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CYBERCULTURE, CONNECTIVITY AND GenAI: foundations for an education in transformation

CIBERCULTURA, CONECTIVISMO E IAG: fundamentos para uma educação em transformação

CIBERCULTURA, CONECTIVISMO E IAG: bases para una educación en transformación

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Abstract
This study analyzes the convergence of the assumptions of Connectivism and the concepts proposed by Pierre Lévy in *Cyberculture* to investigate the use of generative artificial intelligence (GenAI) in education. Methodologically, this is a theoretical-analytical essay with a qualitative approach and an exploratory character. Without empirical procedures, the study proposes a critical reflection and articulation of theoretical frameworks. The analysis is developed in two parts: the first contextualizes epistemologies, introducing Connectivism in relation to Constructivism and Socio-constructivism; the second promotes a dialogue between the epistemological categories of Connectivism and the concepts presented in *Cyberculture*, examining their possible articulations with the use of generative artificial intelligence in education. The comparison between the five fundamental principles of Connectivism and Lévy's concepts reveals theoretical convergence, providing a coherent framework for understanding the potential uses of generative artificial intelligence in education. This theoretical convergence demonstrates the potential to overcome paradigms and update pedagogical practices, although it poses challenges related to the critical use, autonomy and ethical implications of technology.

Keywords: Generative Artificial Intelligence. Pierre Lévy. Epistemology. Connectivism.

Resumo
O estudo analisa a convergência dos pressupostos do conectivismo e de conceitos propostos por Pierre Lévy em *Cibercultura* para investigar o uso da inteligência artificial generativa (IAG) na educação. Metodologicamente, trata-se de um ensaio teórico-analítico, de abordagem qualitativa e caráter exploratório. Sem procedimentos empíricos, o estudo propõe

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uma reflexão crítica e articulação de referenciais teóricos. A análise desenvolve-se em dois movimentos: o primeiro contextualiza epistemologias, introduzindo o Conectivismo em relação ao Construtivismo e ao Socioconstrutivismo contemplando autores clássicos e contemporâneos da educação — em especial Piaget, Vygotsky, Siemens, Downes, Lévy e Saviani; o segundo promove um diálogo entre as categorias epistemológicas do Conectivismo e os conceitos apresentados em Cibercultura examinando suas possíveis articulações com o uso de inteligência artificial generativa na educação A comparação entre as cinco questões fundamentais do Conectivismo e os conceitos de Lévy revela convergência teórica, fornecendo um referencial coerente para compreender os potenciais usos da inteligência artificial Generativa na educação. Essa convergência teórica demonstra potencial para superar paradigmas e atualizar práticas pedagógicas, embora imponha desafios relacionados ao uso crítico, à autonomia e às implicações éticas da tecnologia.

Palavras-chave: Inteligência Artificial Generativa. Pierre Lévy. Epistemologia. Conectivismo.

Resumen
Este estudio analiza la convergencia de los supuestos del Conectivismo y los conceptos propuestos por Pierre Lévy en *Cibercultura* para investigar el uso de la inteligencia artificial generativa (IAG) en educación. Metodológicamente, se trata de un ensayo teórico-analítico con un enfoque cualitativo y carácter exploratorio. Sin procedimientos empíricos, el estudio propone una reflexión crítica y la articulación de marcos teóricos. El análisis se desarrolla en dos movimientos: el primero contextualiza las epistemologías, introduciendo el Conectivismo en relación con el Constructivismo y el Socioconstructivismo; el segundo promueve un diálogo entre las categorías epistemológicas del Conectivismo y los conceptos presentados en *Cibercultura*, examinando sus posibles articulaciones con el uso de la inteligencia artificial generativa en educación. La comparación entre las cinco preguntas fundamentales del Conectivismo y los conceptos de Lévy revela una convergencia teórica, proporcionando un marco coherente para comprender los usos potenciales de la inteligencia artificial generativa en educación. Esta convergencia teórica demuestra el potencial para superar paradigmas y actualizar las prácticas pedagógicas, si bien plantea desafíos relacionados con el uso crítico, la autonomía y las implicaciones éticas de la tecnología.

Palabras clave: Inteligencia Artificial Generativa. Pierre Lévy. Epistemología. Conectivismo.

Introduction

Since the 1960s, there have been records of technical and scientific revolutions related to cybernetics, biotechnology, information technology, and robotics, especially in the context of financial globalization and the production and marketing of goods and services. These technologies impact the world of work and deeply penetrate daily life and social relations, which are also reflected in the educational field.

The digital revolution in education has introduced new media and technologies into classrooms, altering the dynamics between students and teachers (Tamanini *et*

al., 2020). Several authors, such as Nóvoa (2018), Lévy (1997), and Castells (1999), warn of the risks of an uncritical and accelerated incorporation of these technologies. The increased emphasis on the use of technological resources during the COVID-19 pandemic, which began in 2020, intensified a movement that was already underway.

This movement, driven by the interests of capital and large private companies that dominate the technology sector, raises concerns about the control of processes, content, and users. The adoption of digital technologies in education often clashes with the perspectives of teachers and students, especially regarding the replacement or precarization of teaching work and the quality of education (Colemarx, 2020; Nóvoa, 2020). Rather than considering technologies as mere tools, it is essential, as Nóvoa (2020) argues, to reflect on the meaning of the changes they promote: what impacts, transformations, and implications do they cause?

Among the technologies that have significantly impacted education, are artificial intelligence (AI) and generative artificial intelligence (GenAI). Kaufman (2019) defines AI as a field focused on language, intelligence, learning, and problem-solving, fostering a symbiosis between humans and machines. Santaella (2019) argues that although human intelligence represents the pinnacle of complexity, AI still lacks more sophisticated functions. Nevertheless, it has been increasingly applied in educational contexts.

Since 2016, AI has become so widespread that, in many cases, it is difficult to separate the technique from its application, as in adaptive learning platforms (Mello, 2023). Platforms such as Khan Academy, Coursera, and Duolingo incorporate AI to adapt content to students' needs. Khamigo, for example, offers immediate and personalized *feedback;* Coursera adjusts content based on student progress; Duolingo calibrates the complexity of exercises in real time. Tools such as Coursera Coach, Khamigo, and Tutoria automate personalized corrections and feedback. Duolingo Max allows dialogue simulations with AI-generated characters.

GenAI, in turn, is a subfield of AI that uses computational techniques to learn, understand, and generate content in human language (Filatro, 2020). Its development was made possible by the Markov chain, the Turing machine, and subsequent advances in machine learning and artificial neural networks (Marchi,

2023). In education, GenAI has been used to personalize learning, automate assessments, and provide support through virtual assistants (Mello, 2023).

Virtual assistants have also been gaining ground as tools for educational support, as in the case of Georgia Tech's "Jill Watson," which automatically answers questions in forums. Predictive analytics, in turn, applies AI algorithms to predict academic performance, school dropout, and emotional and cognitive engagement. Arizona State University, for example, uses the eAdvisor system to identify struggling students and guide interventions. Tools like Khamigo also monitor student progress and generate data-driven reports.

Despite the progress, the implementation of AI raises essential concerns: issues of equity, data privacy, algorithmic biases, technological dependence, human interaction, and ethical implications. The question also arises: does AI promote learning? In what ways? For which age groups? These, however, are not questions that this study aims to answer.

The objective of this paper is to analyze the convergence of connectivist assumptions and Lévy's concepts to investigate the use of AI in education. It begins with the perception that few studies in the field of education address AI or GenAI from a consistent theoretical-epistemological perspective. Most publications focus on practical applications, disregarding alignment with educational and/or epistemological theories.

Some relevant exceptions include:

Marchi (2023), who analyzes the use of ChatGPT by students based on Knowles' andragogy, Jarvis' learning model and Illeris' dimensions.

Oliveira and Neves (2023), who discuss the use of GenAI from a critical and decolonial perspective, relating it to digital colonialism and academic standardization.

Schlemmer and Morgado (2024), who propose a technological architecture based on contemporary epistemologies, highlighting hyperconnectivity and complexity.

Ouyang and Jiao (2021), who describe three paradigms of GenAI and their pedagogical implications, connecting them to approaches such as Behaviorism, Constructivism and Connectivism.

Methodologically, this study is characterized as a theoretical-analytical essay as

proposed by Severino (2016) and Demo (2012), situated within the qualitative-interpretative field according to Lüdke and André (2012), and of an exploratory nature. It is an interpretative investigation, focused on critical reflection and the articulation of theoretical frameworks, without carrying out empirical procedures. The central purpose is to analyze, from an epistemological perspective, the relationship between Connectivism (Siemens, 2006), the concepts presented in *Cyberculture* (1999) by Pierre Lévy (1999), and the relationships of this theory with the use of generative artificial intelligence (GenAI) in contemporary education.

The starting point is the following question: do Connectivism and Lévy's concepts converge to analyze the use of GenAI in education? The text is structured in two movements: the first presents concepts relevant to the analysis, encompassing classical and contemporary authors in education — especially Piaget, Vygotsky, Siemens, Downes, Lévy, and Saviani — to contextualize the main epistemologies and theories of learning, highlight the convergences and distinctions between Constructivism, Socio-constructivism, and Connectivism. This movement is justified by the theoretical foundation and by the introduction of the reader to Connectivism through a comparison of its characteristics with those of more widely accepted perspectives.

The second movement promotes dialogue between the epistemological categories of Connectivism and the concepts presented in *Cyberculture* by Pierre Lévy (1999), examining their possible articulations with the use of GenAI in education, without intending to address all possibilities. This analysis seeks to identify principles, limits, and potentialities in the integration between collective intelligence, networked learning, and emerging technologies.

Thus, the study adopts an analytical-interpretative approach, focusing not on describing empirical phenomena but rather on producing a critical and grounded reflection on the transformations of learning and knowledge in the digital age. From this perspective, the theoretical-analytical essay serves as a space for dialogue between different conceptions of learning and the new challenges posed by cyberculture and GenAI.

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1 Development

1.1 Epistemologies, Theories of Education and Philosophies of Education

Epistemology is a Greek word that refers to knowledge. It is similar to other words of the same origin but with distinct meanings: "doxa," which means common sense or the opinion of a person or group of people; "sophia," which corresponds to knowledge derived from extensive life experience; "gnosis, " which means knowledge in a generic or general form; and "episteme" which refers to methodical and systematic knowledge, that is, scientific knowledge (Saviani, 2016).

The term "educational theory" does not have a single definition. Its meaning and definition should be used according to the specific educational theory to be applied to a given concept. Therefore, just as there are various conceptions of education, there are also different theories of education (Saviani, 2016).

Considering a broad view of the main concepts of education, they can be grouped into broad categories. According to Saviani (2016):

> [...] the religious and the secular; the modern humanist conception; the analytical conception, which should be considered in parallel with the productivist conception; the critical-reproductivist conception; and the dialectical or historical-critical conception. Each of these conceptions generally comprises three distinct, but interconnected, levels. These are: a) the level corresponding to the philosophy of education; b) the level of educational theory, also generally called pedagogy; and c) the level of pedagogical practice. Thus, we postulate that one pedagogical conception is distinguished from another not necessarily by containing one level rather than another, but often by the way it articulates these levels and the greater or lesser weight that each of them acquires within the conception (Saviani, 2016, p. 16).

According to Saviani (2016), different conceptions of pedagogy reflect different philosophical understandings of human beings and of the role of education.

Traditional pedagogy is based on an essentialist view, according to which education's role is to shape the individual according to a universal essence, emphasizing transmission and discipline. In contrast, the new or modern humanist pedagogy considers the human being in his concrete and singular existence, valuing activity, experience, and interests of learners, drawing on fields such as biology,

psychology, and sociology (Saviani, 2016).

The analytical conception is restricted to the philosophy of education, treating educational language as an object of analysis without seeking to guide pedagogical practice. Similarly, the productivist or technicist conception adopts the assumptions of objectivity, efficiency, and productivity, influenced by positivism and behaviorism (Saviani, 2016).

The critical-reproductivist conception understands that schools tend to reproduce social inequalities. In contrast, the historical-critical or dialectical conception proposes overcoming this reproduction through mediation between theory and practice, taking pedagogical practice as a starting and ending point (Saviani, 2016).

This review serves to contextualize the philosophical foundations that underpin different ways of understanding the educational act and the production of knowledge. Thus, it provides a starting point for understanding Connectivism, a theoretical-epistemological conception attributed to Pierre Lévy in "*Cyberculture*". A closer look reveals a dialogue between the aforementioned author and constructivist and socio-constructivist foundations. The author and part of his work will be addressed in the following chapter, seeking a theoretical basis that helps to understand the phenomenon of GenAI in education. Previously, we presented more details about George Siemens and Stephen Downes' Connectivism, Jean Piaget's Constructivism, and Lev Vygotsky's socio-constructivist perspective.

Connectivism emerged after Behaviorism, Cognitivism, and Constructivism. These theories were widely used, but they were not developed in an era marked by so many technologies capable of fostering connections. Technologies facilitate connections and revolutionize people's lives, including how they learn. Connectivism was created by George Siemens, together with Stephen Downes, in 2004; therefore, it is a recent theory characteristic of the Information Age (Coelho, 2019).

For a complete and original definition, we turn to the creator of the theory. Siemens (2005) states that:

> Connectivism presents a learning model that recognizes tectonic shifts in society, where learning is no longer an internal, individual activity. The way

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> people work and function is altered when using new tools. The field of education has been slow to recognize both the impact of new learning tools and the environmental changes that make learning meaningful. Connectivism provides insight into the skills and learning tasks necessary for learners to flourish in the digital age (Siemens, 2005, p. 8).

According to the author, the characteristics of Connectivism are:

> I. Learning and knowledge are supported by diversity of opinion. II. Learning is a process of connecting specialized nodes or sources of information. III. Learning can reside in non-human devices. IV. The ability to know more is more critical than what is currently known. V. It is necessary to cultivate and maintain connections to facilitate continuous learning. VI. The ability to see connections between areas, ideas, and concepts is a fundamental skill. Updating (accurate and up-to-date knowledge) is the intention of all connectivist learning activities (Siemens, 2005, p. 6).

In summary, according to Siemens (2006), there are five fundamental questions that distinguish learning theories: a) How does learning occur? b) What factors influence learning? c) What is the role of memory? d) How does transfer occur? e) What types of learning are best explained by this theory? Siemens (2006) produced a table comparing the answers to these questions for Behaviorism, Cognitivism, Constructivism, and Connectivism. The comparison between the latter two is presented below. Answers regarding the socio-constructivist perspective were sought in Boiko and Zamberlan (2001) and Rosa and Goi (2024).

Connectivist theories differ in how they understand the learning process, but they share the idea that the subject actively constructs knowledge.

In Constructivism, according to Piaget (1973), learning results from the individual's interaction with the environment and other people, influenced by cognitive development, previous experiences, and social interactions. Knowledge is conceived as a continuous construction, resulting from processes of assimilation and accommodation, which allow the individual to adapt to the environment and transform it.

Social Constructivism, inspired by the ideas of Vygotsky (1998), expands this perspective by emphasizing the role of interpersonal relationships, the social, cultural, and historical context, and symbolic mediation in the internalization of cultural and linguistic practices. In this conception, learning initially occurs on the

social plane and is subsequently internalized by the individual, reinforcing the importance of language and collaboration as tools for cognitive development.

Connectivism, formulated by Siemens (2005), proposes a more profound rupture by understanding learning as the creation and navigation of knowledge networks that integrate people, data, and technologies. In this approach, the ability to establish, maintain, and analyze connections is central, and knowledge is seen as a dynamic, distributed, and continuously updated process.

Regarding memory, Constructivism understands it as the basis for the assimilation of new information; Socio-constructivism, as a social construction mediated by cultural tools, with less emphasis on memorization; and Connectivism, as a distributed process supported by networks and external devices, in which the essential is to access and update relevant information.

The transfer of learning occurs, respectively, when the student applies knowledge in new contexts (Constructivism), when he expands networks by connecting existing information (Connectivism) or when he uses cultural tools in different social contexts (Socio-constructivism).

Finally, regarding the types of learning favored, Constructivism values discovery and problem-solving; Socio-constructivism prioritizes collaboration, language, and social interaction; and Connectivism emphasizes technology-mediated learning, including distance learning and the collective construction of knowledge in digital environments.

Each of these theories emerged in distinct historical and technological contexts, reflecting changes in how learning is understood over time: Constructivism originated in the 1920s, Social Constructivism in the 1930s, and Connectivism in 2004. Understanding these theories allows us to rethink pedagogical practices in light of the challenges of digital culture, where knowledge is fluid, hyperconnected, and collaboratively produced. The articulation of constructivist, social constructivist, and connectivist foundations provides support for the development of critical, autonomous individuals capable of continuous learning within increasingly complex networks.

Below, some concepts from Pierre Lévy in *Cyberculture* (1999) are identified to

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highlight the dialogue with Connectivism and the possible articulation with GenAI.

1.2 Bringing Connectivism, Pierre Lévy and Generative Artificial Intelligence Together

Pierre Lévy's work, especially his book *"Cyberculture"* (1999), is part of a hybrid theoretical-epistemological conception, that is, it presents characteristics from different approaches. Several studies classify the author's work as belonging to Constructivism, Socio-constructivism, the epistemology of complexity, and Connectivism, by articulating technology, networks, and collective intelligence as new paradigms of knowledge in the digital age. Connectivism, a theory proposed by George Siemens and Stephen Downes, understands learning as a process of creating and continually updating connections between people and information systems. From this perspective, Lévy's ideas anticipate central principles of Connectivism, especially by conceiving knowledge as a distributed and dynamic phenomenon. This assumption is now manifested in the educational applications of GenAI.

In this text, Connectivism stands out as the central axis of analysis. It seeks to bring together the categories of this theoretical-epistemological concept, Pierre Lévy's work *Cyberculture,* and the projection of each of these categories in the study of the use of GenAI in education.

Table 1 presents the answers found in Lévy's work to the fundamental questions proposed by Siemens (2006) to distinguish different learning theories. Comparing Lévy's work with theoretical-epistemological concepts is not intended to transform it into a learning theory; rather, it aims to align its categories with those of Connectivism to understand how Lévy conceives of the processes essential to learning. This alignment also aims to enable a subsequent dialogue between Lévy's assumptions, the foundations of Connectivism, and the potential of GenAI in education.

Table 1 — Answers to the fundamental questions distinguishing learning theories according to Connectivism and the answers according to Pierre Lévy in *Cyberculture*.

	Connectivism	Pierre Lévy — *Cyberculture*
1. How does	It occurs through the creation and	In a network, collective,

learning occur?	navigation of knowledge networks, in which connections are made between different sources, including people and technology.	distributed, and interactive way.
2. What factors influence learning?	Access to information, connections established between networks and the ability to filter and analyze data.	Interconnectivity, Collective Intelligence and Learner Autonomy.
3. What is the role of memory?	Memory is distributed across networks and external devices, being less dependent on individual retention and more focused on the ability to access relevant information.	Memory is not just individual, but collective and expanded by technology. Retention becomes less important than the ability to seek, interpret, and apply knowledge.
4. How does the transfer occur?	Transfer occurs through the expansion of knowledge networks, connecting new information to existing structures.	Through connectivity and collaboration, ideas spread rapidly across digital networks.
5. What types of learning (...)?	Technology-mediated learning, distance education and network-based learning and online collaboration.	Collaborative, self-directed, multimodal, problem-based learning.

Source: prepared by the author based on Siemens (2006) and Lévy (1999).

Considering Table 1 and the comparison between Connectivism and Pierre Lévy's work *"Cyberculture"*, it is immediately apparent that the answers have a high degree of similarity. These questions were described by Siemens (Connectivism - 2006) to distinguish learning theories, and Lévy's work is dated 1999. To analyze the coherence between the categories (answers) in Pierre Lévy's Connectivism in "*Cyberculture*" and the possibilities of GenAI in education, the five fundamental questions proposed by Siemens are examined in conjunction with Lévy's work and some possibilities of GenAI in education.

Learning in the AI era occurs not only through human-to-human interaction, but also through collaboration between humans and digital systems. Collective intelligence, as proposed by Lévy, expands beyond social networks and digital forums, incorporating AI assistants, generative algorithms, and predictive models that aid in the production and personalization of knowledge. Thus, the student ceases to be merely a receiver of information and becomes an active agent in the construction of knowledge (using AI or, previously, with other platforms), interacting with platforms such as ChatGPT, Gemini, and Copilot to generate new *insights*, solve complex problems, and refine their understanding.

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Interconnectivity is one of the factors that influence learning. In cyberculture, for Lévy (1999), learning is not just about absorbing information in isolation, but also about participating in learning communities, where knowledge is constantly updated and improved. The author illustrates this statement by describing the example of scientific experiments conducted in large particle accelerators, more specifically the results produced by these experiments:

> Now, these data can be consulted and processed in a large number of dispersed laboratories thanks to the communication and processing tools of cyberspace. Thus, the entire scientific community can participate in these very particular experiments, which are also events. Universality rests, then, on the real-time interconnection of the scientific community, its global cooperative participation in the events that concern it [...] (Lévy, 1999, p. 165).

In this sense, the use of GenAI is not collective; each student uses his or her own *prompt* to interact with it. Collaboration with others in the learning community continues through the platforms previously used. Thinking about relationships within the learning community, interaction with peers and experts can be simulated by GenAI or carried out through other digital resources. GenAI reinforces the dynamic nature of knowledge, since its capacity to process large amounts of information is significant. Thus, with each new moment of interaction, it is possible — in the sense of being a potential, not necessarily a case of each interaction — to update or improve, or at least add to the state of knowledge on a given subject, based on real-world actions.

Another factor that influences learning is highlighted by Lévy: personalized and autonomous learning, meaning each student can follow their own pace and learning style. The internet offers multiple ways to learn, allowing each student to personalize their journey. As he describes: "Individuals are less and less tolerant of following uniform or rigid courses that do not correspond to their real needs and the specificity of their life path" (Lévy, 1999, p. 169). GenAI can contribute to autonomy and personalized learning. One of the most widespread uses of technology is the personalization of student learning, as seen in the tools mentioned in the introduction. However, considering autonomy, it is believed that it is more complex to make definitive statements. To some extent, the tool can encourage learner

autonomy, allowing them to explore subjects in different ways and to the depth they desire. On the other hand, if autonomy has a meaning other than the learner not depending on another person, or, in this case, on a technology, the use of GenAI could generate dependence, preventing the learner from performing a specific task without the support of technology.

Still considering the author's contributions regarding factors that influence learning, Lévy states that simulation occupies a central place among the new modes of knowledge brought about by cyberculture. He defines simulation as:

> It is an intellectual technology that amplifies individual imagination (enhanced intelligence) and allows groups to share, negotiate and refine standard mental models, whatever their complexity (enhanced collective intelligence) (Lévy, 1999, p. 165).

In this sense, he cites artificial intelligence — a point that could be explored further in future studies — noting that it should be considered a technique for communication and rapid mobilization of practical knowledge in organizations, not a substitute for human experts. He states: "Both at the cognitive level and at the level of work organization, intellectual technologies must be thought of in terms of articulation and the creation of synergy, and not according to a substitution scheme" (Lévy, 1999, p. 165). The author also discusses the use of simulation, its benefits, and its growing role in research, industrial creation, management, learning, and other activities. Considering the potential of AI in conducting simulations, it is believed that this aspect of cyberculture is also present in the context of AI.

The role of memory in cyberculture is undergoing a redefinition in light of the immediate access to information, with AI now taking an active role in organizing, retrieving, and contextualizing knowledge. Generative models not only store information but also interpret, synthesize, and present it in a personalized way for each learner. Thus, learning becomes less dependent on memorizing content and more dependent on the ability to formulate questions, validate information, and apply knowledge in different situations. This transformation requires even greater development of critical thinking, as interaction with AI demands discernment to assess the quality and relevance of the responses generated.

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The way we access knowledge or transfer it, according to Pierre Lévy in *Cyberculture* (1999), is altered by digital technologies. The student goes from being a passive receiver, who merely consumes information previously organized by educational institutions, to an active agent in the construction of knowledge, acting in a participatory, collaborative, and interactive manner through digital resources. Previously, knowledge was hierarchical: the teacher or institution held the knowledge and transmitted it to the student. In cyberculture, this hierarchy dissolves, as the student can learn from different sources and even teach others. As the author points out in the following excerpts: "[...] if schools and universities progressively lose their monopoly on the creation and transmission of knowledge [...]" (Lévy, 1999, p. 158). And in:

> From the 20th century onwards, with the expansion of the world, the progressive discovery of diversity, and the increasingly rapid growth of scientific and technical knowledge, the project of mastering knowledge by an individual or small group became increasingly illusory (Lévy, 1999, p. 161).

In this sense, GenAI reinforces the dilution of the hierarchical system, granting more possibilities to students and teachers. With GenAI, the student's relationship with knowledge undergoes a new transformation. In addition to accessing knowledge on various digital platforms — through the internet — with GenAI, students can seek understanding and deepen their knowledge of interest, benefiting from the facilities and conveniences provided by technology. It is important to remember that the use of GenAI must be conscious, critical, and discussed in the classroom to reduce the risk of learners passively accepting the errors or biases of GenAIs. Furthermore, Lévy already mentioned the possibility of new forms of indexing: "New indexing and search instruments must be invented, as we can see from the wealth of current work on the dynamic cartography of data spaces, intelligent 'agents,' or cooperative filtering of information" (Lévy, 1999, p. 160). It is known that GenAI is much more than an indexer, however, it assumes this function by searching for content in different sources and presenting it in an organized way to users, based on their interests and the demands requested via *prompts*.

Furthermore, AI facilitates the translation and adaptation of knowledge for

different audiences, breaking down linguistic and cultural barriers. The transfer occurs not only between humans, but also between humans and machines, creating a new learning dynamic in which AI not only aids in the dissemination of information but also learns from users themselves, refining its responses through interactions. This phenomenon makes knowledge fluid and evolving, with multiple actors contributing to its construction and continuous improvement.

The types of learning most favored by GenAI are those that presuppose autonomy, interconnectivity, and collaborative knowledge creation—core principles of Connectivism. By integrating generative assistants into pedagogical practices, project-based learning (PBL), for example, is strengthened, as the student becomes an active node in a co-authorship network, articulating human and algorithmic information. This dynamic embodies the collective intelligence described by Pierre Lévy (1999), as knowledge is produced in a distributed and shared manner. Self-directed learning is also being renewed: mediated by GenAI, it enhances continuous and personalized *feedback*, but requires discernment and critical thinking to avoid technological dependence. Thus, multimodal environments created with GenAI embody the connectivist ideal of networked learning, in which knowledge emerges from the interaction between individuals, technologies, and diverse cultural contexts.

Final Considerations

This theoretical-analytical essay aimed to analyze the theoretical-epistemological perspective of Connectivism, and the concepts proposed by Pierre Lévy in *Cyberculture,* projecting the use of this lens to analyze the use of GenAI in education. To this end, the epistemological foundations of learning were initially introduced, with an emphasis on constructivist, socio-constructivist, and, especially, connectivist approaches. The paper then sought to establish a dialogue between the principles of Connectivism and the concepts present in Pierre Lévy's work *Cyberculture* (1999), relating them to the possibilities and challenges of using GenAI in the educational context.

A comparison between five fundamental questions proposed by Siemens

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(Connectivism) and the concepts presented by Pierre Lévy reveals convergence. Both conceive of knowledge as a networked, collaborative, and disruptive process. This shared vision provides a framework for understanding potential uses of GenAI in education, as generative systems reproduce collective intelligence and the constant updating of knowledge, described by both Lévy and Siemens. By creating and interpreting content in flux, GenAI acts as an agent of interconnection between subjects and databases, expanding the reach of collective intelligence and shaping a scenario that reinforces — and simultaneously challenges — the connectivist notions of autonomy and decentralized learning.

It's also possible to imagine that cyberculture and AI converge to overcome paradigms. Learning isn't just human; it's hybrid and collaborative between humans and machines, considering machine-mediated learning, which is therefore different from human understanding. Students take on an even more active role in knowledge construction, utilizing the potential of AI to learn autonomously, in a personalized and interactive manner. This path challenges educators and educational institutions to rethink their methodologies, promoting pedagogical practices that encourage critical thinking, information curation, and the conscious and ethical integration of technologies into learning. Thus, the future of education is built as a simultaneously human and digital space, in which collective (not just individual) intelligence and AI intertwine in the continuous production of knowledge.

Adopting this framework requires further study, given the complexity of the phenomenon. Future studies could benefit from a more specific analysis of the categories contained in *Cyberculture*, as well as other works by the author, such as *The Technologies of Intelligence*, exploring concepts such as technodemocracy and cosmotechnics. It is hoped that this research will contribute to advancing discussions on the critical integration of GenAI in the educational field, encouraging new theoretical approaches and innovative pedagogical practices.

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