PERSPECTIVA
REVISTA DO CENTRO DE CIÊNCIAS DA EDUCAÇÃO
Volume 43, n. 4 – p. 01 – 22, out./dez. 2025 – Florianópolis

eISSN 2175-795X

AI, education and sociodigital futures: beyond the hype, beyond the obvious

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Abstract

The constant transformations in social, economic and political contexts driven by datafication and Artificial Intelligence (AI) raise questions about the role of contemporary education in promoting the construction of fairer and decolonial sociodigital futures. This essay explores a number of AI research questions in a transdisciplinary manner, as addressed by a group of early career researchers invited to a series of workshops held in Brazil in 2024 under the title '*AI and Sociodigital Futures: beyond the hype, beyond the obvious*'. The overarching methodology of this workshop was inspired by the emerging research field of sociodigital futures, developed by the ESRC Centre for Sociodigital Futures (CenSoF) (University of Bristol), in which social life and digital technologies are inextricably linked and cannot be separated. We conclude that education, both in its configuration as a fundamental right and in its role as a field of applied research, urgently needs to break away from the simplistic view of AI as a mere tool to improve curricular contents, seeking new ways of contributing towards more inclusive and sustainable societies.

Keywords: Artificial intelligence. Sociodigital futures. Education. Sustainable society.

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Received on: 02/27/2025
Approved on: 08/28/2025

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http://www.perspectiva.ufsc.br
http://dx.doi.org/10.5007/2175-795X.2025.e105467

Resumo

IA, educação e futuros sociodigitais: além do hype, além do óbvio

As constantes transformações nos contextos sociais, econômicos e políticos impulsionadas pela Inteligência Artificial (IA) levantam questões sobre o papel da educação contemporânea na promoção da construção de futuros sociodigitais mais justos e decoloniais. Este ensaio explora algumas das questões de pesquisa sobre IA abordadas de maneira transdisciplinar por um grupo de pesquisadores em início de carreira acadêmica convidados para uma série de workshops, realizada no Brasil em 2024, sob o título "*IA e Futuros Sociodigitais: além do hype, além do óbvio*". A metodologia abrangente utilizada nos workshops foi inspirada no campo emergente de pesquisa em futuros sociodigitais desenvolvida pelo ESRC Centro de Futuros Sociodigitais (CenSoF) (Universidade de Bristol), em que a vida social e as tecnologias digitais estão inextricavelmente ligadas e não podem ser separadas. Concluímos que a educação, seja em sua configuração como direito fundamental, seja em seu papel como campo de pesquisa aplicada, precisa urgentemente romper com o simplismo de enxergar IA como mera ferramenta para impulsionar conteúdos curriculares, e assim buscar novas formas de contribuição rumo a sociedades mais inclusivas e sustentáveis.

Palavras-chave: Inteligência artificial. Futuros sociodigitais. Educação. Sociedade sustentável.

Resumen

IA, educación y futuros sociodigitales: más allá del hype, más allá de lo obvio

Las constantes transformaciones en los contextos sociales, económicos y políticos impulsadas por la Inteligencia Artificial (IA) plantean interrogantes sobre el papel de la educación contemporánea en la promoción de la construcción de futuros sociodigitales más justos y decoloniales. Este ensayo intenta explorar algunas de las cuestiones de investigación sobre IA abordadas de forma transdisciplinaria por un grupo de investigadores en el inicio de su carrera profesional invitados a una serie de talleres celebrados en Brasil en 2024 bajo el título «*IA y futuros sociodigitales: más allá del hype, más allá de lo obvio*». En este sentido, la metodología utilizada fue presentar el enfoque de investigación para futuros sociodigitales desarrollado por el ESRC Centre for Sociodigital Futures (CenSoF) (Universidad de Bristol), en el que lo social y lo digital no pueden pensarse de forma dicotómica, sino a través de la recursividad. La conclusión es que la educación, tanto en su configuración como derecho fundamental como en su papel de campo de investigación aplicada, necesita romper urgentemente con la visión simplista de la IA como mera herramienta para promover contenidos curriculares, y buscar así nuevas formas de contribuir a sociedades más inclusivas y sostenibles.

Palabras clave: Inteligencia artificial. Futuros sociodigitales. Educación. Sociedade sostenible.

1. Introduction

The hype around contemporary EdTech, driven by generative AI (GenAI), is surrounded by the promise of benefits such as efficiency, personalized feedback, and reduced teacher workload. However, these assumed benefits come at the cost of excessive data sharing required for these systems to work effectively. Concerns include the commodification of education, digital colonialism due to AI being trained on data from the Global North, the amplification of biases in automated decision-making, and the environmental impact of large-scale AI deployment in education (Williamson *et al*. 2024).

In the quest for educational futures that benefit from technological advancements such as AI, we need to understand the introduction of digital infrastructures in education as a *sociodigital* phenomena (Sriprakash *et al*., 2024). This implies the recognition that educational practices and technology developments are indivisible from each other and from wider social phenomena. Such a framing allows us to see digital infrastructures not only as tools aiding teachers' and students' existing needs, but as a complex interplay of economic, political and moral interests seeking to control what is taught in schools and how this is done. As Shriprakash *et al* (2024, p. 2) argued, educational technologies "fundamentally remake educational relationships and values: changing the way we relate to each other; what we understand learning to be; how we envisage the learner; and what we envisage as the purpose of education". By rejecting a fragmented view of technology, education and society as separate entities, we aim to move away from techno-solutionist narratives (Morozov, 2018; Saura *et al*., 2024) in which complex social problems are seen as fixed through technological innovations.

We advocate that only by paying attention to how education and technology are mutually constituted can we envision educational futures that respond to students' diverse needs and protect their rights, including the fundamental right to education. This requires inter/transdisciplinary dialogue and reconnection between fields (Morin, 2003) to critically evaluate the processes, impacts, and political implications of technology in schools, beyond simplistic narratives of benefit. Key questions emerge: what is education for, who defines better futures, and how can education address the social and environmental costs of AI?

This essay sheds light on these questions through an exercise of inter/transdisciplinary dialogue. It draws on reflections gathered through a workshop series organised by the Center for Research in Posthumanism and Digital Humanities (P_2HD) at University of Campinas, Brazil in 2024. The series brought to the fore the work of Brazilian early career researchers, and promoted provocations to critically explore sociodigital futures of education across disciplines. Before diving

into the seminars' insights, the paper starts by introducing the relevance of Futures Studies for the field of education, placing particular relevance to the emerging field of sociodigital futures. In doing so, we explore the catalyst work carried out by the ESRC[1] Centre for Sociodigital Futures (CenSoF) at the University of Bristol. The essay then delves into the provocations offered by the "beyond the hype and beyond the obvious" workshop series. This is followed by a discussion and a call for action, grounded in the themes identified through the analysis of seven seminar presentations, and examined with the conceptual framework of sociodigital learning futures, in order to challenge dominant techno-solutionist discourses in contemporary EdTech.

2 Sociodigital futures of education

The premise at the heart of the field of sociodigital futures is that social life – how we learn, consume, care, move, and organise – is deeply intertwined with digital technologies, and the data, services and devices that enable access to them (Gonsales *et al*., 2024). According to Halford and Southerton (2023), rather than focusing on predicting or determining what lies ahead, this field examines the ways in which we think about, imagine, and act on possible futures. The future is not completely separated from the present (Coleman, 2018) nor a continuation of the past, but a consequence of "actions in the present" (Adam, 2023, p. 280). It is therefore important to interrogate what claims about the future are made in the present, by whom, and who is benefited – or disadvantaged – by those futures-in-the-making. By paying attention to how futures are constructed in the present, we can build capacity to generate more just and sustainable ways of life (Gonsales *et al*., 2024).

The emergent field of sociodigital futures is predominantly shaped by transdisciplinary research and collaborations at the ESRC Centre for Sociodigital Futures (CenSoF) at the University of Bristol, UK. Established in 2022, CenSoF brings together UK and international universities with public and private sector partners. It integrates social sciences, arts, humanities, and engineering to explore new methods, theories, and collaborations. CenSoF fosters cross-sector dialogue, including predictive analytics in governance, participatory futuring with local communities, and critical making with engineers. Its goal is to build capacities, analyze evolving sociodigital futures, and address widening inequalities.

While CenSoF promotes dialogue across disciplines, its network remains largely centered on Global North institutions. Expanding collaborations with scholars, practitioners, and industries from diverse epistemological traditions is crucial to broadening the study of sociodigital futures. Research in the Global North often reflects Eurocentric assumptions, that, in turn, can produce "racialized

[1] Economic and Social Research Council: https://www.ukri.org/councils/esrc/. Accessed on Feb. 27, 2025.

temporalities of people and societies that are considered 'deviate' from, or lag behind" (Sriprakash *et al.*, 2024, 189). This is why we argue for expanded efforts to explore ongoing sociodigital futures from other perspectives, particularly in the Global South, in order to widen and enrich knowledge generation in this emerging field.

Inayatullah (1990) states that engaging in conversations about futures requires a critical examination of the epistemological and ontological foundations of its research and practice. Therefore, the context in which sociodigital futures research originates is profoundly significant, as emerging theories, methods and practices cannot be disentangled from this historical and cultural backdrop. Indeed, the City of Bristol (UK) and its University have faced a reckoning and recognition of the deep ties between its historical wealth and transatlantic slave trade (Otele *et al.*, 2024). Therefore, our responsibilities as researchers in this field is to be deeply aware and critically engage with the injustices of the past and how they continue to endure in people's lives in material and affective ways. The intention is to historicise and deconstruct (Inayatullah, 1990), repair and seek justice (Sriprakash *et al*., 2020), and make futures that amend colonial pasts and dismantle contemporary systems of domination (Paradies, 2020). As Sriprakash *et al*. (2020, p.6) argue, an "understanding of the past and its active formations today is crucial for futures thinking."

In an effort to address the interests of perspectives from different pluralities and temporalities, we draw inspiration from the work of Esteva and Escobar (2017), to advocate for the use of *hospitality* as a lens for the exploration of sociodigital futures. Hospitality, as opposed to *inhospitality*, is a profound, politically grounded practice that challenges extractive research paradigms and fosters collaborative, egalitarian encounters towards a justice-oriented vision. On the one hand, hospitality is aligned to the concept of *buen vivir* (Gudynas, 2011), as it challenges the dominant notion in contemporary Western societies where digital technologies are synonymous with development, innovation and progress (Adam; Groves, 2007). Hospitable sociodigital futures require that questions of *who* is advantaged and disadvantaged from AI and other techno-fixes remain open and troubled (Haraway, 2016; Costanza-Chock, 2020). On the other hand, hospitality invites us to embrace the "thousand different ways of thinking, existing, living and experiencing the world that characterize reality" (Esteva; Escobar, 2017, p. 2561). This includes not only how different individuals and communities move, learn, and intra-act with digital technologies, but also how they interpret temporalities, affects and the "contents of the future that are bound by various cultural contexts" (Inayatullah, 1990, p.123).

The workshop series reported in the following section exemplify how hospitality can be embraced in the field of sociodigital futures. The thematic curation is a collective effort to bring together early career researchers in Brazil to explore aspects of AI in education from a sociodigital

futures perspective. Instead of imposing definitions, praxis or languages, the workshops series' purpose is to open up spaces for cross-cultural, inter/transdisciplinary conversations aligned to the needs, sensitivities and priorities in the context of Brazil and Latin America. These are vital efforts to shape public debates, government policies and educational practices to enable a more direct and inclusive engagement with futures-making.

3 Transdisciplinary dialogues for sociodigital futures in education

Inspired by sociodigital futures research, and in an attempt to pluralise and diversify perspectives in this field, inter/transdisciplinary dialogues are imperative to foster dialogue on sociodigital futures in education. This is in order to care for and protect students' rights, privacy and dignity while offering innovative and meaningful learning experiences. In an effort to promote such dialogues, the Center for Research in Posthumanism and Digital Humanities (P_2HD), at University of Campinas, organised a series of workshops in 2024. It invited speakers from the areas of Law, Engineering, Comunication, Design, Physics and Computer Science to offer research insights and provocations under the theme '*AI beyond the hype, beyond the obvious*'. In this sense, the proposal for the series of workshops favored early career researchers who had just defended dissertations and theses on AI from different approaches, considering the interrelations of the field of knowledge of AI with the Humanities and Social Sciences. Each workshop lasted two hours in an expository-argumentative moment, followed by small groups and plenary discussions on the main insights.

In order to select and invite researchers participating in the series, a thematic curation was carried out. This process sought to contemplate multidimensional aspects of the contemporary context marked by the impacts of AI that need to be considered in the construction of education policies and practices. Below, we delve into the central arguments highlighted by each of the workshops, shedding light on the rich disciplinary contributions to critical sociodigital futures of education in the context of AI.

3.1 Cognition, body and technologies

In the opening workshop, "Cognition, Body and Technologies", Dr. Camila Leporace presented compelling insights into the relevance of the Cognitive Sciences to understanding AI innovations and their computational logic, as well as the impact they can have on the way learning is understood as a process of manipulating symbols and rules stored in memory (Alves; Valente, 2021). Because of that, she argued, the human mind has been commonly associated with the brain. In her talk she explained that a common belief in computational sciences was that by reproducing the human brain through AI, it would be possible to reproduce the human mind and therefore technologically generate a complete human.

However, through her presentation, she explained that science is still a long way from being able to decipher the brain and further away to replicate it digitally. An example of this is the concept known as Moravec's Paradox, which shows how the simplest, most natural tasks for human beings, such as moving, dancing, and manipulating objects, are highly complex to formulate via programming for machines. On the other hand, more elaborate tasks for humans, such as playing chess, would be relatively simple for machines through data processing (Leporace, 2023). Leporace's studies point to the intrinsic interrelationship between the human mind and body, to demonstrate that not everything in human activity is amenable to information processing.

The ideas of Dreyfus (1975) provide input for thinking critically about this paradox, where machines still cannot do certain tasks, but outperform humans in others. For Dreyfus, computers should not be equated with human activities, precisely because the body and emotions are very important, but neglected by many researchers. Dreyfus was a pioneer in drawing attention to the fact that human development occurs from the environment in which one lives, in which one relates to other humans. In other words, there is an inseparability between mind and body, cognition and emotions. Phenomenology, as developed by Merleau-Ponty (1971) and later by Dreyfus (1975), places perception and action at the center of human experience and offers a framework for understanding how humans act in the world without relying on linear stimulus-response models.

Leporace recalled how the human body, which is highly regarded in the early years of education, is neglected as students' progress through the school years, being led to a single position of sitting and remaining almost motionless. However, it is through the body that we learn, feel and experience. As she pointed out, Dreyfus' ideas are in dialogue with the enactivist concept of creation of meaning by human beings given their ability to act in conjunction with the environment, making them cognitive subjects, that is, subjects who construct knowledge as they experience situations and learn to deal with them. Although the foundations of machine learning systems are essentially inspired by the human biological brain, as they learn through statistical methods, the most advanced machine learning networks are systems isolated from the world, separated from it and disembodied, free of emotions, incapable of living experiences, which are central to cognitive activity.

3.2 Which cyborgs do we want to be?

With the intriguing title "Which cyborgs do we want to be?", Dr. Paulo Kawanishi, brought up a thought-provoking topic that is still little discussed in the educational field. Kawanishi sees himself as a representative of the so-called millennial generation – those born after 1980, who have lived with digital technologies from an early age. His upbringing as a person and professional has been shaped by a deep engagement with these technologies, often "existing" more in forums, social

networks and online games than in face-to-face moments. Within this context, he became interested in studying the post-human subject and cyborg subjectivity.

Based on the premise of posthumanism, considered a field of philosophical debate punctuated by "arguments, objects, theories, methods and, above all, questions and provocations that emerge from the rupture of binaries constitutive of humanism, such as: subject vs. object, culture vs. nature, human vs. non-human (machine, animal, object or mind vs. body etc.)" (Buzato, 2019, p. 480, free translation), Kawanishi's research emphasised the constitution of cyborg subjects based on the observation of a group of biohackers.

Contrary to the image widely disseminated in common sense, especially in the cinema, the concept of cyborg has its origins in the abbreviation for "cybernetic organism". It describes a human body amplified by technological devices to perform functions similar to human organs in adverse situations, such as astronauts, so that their vital organs adapt quickly to the environment (Clynes; Kline, 1960). This premise, as Kawanishi pointed out, became fundamental in the constitution of a movement called transhumanism, which is based on the belief that the next evolutionary stage of the human being will be based on the ability of humans to use technology to extend their vital functions as well as cognition.

However, as the researcher pointed out, humans have always been cyborgs in the sense that they establish extremely intimate relationships with non-humans, whether animals (Haraway, 2000) or technologies. For example, anyone who needs to wear glasses knows that they are constituted as a subject with glasses. In contemporary times, the popularisation of mobile phones has made this relationship clearer, or even the pandemic, when videoconferencing was fundamental for people to be able to meet and work.

The cyborg, therefore, is constructed by all this and a way of seeing hybrid subjectivities with various functions. When we use the expression "non-human", it is a resource to be able to talk about machines, planets, animals, understanding that the non-human is an element that affects the world instead of the anthropocentric view. By understanding that situations and phenomena emerge from relationships, it is possible to study the power relations that are established in these relationships between individuals, or as Latour (2013) points out in Actor-Network Theory, between actors. Modern biohackers experiment with technology and genetic modifications to enhance their abilities, as studied by Kawanishi (2023). One example is the use of nootropics to boost cognitive function and productivity. Kawanishi highlighted how capitalism drives a belief in technological determinism – the idea that technology can solve all problems. This is evident in cases like a biohacker who practiced extreme fasting to improve focus or individuals using biochips for professional efficiency rather than personal expression. Ultimately, contemporary cyborgs, influenced by Silicon Valley, are shaped to become hyper-productive workers.

3.3 Datified childhoods

As technologies in education are increasingly present, especially after the pandemic, and technology companies often have a very specific narrative about the beneficial promises of these technologies, Dr. Elora Fernandes presented how the right to data protection of children and adolescents is at risk in these narratives. As she pointed out, the first very clear promise of these technologies is that they can improve accessibility, reduce costs and make it easier for students in remote areas to access content. They also promise to "personalize" teaching, especially with the inclusion of artificial intelligence, and to "simplify" the work of the educator or institution. Another recurring promise is to improve student engagement with gamification, through the design of technologies.

Fernandes emphasised that the changes brought about by technologies in education are incremental and homogenising. However, the supposed benefits continue to be trumpeted by the corporations that are developing these technologies, which even fund research aimed at pointing out the benefits. Although there is no scientific evidence on a large scale that most of these technologies actually work, there are already well-documented reports of the disproportionate side effects they can have on children's fundamental rights (Human Rights Watch, 2022). Effects such as excessive screen time, cyberbullying, exploitation of body image, access to self-content, and data protection and privacy issues.

The focus of her research was a comparative analysis of how the Brazilian (Brazil, 2018) and European (GDPR, 2016) data protection laws deal with protecting the privacy of children and adolescents, considering that their digital footprint is proportionally greater than previous generations (Fernandes, 2024). Children are being exposed to social media at an increasingly early age, even from the moment they are in their mother's womb, in ultrasound photos, or in pregnancy tracking apps. At birth, internet-connected toys collect data with sensors, and when they go to school, educational technologies continue to collect data. In this context, EdTech includes tools for both educational and administrative purposes, supporting teachers with automation and students with personalized learning. Learning Analytics adds by tracking students' understanding and performance.

In addition to the fact that the digital environment is not designed for children, it requires the mediation of adults, family members or educators, who make decisions for these children in general. Brazil's Constitution (Art. 227), along with the Child and Adolescent Statute (1990) and the General Data Protection Law (2018), emphasizes the shared responsibility of protecting children's rights.

The researcher's theoretical framework is based on *The Cost of Connection* (Coldry & Messias, 2019), which compares historical colonialism to data colonialism – where contemporary capitalism exploits human life as a data resource. Fernandes highlights a major issue with AI-driven

education: the risk of reducing learning to quantifiable subjects like math, while fields like literature struggle with AI's inability to interpret context. This can lead to homogenized curricula driven by data rather than educational needs. Additionally, she argues, outsourcing decisions to algorithms based on outdated data is unlikely to reflect current realities.

3.4 Copyright in the age of Big Data

MSc. Miguel Alvarenga began his presentation by bringing up two aspects of the intersection of AI and copyright in terms of cultural and innovation policies. On the one hand, there is the question of "inputs", the problems that arise from the use made of protected material by humans, used to train AI. On the other hand, there are the "outputs", products generated by AI such as visual or audio compositions, that, if produced by a human, would be considered a work of authorship and thus protected by copyright. At this point, there are already discussions about AI-generated content in relation to copyright, cultural policy, and innovation frameworks.

Since the Berne Convention[2] copyright law has focused on the notion of originality as a legal requirement for a work to be protected. Brazilian legislation, for example, defines a *work* as a "creation of the spirit", i.e, a work is original when it comes from human intellect, whether from existing and combined ideas or composed of a particular cultural background that has been learnt throughout life, something that emerges from a creative exercise.

From a legal point of view, the law only protects works that were created by a human, so there is no legal possibility of there being a non-human author. In the case of works "created" by AI, administrative and even judicial issues begin to emerge, as we consider whether or not a work in which AI has participated can be protected or not, and to what extent. As an example, Alvarenga cited the case of Zarya of the Dawn[3], a comic book created by an individual author, but which used AI-generated images based on prompts that the same person had entered. When the author of the book tried to register it in the US, which requires formal registration for copyright protection, she was denied registration because she had used AI in the images. In China, on the other hand, the decision was the opposite: images generated by AI may be eligible for copyright[4] considering the human intervention required.

According to Alvarenga (2019), the two cases reveal that the human being still occupies a central role in the issue. There were similar debates about photographs in the last century, whether or not photos should be protected, considering that the image is ready, static, and all the photographer has to do is press the button to capture it. But at the time, the conclusion was that there is always a

[2] International treaty on common rules for the copyright of literary and artistic works signed by 181 countries in 1886 in Berne, Switzerland. https://www.wipo.int/treaties/en/ip/berne/. Accessed on Aug. 25, 2024.
[3] More information: https://www.copyright.gov/docs/zarya-of-the-dawn.pdf. Accessed on Aug. 25, 2024.
[4] More about the case: https://www.roedl.com/insights/artificial-intelligence-china. Accessed on Aug. 25, 2024.

degree of human creativity, decision-making and aesthetic choices. But is it the same with AI? To what extent is the human intervention of generating prompts and instructing a machine to create an image enough for you to have a protected work? These questions are still unanswered and remain controversial, because authorship can belong to the person who generated the prompts, to the system developer or to the data source.

For the researcher, using copyright to protect AI-generated content triggers two problems. The first is that AI does not understand what it is doing, it just works by correlating data. The second is of a practical public policy nature, because if the purpose of copyright is to provide authors some income from their works' commercialisation or control, AI does not need it.

In this sense, works generated by AI or with a majority of AI intervention should be in the public domain. The "inputs" are another matter, considering that AIs are trained with works, images, texts protected by copyright and this implies knowing how the machine learning process takes place. In a nutshell, it involves collecting data (various contents) from several sources, storage in a repository and the technical operation of searching for patterns and correlations in this data that may result in some relevant content.

The rise of big data and AI enables rapid automated analysis but raises serious copyright concerns. AI models often use protected works without permission, potentially violating the law. Recent artist protests[5] highlight how generative AI trained on specific styles can mimic original creations, threatening authorship and livelihoods. Current laws focus on the final product, overlooking distinctions between human and AI-generated content. Given the difficulty of identifying all rights holders, there is an urgent need for updated regulation.

3.5 Digital colonialism in education

Looking at Higher Education, Dr. Helena Mendonça made a comparative analysis of undergraduate and postgraduate courses held online during the pandemic at two different universities. In line with the Freirean perspective, the analysis of the courses' practices identified a strong influence of digital colonialism (Kwet, 2021; Couldry; Mejias, 2020; Zuboff, 2015; Silveira, 2019).

The researcher used a theoretical framework on decolonial digital education (Souza *et al*., 2021; Walsh, 2013), based on three dimensions: space, knowledge/materials/content, and time, as well as the relationships and interactions that emerge in this educational context, with three research questions. The first question was about how digital colonialism appears veiled, invisible, underlying the proposals in the two institutions investigated, considering interaction with and in digital

[5] About the protests: https://dig.watch/updates/thousands-of-artists-protest-ais-unlicensed-use-of-their-work. Accessed on Nov. 25, 2024.

educational practices. The second question investigated which aspects of digital colonialism and decoloniality can be perceived in the educational practices analysed. The third question was about the relevance of decoloniality to the academic proposal, which has become more evident in multilearning projects in Brazil.

As a theoretical reference, in addition to the Freirean perspective for a transformative educational practice (Freire, 1988), the pedagogy of multilingualism proposed by the New London Group[6] in the 1990s was used. It brought together various researchers for whom language studies needed to take into account the advances brought about by digital technologies, such as changes in communication, the multimodality of different textual structures and images.

This research explored digital colonialism – the exploitation of personal data for corporate profit – drawing on Coldry and Mejias (2019). Unlike historical colonialism, data colonialism operates subtly through manipulative marketing and opaque data mining, reinforcing corporate control over digital learning spaces. The study (Mendonça, 2023) identified three layers of digital colonialism: a) infrastructure: the technological platforms that dictate learning conditions; b) content**:** whether materials are culturally diverse, open-access, or dominated by Global North perspectives; c) interactions: how digital environments shape methodologies, relationships, and time management. Drawing from decolonial studies, the research highlights the *coloniality of knowledge* (the suppression of non-Eurocentric worldviews) and the *coloniality of being* (the dominance of Western thought in shaping human subjectivities and social practices (Quijano, 2009)).

The lack of platform regulation fosters aggressive engagement tactics and excessive digital consumption. To counter this, decolonial pedagogy promotes questioning and disrupting colonial structures by valuing non-European knowledge and identities (Walsh, 2013). Hui's (2020) concepts of *cosmotechnics* and *technodiversity* further emphasize how technology is shaped by diverse cultural and philosophical worldviews. Mendonça proposes a set of guiding questions to support a decolonial pedagogy in digital spaces, encouraging reflection on technical infrastructure, data circulation, and whether these elements foster equity, social justice, and decolonial relationships with knowledge and people.

3.6 Digital sovereignty and AI sovereignty

MSc. Alexandre Costa Barbosa, an associate researcher at the Weizenbaum Institute in Germany, has been working on his doctorate in digital public infrastructure design at the Berlin

[6] More information: https://www.sfu.ca/~decaste/newlondon.htm. Accessed on Nov. 28, 2024.

University of the Arts. Digital sovereignty and AI sovereignty were two topics that were widely discussed in the different G20[7] working groups, under the presidency of Brazil in 2024.

In order to understand the current relevance of the term digital sovereignty, it is important to remember that the Internet itself is made up of layers. There is the application layer visible to users, but there is also the transport layer, which is how data communicates and travels. There is an Internet protocol, IP, and there is also the physical layer at the base, which hosts all this traffic, such as submarine cables, terrestrial cables, satellites, towers, transmission etc.

The concept of sovereignty has evolved from its 16th-century origins with Jean Bodin[8], where it was linked to the divine authority of kings, to Rousseau's[9] 18th-century idea of popular sovereignty, which shaped modern nation-states. Over time, sovereignty expanded beyond territorial and state control to represent the self-determination of social groups, encompassing political, legal, and normative dimensions. With the rise of the commercial internet in the late 1990s, efforts to standardize the "information society" emerged. By the 2010s, digital sovereignty gained global attention, especially after Edward Snowden's revelations. It revolves around three key aspects: state sovereignty (control over digital infrastructure and policies), national industrial policy (developing domestic digital industries), and individual autonomy (citizens' ability to understand and control digital tools).

Efforts toward digital sovereignty have led to regulatory initiatives worldwide, with European countries pioneering laws to govern digital platforms and services, influencing nations like Brazil. In 2022, researchers and activists urged President Luiz Inácio Lula da Silva to adopt policies ensuring digital sovereignty, warning against strategic data being stored in North American big tech cloud centers (Barbosa; Gonsales, 2025). Meanwhile, feminist, labor, and Indigenous movements advocate for digital infrastructure as public goods based on open-source standards. Applied to AI, digital sovereignty means a nation's ability to develop, regulate, and secure AI systems while considering cybersecurity and environmental impact (Belle, 2023). In 2023, FGV

[7] Group of 20 countries: members of the G20 are: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Republic of Korea, Mexico, Russia, Saudi Arabia, South Africa, Türkiye, the United Kingdom, the United States, the African Union and the European Union.

[8] "considered the father of the modern theory of sovereignty, a consequence of his effort to build a rational theoretical basis capable of sustaining monarchical authority and, at the same time, subjecting its power to some limits, especially those arising from Natural Law" (Santiago *et al.*, 2014 p. 15, free translation). https://repositorio.idp.edu.br/bitstream/123456789/1533/1/Cr%C3%ADtica%20%C3%A0%20Teoria%20do%20Estado%20O%20conceito%20tradicional%20de%20soberania.pdf. Accessed on Nov. 28, 2024.

[9] "In Rousseau are the foundations of a social theory, which considers collective action as a condition for making the best decisions, capable of ensuring the common good" (ibidem, p. 30).

researchers introduced the KASE framework[10] to promote democratic and inclusive AI. The UN Secretary-General, António Guterres, called for international digital cooperation and an organization to promote digital public goods (DPG) and digital public infrastructures (DPI)[11]. DPGs include open software, data, AI models, and protocols that align with sustainable development goals and integrate into public digital infrastructures.

3.7 AI and climate change

MSc. Aline Andrade do Nascimento, a researcher at Brazil's National Institute for Space Research, highlighted differences in net CO_2 emissions[12] between Brazil and other emerging economies like China and India. According to the 2022 Greenhouse Gas Emissions and Removals Estimation System report[13], 66% of Brazil's CO_2 emissions come from vegetation changes, 29% from land use and forestry, and 37% from agriculture. The remainder comes from energy, waste, and industry. In contrast, China and India's emissions (60-80%) mainly stem from fossil fuel burning.

The CO_2 cycle is composed of three basic processes: (i) absorption through photosynthesis, (ii) storage through processes that maintain vegetation itself, and (iii) emission through autotrophic and heterotrophic[14] respiration processes and emission flows resulting from disturbances induced by human action. Deforestation, burning, and extractive activities release stored carbon from vegetation and soil into the atmosphere, leading to a positive carbon balance. This accumulation, along with other greenhouse gases, amplifies the greenhouse effect and contributes to global warming.

Nascimento used machine learning models to estimate net carbon exchange in the Amazon, incorporating meteorological, remote sensing, and flux tower data. The study aimed to enhance understanding of Amazonian ecosystems' carbon flux and environmental interactions. However, challenges include limited data availability, vast territorial diversity, sparse flux towers, and high

[10] KASE: Key AI Sovereignty Enablers, include sound (personal) data governance and algorithmic governance, strong computational capacity, meaningful connectivity, reliable electrical power, a digitally literate population, solid cybersecurity, and last, but not least, an appropriate regulatory framework (Belle, 2023).
[11] Our Common Agenda: https://www.un.org/en/common-agenda.
[12] The difference between the actual amount of CO2 emitted and the amount captured through natural or human-induced removal processes. An ecosystem is in balance when the amount of CO2 emitted is equal to the amount absorbed. If emissions exceed capture, net emissions are positive, generating global warming; when capture is greater than total emissions, net emissions are negative.
[13] The most recent report, launched in 2023, pointed out the agricultural sector takes the lead in the country, with 38% of total greenhouse gases in 2023, followed by energy and land use change in a virtual tie (25% each), industrial processes and waste (6% each). https://oc.eco.br/wp-content/uploads/2024/11/FINAL_SEEG_emissoes_2024_v7.pdf. Acessed on Feb. 7, 2025.
[14] Autotrophic respiration: process by which plants use CO2 from photosynthesis to produce nutrients for their growth and maintenance; Heterotrophic respiration is the process by which living beings seek nutrients by feeding other living beings, respiration can be by fermentation or aerobics.

cloud cover affecting satellite measurements. A generalized model risks favoring certain regions over others due to the region's ecological heterogeneity.

The researcher used machine learning models and meteorological data from the ERA5[15] and Merge[16] products, together with other remote sensing data to estimate a daily time series of net CO_2 exchange in the period from 2002 to 2011, considering three towers in the Tapajós National Forest. The measured values were validated and tested in a tower located in Manaus, to assess their generalization capacity.

As a result of the estimation of net CO_2 emissions using machine learning techniques, the researcher found that the Random Forest[17] and Gradient Boosting[18] algorithms performed best performance metrics in the estimation, combined with remote sensing data surpassing traditional "fluxcom" models. The study demonstrated the potential of AI in improving CO_2 emission estimates, despite data limitations. Future research should explore new models and predictors for even more accurate results.

4 Discussion

The multidisciplinary review of AI in education explored through the workshops above offers a rich set of critical reflections of the possible implications of recent technological developments for the trajectories that education may take over the following decades. Based on the various themes raised by the early career researchers, we draw a series of recommendations to education stakeholders to respond in a critical and human-centered approach to the accelerated development of AI and its continued incorporation in educational policies, systems and processes.

Firstly, we stress the need for educational practitioners, decisionmakers and researchers to review the simplistic and deeply decontextualized view of technology as a mere "tool" that aids teaching and learning. Technologies in Education need to be understood within their broader and more diverse contextual groundings. This includes, for instance, 1) their materiality and the natural and human resources (and abuses) required to build them, 2) the economic drivers that often see

[15] ERA5-Land is an hourly and monthly dataset of land surface meteorological variables since 1950, created by the European Centre for Medium-Range Weather Forecasts and available for public use. https://cds.climate.copernicus.eu/datasets/reanalysis-era5-land-monthly-means?tab=overview. Accessed on December 6, 2024.

[16] More information: https://ftp.cptec.inpe.br/modelos/tempo/MERGE/READ_ME-MERGE.pdf. Accessed on December 6, 2024.

[17] "Random Forest (RF) is a machine learning algorithm that is based on the concept of ensemble learning. (...) combining predictions from multiple machine learning algorithms (decision trees) in order to obtain more accurate predictions than any individual model." (Nascimento, 2024, p. 16).

[18] "The Gradient Boosting (GBoost) algorithm works in a similar way to Random Forest, as it creates multiple simple models and combines them to ensure better estimation performance. It builds a predictive model by combining several simple decision trees" (Nascimento, 2024, p. 17). More information: https://www.fluxcom.org/CF-Products/. Accessed on December 6, 2024.

education as a site of profit and extraction, or 3) the political drivers that use the rhetoric of innovation as a flag of prosperity. Situating technology in education within its wider contextual mechanics, we argue, is crucial to deal in a more sustainable and equitable way with the impacts these may have in the so called 'planetary era' (Morin, 2023; Bridle, 2022). In Morin's words:

> Understanding our times means, in fact, understanding the globalization that drives the human adventure, which has become planetary interdependent, made up of actions and reactions, particularly political, economic, demographic, mythological and religious; it means trying to question the future of humanity, which, through the joint engines of science/technology/economy, is driven towards an "augmented man" but in no way improved, and towards a society governed by algorithms, which tends to be guided by artificial intelligence and, at the same time, to transform us into banal machines. At the same time, these same science/technology/economy engines in turn lead to interdependent catastrophes: degradation of the biosphere and climate change, which lead to massive migrations; multiplication of deadly threats with the increase in nuclear weapons, chemical weapons and the emergence of computer weapons, capable of disintegrating societies. All of this causes anguish, withdrawal into oneself, and delusional fanaticism. (Morin, 2023, online, our translation)

Secondly, we call for a recognition of education as a field of knowledge, practice and, above all, as a site with enormous responsibilities with human rights. Such recognition demands openness to epistemic plurality in our understanding of the meaning and purpose of education and its relationship technologies. This implies the assumption that there is no single or correct way of defining educational needs and priorities and challenging the top-down model (Esteva, 2014) of inherited futures, often shaped by Global North perspectives. Instead, we urge education stakeholders to pluralise sociodigital futures of education through a legitimate exploration of local needs of educational practitioners, communities and learners. This reflection is very present, for example, in Mendonça's and Barbosa's research (Section 3.5 and 3.6) on Colonialism and Digital Sovereignty, reported in this essay, who questions – what do we need to do to build our own futures and also our sociodigital identity?

This question takes us to Facer's (2011) work on the 'myth of the future'. Facer problematises the way in which community-led futures have been deemed as non-viable, by two well established narratives taking over educational futures. The first narrative concerns the inevitability of the competitive market economy to which education needs to adapt as quickly as possible. The second narrative involves the failure of educators and education to meet the changing technological times of the contemporary world. She argues that both narratives are often reproduced and absorbed as indisputable, so that the future cannot be shaped by people and communities, but rather determined and it is up to society to adapt (Facer, 2011). Even in Kawanishi's workshop about cyborgs (Section 3.2), a notorious metaphor used by activist researchers like Haraway (2006) to nominate our intrinsic relationship with the machines, the main motivation for the biohackers was to become more competitive. Thinking about the future, however, means thinking from a place, a territory, an identity and with that a particular set of concerns. In this sense, education should ask itself how it can

contribute to mitigating inequalities and thereby foster more just and democratic futures. We need to ask "Who benefits?" (Facer, 2011, p. 20) in any of these narratives of the future that are offered to us or that we are working towards.

Thirdly, and linked to the 'myth of the future' reflections above, we encourage the educational community to be critical of the power imbalance of discourses about AI in education, and to take an active role in exploring diverse voices that debate the introduction of these systems in education, not taking for granted the assumptions and aspirations of the dominant discourses. As Fernandes's workshop (Section 3.3) proposed, when education is pressured to align uncritically with a competitive market logic, it often justifies practices like large-scale data extraction in the name of "innovation." This means a commodification of learning risks, which Mendonça's workshop (Section 3.5) criticises when discussing how students can become raw material for data extration (Zuboff, 2019). Barbosa's workshop also shed lights on this (Section 3.6) by discussing the level of control that EdTech has over public services and university infrastructures (Amiel *et al.*, 2023; Williamson, 2024), leaving aside deeper pedagogical concerns such as ethics, consent, and contextual learning.

Building sociodigital futures with a hospitality lens means freeing education from technological and commercial imperatives, and notions of development. There is a need to shape technologies according to civic values, such as respecting copyright and engaging in the debate on climate change, as highlighted by Alvarenga (Section 3.4) and Nascimento (Section 3.7) respectively. Education should resist universalisation, and avoid being reduced to producing digitally compliant workers rather than critically engaged citizens constituted by body, cognition and emotions, as argued by Leporace (Section 3.1).

The workshop themes align with Facer's (2011) call to challenge the idea of a single, inevitable future is especially relevant here: if students are not invited to question who imagines the future and for whom, education fails to equip them with the tools to envision and claim plural, equitable futures. By not addressing the difference between a future imposed by external agents and collectively constructed futures, schools become complicit in reproducing inequalities. Educators and policymakers, therefore, must resist deterministic narratives and instead foster spaces where students can imagine (and shape) alternative, socially just sociodigital futures.

In this sense, AI's social, ethical and environmental challenges should be part of the educational policy agenda, based on a broader view of the types of futures that are being imposed by the technology industry. Sriprakash *et al*. (2024) propose that the educational field considers alternative sociodigital futures from the lenses of four values to design research agendas, curriculum and regulation of the EdTech sector: reparation, sovereignty, care and democratisation. Only by looking at the process and practices in which education and technologies are mutually constituted can

we seek educational futures that respond to diverse needs of students, teachers and ensure the ongoing protection of the environment.

As researchers, it is our responsibility to actively promote a deeper, more critical engagement with AI and the futures-in-the-making, in order to rethink the intra-actions[19] (Barad, 2007) between human and digital technologies. Moreover, it is the duty of governmental education systems to demand transparency and accountability regarding the environmental impacts of the AI technologies that they intend to adopt within an educational policy. It is worth remembering, as pointed out by Fernandes (Section 3.3), that children and young students are holders of rights, who have been forced to authorise and/or consent to the use of their data on opaque platforms and applications to access educational content. Therefore, it is crucial to challenge dominant technosolutionist discourses and seek hospitable, reparative sociodigital futures of education and EdTech that dismantle and redress past and present injustices.

5 Concluding remarks

The research examples in this paper urge us to engage in discussions about how education, whether as a field of knowledge or as a social sector that provides a fundamental human right, can broaden its repertoire by engaging in sociodigital futures-making practices rather than simply executing future visions determined by external agents, such as AI companies. It is urgent for future investigation to see how we might build relevant pedagogies that promote a comprehensive vision and essential values based on the idea of fostering alternative, more just and sustainable sociodigital futures.

We conclude with a call for action to continue strengthening intra/transdisciplinary, hospitable efforts in sociodigital futures research that attend not only to human-machine entanglements, but also the environmental impact of these technologies, a key issue for thinking about futures. A pertinent case is the environmental and cultural implications of Generative AI in Latin America, as the infrastructure will cause a substantial increase in electronic waste on the planet. A study published in the scientific journal Nature Computational Science (Wang *et al*. 2024) calculates that computer servers specifically for GenAI could cause up to five million metric tonnes of e-waste by 2030. This is equivalent to a thousand times the total produced in 2023, since the technologies and hardware infrastructures (data centres) require constant and accelerated updating and improvement. Previous studies have already indicated that the maintenance of AI systems would use 4.5 per cent of global energy production by 2030 (Schwaller, 2024).

[19] Barad (2007) formulated the proposal of intra-actions as opposed to "inter-action"; the central idea is to indicate the inseparability between subject and object, or between observed and observer, i.e. phenomena that make up the world need to be considered in their relational dynamics.

Interestingly, the year 2030 also represents a global milestone for achieving the United Nations' 17 Sustainable Development Goals (UN-SDGs). Practically all of the goals are related to environmental preservation, even if they are not explicitly mentioned in the title, such as SDG9, on Innovation and Infrastructure, which includes AI data centres. Similarly, SDG4, which emphasizes the urgency of Quality, Equitable and Inclusive Education, dialogues with the environmental issue from a pedagogical point of view, especially because it involves a complex ecosystem of demands. As Barbosa (Section 3.6) highlighted, the role of digital sovereignty in education is closely related to combating extractive and profiling practices led by the EdTech industry. The work by early career researchers described in this essay is a hopeful step towards inter/transdisciplinary collaborations and interventions that take into account local and global contexts, and make more sustainable sociodigital futures in education for Brazil, Latin America and beyond.

Acknowledgments

We would like to thank the researchers who contributed to the series of workshops, the National Council for Scientific and Technological Development (CNPq) for financially supporting this research in the modality Doctoral Scholarship (140935/2022-3), to CAPES-PRINT for the Internationalisation Grant (88887.836851/2023-00) and also the support of the Economic and Social Research Council (ESRC) (ref. ES/W002639/1) is gratefully acknowledged.

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