

EMERGING TECHNOLOGIES AND KNOWLEDGE PRODUCTION IN THE DIGITAL SOCIETY: EPISTEMOLOGICAL TRANSFORMATIONS, CONTEMPORARY CHALLENGES, AND PERSPECTIVES FOR EDUCATION AND INNOVATION

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Abstract

Emerging technologies have driven profound transformations in the digital society, directly impacting knowledge production processes, education, and innovation. This study aims to analyze the contributions of these technologies to the construction of knowledge in contemporary times, as well as their

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epistemological and educational implications. This is an integrative literature review conducted in the Latindex, ERIC, DOAJ, SpringerLink, and Miguilim databases, covering the period from 2021 to 2026 and including texts in Portuguese and English. Fourteen studies were selected after the application of inclusion and exclusion criteria. The results show that emerging technologies foster collaborative environments, expand access to information, and strengthen innovative educational practices, contributing to the reconfiguration of learning processes. However, challenges related to digital inclusion, teacher training, and the need to develop critical literacy were observed. It is concluded that knowledge production in the digital society assumes a dynamic, collaborative, and technology-mediated character, requiring new competencies and educational approaches.

Keywords: Digital education, Digital society, Emerging technologies, Innovation, Knowledge production.

INTRODUCTION

The advancement of digital technologies has promoted profound transformations in the ways society produces, shares, and uses knowledge. The expansion of the internet, artificial intelligence, cloud computing, data analysis, and other emerging technologies has significantly altered communication, learning, research, and innovation processes, contributing to the consolidation of a society that is increasingly connected and dependent on digital flows of information (Lévy, 2010; Criollo-C et al., 2023). In this context, the digital society is characterized by permanent connectivity, the accelerated circulation of information, and the expansion of possibilities for interaction among individuals, institutions, and technological systems, redefining the foundations of contemporary knowledge production (Mena-Guacas et al., 2025).

The changes associated with digital transformation are directly related to the development of cyberculture, understood as a social and cultural phenomenon resulting from the expansion of cyberspace and digital communication networks (Lévy, 2010). The growing integration between people and

technologies has fostered new forms of social participation and collective construction of knowledge, enabling knowledge to be produced in a more dynamic, decentralized, and collaborative manner.

In this scenario, collective intelligence stands out as one of the main elements of the digital society. The ability to connect individuals in collaborative networks expands opportunities for sharing experiences, solving problems, and producing innovative knowledge (Lévy, 2014). Knowledge comes to be constructed through interaction among different subjects and contexts, strengthening collaborative processes that transcend geographical, institutional, and disciplinary boundaries.

At the same time, contemporary technological transformations have brought about significant changes in the epistemological foundations of knowledge production. The increasing complexity of social, scientific, and technological phenomena requires approaches capable of overcoming fragmented models for understanding reality and promoting an integrated view of contemporary problems (Morin, 2005).

The need to rethink educational processes becomes particularly relevant in this context. Contemporary education is challenged to form individuals capable of dealing with the complexity, uncertainty, and constant transformations of the digital world. To this end, it is essential to develop competencies that foster critical reflection, intellectual autonomy, and the capacity to learn continuously throughout life (Morin, 2015).

Several recent studies have demonstrated the potential of emerging technologies to transform teaching and learning processes. Tools such as artificial intelligence, augmented reality, virtual reality, adaptive learning, and digital platforms have contributed to the creation of more interactive and personalized educational experiences, fostering student engagement and expanding learning opportunities (Criollo-C et al., 2023).

The growing integration between technology and education is also related to the demands of Society 5.0, a model that seeks to balance technological development, innovation, and human well-being. In this context, technological innovation assumes a strategic role in the construction of more flexible and

inclusive educational systems aligned with the needs of contemporary society (Legi, Damanik and Giban, 2023).

However, despite the numerous opportunities offered by emerging technologies, challenges persist that hinder their effective implementation in educational systems. Problems related to technological infrastructure, digital inclusion, teacher training, and inequalities in access continue to limit the full use of digital resources in various educational contexts (Alenezi, Wardat and Akour, 2023). These limitations highlight the need for policies and strategies that promote greater equity and democratization of access to knowledge.

In addition to structural challenges, the digital society faces issues related to the quality, reliability, and validation of information available in virtual environments. The growing volume of content produced and shared daily requires the development of competencies capable of fostering critical analysis of information and the construction of scientifically grounded knowledge. In this context, epistemic literacy emerges as an essential competence for the formation of reflective individuals who are aware of their role in knowledge construction (Nascimento et al., 2026).

Emerging technologies also play a relevant role in promoting innovation, entrepreneurship, and economic development. The integration between digital technology, innovation, and education has contributed to strengthening entrepreneurial competencies, stimulating creativity, problem-solving capacity, and the generation of innovative solutions to contemporary challenges (Udekwe and Iwu, 2024). Thus, knowledge becomes a strategic resource for sustainable development and for the competitiveness of organizations and societies.

Future perspectives point to an even greater expansion of the presence of emerging technologies in educational and scientific environments. Recent evidence indicates that these technologies will continue to significantly influence teaching, learning, and knowledge production processes, requiring constant adaptations on the part of educational institutions and professionals (Mena-Guacas et al., 2025). At the

same time, pedagogical innovations associated with digital transformation tend to foster the construction of more participatory, collaborative educational models centered on students' needs (Fuente, 2025).

Despite the advances observed, there are still gaps related to understanding the epistemological impacts arising from the incorporation of emerging technologies into knowledge production processes. The speed of digital transformations, combined with the growing technological dependence of educational and scientific institutions, requires deeper reflection on the opportunities and challenges involved in this phenomenon.

Given this scenario, this study is justified by the relevance of emerging technologies in reconfiguring the processes of knowledge construction and dissemination, as well as by the need to understand their impacts on education, innovation, and the epistemological dynamics of the digital society. Understanding these transformations can contribute to the development of more effective strategies aimed at the critical, ethical, and innovative use of technologies in different educational and scientific contexts.

Thus, this study aims to analyze the contributions of emerging technologies to knowledge production in the digital society, discussing the epistemological transformations resulting from this process, the contemporary challenges related to education and innovation, and future perspectives for the construction of knowledge in increasingly digital and interconnected contexts.

METHODOLOGY

This is an integrative literature review, a method that enables the synthesis and critical analysis of scientific knowledge produced on a given topic, allowing evidence from different studies to be brought together and contributing to a broader understanding of the phenomenon under investigation. The choice of this approach is justified by the need to identify, analyze, and integrate scientific findings related to emerging technologies and knowledge production in the digital society, considering their epistemological, educational, and innovative implications.

To guide the development of the research, the following guiding question was formulated: *how have emerging technologies influenced knowledge production in the digital society, and what are their implications for epistemological transformations, education, and innovation in the contemporary period?*

The search for studies was carried out in the scientific databases and libraries Latindex (Sistema Regional de Información en Línea para Revistas Científicas de América Latina, el Caribe, España y Portugal), ERIC (Education Resources Information Center), DOAJ (Directory of Open Access Journals), SpringerLink, and Miguilim, selected for their relevance in indexing national and international publications related to the fields of education, technology, innovation, and knowledge production.

To construct the search strategy, descriptors in Portuguese and English were used, combined through the Boolean operators AND and OR. The main descriptors employed were: “tecnologias emergentes”, “sociedade digital”, “produção do conhecimento”, “transformação digital”, “educação digital”, “inovação educacional”, “emerging technologies”, “digital society”, “knowledge production”, “digital transformation”, “digital education” and “educational innovation.” The combinations of descriptors were adapted to the specificities of each database in order to broaden the sensitivity and scope of the search.

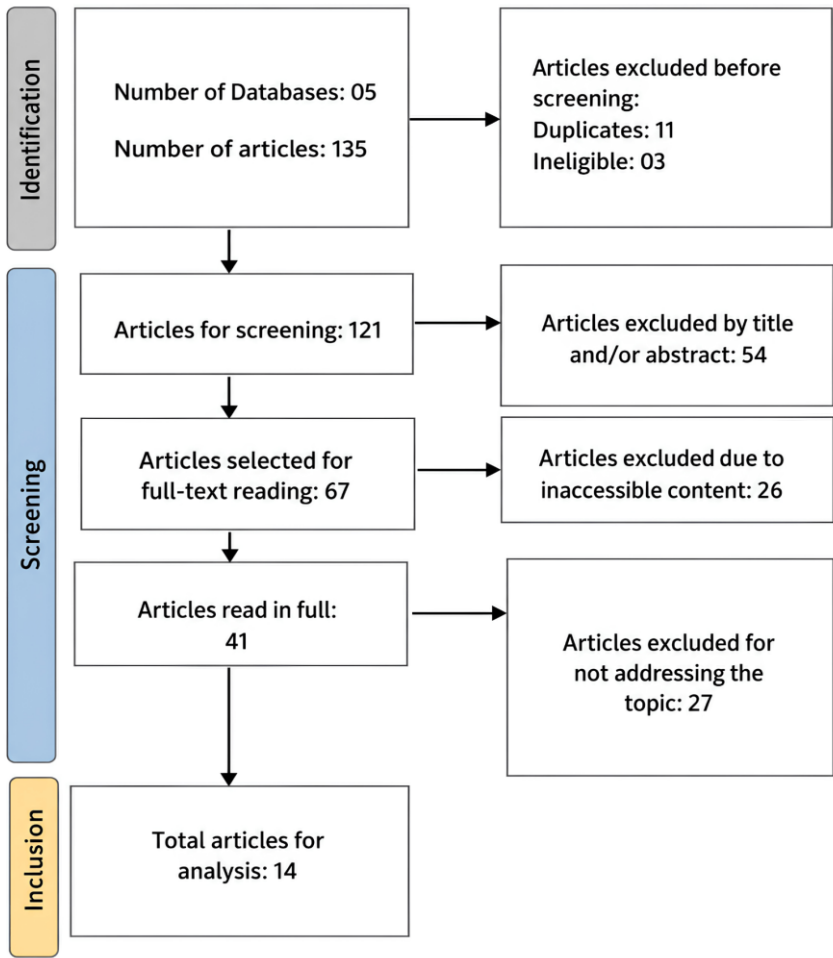
Inclusion and exclusion criteria were established to ensure the methodological quality and relevance of the selected studies. The inclusion criteria considered were: full-text scientific articles; published between 2021 and 2026; written in Portuguese or English; related to the theme of emerging technologies, knowledge production, digital education, innovation, or epistemological transformations; and presenting results relevant to answering the research guiding question.

As exclusion criteria, duplicate studies across databases were discarded; simple abstracts, editorials, letters to the editor, undergraduate final papers, dissertations, theses, book chapters, and conference proceedings; publications without access to the full text; studies published in languages other than those previously defined; and articles that, after reading the title, abstract, and full text, did not present a direct relationship with the proposed objectives.

The study selection process occurred in successive stages. Initially, electronic searches were conducted in the selected databases. Next, titles and abstracts were read to identify potentially eligible studies. Subsequently, the selected articles were read in full to verify their adequacy according to the established criteria. At the end of this process, the included studies composed the final sample of the integrative review.

The organization of the methodological stages of the research is presented in Figure 1, prepared based on recommendations for integrative literature reviews. The flowchart demonstrates the path adopted from the identification of studies to the definition of the final sample analyzed.

Figure 1
Flowchart of the study selection process for the integrative review



Source: Authors (2026).

After the articles were selected, the information was extracted and organized using an instrument developed by the researchers, containing variables such as author, year of publication, country of origin, study objective, methodology employed, and main results related to emerging technologies, knowledge production, education, and innovation. The data obtained were organized into synoptic tables to facilitate comparison and interpretation of the findings.

The studies were analyzed using thematic analysis, making it possible to identify convergences, divergences, and trends present in the scientific literature. The results were grouped into thematic categories constructed from the research objectives and the evidence found, enabling a critical discussion of the epistemological transformations associated with the use of emerging technologies in the digital society, as well as their impacts on educational and innovative processes.

Because this research was developed exclusively with secondary data available in publicly accessible scientific databases, without direct involvement of human beings, there was no need for submission to a Research Ethics Committee, in accordance with the current guidelines for literature review studies.

RESULTS AND DISCUSSION

The bibliographic search carried out in the Latindex, ERIC, DOAJ, SpringerLink, and Miguilim databases resulted in the identification of studies related to emerging technologies, knowledge production in the digital society, epistemological transformations, and implications for education and innovation. After applying the previously established inclusion and exclusion criteria, as well as removing duplicate publications and carefully reading the full texts, 14 scientific articles were selected to compose the final sample of this integrative review.

The studies analyzed were published between 2021 and 2026 and presented different approaches to the influence of emerging technologies on the processes of constructing, sharing, and validating

knowledge. The characterization of the included articles, encompassing authorship, year of publication, objective, and main contributions to the topic investigated, is presented in Table 1.

Table 1

Characterization of the studies included in the integrative review

Author/Year	Study objective	Study axis	Main contributions
Tan <i>et al.</i> (2021)	To analyze the Knowledge Building model as a strategy for aligning education with the demands of the digital age.	Knowledge production and collaborative learning.	Demonstrated that collaborative digital environments foster the collective creation of knowledge, the development of critical thinking, and the active participation of students in processes of inquiry and innovation.
Ciarli <i>et al.</i> (2021)	To investigate the relationship among digital technologies, innovation, and the development of competencies for the knowledge economy.	Digital transformation and competency development.	Showed that technological innovation requires new cognitive and professional skills, reinforcing the need for educational systems to adapt to the demands of the digital economy.
Akour and Alenezi (2022)	To discuss the future of higher education in the face of digital transformation.	Higher education and digital transformation.	Identified that the digitalization of educational institutions promotes structural changes in academic management, pedagogical methodologies, and knowledge production processes.
Haleem <i>et al.</i> (2022)	To review the role of digital technologies in contemporary education.	Digital technologies applied to education.	Highlighted that digital tools expand access to knowledge, foster personalized learning, and strengthen more flexible and interactive educational processes.
Almufarreh and Arshad (2023)	To examine promising emerging technologies for teaching and learning.	Emerging technologies and educational innovation.	Identified the potential of artificial intelligence, virtual reality, augmented reality, and data analysis to improve the educational experience and promote greater student engagement.
Farias-Gaytan, Aguaded and Ramírez-Montoya (2023)	To analyze digital transformation and digital literacy in higher education institutions.	Digital literacy and higher education.	Demonstrated that digital transformation requires strengthening digital, informational, and critical competencies to ensure effective participation in the knowledge society.
Shenkoya and Kim (2023)	To investigate the impacts of the digital transformation of the Fourth Industrial Revolution on open knowledge.	Open knowledge and sustainability.	Demonstrated that digitalization favors the democratization of knowledge and expands access to scientific production, strengthening open science practices and global collaboration.

Zhang, Chen and Wang (2023)	To evaluate how technology drives innovation in university teaching from the perspective of knowledge creation.	Pedagogical innovation and knowledge creation.	Found that technological integration fosters educational innovation and strengthens environments focused on knowledge production and sharing.
Deák and Kumar (2024)	To review the role of STEAM education in developing digital competencies for sustainable innovations.	Digital competencies and sustainable innovation.	Found that interdisciplinary approaches contribute to the development of digital skills, creativity, and complex problem-solving.
Ghanbaripour <i>et al.</i> (2024)	To analyze the impacts of emerging technologies on students' learning, engagement, and employability.	Emerging technologies and academic performance.	Identified significant improvements in engagement, active learning, and the development of professional competencies aligned with the demands of the contemporary labor market.
Ajani (2025)	To examine challenges and opportunities for knowledge production through the management of technology and innovation in higher education.	Innovation management and knowledge production.	Demonstrated that the strategic management of technology strengthens research, stimulates institutional innovation, and enhances scientific production.
Fitzpatrick <i>et al.</i> (2025)	To propose recommendations for higher education institutions to move from digital transformation toward new organizational models.	Digital governance and institutional innovation.	Highlighted the need for institutional policies aimed at digital sustainability, technological ethics, and organizational adaptation in scenarios of continuous transformation.
Stanciu (2025)	To discuss the integration of new technologies into teaching and learning processes.	Technological integration in teaching.	Showed that the adoption of innovative technologies enhances the quality of learning and fosters more participatory, student-centered methodologies.
Zou <i>et al.</i> (2025)	To analyze trends, challenges, and innovations related to digital learning in the twenty-first century.	Digital learning and educational innovation.	Demonstrated that technological integration will continue to reshape educational processes, requiring new competencies, methodologies, and knowledge management models.

Source: Authors (2026).

The integrated interpretation of the studies analyzed shows that the articulation among emerging technologies, knowledge production, and educational transformation constitutes a systemic process marked by epistemological, pedagogical, and institutional reconfigurations. The findings point to

theoretical convergence among the authors regarding the structuring role of digital technologies in reorganizing contemporary forms of learning, innovation, and knowledge construction.

The discussion was organized into two analytical axes: (1) the reconfiguration of knowledge production mediated by emerging technologies; and (2) the challenges and perspectives of digital transformation in the contemporary educational context.

EMERGING TECHNOLOGIES AND THE RECONFIGURATION OF KNOWLEDGE PRODUCTION

With regard to transformations in knowledge production, it is observed that emerging technologies have been redefining the epistemological foundations of learning and scientific inquiry processes. Tan et al. (2021) show that knowledge, in the digital age, shifts from transmissive models to collaborative dynamics of collective construction, in which subjects assume an active role in the production of knowledge. Similarly, Zhang et al. (2023) emphasize that innovation in higher education emerges from interactive knowledge-creation environments, in which learning is constituted as a shared and continuous process.

From the perspective of contemporary competencies and demands, Ciarli et al. (2021) highlight that the expansion of digital technologies redefines innovation trajectories and requires more complex cognitive skills, especially those related to critical analysis and problem-solving. In a complementary manner, Ajani (2025) argues that the strategic management of technology and innovation in higher education strengthens the institutional capacity for producing scientific and technological knowledge.

Regarding the democratization and circulation of knowledge, Shenkoya and Kim (2023) point out that digital transformation has driven the consolidation of open science practices, expanding access to knowledge and promoting greater collaboration among researchers on a global scale. Along the same lines, Haleem et al. (2022) reinforce that digital technologies broaden educational accessibility and foster more flexible, personalized, and inclusive learning processes.

In the field of pedagogical practices, Tan et al. (2021) argue that digital environments structured for collective knowledge enhance students' active participation in the construction of knowledge. Similarly, Ghanbaripour et al. (2024) show that the use of emerging technologies positively affects student engagement and academic performance, especially in educational contexts that value active methodologies.

As for competency development, Ciarli et al. (2021) and Deák and Kumar (2024) converge in affirming that knowledge production in the digital society depends on the integration of digital skills, critical thinking, and innovation capacity. These authors emphasize that contemporary education needs to incorporate such competencies as a structuring axis of academic formation.

In the field of educational trends, Zou et al. (2025) highlight that twenty-first-century digital learning is characterized by the strong integration of intelligent technologies and innovative pedagogical practices, resulting in new models of knowledge production. In a complementary manner, Stanciu (2025) reinforces that the incorporation of technologies into teaching increases interactivity and promotes more dynamic, student-centered educational environments.

Thus, the studies analyzed indicate that knowledge production in the digital society is structured as a distributed, collaborative, and technology-mediated process, in which learning is continuously reconstructed through interaction among subjects, data, and digital environments.

CHALLENGES AND PERSPECTIVES OF DIGITAL TRANSFORMATION IN CONTEMPORARY EDUCATION

With regard to structural changes in education, it is observed that digital transformation has brought about profound reconfigurations in educational institutions, requiring organizational and pedagogical adaptations. Akour and Alenezi (2022) highlight that higher education is undergoing a transition process marked by the digitalization of academic systems, which implies new forms of management, teaching, and assessment.

From the perspective of digital competencies, Farias-Gaytan, Aguaded and Ramírez-Montoya (2023) emphasize that the advancement of digital transformation requires strengthening digital and informational literacy as an essential condition for critical participation in the knowledge society. Similarly, Alenezi et al. (2023) point out that challenges such as inequality of access, infrastructure limitations, and gaps in teacher training still compromise the full integration of technologies into education.

Regarding institutional governance, Fitzpatrick et al. (2025) argue that higher education institutions need to move toward more complex models of digital transformation, incorporating ethical, structural, and strategic dimensions into their management processes. This perspective shows that isolated digitalization is not sufficient; rather, a systemic restructuring of educational organizations is necessary.

In the field of technological implementation, Almufarreh and Arshad (2023) highlight that, although emerging technologies present high educational potential, their effectiveness depends on teacher training and methodological adequacy. Similarly, Haleem et al. (2022) reinforce that technological integration must be aligned with clear pedagogical objectives, avoiding merely instrumental approaches.

With regard to pedagogical practices, Stanciu (2025) emphasizes that the use of technologies in teaching must be accompanied by active methodologies that promote autonomy, participation, and meaningful learning. In a complementary manner, Zou et al. (2025) point out that the increased availability of information in the digital environment requires the development of critical competencies for selecting, analyzing, and validating knowledge.

Regarding future perspectives, Shenkoya and Kim (2023) indicate that the expansion of open knowledge tends to strengthen the democratization of access to information and expand global scientific collaboration. Deák and Kumar (2024) complement this view by highlighting that interdisciplinary approaches such as STEAM contribute to the development of competencies oriented toward sustainable innovation.

In the context of innovation management, Ajani (2025) emphasizes that effective institutional policies are fundamental to enhancing knowledge production and strengthening the innovative capacity of educational institutions. Similarly, Ghanbaripour et al. (2024) show that the incorporation of emerging technologies can positively affect students' academic performance and employability.

Finally, Zhang et al. (2023) reinforce that technological innovation in teaching must be understood as a continuous process of knowledge construction, requiring the permanent adaptation of pedagogical and institutional practices. Thus, digital transformation in contemporary education presents itself as a complex phenomenon that simultaneously promotes innovative opportunities and generates structural and epistemological challenges, requiring articulated and integrated responses.

CONCLUSION

Based on the critical analysis of the studies, it is observed that emerging technologies exert a significant and multifaceted influence on knowledge production processes in the digital society. The evidence gathered demonstrates that such technologies not only expand forms of access to information but also reconfigure the epistemological, pedagogical, and social foundations that sustain contemporary knowledge construction.

In response to the guiding question, it was found that emerging technologies directly influence knowledge production by promoting collaborative, dynamic, and interactive digital environments. These environments foster the collective construction of knowledge, the expansion of access to information, and the strengthening of more flexible and innovative educational practices. However, such transformations also reveal challenges related to digital inclusion, the critical formation of individuals, and the need for scientific validation of the information available.

With regard to the objective of the study, which consisted of analyzing the contributions of emerging technologies to knowledge production in the digital society, it was observed that this objective was achieved. The findings demonstrated that these technologies significantly impact educational and

scientific processes while also driving new forms of interaction among subjects, knowledge, and technology, promoting important epistemological reconfigurations.

Among the main findings, it is noteworthy that knowledge production in the digital society assumes a collaborative, distributed, and technology-mediated character, breaking with traditional models centered on the unidirectional transmission of information. In addition, it was shown that the integration of emerging technologies into education enhances pedagogical innovation, expands student engagement, and contributes to the development of digital and critical competencies essential to the contemporary context.

Another relevant aspect identified concerns the persistent challenges in implementing these technologies, especially with respect to inequalities in access, the need for continuous teacher training, and the construction of epistemic literacy. These factors indicate that the mere adoption of digital tools is not sufficient to guarantee effective changes in the production and use of knowledge, making a more structured and critical pedagogical and institutional approach necessary.

In view of this, future research should conduct empirical studies in specific educational contexts, focusing on the analysis of the effectiveness of emerging technologies in learning, the development of critical competencies, and knowledge production. It is also recommended that investigations explore the impact of generative artificial intelligence and adaptive systems on academic formation, as well as comparative studies among different levels of education and socioeducational realities, with the aim of deepening the understanding of the effects of digital transformation on contemporary education.

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