved, keeping pace with technological development, especially with the expansion of the internet, which has profoundly transformed forms of communication and learning (Pilonetto; Paz; Rodrigues, 2019).

In this context, George Siemens (2004) and Stephen Downes (2005) developed the theory of Connectivism, arguing that knowledge is not restricted to individual memory, but circulates in networks and databases, and can be accessed and learned from the connections established. For the authors, learning occurs at different levels—biological, conceptual, and social—and is stimulated by external factors.

Inspired by complexity theory and Morin's (2005) systemic vision, Connectivism understands society as an interconnected network of elements. Each "node" can represent a person, idea, data, organization, or information, composing a system of interdependence in which subjects are understood as points of connection that interact with others, human or not. This conception broadens the notion of knowledge, which comes to be understood as something dynamic, distributed, and constantly updated.

Recognizing that learning is not limited to the individual, but is constructed in relationships and information flows, Connectivism proposes an innovative approach to social and technological transformations. Siemens (2005) highlights that, although education still shows resistance to such changes, it is urgent to consider new digital tools and contexts, as they redefine the ways of learning and relating to knowledge.

Although widely discussed, Connectivism is not without its critics. Kop and Hill (2008) and Verhagen (2006), cited by Gomes, Monteiro and Nascimento (2017), question whether the proposal can actually be considered a learning theory, pointing out conceptual and methodological weaknesses, as well as the absence of significant differences compared to other approaches, such as Constructivism and Cognitivism.

To counter such criticisms, Siemens (2005) compared the principles of Connectivism with other theories — Behaviorism, Cognitivism, and Constructivism — using the criteria of Ertmer and Newby (1993), which allowed him to support the theoretical status of his proposal.

Table 1 – Comparison between Learning Theories

Propriedades	Behaviorismo	Cognitivismo	Construtivismo	Conectivismo
Como ocorre a aprendizagem?	Caixa negra com enfoque no comportamento observável	Estruturado, computacional	Social, sentido construído por cada aprendente (pessoal)	Distribuído numa rede social, tecnologicamente potenciado, reconhecer e identificar padrões
Fatores de influência	Natureza da recompensa, punição, estímulos	Esquemas (*schema*) existentes, experiências prévias	Empenho (*engagement*), participação social e cultural	Diversidade da rede
Qual é o papel da memória?	A memória é o enculcar (*hardwring*) de experiências repetidas – onde a recompensa e a punição são mais influentes	Codificação, armazenamento e recuperação (*retrieval*)	Conhecimento prévio remisturado para o contexto atual	Padrões adaptativos, representativos do estado atual, existentes nas redes
Como ocorre a transferência?	Estímulo-resposta	Duplicação dos contructos de conhecimento de quem sabe ("knower")	Socialização	Conexão (adição) com nós (nodes)
Tipos de aprendizagem melhor explicados	Aprendizagem baseada em tarefas	Raciocínio, objetivos claros, resolução de problemas	Social,vaga ("mal definida")	Aprendizagem complexa, núcleo que muda rapidamente, diversas fontes de conhecimento

Source: Gomes, Monteiro, Nascimento (2017, p. 848 - Journal of Medicine and Health Promotion)

In short, Connectivism offers a new perspective on the educational process, understanding it as fluid, decentralized, and dependent on multiple sources, in a scenario where learning is organized in a network and renewed through diversity, collaboration, and adaptability.

Building Education 4.0

Marc Prensky (2001) is an American educator and writer, known for his theories in the field of Education and Technology. Famous for calling the 21st-century generation "digital natives," due to the fact that they are born hyper-stimulated by technology, and for calling their parents and teachers "digital immigrants," as they are part of a generation that had to adapt to the digital age; not dividing them into two groups to create barriers, but rather highlighting the generational differences that coexist in the same time and physical space, he also presents discussions on the educational policies necessary for the implementation of Information and Communication Technologies (ICTs).

From the perspective of Coelho, Costa, and Mattar Neto (2018), Brazilian educational policy considers programs for only one generation, whether "natives" or "immigrants," even though both groups participate in the educational landscape, share knowledge, possess potential, and are deserving. Based on Prensky (2001), the reactions of the nervous, kinesthetic, neuronal, articulatory, and sensory systems of "digital natives" are different. Given this, and being aligned with the digital age, it is impossible to demand that they learn in the same way as "digital immigrants," as they feel, react, speak, and act differently, and vice versa.

As Prensky (2001) argues, teachers often say that students don't want to learn or don't pay attention; in the author's view, the "digital native" chooses not to pay attention and not to do the activities because what is proposed at school is not attractive to them, since their way of relating to learning is different.

Neuroscientist Desmurget (2021) challenges Prensky's (2001) theories, elucidating that "digital natives" only show interest in recreational tasks linked to technology, thus experiencing difficulties with concentration and learning at school. They show no interest in any content outside of social networks and recreation.

Pierre Lévy (1999), philosopher and sociologist, was born in Tunisia and for over 30 years has been researching and writing about the impacts of the internet on society, cyberculture, virtual reality, fake news, collective intelligence, cyberdemocracy, cybereducation, artificial intelligence and technopower.

As Lévy (1999) argues , cyberculture and its relationship with education are reaching levels that will force educational systems to update themselves due to the following factors: the extreme speed at which information emerges and changes; the new nature of knowledge; distance learning; the teaching profession, which will depend on constant renewal and updating, where the teacher will take on the role of guiding individual paths, creating contexts for critical reflection, and recognizing the experiences acquired by students ; and cyberspace, which will empower the collective, excluding the paradigm that one person or group holds all information, as the internet universalizes them. However, Lévy (1999) points out that information and knowledge are distinct things.

Trindade (2023), based on the theories of Pierre Lévy and Connectivism, outlines new educational practices in the professional context, elucidating that teaching and learning are linked to Virtual Learning Environments – VLEs, the Web , knowledge networks, various teaching platforms, virtual communities, podcasts , discussion forums, blogs, among others . In light of this, it is increasingly necessary for educators to seek professional development. and new ways of appropriating cybereducation to promote learning.

The concept of Education 4.0 emerges as a consequence of the historical evolution of educational models, strongly influenced by the industrial and technological revolutions. The so-called Education 1.0 was characterized by teaching centered on the authority of the teacher and the rigid and passive transmission of knowledge, initially focusing on reading, writing, and Christian teaching, gradually expanding to subjects such as arithmetic, grammar, rhetoric, and dialectic (Führ; Haubenthal, 2018). With the Industrial Revolution, the educational model began to meet the demands of factory work, prioritizing the repetition of tasks, memorization, and individual learning, constituting what was called Education 2.0. Education 3.0, in turn, incorporated emerging digital tools, such as social networks and online platforms, and sought to promote greater student protagonism, stimulating creativity, autonomy, and collaborative work.

Education 4.0, in turn, represents a qualitative leap, integrating emerging technologies such as artificial intelligence, augmented reality, big data, the internet of things, and robotics, proposing a personalized and adaptive learning environment (Führ; Haubenthal, 2018; Felcher; Blanco; Folmer, 2022). The notion was introduced into the educational debate by the German engineer and economist Klaus Schwab in 2017, inspired by the term "Industry 4.0," coined years earlier to describe the processes of industrial automation and digitalization (Lemes and Santos, 2022). The Brazilian researcher Cassiano Zeferino de Carvalho Neto (2021) contributed to the systematization of the concept in the country, reinforcing that educational innovation is not limited to the insertion of technological equipment in the classroom, but implies the construction of critical and meaningful methodologies that use technology to promote learning.

The Covid-19 pandemic further highlighted the relevance of the discussion, shifting face-to-face education to other territories, in a process of deterritorialization and reterritorialization, as defined by Lacerda and Greco Junior (2021). The closure of schools required the rapid adaptation of pedagogical practices to virtual environments, intensifying the use of digital technologies and connectivity as indispensable resources for the continuity of the teaching-learning process.

In this context, teaching practice faces new challenges. Pilonetto, Paz, and Rodrigues (2019) emphasize that changes should not be limited to the scope of school units, but need to be articulated by education systems, which still lack effective policies to guarantee adequate infrastructure, material resources, and continuing teacher training. Public schools, in particular, suffer from precarious physical spaces, outdated equipment, and a lack of investment, which compromises the implementation of proposals linked to Education 4.0.

Peredrienko, Belkina, and Yaroslavova (2020) argue that the implementation of Education 4.0 should go beyond the mere ability to manipulate digital tools, proposing a formative process aimed at developing autonomous individuals with digital competencies, encompassing managers, teachers, and students. Thus, teaching in contemporary times implies understanding that technology must be appropriated critically and pedagogically, as an instrument of transformation, and not merely as technical support.

Building Education 5.0

Education 5.0 represents the most recent phase of educational evolution and is associated with the so-called fifth industrial revolution, which integrates technological advances with the human and socio-emotional dimensions of learning. Unlike Education 4.0, focused on mastering digital technologies and preparing for the automated job market, the Education 5.0 proposal emphasizes the holistic development of the student, considering both cognitive and socio-emotional development. This concept emerged in Japan in 2016 and has been further explored by various researchers and educational institutions seeking to reconcile high technology with a humanistic approach, capable of preparing individuals not only for professional performance but also for the full exercise of citizenship (Felcher; Blanco; Folmer, 2022).

According to Felcher, Blanco, and Folmer (2022), Education 5.0 is not limited to innovative methodologies or the use of advanced digital resources, but proposes a curricular restructuring that articulates inclusion, neuroscience, multiple intelligences, learning styles, and diversified forms of assessment. The authors compare the proposal to an iceberg: the most visible part includes elements such as digital technologies, active methodologies, and blended learning, while below the surface are less apparent, but equally essential, dimensions such as equity, the valuing of individual differences, and the strengthening of socio-emotional skills. Thus, there is no hierarchy among the elements that make up Education 5.0, since they all contribute in an integrated way to the education of the 21st-century student.

This approach also presupposes a review of the philosophical and social foundations that underpin educational practice.

From a philosophical point of view, Education 5.0 proposes a transformation of the school as a learning space, guided by a student-centered pedagogy personalized according to their needs, potential, and contexts. Technology is incorporated as a mediator of knowledge, but always at the service of humanizing teaching processes and promoting values such as empathy, collaboration, and sustainability (Felcher; Blanco; Folmer, 2022).

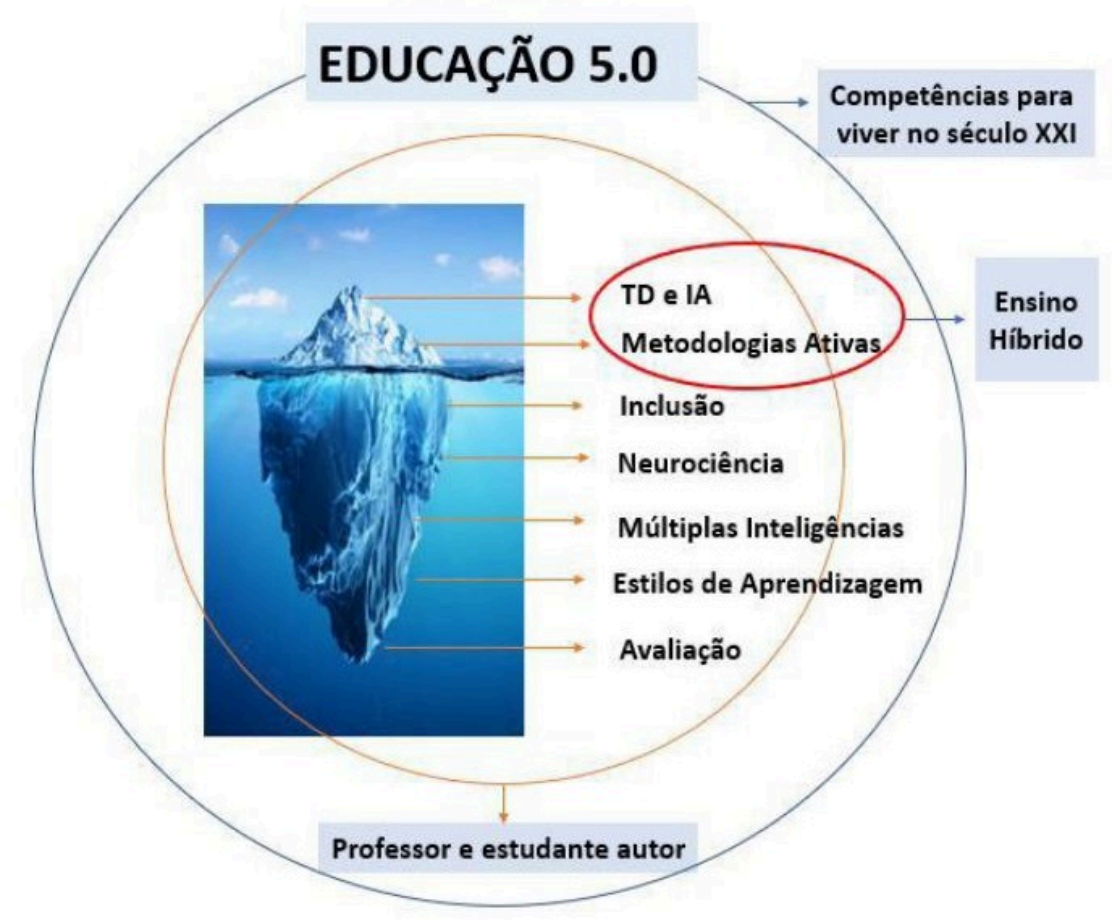
Historically, Education 5.0 is part of a continuous line of educational evolution, starting from traditional models, passing through Education 4.0, and renewing itself in light of technological innovations. However, it distinguishes itself by emphasizing that digital advancement should not be dissociated from respect for cultural and social diversity. In this sense, technological innovations, far from being an end in themselves, become tools for building a more inclusive and equitable education, aligned with contemporary global needs (Felcher; Blanco; Folmer, 2022).

From a social perspective, Education 5.0 seeks to train citizens capable of responding to the

demands of a constantly transforming world, valuing preparation for the job market, but also a commitment to a more just and sustainable society. To this end, it emphasizes the development of digital skills combined with critical, creative, and emotional abilities, allowing students to move between different areas of knowledge and interact collaboratively in multicultural environments (Felcher; Blanco; Folmer, 2022).

Culturally, Education 5.0 recognizes diversity as a structuring element of the educational process. Globalization and digital interconnection have broadened the possibilities of contact between cultures, requiring pedagogical practices to be sensitive in adapting methodologies and technologies to different realities. Thus, the proposal values both the universality of access to knowledge and respect for local contexts, reaffirming the role of the school as a plural space for civic education and the strengthening of cultural identity (Felcher; Blanco; Folmer, 2022).

Figure 1 - Education 5.0 and its Fundamental Elements



Source: Felcher, Blanco, Folmer (2022). https://rsdjournal.org/index.php/rsd/article/view/35264

Felcher, Blanco, and Folmer (2022) present, in the figure above, an analogy with an iceberg, highlighting more visible elements, such as digital technologies, artificial intelligence, and active methodologies, which form blended learning, and less visible elements, such as inclusion, neuroscience, multiple intelligences, learning styles, and assessment. However, they emphasize that there is no hierarchy of priority among the elements, as all are relevant.

The analysis of the results of this research was carried out based on Farias Filho and Arruda Filho (2013), in two movements. The first sought to identify the differences and similarities between

Education 4.0 and Education 5.0, while the second examined how Connectivism influenced both educational proposals from philosophical, historical, social, and cultural perspectives.

Regarding the differences, based on the theoretical contribution of Felcher, Blanco, and Folmer (2022), it is observed that Education 4.0 has consolidated itself in a context strongly marked by the incorporation of digital technologies and the preparation of students for an automated and globalized job market, emphasizing efficiency, productivity, and the development of technical and digital skills. Education 5.0, on the other hand, broadens this horizon by proposing the integration of technology with the human dimension, understanding that education should prepare for a more sustainable, inclusive, and sensitive future to socio-emotional issues.

From this perspective, while Education 4.0 maintains structured curricula, data-driven teaching methods, and assessments focused on quantitative results, Education 5.0 values flexible curricula, holistic assessment processes, and pedagogical practices centered on the student as an active protagonist of learning.

Analyzing through the theories of Trindade (2023), despite these differences, there are important convergences between the two proposals. Both Education 4.0 and Education 5.0 recognize the centrality of digital technologies in the teaching-learning process and the need to promote personalized and active education. Both share the concern of preparing students for the challenges of the future, although the emphasis falls on different aspects: Education 4.0 prioritizes technological adaptation and the development of digital skills, while Education 5.0 integrates these skills with socio-emotional, collaborative, and critical abilities. In both, the importance of lifelong learning is recognized, a fundamental characteristic in a constantly transforming world.

In the second stage of the analysis, considering the influence of Connectivism on the proposals of Education 4.0 and 5.0, and using the theoretical basis of Felcher, Blanco, and Folmer (2022), it was identified that this theory constitutes a structuring basis in both models, although with different approaches. In Education 4.0, Connectivism manifests itself in a restricted way, aligned with the logic of digital interconnection and networked learning, reinforcing the idea that knowledge is distributed in databases and digital systems. The focus, in this case, is on rapid adaptation to technological changes and efficiency in accessing and using information.

In Education 5.0, anchored in the theoretical framework of Felcher, Blanco, and Folmer (2022), Connectivism is reinterpreted and expanded, incorporating not only the digital dimension but also the human and social dimensions. Networked learning is seen as a space for integrating technical skills and humanistic values, seeking to balance technological advances with principles of empathy, collaboration, and sustainability. Historically, while Education 4.0 is associated with the context of the digital revolution, Education 5.0 emerges from the need to rethink educational practices in light of the social and cultural consequences of this process, proposing a more holistic and balanced approach.

From a social perspective, according to the aforementioned theoretical assumptions, Education 4.0 responds to the demands of a digitized and rapidly transforming society, highlighting the role of social and professional networks as learning channels. Education 5.0 expands this vision by emphasizing social inclusion and diversity, recognizing that access to technologies must be accompanied by policies that ensure equity and democratic participation.

From a cultural point of view, theoretically grounded in Felcher, Blanco and Folmer (2022), while Education 4.0 reflects the digital culture marked by the speed of information and constant technological renewal, Education 5.0 articulates this culture with respect for local and global identities, promoting a balance between innovation and the appreciation of cultural diversity.

Thus, the analysis allows us to affirm that Connectivism is present in both Education 4.0 and 5.0,

but assumes distinct roles: initially it supports digital interconnection as the basis of the learning process and, subsequently, it integrates social, human and cultural dimensions, proving itself as an indispensable reference for understanding and guiding education in the 21st century.

FINAL CONSIDERATIONS

The study revealed that Education 4.0 and Education 5.0 constitute educational responses to the transformations brought about by the technological revolution and the new social demands of the 21st century. Education 4.0 is characterized by the incorporation of digital resources, artificial intelligence, robotics, and big data, primarily aimed at preparing individuals for a highly technological job market. Education 5.0, while still valuing digital innovation, broadens the perspective by placing the human being at the center of the educational process, promoting a training that integrates cognitive, technical, social, and emotional competencies.

It was also found that Connectivism, a theory that understands knowledge as a constantly updated network, plays a fundamental role in underpinning both proposals. In Education 4.0, it manifests itself in a more technical way, reinforcing the centrality of digital connections and rapid adaptation to technological transformations. In Education 5.0, however, Connectivism takes on a more comprehensive character, articulating human, social, and cultural dimensions, in order to support a pedagogical practice that unites technological innovation and humanization.

The results also show that, although these proposals are circulating in academic debate and in some school practices, many institutions still operate under older models, demonstrating the mismatch between the speed of technological transformation and educational reality. This gap points to the need for public policies that guarantee infrastructure, investments in technology, and ongoing teacher training, in order to enable the effective implementation of these concepts.

It can be concluded, therefore, that Education 4.0 and Education 5.0 should not be seen as separate stages, but as complementary processes, in which the former prepares the ground for the latter to be fully realized. The advancement of contemporary education demands that technological innovation go hand in hand with the integral formation of the individual, ensuring both adaptation to the demands of a digital world and the construction of a more just, inclusive, and sustainable society.

For future research, it is recommended to conduct empirical studies that investigate how the principles of Education 5.0 have been effectively implemented in schools and universities, as well as comparative analyses between different sociocultural contexts. Furthermore, it is relevant to critically explore the tensions between technology and social equity, in order to prevent digitalization from deepening inequalities instead of contributing to the democratization of knowledge.

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