Revista EDaPECI
EDUCAÇÃO A DISTÂNCIA E PRÁTICAS EDUCATIVAS COMUNICACIONAIS E INTERCULTURAIS

ISSN: 2176-171X

Revista EDaPECI
São Cristóvão (SE)
v.26. n. 2, p. 4-14
mai./ago. 2026

DOI: http://dx.doi.org/10.29276/redapeci.2026.26.224515.4-14

A "critical use" of technology: epistemological contributions of critical theory of technology to distance education

---

O "uso crítico" da tecnologia: contribuições epistemológicas da teoria crítica da tecnologia para a educação a distância

---

El «uso crítico» de la tecnología: contribuciones epistemológicas de la teoría crítica de la tecnología a la educación a distancia

Francis Pereira Dias Ferreira[1]
Marina Bazzo de Espíndola[2]
Roseli Zen Cerny[3]

Abstract: *What is the meaning of adopting a critical use of technology? And how does it reframe educational practices? Although there is a broad consensus on the need for a critical approach to technology, the absence of a consistent epistemological framework constrains the development of methodological models that align pedagogical intentionality with instructional design. This study examines the evolution of Critical Theory of Technology (CTT) and its implications for distance education, articulating its critical epistemology with current educational challenges. CTT provides a theoretical basis for overcoming technocratic perspectives by framing technology as a sociotechnical construct embedded with values, interests, and power relations. The analysis explores CTT's assumptions and their application in education, highlighting how a critical framework supports the ethical and democratic appropriation of technology. Findings suggest that CTT has the potential to transform pedagogical practices by fostering a dialogical, reflective, and emancipatory educational model grounded in critical technology use.*

Keywords: *Critical Theory of Technology. Critical use. Distance education. Epistemology.*

Resumo: O que implica um uso crítico da tecnologia, e como isso pode ressignificar as práticas educacionais? Embora haja consenso quanto à necessidade de um olhar crítico, a ausência de uma conceituação epistemológica consistente limita a construção de abordagens metodológicas que integrem a intencionalidade e o direcionamento pedagógico. Investiga-se a evolução da Teoria Crítica da Tecnologia (TCT) e suas implicações para a EaD por meio de análise que articula sua epistemologia crítica aos desafios atuais. A TCT oferece um referencial para superar a visão tecnocrática da tecnologia, ao reconhecê-la como construção sociotécnica permeada por valores, interesses e poder. Examinam-se os pressupostos da TCT e sua aplicação à educação, evidenciando como um referencial crítico favorece a apropriação ética e democrática das tecnologias. A análise aponta seu potencial para transformar práticas pedagógicas, promovendo um modelo educacional dialógico, reflexivo e emancipador, com uso crítico da tecnologia.

Palavras-chave: Educação a distância. Epistemologia. Teoria Crítica da Tecnologia. Uso crítico.

Resumen: *¿Qué implica un uso crítico de la tecnología y cómo puede esto resignificar las prácticas educativas? Si bien existe consenso sobre la necesidad de una perspectiva crítica, la ausencia de una conceptualización epistemológica consistente limita la construcción de enfoques metodológicos que integren la intencionalidad*

1 Doutoranda no Programa de Pós-Graduação em Educação Científica e Tecnológica (PPGECT) da Universidade Federal de Santa Catarina (UFSC), Técnica de Laboratório na UFSC, francispdias@gmail.com.
2 Doutora em Educação, Gestão e Difusão em Biociências, Professora no Programa de Pós-Graduação em Educação Científica e Tecnológica (PPGECT) da Universidade Federal de Santa Catarina (UFSC), marina.bazzo@ufsc.br.
3 Doutora em Educação, Professora no Programa de Pós-Graduação em Educação Científica e Tecnológica (PPGECT) da Universidade Federal de Santa Catarina (UFSC), roseli.cerny@ufsc.br.

y la dirección pedagógica. Este estudio investiga la evolución de la Teoría Crítica de la Tecnología (TCT) y sus implicaciones para la educación a distancia mediante un análisis que articula su epistemología crítica con los desafíos actuales. La TTC ofrece un marco para superar la visión tecnocrática de la tecnología, reconociéndola como una construcción sociotécnica permeada por valores, intereses y poder. Se examinan los supuestos de la TTC y su aplicación a la educación, destacando cómo un marco crítico favorece la apropiación ética y democrática de las tecnologías. El análisis señala su potencial para transformar las prácticas pedagógicas, promoviendo un modelo educativo dialógico, reflexivo y emancipador con un uso crítico de la tecnología.

Palabras-clave: *Educación a distancia. Epistemología. Teoría Crítica de la Tecnología. Uso crítico.*

1 INTRODUCTION

The term "critical use" of technology in education has been recurrently invoked in institutional discourses, public policies, curricular proposals, and pedagogical practices. However, such usage does not necessarily reflect an understanding of its epistemological and political implications. The expression is often employed superficially, reduced to a functionalist and technical perspective that equates criticality with efficiency or with mere compliance with predetermined pedagogical goals. This uncritical appropriation weakens the term's transformative potential, concealing the conflicts, interests, and rationalities that shape the integration of technology into the educational field.

A substantial understanding of "critical use" requires moving beyond reductionist approaches. The first step is to recognize that technology is both complex and ubiquitous. As a human and social phenomenon, technology transcends its instrumental dimension and functions as a mediating force that transforms human relationships with the world, with oneself, and with others. It entails contradictions: while it fulfills needs and facilitates communication, it also produces unemployment, pollution, and economic dependency (Medeiros; Medeiros, 2010). For this reason, technology must be examined through multiple dimensions. According to Mitcham (1994), it is an object, a mode of knowledge, a specific form of activity, and an expression of volition. Technology is not merely a set of tools or utilitarian practices; it is a symbolic and ontological construct capable of redefining modes of being and acting (Cupani, 2017). In this multifaceted context, where cultural and political forces are deeply embedded in social, historical, and ethical dynamics, technology, including digital technologies, is also integrated into the educational domain.

This complexity becomes even more challenging in distance education, where technology plays a central role in mediating teaching and learning (Belloni, 2015). Digital technologies not only enable new forms of access to knowledge, but also reproduce and, in many cases, intensify inequalities, power structures, and mechanisms of control (Pretto; Bonilla; Sena, 2020). In Brazil, where distance education has played a strategic role in the democratization of educational access (Belloni, 2015; Bevort; Belloni, 2009), these contradictions become particularly evident (Cerny, 2009). Digital platforms, although often praised for their capacity to reach large audiences, frequently reduce the educational experience to an instrumental and technicist logic, privileging metrics of efficiency and control over meaningful interaction, critical reflection, and student autonomy (Cerny, 2009; Cerny; Almeida; Espíndola, 2023; Espíndola; Cerny; Rocha; Neto, 2022).

This article proposes a theoretical and conceptual analysis of the term "critical" based on Critical Theory of Technology, articulating its epistemological foundations and its contributions to the challenges of distance education. To address the central question concerning the notion of critical use of technology, this study adopts epistemology as the basis for historically situating the development of Critical Theory of Technology and for examining its implications for understanding the relationship between technology and society (Cupani,

2004; Feenberg, 1999; 2022; Kujawski, 1994; Mitcham, 1994; Ortega Y Gasset, 1991). Subsequently, the discussion examines how the Critical Theory of Technology engages with the field of distance education (Belloni, 2015; Cerny, 2009; Cerny; Espíndola, 2016), considering its contemporary challenges and analyzing how a critical approach can reframe pedagogical practices.

2 HISTORICAL AND EPISTEMOLOGICAL FOUNDATIONS OF THE CRITICAL THEORY OF TECHNOLOGY

The term "critical use of technology," widely disseminated in both academic literature and popular discourse (Feder, 2024), does not emerge by chance but rather stems from a historical and conceptual trajectory rooted in philosophical debates on technology and society. Among the various approaches (Cupani, 2017; Mitcham, 1994), this study centers on the most influential authors in the epistemological construction of Critical Theory of Technology (CTT) (Feenberg, 2003). To grasp the complexity of this topic, it is essential to clarify the meanings of "critical" and "technology." For this purpose, the study draws on epistemology, a branch of philosophy concerned with the nature and limits of knowledge (Abbagnano, 2007). By examining its foundations and transformations, it becomes possible to identify the conceptual tensions and educational implications involved

The first step is to understand the etymology of the term critical. Derived from the Greek krisis, the word crisis means separation, rupture, and judgment or decision (Santos, 2017). According to Santos (2017), a crisis leads individuals to critique, as knowledge involves distinguishing and separating elements; we apprehend reality gradually, not all at once. Although various philosophers have addressed crisis and critique, within the framework of Frankfurt School critical theory, critique is reframed not as abstract questioning, but as a tool for exposing present contradictions and identifying their underlying barriers (Cupani, 2004; Cupani, 2017). In this view, critique plays an active role in social transformation and becomes central to analyzing the relationship between technology and power (Cupani, 2017). Santos (2017) further argues that crisis and critique are inseparable from the act of knowing itself. All knowledge entails a process of separation (diakrisis), which inevitably generates crisis, as understanding something also reveals what remains unknown. Thus, critique not only exposes limits and contradictions, but also opens possibilities for new understandings and transformations. This conceptual framework underpins the notion of critique adopted in this study.

The evolution of the concept of critique also broadens the understanding of technology, shifting it from a purely instrumental view to a more reflective approach (Medeiros; Medeiros, 2010). Technical positivism, whose tradition traces back to Francis Bacon and Auguste Comte, was consolidated in the twentieth century by Mario Bunge, who conceived technique as a rational system for controlling nature, grounded in universal laws and empirical predictability. According to Bunge, technology must be analyzed objectively, as a body of scientific knowledge applied to problem-solving (Cupani, 2017). However, this approach disregards the political and social implications of technology, a central aspect of the Critical Theory of Technology.

Technological positivism holds that technological advancement leads to continuous progress and can solve all human difficulties (Cupani, 2017; Neder, 2010). This perspective remains prevalent, particularly in Bunge's reflections on demotechnical [1] society (Cupani,

1 In Bunge's work, the term *demotechnical* refers to a model of society in which scientific and technological progress is governed by democratic and participatory control. As the author explains: "To be effective, democratic control of technical progress would have to involve not only technicians, their professional organizations, and the state, but also firms (whether private or cooperative), consumers, and all those who might be affected by technical innovations. The orderly participation of these various groups, often with conflicting interests, would gradually contribute to the construction of a technodemocratic or, if preferred, demotechnical society" (Bunge, 2012, p. 44).

2017). According to Bunge (1985), although technology involves a creative component, it functions within a structured rational system guided by the application of scientific principles. However, this view disregards that technological choices are not neutral; they entail structural implications that go beyond the mere functionality of artifacts.

The Frankfurt School was a pioneer in problematizing the relationship between technology and domination. In Dialectic of Enlightenment (1947), Adorno and Horkheimer argue that instrumental rationality became the dominant mode of thought under administered capitalism, eliminating concrete possibilities for emancipation and subjecting individuals to a system from which they cannot escape (Cupani, 2017; Mitcham, 1994). Marcuse extends this critique by showing that technology not only structures power relations, but also shapes subjectivity, rendering individuals incapable of conceiving alternatives to the existing system (Cupani, 2017; Feenberg, 2022). This shaping of consciousness, which he terms the "one-dimensional man", reveals how technical rationality is intertwined with the preservation of social order.

Habermas introduces an epistemological shift by distinguishing between instrumental rationality and communicative rationality (Feenberg, 2022). Habermas argues that the Frankfurt School's critique faces a fundamental impasse: if instrumental rationality entirely dominates society, on what basis can it be questioned? To overcome this aporia, Habermas differentiates between technical logic, oriented toward efficiency and control, and communicative rationality, aimed at mutual understanding and democratic deliberation (Cupani, 2017). Unlike his predecessors, he does not view technology as inherently a means of domination, but emphasizes that its use depends on the normative contexts in which it operates. As Cupani (2004) notes, Habermas accepts technical applications, provided they are subordinated to democratic deliberative processes.

Langdon Winner deepens this discussion by showing that some technologies are not only used politically, but also embed power structures within their very design. His study of the atomic bomb exemplifies how certain artifacts require a centralized and hierarchical model of social organization, thereby reinforcing relations of domination (Cupani, 2004; Cupani, 2017). The core implication of this approach is that technology is never neutral: its material configuration and conditions of use directly shape the structure of power.

Beyond the Frankfurt School tradition, contemporary approaches such as Actor–Network Theory (ANT) shifted the debate by treating technology not merely as a means of domination, but as an active agent in the construction of social relations. Bruno Latour, Michel Callon, and John Law reject both technological determinism and sociocentric perspectives, emphasizing that technical artifacts possess agency and actively shape the social world. In this view, technology and society cannot be analyzed separately, as they co-emerge in hybrid networks composed of both human and non-human actors (Cupani, 2017).

Although Actor-Network Theory rejects reductionist explanations, its lack of an explicit normative stance distances it from the concerns of the Frankfurt School, which seeks to understand the political and ideological implications of technology. Likewise, the phenomenology of technology (Cupani, 2004; Cupani, 2017) focuses on how artifacts structure human experience, while avoiding a broader framing of the systemic effects of technology. Both approaches describe sociotechnical interactions and modes of technological mediation, yet they stop short of proposing a concrete project of social transformation.

Considering this landscape, Feenberg (1999) highlights substantivism as a counterpoint to both instrumentalism and technological determinism. While instrumentalism, more associated with the liberal framework, holds that technology is a neutral tool whose social impact depends solely on its use, technological determinism asserts that technical advancement is the primary driver of histori-

cal transformation, shaping social structures regardless of human agency. Substantivism, by contrast, offers a more radical view, contending that technology is not merely a means, but an autonomous system that imposes specific values and ways of life (Neder, 2010).

Against this epistemological backdrop, Andrew Feenberg develops Critical Theory of Technology (Feenberg, 1999; 2002; 2003; 2017; 2022; Neder, 2010), which seeks to synthesize the concerns of the Frankfurt School with contemporary pragmatic approaches. Feenberg rejects both deterministic pessimism and the technological neutrality claimed by positivism. He argues that technology is not neutral, yet neither is it an inevitable vehicle of domination. In his view, technology constitutes a contested terrain in which different agents can intervene to redefine its uses and meanings (Neder, 2010). Thus, critical engagement with technology does not merely analyze its distortions, but also identifies its suppressed potential, enabling its democratic and emancipatory reappropriation.

3 CRITICAL USE OF TECHNOLOGY ACCORDING TO CRITICAL THEORY OF TECHNOLOGY

Previously, this study examined how critique and technology each carry their own conceptual frameworks. For Feenberg, the critical use of technology differs from instrumentalism, which assumes the neutrality of technique, and from determinism, which treats technology as an autonomous force shaping society independently of human agency. Critical Theory of Technology argues that technology constitutes a contested domain in which different social actors can intervene to redefine its uses and meanings (Feenberg, 2003), as summarized in Figure 1.

This approach contrasts with the pessimism of the first generation of the Frankfurt School, particularly Adorno and Horkheimer (1985), who regarded technical rationality as an inescapable instrument of domination (Table 1) (Neder, 2010). Feenberg distances himself from this fatalism by arguing that although technology is value-laden, it can be democratically reappropriated, thereby enabling the emergence of emancipatory alternatives (Feenberg, 2022).

Critical Theory of Technology is grounded in a critique of technological determinism, which treats technical progress as an autonomous and inevitable process, and of naïve instrumentalism, which views technology as a neutral means (Figure 1) (Neder, 2010). Feenberg moves beyond this dichotomy by recognizing that technology is socially constructed and open to democratic reappropriation (Feenberg, 2003). His proposal engages with phenomenology, particularly Heidegger's critique of modern technology (Neder, 2010). Heidegger argued that technology reduces nature to a standing reserve of available resources. However, while Heidegger adopts a fatalistic stance, suggesting that technology inevitably leads to alienation, Feenberg (1999) contends that technology can be re-signified through social intervention. Incorporating elements from sociotechnical constructivism and Science and Technology Studies (STS), Feenberg maintains that technical artifacts are neither neutral nor exclusively determined by technical or economic factors, but result from processes of social negotiation (Feenberg, 1999; 2002; 2003; 2017; 2022; Neder, 2010).

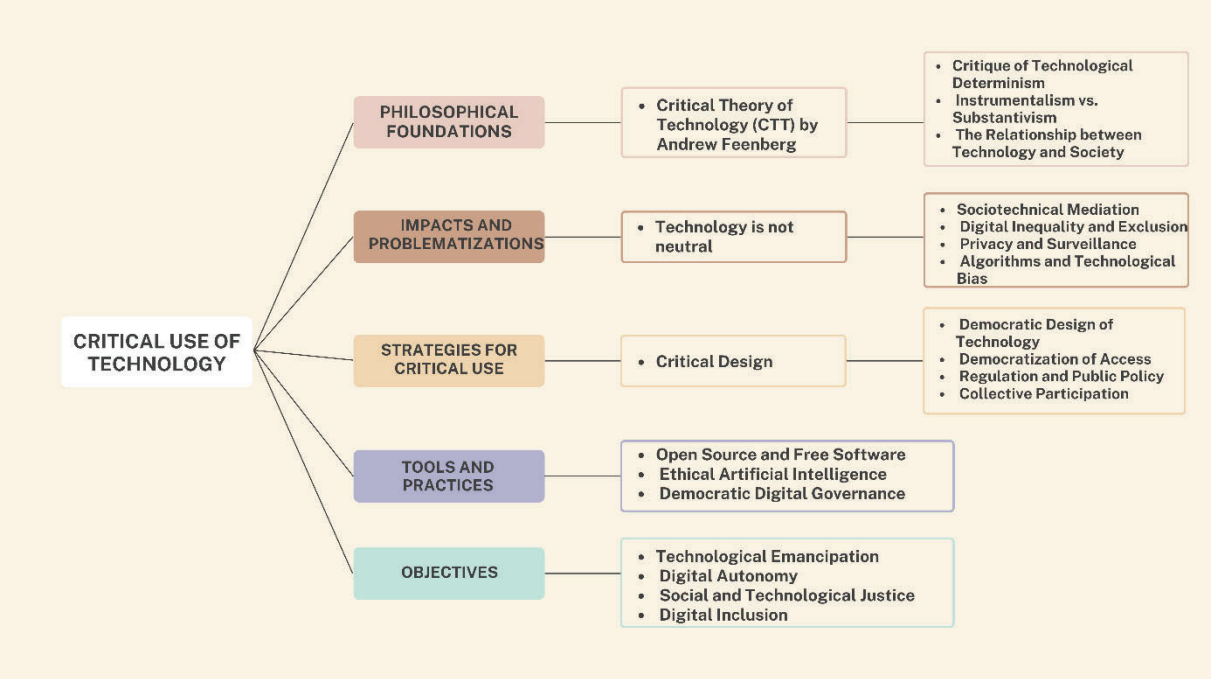
Within the Frankfurt School tradition, Critical Theory of Technology rejects the technological determinism of the first generation while preserving the critique of instrumental rationality. Drawing on Marcuse, Feenberg conceives of technology as a political arena in which diverse actors may intervene to reconfigure its uses (Cupani, 2017). However, whereas Marcuse suggested that only a radical transformation of social structures could alter the trajectory of technology, Feenberg argues that there is room for intervention within technical design itself. This theoretical shift implies that the democratization of technology does not depend solely on large-scale social revolution, but can also emerge through incremental re-significations within technical systems (Cupani, 2004).

The critical use of technology recognizes that technical artifacts shape lifestyles, pow-

er relations, and social practices (Figure 1). Feenberg emphasizes that "technology is not merely the rational control of nature; both its development and its impact are intrinsically social" (Feenberg, 2022). Critical use, therefore, requires identifying the values embedded in technical systems, analyzing how they influence everyday life, and reinterpreting their applications in the direction of more democratic and sustainable models (Feenberg, 2022). This process involves the social mediation of artifacts, the democratization of technological decision-making, and the critique of the implicit assumptions underlying technical choices.

To achieve this, it is necessary to reject both technological determinism, which denies the possibility of human intervention, and naïve instrumentalism, which assumes technology to be a mere means without structural effects. Moreover, technical development must not be guided exclusively by efficiency and profit, but must incorporate ethical, social, and environmental considerations. The critical use of technology, therefore, not only examines its impacts, but also proposes structural changes in design and implementation processes to ensure that technologies serve the public interest and promote social justice.

Figure 1 – Conceptual map summarizing the main aspects of the critical use of technology, highlighting its philosophical and epistemological foundations, sociotechnical impacts, intervention strategies, technological tools and practices, as well as its emancipatory goals.



Source: Illustration created by the author (2025).

This perspective is embodied in the concept of critical design (Feenberg, 2017), which advocates for the dialogical and participatory reappropriation of technologies. Rather than being passively accepted, technologies can be modified to break away from their initially determined functionality, creating space for new forms of social and pedagogical interaction.

In the field of education, Critical Theory of Technology (CTT) proposes a transformation that goes beyond mere adoption of technological tools, focusing instead on the restructuring of pedagogical processes. This means that technology users, including teachers and students, must play an active role in shaping and designing the technical systems used in education. A significant example of this process is distance education (DE), which has historically been dominated by technocratic models that reduce technology to a means of automated

content delivery. Such an approach neglects its potential to foster critical interaction and active student participation.

Feenberg (1999) distinguishes between primary instrumentalization and secondary instrumentalization in education. The former refers to reducing technology to a set of objectives, operational functions, without regard for its social impact. The latter seeks to recover the social, cultural, and political values neglected in technical design, enabling technology to be appropriated in more democratic and meaningful ways. In the context of DE, this distinction is crucial to prevent educational platforms from reinforcing a one-dimensional logic of instruction and, instead, to design them to support dialogical interaction, collaboration, and students' intellectual autonomy.

Thus, the critical integration of technology in education requires not only the implementation of new technologies, but also a structural transformation of pedagogical practices and digital learning environments. The democratic rationalization of technology in education implies that users, formerly passive, actively influence the design and implementation of educational systems, ensuring that technology serves not only operational efficiency, but also the collective construction of knowledge and the intellectual emancipation of students.

Table 1- Comparative Table of Theories of Technology: Epistemological Origins, Conceptual Evolution, and Educational Implications

Period	17th–19th Century	Early 20th Century	1920s–1940s	1960s–1980s	1980s–1990s	1990s–Present
Approach	Positivism.	Substantivism and phenomenology.	Frankfurt School (1st generation).	Frankfurt School (2nd generation).	Actor–Network Theory (ANT).	Critical Theory of Technology (CTT).
Key Authors	Francis Bacon, Auguste Comte, Mario Bunge.	Jacques Ellul, Martin Heidegger, Don Ihde.	Adorno, Horkheimer, Marcuse.	Habermas.	Latour, Callon, Law.	Feenberg.
Conception of Technology	Instrument of progress and control over nature.	An autonomous system that shapes society and imposes values.	Instrument of domination and reproduction of technical rationality.	Medium for communication and rational interaction, though subject to systemic colonization.	Heterogeneous network of human and non-human actors in constant reconfiguration.	Sociotechnical arena shaped by political and cultural choices.
Nature of Technology	Neutral; the result of rational and scientific advancement.	Non-neutral; it imposes specific ways of life and reduces human autonomy.	Non-neutral; linked to capital and social control.	Potentially neutral, but frequently instrumentalized by power.	Neither inherently neutral nor fully determined; its impact emerges from sociotechnical interactions.	Non-neutral; a structure of power that can be democratically re-signified.
Technology–Society Relation	Technology drives social progress, and society must adapt to it.	Technology develops independently and subordinates' society to its internal logic.	Technology not only reflects, but reinforces relations of domination and alienation.	Technology can serve emancipation if linked to communicative rationality.	Society and technology are co-constructed; no separation between the technical and the social.	Technology reflects power relations, but can be transformed through democratic interventions.

Period	17th–19th Century	Early 20th Century	1920s–1940s	1960s–1980s	1980s–1990s	1990s–Present
Role of Users	Users as passive recipients of technological innovations.	Users as alienated subjects subordinated to technique.	Users as passive recipients, though Marcuse suggests potential for resistance.	Users can be critical and participatory agents if deliberative spaces are available.	Users as active actors, though without a normative stance on technological transformation.	Users as transformative agents who can modify both the design and use of technology.
Analytical Focus	Continuous technological development for societal benefit.	Demonstrate that technology imposes patterns and restricts human autonomy.	Reveal how technology perpetuates alienation and social control.	Differentiate between technical and communicative rationality.	Map and describing interactions among various actors in sociotechnical networks.	Overcome technical rationality and enable critical appropriation.
Epistemology	Empiricist and deterministic epistemology.	Existentialist (phenomenological) and critical (substantivism) epistemology.	Critical and dialectical epistemology, influenced by Marxism.	Pragmatic and discursive epistemology, based on rational consensus.	Pragmatic and relational epistemology, without commitment to emancipatory values.	Critical epistemology, influenced by the Frankfurt School and sociotechnical pragmatism.
Example of Application in Education	Use of instructional technologies for standardized content delivery, prioritizing efficiency and control.	Critique of dependence on proprietary educational technologies and digital alienation, arguing that platforms limit students' creativity and autonomy.	Analysis of distance education (DE) as an extension of the culture industry, where technology reinforces uncritical thinking and commodification.	Proposal of a dialogic educational model in which digital technologies foster critical argumentation and active student participation.	Study of how educational platforms reconfigure teaching–learning relations, analyzing how teachers, students, and algorithms shape educational processes.	Critical reappropriation of distance education technologies, enabling teachers and students to modify interfaces, challenge algorithmic prescription, and use open, collaborative platforms to strengthen autonomy and co-creation of knowledge.

Source: Data collected and organized by the authors (2025).

4 FROM EPISTEMOLOGY TO EDUCATION: THE CRITICAL USE OF TECHNOLOGY IN EDUCATIONAL CONTEXTS SUCH AS DISTANCE EDUCATION

Distance education (DE) has become, in recent decades, a central strategy for expanding access to higher education in Brazil, driven by policies aimed at democratizing access (Inep, 2022). However, this massification has occurred without a thorough debate on its epistemological and pedagogical foundations, resulting in the predominance of an instrumentalist, market-oriented model. Digital platforms, often treated as neutral operational tools, tend to restrict the autonomy of educational subjects and weaken the collective construction of knowledge (Bizzo, 2009).

Critical Theory of Technology (CTT), as discussed throughout this study, offers an essential framework for problematizing this reductionist view of educational technology. Based on the epistemology of technology (Cupani, 2017; Feenberg, 2022; Kujawski, 1994; Mitcham, 1994; Neder, 2010), it is understood

that technology is not an isolated phenomenon, but develops within a web of social, political, and economic values. Feenberg (1999) rejects both technological determinism, which views technical advancement as an autonomous and inevitable process, and naïve instrumentalism, which assumes technology to be a neutral means. When applied to DE, this approach shifts the debate away from mere operational efficiency toward a broader analysis of the sociotechnical mediations that structure pedagogical processes.

The distinction between primary and secondary instrumentalization (Feenberg, 1999) helps explain how educational platforms are often structured under a logic of control and efficiency, simplifying the complexity of teaching through the automation of content and assessment. However, educational technology can be re-signified by shifting the focus from content delivery to the creation of dialogical environments that promote co-authorship, experimentation, and active student participation (Espíndola; Cerny; Rocha; Neto, 2022; Pereira-Dias; Espíndola, 2022). For this to occur, the first step is to reduce dependence on proprietary platforms and to encourage the use of open technologies, thereby allowing greater flexibility in adapting educational resources to local needs (Alonso, 2017; Belloni, 2002; 2015; Bevort; Belloni, 2009; Cerny, 2009; Cerny; Espíndola, 2016).

The growing adoption of artificial intelligence (AI) in DE presents a new challenge within this framework. Personalized learning algorithms, often portrayed as pedagogical advances, may reinforce technological alienation by replacing teacher mediation with automated systems for monitoring and assessment. Feenberg (2017) warns that when educators and students lose control over technological processes, they become passive users of opaque and unquestionable systems (Feenberg, 2022). This problem becomes even more serious when decisions about platform design and implementation are centralized in private corporations, excluding educators, students, and society from the design process. In such cases, educational materials are not always preserved, leading to the historical loss of collectively built knowledge.

The critique of uncritical uses of technology in education is not new. Marcuse warned of the risks of the technologization of teaching (Cupani, 2017), emphasizing that the focus on efficiency could suppress the reflective dimension of learning. Habermas argues that technology should be embedded in a context of communicative rationality (Cupani, 2017), in which subjects can collectively deliberate about its purposes and social consequences. In Brazil, several authors and research groups have observed that many DE initiatives, when structured through closed digital platforms, tend to reinforce centralized pedagogical processes and limit teacher autonomy (Cerny; Almeida; Espíndola, 2023; Espíndola; Cerny; Xavier, 2020).

In light of this scenario, applying Critical Theory of Technology to distance education requires a change in perspective. Rather than treating technology as a neutral or inevitable element, it must be understood as historically determined and, therefore, open to contestation and transformation. This approach implies reviewing educational policies related to DE to ensure that its expansion is not tied exclusively to market interests but rather to a genuine commitment to educational democratization and social justice (Zuboff, 2018).

To make this shift viable, it is essential to invest in the critical training of educators, students, administrators, and technical staff, equipping them with the knowledge needed to understand the sociotechnical dynamics shaping digital platforms and to intervene actively in their development (Espíndola, 2023). Furthermore, the adoption of policies that encourage the use of free software and participatory governance in educational technology can help expand user autonomy and strengthen a culture of pedagogical innovation grounded in collective participation.

From an epistemological perspective, this study has demonstrated that the critical integration of technology in distance education cannot be reduced to the adoption of new tools or methodologies. It must be grounded in

a deeper inquiry into the values that guide its application and the structural conditions that shape its use. The epistemology of technology enables the analysis of power relations that permeate digital education, making spaces for resistance and transformation more visible.

Critical Theory of Technology not only problematizes traditional models of distance education, but also points to pathways for its re-signification. By proposing that technology be incorporated in emancipatory ways, this approach reinforces the need for an education based on dialogue, collaboration, and learner autonomy (Belloni, 2002). These elements make clear that DE cannot be reduced to issues of access and expansion (Inep, 2022). Instead, it must be understood as part of a broader epistemological and political debate on the future of technology-mediated education. As Belloni (2002) emphasizes, DE should not be conceived merely as a model of instruction, but as a contested field over the modes of knowledge production and circulation in contemporary society. In this regard, Critical Theory of Technology contributes to the development of an educational model that goes beyond reproduction and actively promotes personal and social transformation.

REFERÊNCIAS

ABBAGNANO, N. **Dicionário de Filosofia**. São Paulo: Martins Fontes, 2007. 1026 p.

ALONSO, K. M. Cultura Digital e Formação: entre um devir e realidade pungentes. *In*: CERNY, R. Z.;RAMOS, E. M. F*., et al* (Ed.). **Formação de Educadores na Cultura Digital: a construção coletiva de uma proposta**. Florianópolis: UFSC - CED - NUP, 2017. p. 23–40.

BELLONI, M. L. Ensaio sobre a educação a distância no Brasil. **Educação e Sociedade,** v. 23, p.117–142, 2002. DOI: https://doi.org/10.1590/S0101-73302002000200008 Disponível em: https://www.scielo.br/j/es/a/yvpWm7vFNqhpZYMtjn8kHZD/abstract/?lang=pt. Acesso em: 8 set. 2025.

BELLONI, M. L. **Educação a Distância**. Campinas: Autores Associados, 2015.

BEVORT, E.; BELLONI, M. L. Mídia-Educação: Conceitos, história e perspectivas. **Educação e Sociedade,** v. 30, p.1081–1102, 2009. DOI: https://doi.org/10.1590/S0101-73302009000400008. Disponível em: https://www.scielo.br/j/es/a/5pBFdjL4mWHnSM5jXySt9VF/?lang=pt. Acesso em: 8 set. 2025.

BIZZO, N. Ensino de ciências e EAD. *In*: LITTO, F. M. e FORMIGA, M. M. M. (Ed.). **Educação a Distancia: o estado da arte**. Pearson Education do Brasil: São Paulo, 2009. p. 188–195.

BUNGE, M. **Philosophy of science and technology: parte I, formal and physical sciences.** Dordrecht: Reidel, 1985.

CERNY, R. Z. **Gestão Pedagógica na Educação a Distância: análise de uma experiência na perspectiva da gestora.** 2009. 263 f. - Programa de Pós-Graduação em Educação, Pontifícia Universidade Católica, São Paulo.

CERNY, R. Z.; ALMEIDA, E. V. D.; ESPÍNDOLA, M. B. D. O Desenvolvimento de Tecnologias pela Escola Como um Processo de Luta e Resistência Contra-Hegemônica. **Sisyphus - Journal of Education,** v. 11, p.109–133, 2023. DOI: https://doi.org/10.25749/sis.29422. Disponível em: https://www.redalyc.org/journal/5757/575777387007/. Acesso em: 16 jul. 2025.
CERNY, R. Z.; ESPÍNDOLA, M. B. D. Formação de Professores para à Integração das TDIC ao Currículo. *In*: MACIEL, C. A. e PANIAGO, M. C. (Ed.). **Educação a distância: integração entre sujeitos, plataformas e recursos**. Cuiabá: EduFMT, 2016. p. 463–494.

CUPANI, A. A tecnologia como problema filosófico: três enfoques. **Scientia Studia,** v. 2, p.493–518, 2004. DOI: Disponível em: Acesso em:

CUPANI, A. **Filosofia da Tecnologia: um convite**. Florianópolis: Editora UFSC, 2017. 233 p.

ESPÍNDOLA, M. B. D.; CERNY, R. Z.; ROCHA, J. M. G. D.; NETO, F. F. S. Creation of Digital Educational Technologies by School Subjects a process of emancipation. **Dialnet,** v. 10, p.7–21, 2022. DOI: https://doi.org/10.25749/sis.25417. Disponível em: https://dialnet.unirioja.es/servlet/articulo?codigo=9206879. Acesso em: 27 nov. 2025.

ESPÍNDOLA, M. B. D.; CERNY, R. Z.; XAVIER, R. S. As perspectivas de tecnologia dos educadores em formação: valores em disputa. **Revista Eletrônica de Educação,** v. 14, 2020. DOI: https://doi.org/10.14244/198271993833 Disponível em: http://educa.fcc.org.br/scielo.php?script=sci_arttext&pid=S1982-71992020000100316&nrm=iso. Acesso em: 8 dez. 2025.

ESPÍNDOLA, M. B. D. G., M. Abordagens Críticas em Tecnologia Educativa: questionamentos necessários. **Sisyphus: Journal of Education,** v. 11, p.6–10, 2023.

DOI: Disponível em: Acesso em: https://www.redalyc.org/articulo.oa?id=575777387001. Acesso em: 8 dez. 2025.

FEDER, R. São Paulo na vanguarda do uso consciente da tecnologia. **Folha de São Paulo,** São Paulo, p. 2024. Disponível em: https://www1.folha.uol.com.br/opiniao/2024/12/sao-paulo-na-vanguarda-do-uso-consciente-da-tecnologia.shtml. Acesso em: 8 dez. 2025.

FEENBERG, A. **Questioning Technology**. London: Routledge, 1999.

FEENBERG, A. **Transforming technology: A critical theory revisited.** London: Oxford University Press, 2002.

FEENBERG, A. **O que é a filosofia da tecnologia?** British Columbia: Universidade de Simon Fraser, 2003. 1–10 p. Disponível em: https://www.sfu.ca/~andrewf/books/What_is_Philosophy_of_Technology.pdf Acesso em: 12 out. 2025.

FEENBERG, A. **Technosystem : The Social Life of Reason**. Cambrigde: Harvard University Press, 2017.

FEENBERG, A. **Construtivismo crítico: a filosofia da tecnologia**. São Paulo: Associação Filosófica Scientiae Studia, 2022.

INEP. Censo da Educação Superior 2021: Divulgação dos Resultados. EDUCAÇÃO, D. D. E. E. M. D. Brásilia: Ministério da Educação**:** 2022.

KUJAWSKI, G. D. M. **Ortega y Gasset: a aventura da razão**. São Paulo: Moderna, 1994.

MEDEIROS, J. A.; MEDEIROS, L. A. **O que é a tecnologia?** . São Paulo: Brasiliense, 2010.

MITCHAM, C. **Thinking through Technology: The Path between Engineering and Philosophy.** Chicago: The University of Chicago Press, 1994.

NEDER, R. L. O que (nos) quer dizer a teoria crítica da tecnologia? *In*: NEDER, R. T. (Ed.). **Andrew Feenberg: racionalização democrática, poder e tecnologia**. Brasília: Construção Crítica da Tecnologia & Sustentabilidade, 2010.

ORTEGA Y GASSET, J. **Meditação sobre a técnica**. Rio de Janeiro: Instituto Liberal, 1991.

PEREIRA-DIAS, F.; ESPÍNDOLA, M. B. D. Ensino de Bioquímica durante a pandemia – um relato de uso de tecnologias na educação. **Revista de Ensino de Bioquímica,** v. 20, p.16–32, 2022. DOI: https://doi.org/10.16923/reb.v20i1.986. Disponível em: https://www.bioquimica.org.br/index.php/REB/article/view/986. Acesso em: 20 jun. 2020.

PRETTO, N. L.; BONILLA, M. H. S.; SENA, I. P. F. S. **Educação em tempos de pandemia: reflexões sobre as implicações do isolamento físico imposto pela COVID-19**. Salvador: Edição do Autor, 2020.

SANTOS, M. F. D. **Filosofia da Crise**. São Paulo: É Realizações, 2017.

ZUBOFF, S. Big Other: Capitalismo de Vigilância e Perspectivas para uma Civilização de Invormação. *In*: BRUNO, F.;BRUNO, C. K. M.*, et al* (Ed.). **Tecnopolíticas da Vigilância: Perspectivas de Margem**. São Paulo: Boitempo, 2018. p. 17–68.

Recebido em 12 de fevereiro de 2026
Aceito em 06 de julho de 2026