Metaverse Basic and Applied Research. 2024; 3:.104
doi: 10.56294/mr2024.104

REVIEW

Glossary of emerging terms in artificial intelligence and metaverses from a sociotechnical and educational perspective

Glosario de términos emergentes en inteligencia artificial y metaversos desde una perspectiva sociotécnica y educativa

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Cite as: Lucero Baldevenites EV, Jurado-Vásquez HA, Espinel JE, Bracho-Fuenmayo PL, Contreras-Piña G. Glossary of emerging terms in artificial intelligence and metaverses from a sociotechnical and educational perspective. Metaverse Basic and Applied Research. 2024; 3:.104. https://doi.org/10.56294/mr2024.104

Submitted: 12-01-2024 **Revised:** 07-04-2024 **Accepted:** 09-10-2024 **Published:** 10-10-2024

Editor: PhD. Yailen Martínez Jiménez

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ABSTRACT

Introduction: the rapid development of technologies such as artificial intelligence, the metaverse, and extended reality has reconfigured educational, social, and cultural environments, giving rise to new discourses and practices. However, this progress has also generated conceptual gaps and an imprecise use of key terms, which complicates their critical adoption in the pedagogical field.
Method: the study adopted a qualitative and interpretive approach, based on the hermeneutic-critical paradigm. Content analysis and purposive theoretical sampling were used to select the most frequently used terms in the most recent scientific literature. The data was organized through open coding, grouping them into four thematic areas.
Results: a critical glossary was developed containing 40 terms organized into four main areas: artificial intelligence and education, metaverse and extended reality, sociotechnical and critical dimension, and educational innovation. Each term included a technical definition, a critical commentary, and an applied example, thus promoting a reading that connects the techno-pedagogical discourse in a relational and contextual way.
Conclusions: the glossary proved to be a valuable epistemological tool, useful both for critical digital literacy and for teacher training and educational research. It contributed to highlighting ideological tensions, conceptual gaps, and the social effects of technologies, promoting a more reflective and conscious understanding of the digital ecosystem in education.

Keywords: Critical Glossary; Artificial Intelligence; Metaverse; Digital Education; Sociotechnical Dimension; Critical Pedagogy.

RESUMEN

Introducción: el rápido desarrollo de tecnologías como la inteligencia artificial, el metaverso y la realidad extendida ha reconfigurado los entornos educativos, sociales y culturales, dando lugar a nuevos discursos y prácticas. No obstante, este avance también ha generado vacíos conceptuales y una utilización imprecisa de términos clave, lo que complica su adopción crítica en el ámbito pedagógico.

Método: el estudio adoptó un enfoque cualitativo e interpretativo, fundamentado en el paradigma hermenéutico-crítico. Para su desarrollo, se utilizó un análisis de contenido y un muestreo teórico intencional que permitió seleccionar los términos más recurrentes en la literatura científica más reciente. Los datos fueron organizados a través de una codificación abierta, agrupándolos en cuatro ejes temáticos.
Resultados: se elaboró un glosario crítico que contiene 40 términos organizados en cuatro grandes ejes: inteligencia artificial y educación, metaverso y realidad extendida, dimensión sociotécnica e innovación educativa. Cada término incluyó una definición técnica, un comentario crítico y un ejemplo aplicado, promoviendo así una lectura que conecta de forma relacional y contextual el discurso tecnopedagógico.
Conclusiones: el glosario resulta ser una valiosa herramienta epistemológica, útil tanto para la alfabetización digital crítica como para la formación de docentes e investigación educativa. Contribuye a visibilizar las tensiones ideológicas, las lagunas conceptuales y los efectos sociales de las tecnologías, promoviendo una comprensión más reflexiva y consciente del ecosistema digital en la educación.

Palabras clave: Glosario Crítico; Inteligencia Artificial; Metaverso; Educación Digital; Dimensión Sociotécnica; Pedagogía Crítica.

INTRODUCTION

Emerging technologies such as artificial intelligence (AI), metaverse, and extended reality are profoundly transforming the social, economic, and educational spheres globally. They reshape the dynamics of interaction and production while posing new challenges and opportunities (Fernández-Miranda et al., 2024; Marković-Blagojević et al., 2024; Pradeep et al., 2024; Roman-Acosta, 2024).

In the social domain, AI optimizes processes and offers new forms of interaction, improving academic performance and student satisfaction by personalizing learning and fostering inclusive environments (Mena, 2024; Bracho-Fuenmayor, 2023). The metaverse, meanwhile, creates virtual spaces for interaction and collaboration, overcoming physical barriers (Ramírez-Herrero et al., 2023), while extended reality enables immersive educational experiences (Calderón Cruz et al., 2024).

Economically, AI adoption improves efficiency and competitiveness by enabling deeper data analysis for strategic decisions (Maita-Cruz et al., 2022). The metaverse also opens up new opportunities in commerce and marketing, offering interactive experiences and reducing economic risks (Blas et al., 2023; Chamola).

AI and the metaverse are redefining teaching methods in education, promoting self-learning and a more inclusive and dynamic education (Clemente Alcocer et al., 2024; Díaz Tito et al., 2021; Rahman et al., 2023). Acuna et al. (2024) state that emerging technologies such as AI, AR, and VR enhance teaching and learning, fostering international collaboration and motivation. However, challenges remain in integrating these technologies effectively in multicultural and sustainable global educational contexts. Education 4.0, which uses these technologies, seeks a more interactive and reflective education system (Sánchez Rodríguez et al., 2024).

However, implementing these technologies faces ethical and technical challenges, such as data privacy, equity of access, and biases in AI systems (Vitola-Quintero et al., 2024). In conjunction, the lack of clear regulations on the use of AI and data management in the metaverse can generate inequalities, which requires an adequate regulatory framework to mitigate social tensions (Barrios Tao et al., 2020; Ufarte Ruiz et al., 2021; Bracho-Fuenmayor, 2024).

These innovations shape new forms of interaction, production, and learning and impose new frameworks for understanding the human, the digital, and the educational (Marques et al., 2024; Sánchez Carrera et al., 2024). In this context, the proliferation of technical and conceptual terms has given rise to an ever-expanding vocabulary that, while permeating academic, political, and media discourses, often lacks precise, grounded, and contextualized definitions.

The record shows that various disciplinary fields - such as computer science, education, philosophy of technology, and sociology - have begun to approach this new lexicon but have done so with fragmented approaches or focused on strictly technical dimensions. Recent studies in digital literacy and critical pedagogies warn that concepts such as “avatar,” “algorithm,” “personalized learning,” or “immersive reality” are used in an ambiguous, sometimes even contradictory way, which makes their reflexive application in educational and social scenarios difficult. This phenomenon creates an essential gap in academic literature and pedagogical praxis: the lack of a critical and multidimensional systematization of emerging terms in today’s technological ecosystem.

The need to fill this void becomes urgent, especially in contexts of educational innovation, where the techno-scientific discourse can impose itself without critical mediation, reinforcing instrumental visions of education and hiding its social, ethical, and epistemological implications (Roman-Acosta, 2024; Abreu Fuentes & Roman-Acosta, 2022). Constructing a thematic and analytical glossary that articulates technical definitions

with sociological, ethical-political commentaries, and educational applications constitutes a valuable tool for teachers, researchers, technology designers, and public policymakers.

This paper aims to systematize a set of key terms related to artificial intelligence, the metaverse, and educational innovation, emphasizing their conceptual appropriation from a socio-technical and academic perspective. Through a qualitative approach, the aim is not only to clarify definitions but also to problematize their uses, meanings, and scope in the processes of contemporary digital transformation.

The proposal is structured along four thematic axes that allow us to organize the terms in a coherent and meaningful way: (1) artificial intelligence and education, (2) metaverse and extended reality, (3) socio-technical and critical dimension, and (4) emerging pedagogies and educational innovation. This thematic structure favors a relational rather than merely alphabetical reading, thus allowing us to recognize the interdependencies and tensions that run through the current techno-pedagogical discourse.

METHOD

The present research is framed within an interpretative qualitative approach based on the hermeneutic-critical tradition. This paradigm is based on the assumption that knowledge is socially constructed through shared meanings and that language not only names reality but also shapes it (Guba & Lincoln, 1994; Taylor & Bogdan, 1986). From this perspective, the emerging terms related to artificial intelligence, the metaverse, and educational innovation are not neutral or fixed entities but discursive constructions with ideological, ethical, and political charges that must be problematized.

Consistent with this epistemological positioning, a documentary-type methodological design was chosen, oriented towards the critical systematization of content (Baquero, 2011). The purpose was to analyze, organize, and interpret key terms circulated in contemporary techno-pedagogical discourses, paying attention to their technical definitions, use in different contexts, and socio-cultural implications. This methodological decision responds to the need to fill a knowledge gap regarding the integrated and critical conceptualization of an expanding vocabulary, often assumed without reflexive mediation in the educational and social spheres.

The primary technique used was qualitative content analysis, a tool for identifying latent patterns, categories, and meanings in the documents analyzed (Krippendorff, 2003). An open thematic coding procedure (Saldaña, 2016) was applied to organize the concepts into four axes: artificial intelligence and education, metaverse and extended reality, socio-technical and critical dimension, and educational innovation and emerging pedagogies. This categorization is not arbitrary but responds to problematic nuclei identified in recent literature, which allows us to observe relevant conceptual intersections and favor a relational reading of the glossary.

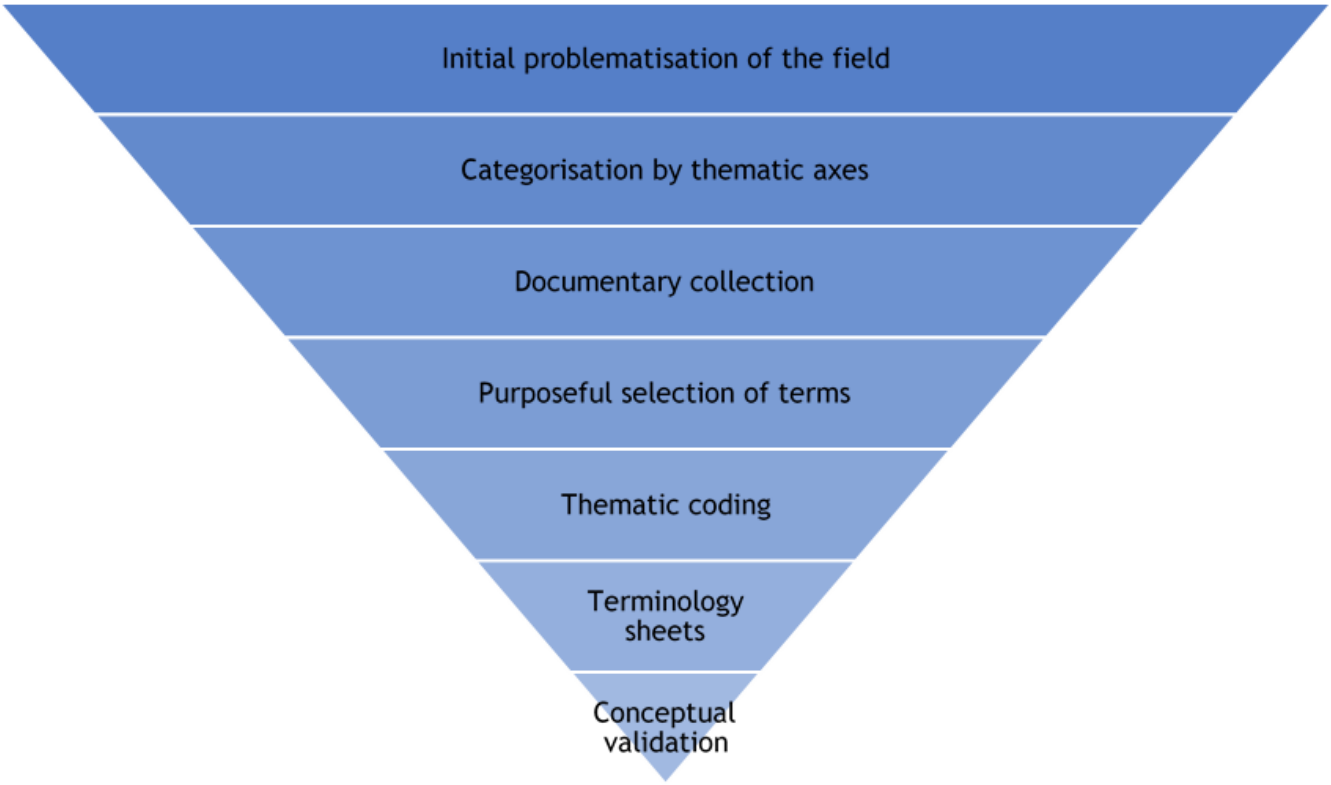

Figure 1. Methodological process for the construction of a critical glossary

https://doi.org/10.56294/mr2024.104

The terms were selected based on a purposive theoretical sampling (Glaser & Strauss, 1967) based on the following criteria: (a) high frequency of use in academic and technical literature of the last five years; (b) conceptual relevance in debates on technology and education; and (c) potential to generate socio-technical or pedagogical analysis. The review of sources focused on articles indexed in databases such as Scopus, Dialnet, ERIC, and SciELO and reports from international organizations such as UNESCO, the OECD, and the World Economic Forum. Technical documents from technology companies that influence the field of education (e.g., Meta, Microsoft, OpenAI) were also considered to contrast institutional definitions with critical readings from academia.

Each glossary entry was constructed as an analytical terminology card, composed of three elements: (1) technical or standard definition of the term, based on reliable sources; (2) critical commentary, from a sociological, educational, or ethical-political perspective, which problematizes the assumptions of the concept; and (3) applied example, which illustrates its use or impact in educational or social contexts. This structure responds to a dialogical approach to knowledge, which seeks to articulate different voices and levels of analysis to enrich the understanding of each term.

This procedure of analysis, organization, and writing was iterative and reflexive, allowing us to constantly revise the meanings attributed to the terms, contrast perspectives, and construct a coherent narrative that accounts for the complexities of the field of study. In this way, the glossary is not presented as a neutral list of definitions but as an epistemological tool for critical digital literacy, teacher education, and research in contexts of technological transformation.

RESULTS

The study results in a critical glossary that groups emerging terms into four thematic axes: artificial intelligence and education, metaverse and extended reality, socio-technical and critical dimension, and pedagogies and educational innovation. These axes are not isolated compartments but arise from conceptual affinities identified in analyzing sources and their use in the literature. Each entry follows a flexible structure: a technical definition based on specialized sources, a critical commentary offering a socio-technical, pedagogical, or political reading, and an example applied in real educational contexts. The intention was not to create a dictionary or a rigid taxonomy but rather a set of concepts to question and redefine current discourses on technology and education, which are often accepted without reflection. The terms are organized alphabetically by axis, facilitating their consultation and encouraging a relational reading that considers them parts of a broader system.

Axis 1: Artificial intelligence and education

This first axis of the glossary focuses on terms that articulate the link between artificial intelligence and educational processes. This relationship is increasingly presented as inevitable or unquestionable in innovation discourses. Here, we group concepts that allow us to understand how algorithmic logic transforms teaching tools, pedagogical frameworks, assessment criteria, and the notion of learning. From the promise of extreme personalization to the automation of teacher feedback, AI permeates multiple layers of the education system. However, not everything that seems new is entirely new. Some terms bring back old debates about control, surveillance, or standardization, but in a new technical guise. Others open up urgent questions about subjectivity, agency, bias, and educational justice. The ten terms selected within this axis are presented below alphabetically to facilitate their comparative reading and show how they relate to each other within the current techno-pedagogical framework.

Table 1. Strand 1: Definitions, critical reflections and applied examples

Term	Definition	Critical commentary	Applied example
Learning analytics	Measurement, collection and analysis of data about learners and their contexts to optimise learning (Siemens, 2013; Corona Ferreira et al., 2019).	Indiscriminate use can lead to pedagogical surveillance and bias, reducing learning to quantifiable metrics.	Implemented in universities to predict dropouts and personalise educational trajectories, without including ethical or emotional dimensions in the models.
Educational filter bubbles	Constrained information environments generated by personalisation algorithms that limit exposure to diverse information (Fieiras-Ceide et al., 2023; López Julca, 2024).	It limits critical thinking and reinforces homogenous epistemologies, undermining holistic student learning.	In adaptive learning platforms, students are guided through content paths that exclude elements considered "not relevant".

Generative artificial intelligence	Uses models such as GAN and GPT to create new content from large volumes of data (Fernández-Miranda et al., 2024).	Challenges in authorship, creativity and automated plagiarism. Promotes a vision of creative efficiency that can displace the value of the human learning process.	Used by teachers and students to generate texts or summaries. Its use without pedagogical accompaniment can encourage passive learning practices.
Algorithmic bias	Systematic distortion in the results of an algorithm derived from training data, model design or human decisions (Noble, 2018).	It can generate exclusion or inequality, favouring certain profiles or learning styles and hiding decisions that reinforce invisible power relations.	Automated admission or assessment platforms may penalise students from certain cultural or socio-economic backgrounds, reproducing inequalities.
Intelligent tutor	AI-based system that simulates the function of a human tutor, adapting feedback to the student's pace and level (Rodríguez Chávez, 2021).	It promotes an instructivist model focused on efficiency and performance, devaluing the emotional and ethical bond of the pedagogical relationship.	Implemented in mathematics, language and programming education systems. Their success depends on sensitive design to cultural and subjective contexts.
Personalisation algorithms	Systems that adapt content and activities according to user behaviour and performance (Brusilovsky & Millán, 2007; Gendler et al., 2019).	Can limit autonomy and critical thinking by reinforcing what is known and suppressing error as a learning opportunity.	Used in platforms such as Khan Academy or Duolingo to recommend activities based on student progress, but may exclude non-normative learning styles.
Augmented cognition	Use of digital technologies, especially AI, to extend human cognitive capabilities (Kaplan & Haenlein, 2019).	Related to a neoliberal vision of education, focused on performance and optimisation, which makes the affective and ethical dimensions of human knowledge invisible.	Writing assistants, machine translation programmes and idea generators. Their effectiveness depends on pedagogical integration and critical reflection on their use.
Automated assessment	Use of AI to automatically correct, score or give feedback on student responses (Shermis & Burstein, 2013; Lillo-Fuentes et al., 2023).	It can dehumanise the educational process, reducing human responses to binary and limited schemes. It raises questions of transparency and accountability.	Used in online standardised tests and LMS platforms that automatically correct exercises, but remains controversial in open and creative texts.
Adaptive learning	Technology-assisted teaching model that adjusts the content and pace of activities according to student performance (Pane et al., 2014; Bailini, 2023).	Although inclusive, it can become a system that fragments the educational experience, focusing on individual performance and making the collaborative components of learning invisible.	Platforms such as Smart Sparrow or DreamBox Education adapt the student journey, but their impact depends on teacher mediation to regulate automated processes.
Adaptive platforms	Digital teaching-learning environments that adjust content and feedback according to the characteristics of each user (Cuervo Méndez, 2021).	It can entrench a technocratic view of education, subordinating pedagogy to computational design and limiting reflection and creativity.	Used in institutions to offer personalised learning paths, especially in STEM areas. Their effectiveness depends on careful curriculum integration and critical evaluation.

This table compiles ten key terms related to AI's impact on education. Organized alphabetically, each term includes a technical definition supported by expert sources, a critical commentary reflecting its socio-technical and pedagogical implications, and a practical example illustrating its application in educational contexts. Table 1 seeks to facilitate an understanding of how AI transforms educational processes, highlighting its benefits and the ethical and pedagogical challenges it poses.

Axis 2: Metaverse and extended reality

This axis groups concepts related to the metaverse's design, use, implications, and extended reality technologies in educational contexts. It deals with terms that allow us to understand how these immersive experiences transform the notion of space, presence, interaction, and identity in learning environments. Beyond the technical component, these concepts open up questions of accessibility, digital embodiment, and exclusion. How virtual worlds are designed and inhabited is neither neutral nor their effects. Below, the selected terms are presented in alphabetical order, organized to facilitate their relational and critical understanding within this emerging field.

https://doi.org/10.56294/mr2024.104

Table 2. Key terms in immersive education and emerging technologies

Term	Description	Source
Educational avatar	An educational avatar is a digital representation of a user within a virtual learning environment, acting as an intermediary between the person and the digital environment. These avatars can be customisable and controlled by the user or by AI, and are used to facilitate interaction in educational simulators and metaverse platforms. However, they can reinforce stereotypes or represent an idealised identity, which affects identity construction and social interaction.	Bailenson, 2018
Design of virtual worlds	Virtual world design is the process of creating interactive, inhabitable, three-dimensional digital environments, used in platforms such as the metaverse. This design is not neutral, as it influences perceptions of values, cultural norms and power structures. In education, it is used to create campus simulations, professional training environments or collaborative spaces, requiring skills in immersive instructional design.	Jerald, 2016; Ayala Pezzutti, 2020
Digital identity	Digital identity refers to the set of attributes and footprints that a person creates and projects in virtual environments. It is composed of elements such as usernames, avatars and behavioural patterns. This identity is often managed by platforms that collect and trade data without transparency. In education, the ethical management of digital identity has become an important part of critical digital citizenship.	Batuecas Caletrío, 2023; Rheingold, 2012
Immersive presence	Immersive presence is the subjective sensation of being fully involved in a digital environment, such as virtual reality. While immersion is intended to maximise immersion, it can lead to dissociation and cognitive fatigue. In education, it must be balanced with pedagogical intent and critical reflection. It is applied in simulations and activities that require an intense and deep experience.	Araviche Chiquito, 2024; Benítez de Gracia y Herrera Damas, 2020
Extended Reality (XR)	Extended reality encompasses technologies that merge the physical and digital worlds, such as virtual, augmented and mixed reality. Its purpose is to offer interactive experiences that broaden the perception of the environment. Although it offers immersive experiences, it can lead to technology dependency and accessibility issues. In education, it is used for interactive activities such as virtual tours and simulations, but requires technical resources and pedagogical evaluation.	Rubio Tamayo, 2019; Milgram & Kishino, 1994
Accessibility in virtual worlds	Accessibility in virtual worlds seeks to ensure that people with disabilities can interact equally with virtual environments through adaptive technologies and inclusive design. While many extended reality technologies replicate barriers of the physical world, an ethical approach must integrate equity and accessibility as key principles. In metaversal education, this accessibility is vital for inclusion, although it is still limited.	W3C, 2021; Villón-Briones et al., 2024
Immersive collaborative spaces	Immersive collaborative spaces are three-dimensional virtual environments designed for users to interact in real time, represented by avatars. Although they encourage cooperation, they can also generate exclusion dynamics if they are not properly designed. They are used for collective activities such as remote work in higher education or co-creation of content. Success depends on interaction rules and appropriate feedback.	Zhao, 2003; Valdés Godínes & Angel Rueda, 2023
Immersive Narrative	Immersive storytelling uses technologies such as virtual reality to create experiences where the user is actively involved as an observer or participant. While this form of storytelling expands the possibilities for expression and learning, it can fall prey to emotional manipulation or loss of critical thinking. Its educational use must be accompanied by clear ethical frameworks. It is used in virtual museums, serious games or interactive historical reconstructions.	Murray, 1997; Caerols Mateo, 2020
Virtual learning objects (VLOs)	OVAs are interactive digital resources designed to facilitate learning in virtual environments. They can include 3D models, simulations or gamified activities. Although they are effective for understanding concepts, their success depends on design and teacher mediation. They are used in fields such as medicine, architecture or science, integrating elements of real-time assessment and personalisation.	Wiley, 2000; Delgado-Ramirez et al., 2020
Mixed Reality (MR)	Mixed reality merges elements of the physical and digital world in real time, allowing simultaneous interaction in both environments. While it offers enriching educational experiences, it can also lead to distractions and sensory overload. Its implementation in education is used in simulations and hands-on learning activities, but requires specialised infrastructure and appropriate pedagogical design.	Azuma, 1997; Marín et al., 2024

This table presents a collection of relevant terms in immersive education, such as virtual, augmented, and mixed reality. Each term is described with its definition, educational applications, and challenges it poses in the pedagogical context. At the same time, the bibliographical sources that support the concepts are included for a deeper understanding of the impact and integration of these technologies in education.

Axis 3: Socio-technical dimension

This axis brings together terms that allow us to critically analyze the social, political, and economic conditions underlying the development and use of digital technologies in education. Far from assuming technology as a neutral or merely instrumental phenomenon, the concepts included here address its structural dimension: power, surveillance, inequality, extractive, and dependency. They are categories that invite us to problematize the infrastructures that make the digital possible and the discourses that legitimize them. Their inclusion in the glossary seeks to clarify what is often hidden behind the techno-pedagogical enthusiasm. The terms are presented in alphabetical order in order to facilitate their reading and articulation with other axes.

Table 3. Terms for Socio-technical Analysis of Technology in Education

Term	Technical definition	Comment	Application
Algocracy	An emerging form of governance or decision-making where algorithms - especially those based on artificial intelligence - operate as mediators or authorities that define courses of action, resource allocation or social control (Aneesh, 2006).	It poses democratic challenges: it depersonalises accountability, opaques deliberation and shifts control to opaque systems. In education, it can technify pedagogical decisions without human mediation.	Algorithms that define access to grants, courses or assessments without transparency or understanding on the part of the student.
Data capitalism	Economic model based on the extraction, processing and commercialisation of personal data as a source of value and control (Zuboff, 2019).	It threatens rights such as privacy or autonomy. In education, it turns interaction into a commodity and reduces the student to a performance profile.	Free platforms that collect data to train commercial models or sell advertising, without clear consent.
Digital colonialism	Extension of colonial practices through platforms and technologies that impose external logics and marginalise local knowledge (Couldry & Mejias, 2019).	It imposes pedagogical models alien to local contexts and weakens epistemic and technological sovereignty.	Use of corporate tools in Global South countries that impose rules and curricula without contextual appropriateness.
Algorithmic inequality	Algorithms reinforce pre-existing social inequalities through biases in data or design (Eubanks, 2018).	It hides the differential impact of automated decisions, generating segmentation and educational exclusion.	Mentoring or admissions systems that disadvantage rural or minority students by relying on urban data.
Technological neutrality	Belief that technologies are objective tools and their impact depends only on human use (Feenberg, 2002).	It ignores the fact that technologies are designed with intentions and within political or economic frameworks.	Neutral" platforms that reinforce exclusion or decisions without teacher participation.
Data extractivism	Intensive exploitation of personal and social data without consent, as a form of power accumulation (Morozov, 2018).	Transfers an extractive logic to education that reduces learning to data useful for the market.	Systems that collect clicks, emotions or interactions for commercial AI, without ethical mediation.
Algorithmic governance	Norms and practices that regulate the design and use of algorithmic systems with social impact (Yeung, 2018).	Lack of regulation and participation jeopardises rights and transparency in educational environments.	Systems that rank students or allocate resources without accountability or participatory feedback.
Digital invisibilisation	Systematic exclusion of certain social groups from the digital environment and its decisions (Graham, 2011).	It reproduces gaps by ignoring the voices of diverse, rural or disabled communities.	Platforms that do not recognise different languages or ways of learning, leading to symbolic and practical exclusion.
Technological sovereignty	The ability of communities or states to autonomously manage their technology and data (Pohle & Thiel, 2020).	Technological dependence compromises pedagogical, curricular and cultural autonomy.	Schools forced to use foreign platforms, with no local alternatives and no control over data and methodologies.
Pedagogical Surveillance	Surveillance exercised in educational contexts through technologies that monitor performance and behaviour (Williamson, 2017).	It transforms the educational experience into an environment of constant control, limiting creativity and critical thinking.	Facial attention analysis or emotional monitoring in class without consent or ethical regulation.

This table summarises the ten concepts selected in the Socio-technical Dimension axis, organized around their technical definition, analytical commentary, and contextual application. Its purpose is to show how far from being neutral digital technologies are traversed by power relations, dynamics of exclusion, and surveillance structures. The organization allows for a comparative and relational reading of the terms, providing conceptual tools for a critical understanding of the contemporary techno-pedagogical environment.

Strand 4: Educational innovation and emerging pedagogies

Table 4. Key terms in pedagogies and educational innovation mediated by digital technologies

Term	Technical definition	Comment	Application
Critical digital citizenship	Ability to participate actively, ethically and reflectively in digital environments, understanding rights, responsibilities and risks (Ribble, 2011).	It goes beyond the normative and seeks to form subjects who question digital structures, act ethically and resist extractive practices.	Promoted in teacher training programmes; includes critical analysis of platforms and ethical content creation in networks.
Expanded education	Model that extends learning beyond the formal classroom, integrating connected, informal and transmedia experiences (Jenkins et al., 2009).	Challenges traditional institutional boundaries; requires reconfiguring inherited teaching roles and educational structures.	Used in maker experiences, community projects, digital art and open collaborative learning.
Immersive gamification	Use of game dynamics and game elements in immersive virtual environments (VR, metaverses) to enhance learning (Deterding et al., 2011).	Risk of trivialising content or reinforcing competitive logics; must be oriented towards clear pedagogical purposes.	Educational simulators, virtual laboratories, digital escape rooms or gamified narratives in educational contexts.
Immersive pedagogy	Approach using XR technologies to generate sensory and emotionally meaningful learning experiences (Radianti et al., 2020).	It is not just about using VR, but about redesigning the educational process with interactivity, student agency and critical reflection.	Applied in clinical simulations, virtual heritage visits or ethical decisions in narrative scenarios.
Educational platforming	The process by which digital platforms become dominant infrastructures in education, redefining roles and practices (Williamson et al., 2020).	Concentration of power in private actors, risks of standardisation, surveillance and loss of teacher autonomy.	LMS such as Moodle or Google Classroom that mediate the pedagogical process and manage sensitive data without transparency.
Digital competence in teaching	Set of knowledge, skills and attitudes to integrate technologies into teaching in a critical and situated way (Redecker, 2017).	Not limited to the technical; implies awareness of social and ethical impacts. Sometimes used to justify processes of precarious self-training.	Evaluated through frameworks such as DigCompEdu; developed in lifelong learning, curriculum redesign and digital communities of practice.
Virtual instructional design	Systematic planning and evaluation of learning experiences in digital environments considering objectives, technologies and accessibility (Reigeluth, 1999).	More than a technique, it is a situated pedagogical practice that demands avoiding technocentrism and integrating narrative, inclusion and student agency.	Present in hybrid classrooms, online courses, educational simulations and collaborative designs in metaverses.
Learning ecologies	Complex network of media, contexts, relationships and experiences - formal and informal - that shape learning processes (Siemens, 2005; Goldie, 2016).	It challenges the fragmented school vision; it promotes continuous, distributed and non-linear learning. It requires institutions that recognise and encourage it.	Self-directed learning networks, communities of practice, decentralised collaborative platforms, flexible itineraries.
Ubiquitous learning	A model that enables anywhere, anytime learning through mobile and contextual technologies (Burbules, 2012).	It democratises access, but can blur the boundaries between personal and school life, leading to digital overload and new inequalities.	Use of educational apps, microlearning in networks, mobile augmented reality, LMS platforms available on multiple devices.
Educational transmedia storytelling	Strategy that uses multiple media and platforms to develop fragmented but interrelated educational content (Scolari, 2013).	Encourages creativity, multiple literacy and participation, but requires complex design and pedagogical intentionality.	Student projects integrating podcasts, video, networks and virtual worlds; educational storytelling with diverse curricular objectives.

This axis addresses concepts linked to new ways of teaching, learning, and designing educational experiences mediated by digital technologies. It includes terms that broaden the view of pedagogical innovation beyond the device or tool, focusing on practices, narratives, and ecologies that emerge in digital contexts. Here, technology is not an end but part of processes that reconfigure the role of teachers, student agency, and the meaning of education. The selected terms allow us to explore approaches, tensions, and formative possibilities in this transformation. They are presented below alphabetically to encourage an open, relational, and situated reading.

This table combines ten concepts for understanding pedagogical transformations driven by digital technologies in educational contexts. It includes emerging approaches, active methodologies, and teaching-learning processes mediated by platforms, artificial intelligence, or immersive environments. Each term is accompanied by its technical definition, a critical commentary that contextualizes it, and an applied example that illustrates its use in educational practice.

DISCUSSION

From the results obtained with the development of the glossary, it is possible to see how the terms circulate in the discourses on artificial intelligence, metaverse, or educational innovation are not just technical or neutral categories, as is sometimes assumed. However, complex constructions are shaped by interests, uses, and ideologies. Many of these expressions, often used efficiently in school, institutional, or media contexts, have ambiguous, changing, and even contradictory meanings. Some, such as "intelligent tutor" or "digital citizenship," seem straightforward at first but, on closer inspection, reveal gaps, unspoken assumptions, and internal tensions. In order to visualize these relationships in an integrated way, Table 5 summarises, for each thematic axis of the glossary, its predominant focus, the most relevant conceptual tensions, and its contributions to the critical analysis. This allows us to observe how the axes dialogue, overlap, or oppose each other regarding the meanings they construct about technology in education.

Table 5. Comparison between thematic axes of the critical glossary

Thematic focus	Predominant focus	Identified conceptual tensions	Contributions to critical analysis
Artificial Intelligence and Education	Automation, efficiency, personalisation	Algorithmisation of pedagogical judgement, reduction of the teaching role	Questioning adaptive systems and automatic evaluation
Metaverse and Extended Reality	Immersion, experience design	Aestheticisation of learning, digital exclusion, idealised identity	Reflection on body, space and digital subjectivity
Socio-technical and Critical Dimension	Power structures, surveillance, ethics	Algorithmic inequality, data extractivism, ideological neutrality	Visibilisation of the political character of digital infrastructures
Pedagogies and Educational Innovation	New ecologies, narrative, agency	Platformisation, commodification of pedagogical innovation	Articulation between technology and emancipatory pedagogical meanings

Beyond the terminological collection, this glossary highlights inevitable structural tensions in the current techno-pedagogical field. For example, the promise of personalization of learning through algorithms is often accompanied by processes of silent standardization. The supposed efficiency offered by educational platforms is often associated with forms of surveillance, automation of decisions, and loss of teacher agency. Tensions also exist between what is offered and omitted and between what is said and what is hidden. This coincides, of course, with what authors such as Feenberg (2002), Eubanks (2018), and Williamson (2017) have suggested, who from different approaches warn about how technology, without a critical view, tends to reinforce inequalities rather than reduce them. Sometimes without realizing it. Sometimes even believing that we are innovating.

Another issue that appears strongly is that these technologies not only modify how we learn but also how we think about what it is to learn, what it is to teach, and what it is to know. There is a reconfiguration of the subject. Of their capacities, agency, and place within the educational process. For example, "augmented cognition" proposes a subject-oriented toward performance, efficiency, and constant optimization. Something that, if left unchallenged, can lead to subtle forms of exclusion. Moreover, with terms like "technological neutrality" or "autocracy," something else becomes visible: that technology never comes alone; decisions, intentions, rules, and silences always accompany it. That there is power. That there is politics behind the code, the algorithm, and the design of the platform.

In this sense, the glossary does not seek to be a simple inventory. The proposal is different. It is about building a tool to read the technological discourse from a different perspective. A tool that invites us to think,

problematize, and question what we take for granted. For this reason, each entry combines definition, critical analysis, and applied examples. The term is not only explained. It shows how it works, its scope, its limits. Moreover, this is done from a thematic organization that allows us to see connections, affinities, and frictions. Thus, the terms are not isolated but dialogue with each other, generating meaning as a whole. This makes it worthwhile not only for research but also for teaching, educational management, and the formulation of public policies.

However, the work has limits, like any study of this nature. Although broad, the number of terms selected does not cover the entire possible spectrum. Nor was there any empirical validation with educational actors, which could further enrich the proposal. Moreover, there is the time factor. This field changes fast. What makes sense today can shift, reconfigure, and disappear in months. Technology is dynamic, and so is its language. The glossary, then, will have to be updated, revised, and expanded to remain useful.

Looking to the future, it would be important to open this proposal to collective participation. Validate the terms with teachers, students, instructional designers, or specialists in educational technology. Use methodologies such as Delphi, interviews, and participatory workshops. Its application in training contexts can also be considered as a didactic resource, as a basis for a curricular unit, or as a trigger for debates in teacher training spaces. In short, we are looking for this: to contribute to a more conscious, critical, socially, and humanly sensitive digital education. One that does not get carried away by novelty or technological promise but rather questions, questions, chooses, and builds.

CONCLUSIONS

The critical glossary constructed in this study represents an effort to systematize, analyze, and re-signify a set of concepts that circulate in artificial intelligence, the metaverse, and educational innovation to contribute to a deeper, situated, and reflexive understanding of emerging technologies. Unlike other terminological repertoires, the aim here is to define and contextualize, problematize, and link each word with its social, ethical, political, and pedagogical implications.

The analysis of the forty terms organized into four thematic axes made it possible to identify dominant discursive patterns - such as the promise of personalization, efficiency, or immersion - often presented as technical neutrality when they carry ideological meanings that shape educational practices. At the same time, the exercise revealed conceptual gaps, unresolved tensions, and areas of ambiguity that need to be explored in greater depth to make progress toward critical and transformative digital literacy.

Among the study's main contributions is the glossary's value as a tool for teacher training, an input for curriculum design, and a starting point for critical analysis of technology policies. Its structure—combining technical definition, critical commentary, and applied example—seeks to facilitate the critical appropriation of concepts, stimulating relational reading and situated reflection. This proposal can be helpful in initial and continuous training spaces and in contexts of educational research and instructional design.

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FINANCING
No financing.

CONFLICT OF INTEREST
None.

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