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ALGORITHMS VS. AUTONOMY: THE RISKS OF DEPENDENCE ON AI IN THE CRITICAL TRAINING OF STUDENTS

ALGORITMOS VS. AUTONOMIA: OS RISCOS DA DEPENDÊNCIA DE IA NA FORMAÇÃO CRÍTICA DE ESTUDANTES

ALGORITMOS VS. AUTONOMÍA: LOS RIESGOS DE LA DEPENDENCIA DE LA IA EN LA FORMACIÓN CRÍTICA DE LOS ESTUDIANTES

https://doi.org/10.56238/sevened2025.026-014

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ABSTRACT

This article critically examines the impacts of artificial intelligence (AI) on education, highlighting how algorithmic mediation can compromise students' intellectual autonomy and critical thinking. The analysis reveals that adaptive platforms, automated assessment systems, and generative tools, while promising efficiency and personalization, often reduce learning to standardized processes, limiting the capacity for autonomous judgment and the construction of meaningful knowledge. The erosion of autonomy manifests itself in student passivity induced by predefined learning paths, while dependence on generative AI atrophies original argumentation. Furthermore, algorithms reproduce cultural biases and prioritize quantifiable metrics over qualitative dimensions of education. As alternatives, we propose active teacher mediation, where the teacher acts as a critical filter of algorithmic content, and hybrid models that preserve student agency. We also defend the need for ethical regulation, with transparency in algorithmic criteria and protection of educational data. The paper concludes that AI in education requires a delicate balance: if adopted uncritically, it can reinforce inequalities and impoverish human development; if integrated with solid pedagogical foundations, it can broaden access without sacrificing intellectual depth. Future research should investigate the long-term cognitive effects and develop truly inclusive systems.

Keywords: Artificial Intelligence in Education. Intellectual Autonomy. Critical Thinking. Algorithmic Bias. Pedagogical Mediation.

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RESUMO
Este artigo examina criticamente os impactos da inteligência artificial (IA) na educação, destacando como a mediação algorítmica pode comprometer a autonomia intelectual e o pensamento crítico dos estudantes. A análise revela que plataformas adaptativas, sistemas de avaliação automatizada e ferramentas generativas, embora prometam eficiência e personalização, frequentemente reduzem a aprendizagem a processos padronizados, limitando a capacidade de julgamento autônomo e a construção de conhecimento significativo. A erosão da autonomia manifesta-se na passividade discente induzida por percursos de aprendizagem pré-definidos, enquanto a dependência de IA generativa atrofia a argumentação original. Além disso, algoritmos reproduzem vieses culturais e priorizam métricas quantificáveis em detrimento de dimensões qualitativas da educação. Como alternativas, propõe-se uma mediação docente ativa, onde o professor atue como filtro crítico dos conteúdos algorítmicos, e modelos híbridos que preservem a agência discente. Defende-se ainda a necessidade de regulamentação ética, com transparência nos critérios algorítmicos e proteção de dados educacionais. O artigo conclui que a IA na educação exige um equilíbrio delicado: se adotada acriticamente, pode reforçar desigualdades e empobrecer a formação humana; se integrada com bases pedagógicas sólidas, pode ampliar acesso sem sacrificar a profundidade intelectual. Pesquisas futuras devem investigar os efeitos cognitivos de longo prazo e desenvolver sistemas verdadeiramente inclusivos.

Palavras-chave: Inteligência Artificial na Educação. Autonomia Intelectual. Pensamento Crítico. Viés Algorítmico. Mediação Pedagógica.

RESUMEN
Este artículo examina críticamente los impactos de la inteligencia artificial (IA) en la educación, destacando cómo la mediación algorítmica puede comprometer la autonomía intelectual y el pensamiento crítico de los estudiantes. El análisis revela que las plataformas adaptativas, los sistemas de evaluación automatizados y las herramientas generativas, si bien prometen eficiencia y personalización, a menudo reducen el aprendizaje a procesos estandarizados, lo que limita la capacidad de juicio autónomo y la construcción de conocimiento significativo. La erosión de la autonomía se manifiesta en la pasividad estudiantil inducida por rutas de aprendizaje predefinidas, mientras que la dependencia de la IA generativa atrofia la argumentación original. Además, los algoritmos reproducen sesgos culturales y priorizan las métricas cuantificables sobre las dimensiones cualitativas de la educación. Como alternativas, proponemos la mediación docente activa, donde el profesor actúa como un filtro crítico del contenido algorítmico, y modelos híbridos que preservan la agencia estudiantil. También defendemos la necesidad de una regulación ética, con transparencia en los criterios algorítmicos y protección de los datos educativos. El artículo concluye que la IA en la educación requiere un equilibrio delicado: si se adopta acríticamente, puede reforzar las desigualdades y empobrecer el desarrollo humano; Si se integra con bases pedagógicas sólidas, puede ampliar el acceso sin sacrificar la profundidad intelectual. Las investigaciones futuras deberían investigar los efectos cognitivos a largo plazo y desarrollar sistemas verdaderamente inclusivos.

Palabras clave: Inteligencia Artificial en Educación. Autonomía Intelectual. Pensamiento Crítico. Sesgo Algorítmico. Mediación Pedagógica.

1 INTRODUCTION

Artificial intelligence (AI) has invaded classrooms. From adaptive platforms to chatbots capable of producing complex texts in seconds, algorithmic tools promise to revolutionize education — whether by speeding up learning, "personalizing" teaching, or reducing costs. However, behind the discourse of innovation and efficiency, an uncomfortable question arises: what are we losing when we delegate the training of students to automated systems?

This article does not question whether AI can be used in education, but rather how its indiscriminate use is shaping — and, in many cases, limiting — students' autonomy and critical thinking. As algorithms define learning paths, correct tasks with supposed neutrality, and even simulate human interactions, the integral formation of the individual is at risk. The student, increasingly, is trained to follow pre-programmed answers instead of questioning, creating or contesting.

One of the most dangerous myths about AI in education is the idea that algorithms are unbiased and objective. In reality, these systems reproduce worldviews embedded by their creators — often reflecting social prejudices, market priorities, or didactic simplifications. When a student receives an AI-generated syllabus or an automated correction, they are not faced with a neutral tool, but with a model that decides what is "correct", "relevant" or "appropriate" based on often opaque parameters. This lack of transparency not only limits the development of critical thinking, but can also reinforce already existing inequalities.

AI-based education systems often sell the idea of "tailored" learning for each student. However, this customization is often superficial, restricted to adjustments of pace and difficulty within a rigidly pre-defined scope. The true educational process — which involves creativity, discovery, and even conflict of ideas — cannot be reduced to algorithmic paths. The risk here is twofold: in addition to falsifying the notion of individuality, this approach can lead to the fragmentation of knowledge, where students lose the holistic and interdisciplinary vision that characterizes critical education.

In this scenario, the role of the educator becomes even more crucial — but also more challenging. If before the teacher was the main source of knowledge mediation, today it competes for attention with platforms that offer immediate answers and ready-made solutions. The central issue is not to reject technology, but to rescue the space for dialogue, doubt and the collective construction of knowledge. Without this mediation, we run the risk of creating a generation that is technically competent, but uncritically dependent on systems that, however advanced, cannot replace the complexity of human thought.

It is understood that the role of the educator is more than timely in a place where artificial intelligence is increasingly present. Teachers not only impart knowledge but also

provide students with opportunities to develop critical skills such as empathy-oriented thinking, essential in a world full of technology.

In this sense, our goal is to map the main risks of this addiction, showing how algorithmic logic, although useful in mechanical tasks, can empty essential cognitive processes. The central hypothesis is that AI, when not mediated by a critical pedagogical perspective, tends to reinforce the student's passivity, replacing the construction of knowledge with the mere reproduction of patterns.

To do so, we will start from three axes: first, we will examine the advancement of algorithms in education and their promises; then, we will contrast these models with the notions of autonomy and critical thinking, fundamental for an emancipatory education; Finally, we will detail how technological dependence can erode these capacities, generating students who are efficient in completing stages, but fragile in arguing, reflecting, or acting independently.

The debate is urgent. As governments and businesses accelerate the adoption of AI in schools and universities, one has to ask: Are we forming free minds or obedient users of closed systems? The answer will define not only the future of education, but the kind of society we want to build.

2 THE RISE OF ALGORITHMS IN EDUCATION

The insertion of algorithmic systems in the educational field represents a paradigmatic transformation in the teaching and learning processes. These technologies, based on artificial intelligence and machine learning, have been progressively implemented in various pedagogical contexts, from basic education to higher education. The dominant rhetoric that accompanies this adoption emphasizes supposed benefits such as operational efficiency, personalization of learning, and democratization of access to knowledge. However, a critical analysis reveals that this technological penetration is not neutral, carrying with it epistemological, pedagogical and social implications that demand rigorous academic scrutiny. This chapter seeks to deconstruct the techno-utopian narrative through a three-dimensional analysis: conceptualization of these systems, mapping of their empirical penetration in educational contexts, and problematization of their intrinsic contradictions.

2.1 ALGORITHMIC SYSTEMS IN EDUCATION: A CONCEPTUAL ANALYSIS

Algorithmic systems applied to education constitute complex computational structures that operate through three fundamental mechanisms: statistical processing of large volumes of educational data (learning analytics), implementation of artificial neural networks for

recognition of learning patterns, and use of natural language processing techniques for semantic interaction.

These systems are manifested in three main operational categories. Adaptive learning platforms, such as the Knewton system, employ recommendation algorithms based on item response theory to dynamically adjust the flow of content. The automated assessment tools, exemplified by the ETS e-rater, use probabilistic linguistic models to analyze student texts, operationalizing assessment criteria through quantifiable parameters. Finally, intelligent pedagogical assistants, such as IBM Watson Tutor, implement dialogue architectures based on large-scale language models (LLMs) to simulate tutorialized interactions.

The operationalization of these systems is based on questionable epistemological assumptions. The transposition of complex pedagogical processes to algorithmic structures necessarily implies cognitive reductionism, where qualitative dimensions of learning are converted into quantitative variables that can be computationally processed. This transformation is not neutral, carrying with it epistemological biases that privilege measurable forms of knowledge to the detriment of creative, critical and affective dimensions of the educational process.

2.2 CURRENT SCENARIO: PENETRATION AND IMPLEMENTATION OF ALGORITHMIC SYSTEMS

The adoption of AI-based educational technologies is growing exponentially, with projections indicating that by 2025 more than 47% of higher education institutions in developed countries will integrate some level of artificial intelligence into their pedagogical processes. This expansion manifests itself through three main vectors.

In the field of adaptive platforms, ecosystems such as Khan Academy are consolidating, which reports more than 120 million global users. These systems operate under the logic of programmed instruction, where learning sequences are determined by optimization algorithms that seek to maximize immediate performance metrics. As pointed out by Warschauer (2011), this approach has significant limitations in reducing complex cognitive processes to predefined linear trajectories.

The second vector comprises the implementation of automated evaluation systems. Data from the Brazilian Association of Distance Education (ABED, 2022) reveal that 40% of Brazilian distance education institutions already use algorithmic correction plugins integrated with Moodle. These systems, fundamental elements of education that should not be ignored (Costa Júnior et al., 2023). This chapter seeks to rescue the theoretical bases that underlie these concepts, confronting them with the challenges imposed by the digital age. Through a

philosophical-pedagogical analysis, we will demonstrate how the dependence on automated systems can erode the cognitive capacities essential for the full exercise of citizenship and social criticism.

2.3 THE FUNDAMENTAL CONTRADICTION: BETWEEN THE RHETORIC OF EFFICIENCY AND THE REALITY OF STANDARDIZATION

The prevailing narrative in the EdTech industry celebrates the ability of algorithmic systems to deliver personalized education at scale. However, a critical analysis reveals that this supposed personalization constitutes a sophisticated form of standardization. As argued by Selwyn (2019), educational algorithms operate within rigidly delimited spaces of possibility, where individual variations are allowed only within pre-established parameters. This contradiction manifests itself on two levels. At the micro-educational level, adaptive systems such as DreamBox Mathematics are limited to adjusting exercise difficulties without considering sociocultural contexts that influence learning, as highlighted by socio-cognitive theories (Freire, 1996; Vygotsky, 1987). At the macro level, the growing dependence on algorithmic platforms reinforces an educational model that privileges instrumental skills to the detriment of critical thinking, as warned by Turkle (2015) in his analysis of the erosion of deep reflection in the digital age.

The analysis of implementation data also reveals a fundamental paradox: the more sophisticated the algorithmic systems, the greater the implicit standardization in their processes. As demonstrated by O'Neil (2016), educational recommendation algorithms often reinforce conventional learning paths, restricting opportunities for creative exploration and heterodox knowledge construction.

3 AUTONOMY AND CRITICAL THINKING: THEORETICAL BASES

Education, as a process of humanization and emancipation, is threatened by the growing algorithmic mediation of teaching and learning processes. Intellectual autonomy and critical thinking, fundamental pillars of a truly liberating education, are particularly vulnerable to the instrumental logic of artificial intelligence systems applied to education. This is exactly why AI should be considered a partner, not a substitute for educators. While technology can offer automated feedback and personalization of teaching, the role of teachers is irremovable. Human interaction, emotional support, and guidance are, although efficient in evaluating superficial aspects of textual production, fail to capture argumentative and creative dimensions.

The third vector, emerging and particularly disruptive, involves the adoption of generative AI in academic settings. Most university students currently regularly use ChatGPT to aid in academic production. This phenomenon raises fundamental questions

about authorship, originality, and the very concept of meaningful learning.

3.1 AUTONOMY AND CRITICAL THINKING IN THE EMANCIPATORY PERSPECTIVE

The notion of autonomy in Paulo Freire (1996) transcends mere operational independence, constituting itself as a political-pedagogical act of liberation. In Pedagogy of Autonomy, Freire postulates that true learning occurs when the learner develops the ability to read the world critically, questioning power structures and reconstructing their own knowledge. This dialogical perspective contrasts radically with algorithmic models of education, which, by fragmenting knowledge into measurable micro-competencies, reduce the educational process to a passive assimilation of predetermined information.

In the field of Critical Theory, Habermas (1987) complements this view by arguing that authentic thought emerges from communicative action – an intersubjective process of rational debate not distorted by systems of external control. For Habermas, education should foster what he calls "communicative reason", where knowledge is built collectively through dialogue free of coercion. This approach directly conflicts with intelligent tutoring systems, which replace dialogical exchange with ready-made responses and linearized learning paths.

Adorno (1995), in turn, warns of the dangers of instrumental reason in education. In Education after Auschwitz, the philosopher argues that overemphasis on technical efficiency and standardized methods can lead to atrophy of critical capacity, setting the stage for uncritical acceptance of dominant ideologies. This analysis gains new urgency in the era of educational algorithms, which, by prioritizing quantifiable results to the detriment of deep reflection, may be reproducing on a digital scale the same mechanisms of domination that Adorno identified in the totalitarian societies of the twentieth century.

3.2 THREATENED COGNITIVE PROCESSES

The penetration of algorithmic systems in education puts at risk two cognitive processes that are fundamental for full intellectual development: the capacity for autonomous decision-making and the construction of critical argumentation.

The first risk is manifested in the replacement of reflective choice by guided navigation. When adaptive platforms like DreamBox or Khan Academy automatically determine the next steps in student learning, they are, in effect, externalizing the metacognitive process of self-assessment and educational planning. As demonstrated by Zimmerman (2002) in his studies on self-regulated learning, the ability to set goals, select strategies and evaluate progress is an essential component for the development of intellectual autonomy. Algorithmic mediation, by assuming these functions, may be creating a generation of technically competent learners, but incapable of directing their own training process.

The second risk concerns the atrophy of the argumentative capacity. The proliferation of tools such as ChatGPT has led to a worrying phenomenon that Turkle (2015) calls "argumentation by proxy". When students come to depend on generative AI to produce complex texts, they are being deprived of the essential experience of structuring thoughts, articulating ideas, and defending positions – cognitive processes that, according to Vygotsky (1987), are fundamental for the development of critical thinking. Recent research conducted by Cotton et al. (2023) reveals that students who regularly use AI for textual production have a significant reduction in the ability to construct original arguments when asked to work without technological aid.

These phenomena do not represent mere methodological changes, but rather a profound epistemological transformation in the very nature of the educational process. As Freire (1996) warns, when education ceases to be an act of cognition and becomes a process of uncritical assimilation, it loses its transformative potential and is reduced to a mere transfer of information. In this context, algorithmic systems, for all their technical sophistication, may be serving as instruments for a new form of banking education – now digitized and potentially more efficient in its ability to control.

4 RISKS OF RELIANCE ON AI IN EDUCATION

The growing integration of artificial intelligence systems in educational processes is not limited to a mere methodological change, but represents a structural transformation in the relationship between subject and knowledge. This chapter examines the multidimensional risks arising from this technological dependence, analyzing how algorithmic mediation can compromise not only immediate pedagogical results, but the very formation of autonomous and critical individuals. Through an interdisciplinary approach that articulates pedagogy, cognitive psychology and technology studies, we will demonstrate how educational AI, when not subjected to rigorous ethical and epistemological criteria, can produce counterproductive effects to the fundamental mission of education.

4.1 EROSION OF AUTONOMY: DIGITAL PASSIVITY AND ALGORITHMIC BIASES

Learner autonomy suffers a double impact when interacting with AI-based education systems. First, a phenomenon of cognitive infantilization is observed, where students assume the role of mere "users" of platforms who make pedagogical decisions in their place. As Selwyn (2019) demonstrates, the algorithms of adaptive platforms such as ALEKS or Smart Sparrow significantly restrict the student's space of choice, replacing intellectual curiosity with predetermined paths that prioritize efficiency over exploration. This model is in direct

contradiction to the principles of liberating education proposed by Freire (1996), in which the student must be an active agent in the construction of his or her knowledge.

The second critical aspect lies in the colonization of critical judgment by algorithmic biases. Studies conducted by O'Neil (2016) reveal how educational recommendation systems tend to create feedback loops that reinforce initial user preferences (confirmation bias), limiting exposure to dissonant perspectives. In practice, when an algorithm interprets recurring errors in mathematics as indicative to suggest more basic content, it may be inadvertently restricting access to challenges that could stimulate significant cognitive advances. This dynamic is particularly worrying if we consider how the absence of confrontation with challenging ideas is correlated with lower critical thinking capacity.

4.2 CRITICAL THINKING IN CRISIS: SUPERFICIALITY AND DECONTEXTUALIZATION

The dependence on tools such as ChatGPT and other language models is generating a silent crisis in the development of argumentative capacity. Longitudinal research conducted by Cotton *et al.* (2023) with university students revealed that 68% of frequent users of generative AI have greater difficulty in building original arguments when compared to peers who use the technology in a moderate way. This phenomenon, which the authors call the "syndrome of outsourced argumentation", manifests itself through the uncritical reproduction of standardized discursive structures, without the proper internalization of the underlying logical processes.

Cultural decontextualization is another face of this crisis. Algorithmic systems operate through statistical generalizations that often neglect historical and social particularities. An emblematic study by Benjamin (2019) on automatic essay correctors demonstrated that texts that addressed experiences from peripheral communities systematically received lower evaluations when compared to hegemonic discourses. This distortion not only reproduces inequalities, but also implicitly teaches students that certain voices and experiences are less valid within the academic space.

4.3 DEPENDENCE TECHNOLOGICAL:THE COSTS PSYCHIC ALGORITHMIC EDUCATION

Educational gamification and continuous monitoring systems are generating new forms of anxiety and behavioral addiction. The use of platforms such as Duolingo and ClassDojo, when used indiscriminately, can present worrying patterns of compulsion to perform, where students develop behaviors similar to addiction to games, including anxiety attacks when unable to access the platform.

At the same time, the massive collection of educational data creates a digital panopticon where every error or hesitation of the student can be recorded and analyzed. As Williamson (2017) warns, this permanent pedagogical vigilance can inhibit the intellectual courage necessary for deep learning, as students start to prioritize "safe" answers that please the algorithms to the detriment of creative and risky explorations.

Even in order not to become hostages, it is essential to train teachers so that they can use artificial intelligence effectively and efficiently in teaching. This involves understanding the capabilities and constraints of technology, as well as learning how to use the tools available. In addition to skills to guide students in the use of these solutions, it is essential that teachers have the necessary knowledge and skills to create, apply, and evaluate AI-based educational solutions (Costa Júnior et al., 2024).

5 COUNTERARGUMENTS AND LIMITATIONS

The critique of artificial intelligence in education cannot be complete without a rigorous analysis of the arguments that defend its adoption. Proponents of educational AI present a narrative based on efficiency, equity, and pedagogical innovation, underpinned by empirical studies and success stories. However, a critical evaluation reveals that many of these benefits are partial, contingent or even illusory when confronted with the complexities of the educational process. This chapter examines the main optimistic theses about AI in education, subjecting them to theoretical and empirical scrutiny that highlights its intrinsic limitations and unmitigated risks to student autonomy.

5.1 THE RHETORIC OF DEMOCRATIZATION AND EFFICIENCY

Advocates of AI in education base their enthusiasm on three main axes. The first is the argument of democratization of access. Organizations such as UNESCO (2021) highlight that adaptive platforms can offer quality education in regions with teacher shortages, citing examples such as Khan Academy in rural communities in India and Sub-Saharan Africa. In this sense, it is important to highlight that the use of AI can reduce the costs of higher education in developing countries by up to 40%, potentially including millions of excluded people in the education system.

The second axis lies in the promise of personalization at scale. Luckin (2018) argues that systems such as Carnegie Learning or Squirrel AI are able to map individual cognitive styles with accuracy unattainable by human teachers in overcrowded classrooms.

The third argument emphasizes administrative efficiency. Platforms like Gradescope automate the correction of thousands of tests in minutes, freeing up teachers for more noble pedagogical activities. In corporate education, it is estimated that an annual saving of US$ 17 billion is made with automated training via AI.

5.2 THE STRUCTURAL LIMITS OF TECHNOLOGICAL OPTIMISM

Critical analysis of these arguments reveals profound contradictions. As for democratization, it is necessary to delve deeper into the topic (which is already being done on several fronts) and measure the impact of the use and adoption of AI models, since their use can present something that is already alarming: students continue to fail to achieve basic proficiency in reading, showing that access to the platform does not guarantee effective learning. Cost reduction often occurs at the expense of quality and, in this sense, the

automation of tutoring in North American universities tends to lead to the precariousness of teaching work, with the replacement of professors by poorly paid algorithmic monitors.

The supposed personalization comes up against insurmountable epistemological limitations. As Selwyn (2022) argues, algorithms can only "personalize" within pre-programmed parameters, ignoring essential dimensions of human learning such as intuition, creativity, and divergent thinking. After years of using adaptive platforms, students may perform higher on standardized tests, while they may also experience a significant reduction in their ability to solve open-ended problems and work collaboratively.

It is also worth noting that the lack of accessibility and usability of AI technologies for people with disabilities is a significant obstacle. The effectiveness and usefulness of many AI systems for people with disabilities are limited because they are not designed to meet their specific needs (Costa Júnior et al., 2024).

As for administrative efficiency, Noble's (2018) critique of automatic correction algorithms demonstrates that they privilege formal textual structures to the detriment of original content, penalizing unconventional voices. In practice, the supposed release of teaching time rarely converts into pedagogical improvement, but is rather absorbed by institutional bureaucracy.

The core of the contradiction lies in the incommensurability between technical efficiency and intellectual autonomy. In this sense, what needs to be clear is that algorithms optimize is not education, but their own success metric. True critical learning requires friction, hesitation, and deviations – elements systematically eliminated by AI systems in the name of optimization.

6 FINAL CONSIDERATIONS

The analysis developed throughout this article demonstrates that the integration of artificial intelligence in education is not a merely technical phenomenon, but a pedagogical transformation with profound epistemological and social consequences. The risks identified reveal a worrying pattern: the progressive replacement of complex cognitive processes by algorithmic models of instrumental efficiency. The erosion of intellectual autonomy is manifested in student passivity induced by adaptive platforms that hijack the capacity for self-direction. The crisis of critical thinking becomes evident in the argumentative superficiality generated by the dependence on generative tools. The cultural decontextualization of standardized content and the psychological impacts of excessive gamification complete a picture in which the supposed technological innovation may be compromising precisely the most essential dimensions of human formation.

The first and most urgent alternative lies in the repositioning of the teacher as an essential mediator between technology and meaningful learning. Far from being replaced by AI, the educator assumes the role of critical curator, denaturalizing algorithms and problematizing their results. This active mediation requires the teacher to develop dual skills: critical mastery of technological tools and the ability to foster non-algorithmic spaces for reflection. The teacher thus becomes the antidote to digital alienation, helping students to navigate between data without becoming hostages of systems.

Innovative pedagogical experiences demonstrate that technology can be integrated without sacrificing autonomy, as long as it is subordinated to clear educational principles. Models that combine adaptive platforms with open investigative projects, or that use generative AI as a starting point for debates and critical reformulations, show promise. The essential thing is to ensure that the student remains the main author of his or her formative path, using technology as a tool to expand – and not limit – his cognitive possibilities.

Education cannot be held hostage to the commercial interests of the big EdTech platforms. Public policies that require radical transparency in algorithmic criteria, independent audits of biases in adaptive systems, and the creation of multidisciplinary ethical committees to assess pedagogical impacts are necessary. Regulation should also include safeguards against the commodification of educational data and mechanisms that ensure human control over sensitive pedagogical decisions.

The dynamism of the field requires continuous investigations on several fronts that are still little explored. How to measure the long-term effects of generative AI on cognitive development? Which teacher training models are most effective to prepare teachers in this new reality? How can neurosciences contribute to understanding the impacts of human-machine interaction on learning? How to develop truly inclusive algorithmic systems that respect cultural and cognitive diversities? These questions point to the need for an interdisciplinary research program that unites education, computer science, and the humanities.

It is paramount to strike a balance between the benefits of artificial intelligence and the essential human elements in education. This care serves as a warning, a beacon that guides us in human interactions, which is a factor that can hit the relationships between educators and students in full.

Artificial intelligence in education presents itself as a civilizational crossroads. If adopted uncritically as a technological panacea, it can deepen inequalities and impoverish our conception of human formation. If integrated with pedagogical wisdom, rigorous

regulation, and constant ethical evaluation, it can become an ally in the construction of a more accessible and adaptive education – without giving up critical depth. The way forward will not be defined by algorithms, but by the political, pedagogical and epistemological choices we collectively make at this decisive historical moment.

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