

**DICT AND TPACK IN TEACHER EDUCATION: AN INTEGRATIVE REVIEW OF
BRAZILIAN ACADEMIC PRODUCTION**

***TDIC E TPACK NA FORMAÇÃO DOCENTE: REVISÃO INTEGRATIVA DA
PRODUÇÃO ACADÊMICA BRASILEIRA***

***TDIC Y TPACK EN LA FORMACIÓN DOCENTE: REVISIÓN INTEGRADORA DE LA
PRODUCCIÓN ACADÉMICA BRASILEÑA***



Inês Maria Gugel DUMMEL¹
e-mail: dummel98@gmail.com:



Madalena Pereira SILVA²
e-mail: madalena.pereira@uniarp.edu.br



Jociane MACHIAVELLI³
e-mail: jociane@uniarp.edu.br



Levi HULSE⁴
e-mail: levi@uniarp.edu.br

How to reference this paper:

DUMMEL, I. M. G.; SILVA, M. P.; MACHIAVELLI, J.; HULSE, L. DICT and TPACK in teacher education: an integrative review of Brazilian academic production. **Nuances: Estudos sobre Educação**, Presidente Prudente, v. 37, n. 00, e026004, 2026. e-ISSN: 2236-0441. DOI: 10.32930/nuances.v37i00.11549.



| Submitted: 03/05/2026
| Revisions required: 05/05/2026
| Approved: 21/05/2026
| Published: 04/07/2026

Editor: Prof. Dr. Rosiane de Fátima Ponce

¹University of Alto Vale do Rio do Peixe (UNIARP), Caçador – Santa Catarina (SC) – Brazil. Doctoral Candidate in the Graduate Program in Basic Education (PPGEB).

² University of Alto Vale do Rio do Peixe (UNIARP), Caçador – Santa Catarina (SC) – Brazil. Professor in the Graduate Program in Basic Education (PPGEB).

³ University of Alto Vale do Rio do Peixe (UNIARP), Caçador – Santa Catarina (SC) – Brazil. Doctoral Candidate in the Graduate Program in Development and Society (PPGDS).

⁴ University of Alto Vale do Rio do Peixe (UNIARP), Caçador – Santa Catarina (SC) – Brazil. Professor in the Graduate Programs in Basic Education (PPGEB) and Development and Society (PPGDS).

ABSTRACT: The integration of Digital Information and Communication Technologies (DICT) into education requires the articulation of pedagogical, technological, and content knowledge, as proposed by the TPACK model. This article presents an integrative review of Brazilian theses and dissertations published in the CAPES Catalog between 2019 and 2023, selecting 16 studies addressing DICT, TPACK, and teacher education. The results indicate weaknesses in initial training, structural limitations in schools, and discontinuity in continuing education policies, resulting in predominantly instrumental practices. Innovative experiences that mobilize TPACK in a critical and contextualized manner are also identified. The study contributes by systematizing recent trends and problematizing the relevance of TPACK as a theoretical framework for teacher education.

KEYWORDS: DICT. TPACK. Teacher training. Digital culture. Pedagogical practice.

RESUMO: *A integração das Tecnologias Digitais de Informação e Comunicação (TDIC) à educação exige a articulação entre conhecimentos pedagógicos, tecnológicos e de conteúdo, conforme proposto pelo modelo TPACK. Este artigo apresenta uma revisão integrativa de teses e dissertações brasileiras publicadas no Catálogo da CAPES entre 2019 e 2023, selecionando 16 pesquisas que abordam TDIC, TPACK e formação docente. Os resultados indicam fragilidades na formação inicial, limitações estruturais nas escolas e descontinuidade nas políticas de formação continuada, resultando em práticas predominantemente instrumentais. Identificam-se também experiências inovadoras que mobilizam o TPACK de modo crítico e contextualizado. O estudo contribui ao sistematizar tendências recentes e problematizar a relevância do TPACK como referencial teórico para a formação docente.*

PALAVRAS-CHAVE: TDIC. TPACK. Formação docente. Cultura digital. Prática pedagógica.

RESUMEN: *La integración de las Tecnologías Digitales de Información y Comunicación (TDIC) en la educación exige la articulación entre el conocimiento pedagógico, tecnológico y de contenido, conforme al modelo TPACK. Este artículo presenta una revisión integradora de tesis y disertaciones brasileñas publicadas en el Catálogo CAPES entre 2019 y 2023, seleccionando 16 estudios que abordan las TDIC, el TPACK y la formación docente. Los resultados evidencian debilidades en la formación inicial, limitaciones estructurales en las escuelas y discontinuidad en las políticas de formación continua, lo que resulta en prácticas predominantemente instrumentales. También se identifican experiencias innovadoras que movilizan el TPACK de manera crítica y contextualizada. El estudio contribuye al sistematizar tendencias recientes y problematizar la relevancia del TPACK como referente teórico para la formación docente.*

PALABRAS CLAVE: TDIC. TPACK. Formación docente. Cultura digital. Práctica pedagógica.

Introduction

Technologies deeply and irreversibly permeate contemporary life, reconfiguring social practices, modes of communication, forms of production, and learning dynamics. Far from constituting a threat or an artificial rupture, their presence accompanies the historical movement of cultural and technical transformation of which human beings have always been a part. Authors such as Lévy (1999) and Kenski (2003) emphasize that technology should not be understood as an external or intrusive element, but as a constitutive component of social practices, capable of expanding and enhancing communicational, cognitive, and educational processes.

In the educational field, the presence of Digital Information and Communication Technologies (DICT) takes on even more challenging contours. Digital Information and Communication Technologies (DICT) are not restricted to the role of tools or technical supports for the transmission of content; they establish new languages, expand learning spaces and times, and introduce interactive, collaborative, and multimodal practices that strain the traditional structures of the school. Digital culture, in this sense, demands that teachers and institutions rethink conceptions of teaching, learning, authorship, and participation.

Silva, Ferreira, and Bonin (2022) observe that, as access to digital information and communication technologies (DICT) expands, social and educational relationships begin to operate under communicative logics typical of digital culture, requiring more consistent articulations between Education and Communication. The authors argue that the school needs to understand digital media as languages and as sociocultural practices that permeate the experience of children, young people, and adults. Thus, the integration of technologies into education must go beyond instrumental perspectives and foster authorial, critical, and creative practices.

In this scenario, the TPACK (*Technological Pedagogical Content Knowledge*) model, proposed by Mishra and Koehler (2006), stands out, which synthesizes the intertwining of pedagogical, technological, and content knowledge as a condition for a pertinent integration of ICTs. The model recognizes that the mere presence of technologies does not guarantee innovation; what determines it is the teacher's ability to mobilize, in a balanced and contextualized manner, knowledge that guides intentional technological choices articulated with learning. TPACK, therefore, offers an epistemological horizon to understand how pedagogical practices can be enhanced by technology, respecting content, context, and educational objectives.

Given this context, it becomes relevant to analyze how Brazilian academic research has understood the integration of ICTs and the development of TPACK in teacher education. This integrative review systematizes advances, gaps, and trends identified in recent theses and dissertations, seeking to offer an updated and critical overview of how these topics have been addressed in Brazilian educational research.

The present review is organized as follows: after this introduction, the methodology used is described. Next, the theoretical framework that articulates technologies, cyberculture, and TPACK is presented. Following this, the results are discussed in light of this framework, culminating in the synthesis of the findings organized into analytical axes. Finally, the study's contributions and final considerations are highlighted.

Methodology

The present investigation is characterized as a qualitative research approach of a bibliographic nature, operationalized through an integrative review, as systematized by Whittemore and Knafl (2005), as it is an approach that allows not only for gathering existing studies but also for producing expanded interpretations and critical syntheses based on the articulation between empirical research, theoretical analyses, and academic documents. Unlike merely descriptive reviews, the integrative review makes it possible to understand the complexity of a phenomenon as a field in transformation—as is the case with the articulation between TDIC, TPACK, and teacher training.

The methodological approach strictly followed the six stages proposed by Whittemore and Knafl (2005): (1) problem identification; (2) definition of search and eligibility criteria; (3) systematic search; (4) evaluation of studies; (5) data analysis and interpretation; and (6) presentation and synthesis of findings. This structure ensures transparency, rigor, and consistency in the process, allowing the results to reflect the convergences and gaps in academic production.

The guiding question was: how do Brazilian theses and dissertations discuss the integration of Digital Information and Communication Technologies (DICT) and the TPACK model in teacher education? Based on it, the descriptors used in the searches were defined: “TDIC”, “TPACK”, and “teacher training”.

The search was conducted exclusively in the CAPES Catalog of Theses and Dissertations, as it is a consolidated national database representative of Brazilian academic

production with the highest scientific density. Filters were applied for the publication period (2019–2023) and the field of Education.

The time frame was defined as it covers a recent and complete five-year period of Brazilian academic production, allowing for the analysis of research conducted during a period marked by the intensification of discussions on digital culture, teacher training, and the integration of ICTs into educational processes. This scope also made it possible to gather works published before, during, and after the health emergency period caused by the COVID-19 pandemic, a time when inequalities in access, the structural limitations of schools, and the weaknesses in teacher training for the pedagogical use of technologies became even more evident. Thus, the selected period facilitated the identification of trends, continuities, and shifts in how TPACK and ICTs have been addressed in recent Brazilian theses and dissertations.

The initial search returned a broad set of works in the areas of education, health, and engineering. The CAPES Catalog of Theses and Dissertations was consulted using the descriptors “TDIC”, “Digital Information and Communication Technologies”, “TPACK”, “teacher education”, and their English equivalents (for example, “digital technologies”, “teacher education”), combined with Boolean operators (AND, OR) and truncations to increase sensitivity. The screening was conducted in two stages: an exploratory reading of titles, abstracts, and keywords to eliminate duplicates and studies clearly out of scope, followed by a full-text reading of the potentially eligible results. The following inclusion criteria were adopted: (1) thematic relevance—studies with an explicit approach to the integration of ICTs in education, investigation or theoretical discussion of the TPACK model, or a focus on the training of Basic Education teachers; (2) availability of the full text in languages that the team could analyze; (3) nature of the work—theses and dissertations; and (4) adherence to the descriptors used. Studies that, although mentioning the descriptors, did not present a substantive discussion on the integration of ICTs and/or TPACK in teacher training (for example, superficial mentions or use of the terms outside the educational context) were excluded, as well as event abstracts without a full version and documents without accessible full text. After applying these procedures, the final corpus consisted of 16 studies (theses and dissertations); this careful exploratory reading was essential to ensure the inclusion of genuinely relevant studies, avoiding reliance exclusively on the presence of the terms in the titles.

For the data extraction stage, an analytical framework was created containing information on year of publication, author, level (master’s or doctoral), institution, objectives,

methodology, and main findings related to ICTs and TPACK. This systematic organization facilitated subsequent categorization.

The data analysis was based on Bardin's (2016) content analysis method, especially in the stages of coding, categorization, and interpretive inference. The recurrent reading of the research allowed for the identification of units of meaning that were grouped into four analytical axes: initial training; continuing education; structural conditions; and emerging potentialities. This categorization represents a contribution of the study, by offering an integrated reading of recent work on the topic.

The final stage consisted of a critical synthesis, which articulated the convergences, tensions, and gaps evidenced in the research with the theoretical framework adopted (Kenski; Lévy; Buckingham; Mishra and Koehler, among others). This interpretive movement made it possible to understand not only what the studies state, but also how they relate, allowing for the identification of persistent trends and challenges.

Thus, the methodology adopted enabled a robust systematization of recent scientific literature, providing a critical and up-to-date overview of the integration of ICTs and TPACK in teacher education.

Technologies, Cyberculture and TPACK in Pedagogical Practice

The pedagogical practices analyzed are understood, in this study, as an expression of the teachers' formative conditions, highlighting how the integration of ICTs and the mobilization of TPACK materialize—or not—in everyday school life. The analysis of the relationships between technologies, cyberculture, and teaching practices goes beyond the description of tools, by recognizing these dimensions as structuring forces in the contemporary configuration of teaching and learning.

Technologies and paradigmatic change

The etymology of the word technology—from the Greek *téchne* (technique, art, craft) and *logia* (study)—reveals its historical link to human practices of production and creation. In this sense, technologies do not constitute elements external to social life, but rather integrate the very constitution of human existence, accompanying its historical processes of transformation (Vieira Pinto, 2005). From fire to the wheel, from writing to the printing press,

from the steam engine to the advent of electricity, each innovation has reshaped ways of living, producing, communicating, and learning. In the 20th century, information and communication technologies, followed by microelectronics and the expansion of cyberspace, profoundly altered the dynamics of knowledge, establishing new ways of thinking and interacting in the world.

In this context of historical continuity, Kenski (2003; 2012) and Lévy (1999) highlight that the incorporation of digital technologies into contemporary life is not reduced to an evolutionary continuity, but rather strains the forms of knowledge production, allowing it to be interpreted as a paradigmatic inflection in cognitive ecologies and ways of learning. This transformation stems from the way in which digital information and communication technologies (DICTs) reconfigure cognitive ecologies, shifting the centrality of the linear and sequential logic of print culture toward hypertextuality, interactivity, and networked learning. Knowing is no longer just about accumulating information; it now involves navigating, selecting, connecting, and producing meaning in multiple and dynamic environments.

Technological mediation is changing the way we teach and learn, paving the way for new forms of expression, authorship, collaboration, and problem-solving. DICTs expand the channels and formats of interaction, altering features of the traditional transmissive model. In this dynamic, the teacher ceases to be just a content repository and starts acting as a facilitator: organizes learning experiences, selects and filters information, and guides investigation processes. Students, in turn, find more opportunities to actively participate in the construction of knowledge, create, and assume leading roles in collective work, something that, in many traditional school contexts, received less space.

These transformations show that the presence of technologies in education cannot be reduced to devices or tools (Silva; Aguiar; Jurado, 2020). They establish new temporalities, new languages, new communicative practices, and new forms of participation. Therefore, treating DICTs merely as “additional resources” limits their pedagogical potential and loses sight of their structuring character in contemporary education. From this perspective, the paradigmatic shift lies not in the artifacts themselves, but in the epistemological reorganization they provoke in the teaching and learning processes.

However, this change does not occur automatically. In contexts where teacher training, institutional support, and adequate material conditions are lacking, technologies tend to assume an instrumental, peripheral, and decontextualized use, being restricted to activities of low cognitive complexity. Without pedagogical intentionality, they do not break with transmissive

practices, nor do they promote collaborative, investigative, or creative methodologies. In this sense, innovation depends less on the artifact and more on the formative and epistemological choices that guide its use.

Thus, understanding technologies in education as a vector of paradigmatic change implies recognizing that they reconfigure practices, roles, and ways of knowing. When critically articulated with teaching practice, they allow for expanding learning horizons, fostering authorship, enhancing interactions, and transforming the classroom into a more dialogical space connected to digital culture.

Given this scenario, it is imperative that teacher training keeps pace with the transformations brought about by ICTs, which, in their most recent developments, are also beginning to incorporate Generative Artificial Intelligence (GAI) systems, capable of producing text, images, code, and other forms of content. Such technologies further expand the possibilities of pedagogical mediation, but they also strain traditional notions of authorship, creation, and knowledge construction.

In this context, the notion of innovation, often associated with the incorporation of technologies, needs to be problematized. As Kenski (2015) already indicated, the presence of technologies does not guarantee expressive pedagogical transformations. In the case of Generative Artificial Intelligence (GAI), artificial intelligence capable of creating content from simple commands, this tension becomes even more evident, since its use can both enhance authorial, investigative, and creative practices and reinforce instrumental, reproductive, and low cognitive complexity dynamics, depending on the pedagogical intentions that guide its integration.

These transformations are not limited to devices or pedagogical practices, but extend into the context of digital culture, configuring new forms of participation and learning that characterize cyberculture.

Cyberculture and modes of participation

Cyberculture, as outlined by Lévy (1999), emerges from the development of cyberspace as an interactive, hypertextual, and globally connected communication environment. It goes beyond the technical dimension, constituting a set of practices, values, languages, and ways of thinking that profoundly transform the human experience. In this context, learning and participating are no longer restricted to individual actions, but involve continuous flows of

interaction, the production of meaning, collaboration, and the circulation of information in a network.

In the Brazilian context, Santaella (2013) contributes to this understanding by highlighting that digital culture is not restricted to the technologies themselves, but involves transformations in the modes of perception, cognition, and interaction of subjects in digitally mediated environments.

In the educational field, this dynamic creates learning ecologies in which students do not rely solely on formal school spaces to access knowledge. They mobilize repertoires of digital culture—videos, tutorials, online communities, platforms based on generative artificial intelligence, forums, social networks, games, *fanfictions* (digital writing communities), podcasts, GAI—which enable them to learn through experimentation, exchange, and authorship. Such ecologies are characterized by the multiplicity of languages, the speed of content circulation, and the participatory nature of contemporary cultural production.

It is in this environment that the modes of participation typical of cyberculture are configured. Participating, in this context, means actively engaging in the creation, sharing, reworking, and resignification of content; collaborating in communities; commenting, curating, co-editing; producing and disseminating ideas; learning from peers, and contributing new knowledge. It is a logic of distributed participation, in which everyone can be readers, producers, and interlocutors, breaking with the passivity typical of educational models based solely on reception.

Buckingham (2010) criticizes perspectives marked by technological determinism and by the technical and disjointed use of ICTs, which tend to reduce digital culture to a set of technical and functional skills, failing to consider the engagement, production, and circulation of meanings that, according to the author, constitute the experience in digital culture. In this sense, the author argues that many curricular proposals disregard precisely these modes of participation, which structure the way children, young people, and adults construct meaning in contemporary times. When the school ignores these practices, it also disregards contemporary modes of meaning-making, creating a disconnect between the curriculum and the lived world, thus becoming less relevant to students. On the other hand, when it understands cyberculture as a field of creation, dialogue, and expression, the school draws closer to the subjects' sociocultural experiences and expands opportunities for meaningful learning, especially when articulated with perspectives that recognize the diversity of the subjects and the complexity of educational processes.

Along these same lines, studies that articulate ICTs, inclusion, and human development broaden the understanding of technologies beyond their instrumental use, highlighting their potential as mediators of broader formative processes (Silva et al., 2021). When discussing the integration of digital technologies in contexts of inclusive education, the need for an approach that considers the complexity of educational processes, the diversity of individuals, and the promotion of equitable pedagogical practices is highlighted.

This movement, therefore, requires a review of pedagogical practices. The teacher ceases to be the center of knowledge circulation and becomes a mediator of collective processes of investigation and construction, recognizing the knowledge that circulates outside school walls. Incorporating cyberculture into teaching practice means opening up space for multiple narratives, languages, and modes of interaction, valuing the active participation of students and their leading role in the production of knowledge.

The modes of participation inherent to cyberculture—characterized by collaboration, authorship, interactivity, and collective construction—not only redefine learning ecologies but also create tension for traditional teaching practices. By understanding these dynamics, the school can transform into a more open, dialogical space connected to digital culture, fostering more critical and creative learning.

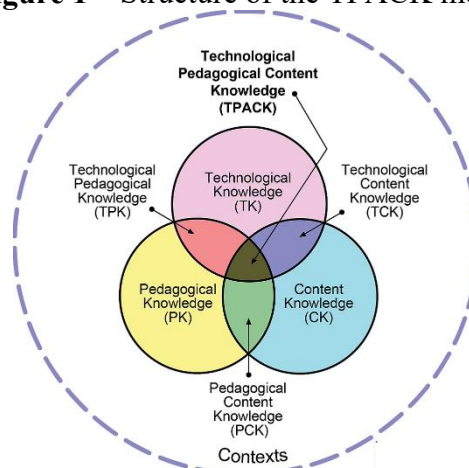
The transformations promoted by cyberculture, by redefining learning ecologies and modes of participation, pose new challenges to teaching practice, requiring not only the incorporation of technologies but the construction of forms of teaching that intentionally articulate knowledge, pedagogical mediation, and digital culture. In this scenario, a theoretical framework capable of guiding this integration in a consistent manner becomes necessary, overcoming fragmented or merely instrumental approaches.

TPACK in teacher education

In light of these transformations, which involve not only the incorporation of technologies but also the reconfiguration of the ways of producing knowledge, participating in digital culture, and promoting inclusive pedagogical practices, a theoretical framework capable of guiding teaching practice in an integrated and contextualized manner becomes necessary. In this context, the TPACK (*Technological Pedagogical Content Knowledge*) model, proposed by Mishra and Koehler (2006), stands out as an approach that articulates content, pedagogical, and

technological knowledge in the construction of teaching practices more coherent with contemporary demands (Figure 1).

Figure 1 – Structure of the TPACK model



Source: Mishra and Koehler (2006).

According to Mishra and Koehler (2006), Content Knowledge (CK) concerns the in-depth and substantial mastery of the object of teaching and learning, the topic of study, and the programmatic contents of the learning units. In parallel, Pedagogical Knowledge (PK) implies the processes, methods, and strategies inherent to teaching and learning. The third component, Technological Knowledge (TK), encompasses the modes of thinking and expertise necessary for the proficient use of technologies and technological resources in the educational environment.

Still according to the authors (Mishra; Koehler, 2006), the intersection of these domains generates four specialized forms of knowledge. Pedagogical Content Knowledge (PCK) manifests itself in the understanding of how teaching and learning processes articulate with content, encompassing the comprehension of curricula and the most effective strategies for their promotion. Technological Pedagogical Knowledge (TPK) directs its focus to the awareness that there are diverse technologies and components, and how these can be employed in different ways to optimize teaching and learning processes. In turn, Technological Content Knowledge (TCK) establishes the intrinsic connection between technology and specific content, requiring that teachers not only possess mastery of their teaching area but also understand the ways in which technology can mediate and facilitate the acquisition of this content by students.

Understanding TPACK shows that technological integration is not limited to the instrumental mastery of tools, but involves their articulation with pedagogical objectives and

curricular content. Authors such as Dogenski and Silva (2024) highlight that the integration of technologies requires a reflective and critical stance from the teacher, capable of mobilizing knowledge in a contextualized and coherent manner. Technology, therefore, cannot occupy the center of educational practice; it must act as a mediation that enhances cognitive processes, promotes experiences, and expands learning possibilities.

More than the simple sum of knowledge, TPACK proposes an understanding of the interrelationships between the pedagogical, technological, and content domains, recognizing that the pedagogical use of technologies requires the teacher to have the ability to make situated decisions, sensitive to the context, the subjects, and the educational purposes. This understanding is in dialogue with Pimenta (2012), by emphasizing teacher education as a reflective and contextualized process, in which pedagogical knowledge is constituted through the articulation between theory and practice. From this perspective, TPACK can be understood not only as a model of technological integration, but as a theoretical-methodological device that contributes to shifting pedagogical practices centered on content transmission to approaches that value authorship, collaboration, and meaning-making, in dialogue with the assumptions of digital culture. Such an approach becomes particularly relevant in light of student diversity and the need to promote inclusive pedagogical practices that recognize different ways of learning and participating in the educational process.

Mishra and Koehler (2006) argue that TPACK involves a complex interaction between pedagogical, technological, and content knowledge, which cannot be treated in isolation. The integration of this knowledge makes it possible to understand that innovative practices emerge when the teacher mobilizes conceptual, methodological, and technological dimensions in a balanced and contextualized manner. When this articulation does not occur, the use of ICTs tends to be superficial, fragmented, or merely instrumental, without producing substantive changes in teaching practices.

The distinction between use and integration thus becomes fundamental. While the use of technology is often characterized by isolated actions centered on the technical functioning of tools, integration is guided by pedagogical intentionality, well-founded choices, curricular coherence, and the development of more complex cognitive skills. This perspective reinforces that the effective integration of technologies depends less on the tool itself and more on the epistemological and didactic decisions that guide teaching work (Silva; Aguiar; Jurado, 2020).

Based on this framework, we proceed to the analysis of the selected research, seeking to understand how these dimensions materialize in teacher education and practice.

Results and Discussion

The integrated analysis of the 16 selected studies—composed of Brazilian theses and dissertations that address the relationship between ICTs, TPACK, and teacher training in different formative contexts, such as undergraduate degrees, continuing education, the role of the pedagogical coordinator, early childhood education, teaching of Science, Mathematics, Portuguese Language, educational robotics, *b-learning*, and reference centers in educational technology—reveals a scenario marked by structural challenges, pedagogical tensions, and potentialities that are still little explored. Although the studies present distinct emphases, the emergence of convergent patterns is observed, which highlight formative weaknesses and limitations in the pedagogical articulation of technologies. This section discusses the findings in light of the theoretical framework, articulating them into four analytical axes: insufficient initial training to integrate ICTs and TPACK; continuing education and the role of the pedagogical coordinator; structural inequalities and material conditions; and emerging potentialities related to TPACK, b-learning, and creative practices.

Technologies in pedagogical practice

The analyzed studies reinforce that the presence of ICTs in Brazilian schools is still marked by profound contradictions. In many contexts, the expectation for innovation contrasts with pedagogical practices that remain anchored in expository models, even when computers, tablets, educational robotics, virtual learning environments, or digital platforms are available. This contradiction appears consistently in the analyzed research, as evidenced in Aracheski (2019), Moraes (2022), and Brito (2022), which identify superficial uses, centered on content presentation, with limited exploration of the collaborative, creative, and investigative potential of the technologies.

The set of analyzed research shows that one of the factors that most contribute to this superficiality is the fragility of teacher training—both in the technical and pedagogical domains—which hinders the critical appropriation of ICTs. In the studies by Moraes (2022) and Bezerra (2022), for example, it is observed that the COVID-19 pandemic exposed and intensified already existing structural inequalities, showing that the lack of infrastructure, connectivity, and technical support makes more elaborate practices unfeasible, leading teachers to resort to emergency strategies focused on maintaining bonds and transmitting content.

Despite these obstacles, some studies present powerful experiences that illustrate the capacity of ICTs to promote authorial and contextualized learning when integrated into pedagogical proposals with intentionality. This is the case of Nogueira (2021), who analyzed practices involving robotics, programming, and creative learning and found an increase in students' motivation, active participation, and investigative thinking; or Roza (2019), who showed how virtual environments can enhance collaboration and authorship.

The analyses as a whole indicate that technology, in and of itself, does not produce innovation: it becomes a mediator of pedagogical transformations when articulated with well-founded didactic choices, open curricular projects, and an expanded view of learning. Thus, the gap observed between technical potential and pedagogical use stems less from the technologies and more from the socio-material, institutional, and formative conditions that structure teaching practice.

Cyberculture and learning ecologies

Research shows that students live in cybercultural ecosystems where learning goes beyond school boundaries, involving social networks, videos, tutorials, games, virtual communities, and other forms of digital interaction. These participatory practices—marked by authorship, reconfiguration, production, and circulation of content—are a constitutive part of digital culture, but are still little understood or valued in the school context.

Studies such as those by Castro (2020) and Falcão (2020) demonstrate that many curricula continue to reduce digital culture to the technical dimension of “tool use,” disregarding precisely the modes of participation that structure the everyday experience of youth. This creates a disconnect between curriculum and life, producing a school that operates in times and logics different from those that organize students' cultural repertoires.

On the other hand, research such as that of Nogueira (2021) reveals that when teachers understand cyberculture as a learning ecology—and not as a threat or distraction—they become capable of planning activities that dialogue with students' cultural practices, valuing creativity, collaboration, and problem-solving. The same occurs in Roza (2019), whose experience in virtual environments showed that students tend to engage more deeply when they can produce content, interact with peers, and exercise some level of autonomy.

Analyses indicate that schools that ignore cyberculture limit their ability to form critical and participatory subjects, as they lose the opportunity to connect school knowledge with youth knowledge. Incorporating cybercultural modes of participation does not mean adhering to technological fads, but rather understanding contemporary social practices and mobilizing them as pedagogical resources that expand student agency.

TPACK in teaching practice

TPACK emerges in research as a powerful theoretical framework, but its effective incorporation into curricula and teaching practices remains limited. Most research indicates that teachers have difficulty articulating the three domains—content (CK), pedagogy (PK), and technology (TK)—in an integrated manner, which results in fragmented or merely technical practices. This scenario highlights the difficulty of the integrated mobilization of the knowledge proposed by TPACK, indicating that, in the absence of this articulation, technology tends to be used in a decontextualized manner and with low pedagogical impact.

Morais (2022) demonstrates that pre-service teachers often recognize the importance of technologies but are unable to plan activities that coherently articulate content, methodology, and digital resources. Cruz (2018) and Rocha (2022), when analyzing continuing education, found that short-term courses hardly promote structural transformations, as they tend to focus more on the use of tools than on reflection regarding their pedagogical function.

However, some research indicates promising movements. Aracheski (2019), when relating TPACK and BNCC, shows that the model contributes to developing digital competencies and investigative practices aligned with the curriculum. Bervian (2019) reinforces that the appropriation of TPACK occurs in a procedural manner: teachers advance as they experience real situations of planning, experimentation, and analysis of their own practices.

The body of research reveals, therefore, that TPACK is a relevant theoretical horizon, but still little explored as a structuring axis for curricular and formative policies. Its adoption requires time, continuity, reflection, and follow-up—elements not always present in the formative contexts analyzed.

Integrated synthesis of the findings: tensions, convergences, and analytical axes

The analytical reading of the studies allowed for the identification that the integration between ICTs, cyberculture, and TPACK depends on a complex articulation between material, epistemological, and pedagogical dimensions. Technologies expand possibilities for mediation; cyberculture redefines learning ecologies; and TPACK provides the framework to guide well-founded pedagogical choices. However, these dimensions are rarely articulated consistently in teacher training.

Research shows that when these dimensions connect, more collaborative, creative, and authorial educational practices emerge; when they dissociate, superficial uses, the reproduction of traditional practices, or actions disconnected from the students' real needs prevail.

In terms of training, an important point of convergence identified in the studies is that teacher education still does not keep pace with the speed of digital transformations. Undergraduate teaching degrees and continuing education programs offer little space for experimentation, authorship, collaborative planning, and critical analysis of technologies. Furthermore, structural inequalities persist between schools, networks, and regions, which directly impact the possibilities for integration.

At the same time, it is observed that teachers who articulate these dimensions tend to develop practices that are more consistent with contemporary demands, highlighting the central role of training in the integration of technologies.

Based on this analytical reading, guided by the procedures of content analysis, four analytical axes were identified that synthesize the main convergences of recent academic production:

Axis 1 — Insufficient initial training to integrate ICTs and TPACK

Studies such as those by Castro (2020), Falcão (2020), Moraes (2022), Ataíde (2021), and Cruz (2021) reveal structural gaps in undergraduate teaching degree curricula. Technical approaches predominate, with an absence of critical discussions on digital culture and little connection between theory and practice. Ataíde (2021) observes that initial training courses tend to teach tools in isolation, without considering the mobilization of TPACK in real teaching situations. Moraes (2022) reinforces this finding by demonstrating that undergraduate students have difficulties in understanding how to integrate technologies into Science teaching.

These findings are in direct dialogue with Kenski (2015), who points out the urgency of innovative proposals for teacher training at all levels of education, especially in light of the new demands of digital culture. As a critical synthesis of Axis 1, we argue that initial teacher training does not sufficiently develop TPACK, resulting in teachers who master content but do not fully understand how technology can mediate learning in a contextualized way.

Axis 2 — Continuing education and the role of the pedagogical coordinator

The strategic role of continuing education is highlighted in the research of Miranda (2019), Cruz (2018), Rocha (2022), and Silva (2022). Cruz (2018) highlights the centrality of the pedagogical coordinator as an articulator of digital culture and a mediator of formative processes. Rocha (2022) demonstrates that training based on active methodologies and the Fedathi Sequence enhances teachers' ability to integrate technologies into investigative practices. Silva (2022) reinforces that the Reference Centers for Educational Technology (CRTes) are essential, but face limitations in infrastructure, staff, and continuity.

As a critical synthesis of Axis 2, we highlight that continuing education is indispensable, but still fragmented and dependent on the local engagement of schools, which hinders the consolidation of permanent professional development policies.

Axis 3 — Structural inequalities and material conditions

Castro (2023) and Bezerra (2022) highlight that technological infrastructure is still one of the main obstacles to the integration of ICTs. During the pandemic, such inequalities widened, revealing the urgency of policies that combine equipment, access, maintenance, and technical support. According to Kenski (2012), equipping schools without adequate training leads to obsolescence and waste, which is confirmed by recent findings.

Given this scenario, it is concluded that structural precariousness prevents the consolidation of innovative practices, contributing to the maintenance of traditional approaches even in well-equipped contexts.

Axis 4 — Emerging potentialities: TPACK, b-learning, and creative practices

Studies such as those by Aracheski (2019), Bervian (2019), Roza (2019), and Nogueira (2021) point to important advances. Aracheski (2019) relates TPACK and BNCC, showing coherence between digital competencies and the pedagogical integration of technologies in early childhood education. Roza (2019) highlights the potential of *b-learning* articulated with TPACK to produce new pedagogies and collaborative practices. Nogueira (2021) highlights creative learning and robotics as fertile spaces for mobilizing TPACK and fostering student agency.

As a critical synthesis of Axis 4, it is evident that innovative experiences exist, but they are still sporadic. They represent promising avenues for expanding the integration of technologies with pedagogical intentionality.

Final Considerations

This integrative review has made it possible to understand how Brazilian academic production has addressed the integration of ICTs and the TPACK model in teacher training, highlighting a field marked by tensions, advances, and persistent challenges. By systematizing theses and dissertations published between 2019 and 2023, the study identified four analytical axes: weaknesses in initial training, limits and potential of continuing education, structural inequalities, and the emergence of innovative practices.

The findings show that TPACK is not yet consolidated in initial teacher training curricula, while continuing education, although recognized as necessary, is not always structured as a permanent policy. Furthermore, a contradiction is observed between legal requirements and institutional conditions, which contributes to the integration of technologies remaining, in many contexts, restricted to instrumental uses. Even so, experiences are emerging that point to possibilities for more significant integration, though often dependent on isolated initiatives and local conditions.

The evidenced limitations have a direct impact on pedagogical practices, which tend to be configured in a fragmented way or poorly articulated with teaching and learning processes. At the same time, when there is didactic intentionality and integration between pedagogical, technological, and content knowledge, more critical, authorial, and contextualized practices are

observed, indicating the potential of ICTs to qualify formative experiences in more consistent contexts.

In this context, the TPACK model reaffirms itself as a relevant theoretical framework for understanding the integration of pedagogical, technological, and content knowledge in teacher education. However, the findings indicate that its appropriation needs to be understood in a situated and critical manner, avoiding the model being taken as a neutral framework or one sufficient to address, in isolation, the challenges of integrating ICTs into education. The connection between technology, pedagogy, and content depends on concrete working conditions, institutional training policies, adequate infrastructure, time for planning, and pedagogical support. Disregarding these mediations can reduce TPACK to an operational planning scheme, distancing it from its analytical power to think about the complexity of teaching in digital culture.

The integration of ICTs cannot be analyzed solely as a methodological or technical issue, as it also involves critical-political dimensions related to inequalities in access, teaching working conditions, the discontinuity of training policies, and disputes surrounding the meanings attributed to educational innovation. The research analyzed shows that more authorial, collaborative, and contextualized practices do not automatically stem from the presence of technologies, but rather from consistent formative processes and pedagogical projects capable of articulating digital culture, didactic intentionality, and a commitment to meaningful learning.

As a contribution, this study offers an integrated reading of recent academic production, highlighting tensions, gaps, and possibilities that can inform teacher education policies and pedagogical practices more sensitive to the demands of digital culture. At the same time, the delimitation of the corpus to the CAPES Catalog of Theses and Dissertations, the period from 2019 to 2023, and the use of the TPACK descriptor as a search criterion is recognized as a limitation. Such a choice conferred specificity to the analyzed corpus, allowing for the examination of research that explicitly mobilizes this theoretical framework; however, it may also have restricted the identification of studies that discuss the pedagogical integration of technologies without directly adopting this nomenclature. Considering that the articulation between technological, pedagogical, and content knowledge cuts across broader debates on teacher education and digital culture, it is possible that relevant research may not have been included because it did not directly name the model. This finding does not undermine the review's results, but it does limit their scope and indicates possibilities for expansion in future

studies, with the inclusion of other databases, different time frames, related descriptors, and empirical investigations that deepen the relationship between teacher education, TDICs, TPACK, and pedagogical practices in diverse contexts.

REFERENCES

- ARACHESKI, S. A. **TPACK – Conhecimento Tecnológico e Pedagógico do Conteúdo:** análise de sua importância na prática docente e na formação do professor da educação infantil. Orientadora: Profa. Dra. Luana Priscila Wunsch. 2019. 87 f. Dissertação (Mestrado Profissional em Educação e Novas Tecnologias) – Centro Universitário Internacional, UNINTER, Curitiba, 2019.
- ATAÍDE, M. C. E. S. **Mobilizando o conhecimento tecnológico e pedagógico do conteúdo na formação inicial de professores:** uso de aplicativos na prática de ensino de Ciências. Orientadora: Profa. Dra. Antonia Dalva Franca Carvalho. 2021. 209 f. Teses (Programa de Pós-Graduação em Educação) - Centro de Ciências da Educação “Professor Mariano da Silva Neto” – Universidade Federal do Piauí - UFPI, Teresina, 2021.
- BARDIN, L. **Análise de conteúdo.** São Paulo: Edições 70, 2016.
- BERVIAN, P. V. **Processo de investigação-formação-ação docente:** uma perspectiva de constituição do conhecimento tecnológico pedagógico do conteúdo. Orientadora: Profa. Dra. Maria Cristina Pansera de Araujo. 2019. 223 f. Tese (Programa de Pós-graduação em Educação nas Ciências) - Universidade Regional do Noroeste do Estado do Rio Grande do Sul - Unijuí, Ijuí, 2019.
- BEZERRA, M. S. **Formação para o uso das TDIC em cursos de licenciatura da área das ciências da natureza da Universidade Federal de Sergipe, Campus Professor Alberto Carvalho.** Orientador: Prof. Dr. Joao Paulo Mendonca Lima. 2022. 125 f. Dissertação (Pós-Graduação em Ciências Naturais) - Universidade Federal de Sergipe - UFS, Sergipe, 2022.
- BRITO, G. C. **A mobilização do conhecimento tecnológico pedagógico do conteúdo:** um estudo com professores de língua portuguesa e matemática do ensino fundamental. Orientador: Prof. Dr. Ernani Martins dos Santos. 2022. 216 f. Dissertação (Formação de Professores e Práticas Interdisciplinares) – Universidade de Pernambuco, Petrolina, 2022.
- BUCKINGHAM, D. Cultura digital, educação midiática e o lugar da escolarização. **Educação e realidade**, v. 35, n. 03, p. 37-58, 2010. Available at: <http://educa.fcc.org.br/pdf/rer/v35n03/v35n03a04.pdf>. Accessed in: 04 Aug. 2025.
- CASTRO, S. B. E. **Entrelaçamentos entre a Formação Docente para o Ensino de Matemática e o uso das Tecnologias Digitais nos Cursos de Pedagogia.** Orientadora: Profa. Dra. Silvana Claudia dos Santos. 2020. 110f. Dissertação (Programa de Pós-Graduação em Educação) - Universidade Federal de Viçosa, Bahia, 2020.
- CASTRO, S. S. P. **A Formação Docente para o Uso das Tecnologias Digitais na Educação Infantil:** Reflexões à Luz da Revisão de Literatura. Orientadora: Profa. Dra. Adriana Maria de Assumpção. 2023. 143 f. Dissertação (Mestrado em Educação) – Universidade Estácio de Sá, 2023, Rio de Janeiro, 2023.
- CRUZ, K. C. **O papel do coordenador pedagógico na formação continuada de professores dos anos finais do ensino fundamental para uso das TDIC.** Orientadora: Profa. Dra. Rosemara Perpetua Lopes. 2018. 133 f. Dissertação (Mestrado em Educação) – Universidade Federal de Goiás, Jataí, 2018.

CRUZ, S. R. M. **A formação para o desenvolvimento de competências digitais: uma análise dos programas de pós-graduação em educação à luz do TPACK.** Orientadora: Profa. Dra. Eucídio Pimenta Arruda. 2021. 210 f. Tese (Programa de Pós-graduação em Educação) – Universidade Federal de Minas Gerais, Belo Horizonte, 2021.

DOGENSKI, J.; SILVA, M. P. O Modelo TPACK para inserção das tecnologias digitais na educação. In: GESSER, V. *et. al.* (org.). **Inovação, Culturas e Decolonialidades: perspectivas e desdobramentos da pesquisa educacional para democratização de políticas e práticas educacionais.** 1ed.: Editora Inovar, 2024, v. 1, p. 325-341. DOI: 10.36926/editorainovar-978-65-5388-233-1.

FALCÃO, M. C. **As proposições formativas das diretrizes curriculares nacionais na formação inicial docente para uso de tecnologias: Estado do Conhecimento.** Orientador: Prof. Dr. Danilo Garcia da Silva. 2020. 121 f. Dissertação (Mestrado em Educação) – Universidade Federal de Mato Grosso, Cuiabá, 2020.

KENSKI, V. M. **Educação e tecnologias: o novo ritmo da informação.** Campinas: Papirus, 2012.

KENSKI, V. M. A urgência de propostas inovadoras para a formação de professores para todos os níveis de ensino. **Revista Diálogo Educacional**, v. 15, n. 45, 2015. DOI: 10.7213/dialogo.educ.15.045.

KENSKI, V. M. Aprendizagem mediada pela tecnologia. **Revista Diálogo Educacional**, Curitiba: PUCPR, n. 4, p. 47-56, 2003. DOI: 10.7213/rde.v4i10.6419.

LÉVY, P. **Cibercultura.** São Paulo: 34, 1999. 264 p.

MISHRA, P.; KOEHLER, M. J. Technological Pedagogical Content Knowledge: a framework for teacher knowledge. **Teachers College Record**, 2006. Available at: https://one2oneheights.pbworks.com/f/MISHRA_PUNYA.pdf. Accessed in: 5 Nov. 2024.

MIRANDA, F. M. **Desafios da Formação Continuada de Professores para o Uso das TDIC na Educação Profissional e Tecnológica.** Orientadora: Profa. Dra. Claudia Smaniotto Barin. 2019. 98 f. Dissertação (Programa de Pós-graduação em Educação Profissional e Tecnológica) – Universidade Federal de Santa Maria. Santa Maria, 2019.

MORAIS, C. S. **Formação inicial de professores do ensino fundamental para o uso das TDIC em aulas de ciências: uma proposta formativa orientada pelo TPACK.** Orientador: Prof. Dr. Rodrigo Claudino Diogo. 2022. 211 f. Dissertação (Programa de Pós-graduação em Educação para Ciências e Matemática) - Instituto Federal de Educação, Ciência e Tecnologia de Goiás. Jataí, 2022.

NOGUEIRA, C. A. **Narrativas de professores de matemática: experiências com aprendizagem criativa em um curso de robótica educativa.** Orientador: Prof. Dr. Cleyton Hercules Gontijo. 2021. 227 f. Tese (Programa de Pós-Graduação em Educação) - Universidade de Brasília – UnB, Brasília, 2021.

PIMENTA, S. G. **Saberes pedagógicos e atividade docente.** 8. ed. São Paulo: Cortez, 2012.

ROZA, J. C. **Aprendizagem na/da docência digital na perspectiva do b-learning e do tpack na produção compartilhada de novas pedagogias**. Orientadora: Profa. Dra. Adriana Moreira da Rocha Veiga. 2019. 279 f. Tese (Programa de Pós-Graduação em Educação) - Universidade Federal de Santa Maria, Santa Maria, 2019.

ROCHA, M. N. P. **A Sequência Fedathi para a Formação Docente no Ensino Superior: uma Proposta Formativa com Uso de Metodologias Ativas e Tecnologias Digitais**. Orientador: Prof. Dr. Herminio Borges Neto. 2022. 115 f. Tese (Programa de Pós-Graduação em Educação) – Universidade Federal do Ceará, Fortaleza, 2022.

SANTAELLA, L. **Comunicação ubíqua: repercussões na cultura e na educação**. São Paulo: Paulus, 2013.

SILVA, L. A. N. **Um olhar para os Centros de Referência em Tecnologia Educacional do Distrito Federal na perspectiva da formação continuada docente para o uso das TICE: a visão dos professores formadores**. Orientador: Prof. Dr. Gilberto Lacerda dos Santos. 2022. 172 f. Dissertação (Mestrado em Educação) – Universidade de Brasília – UnB, Brasília, 2022.

SILVA, M.P.; FERREIRA, H. M.; BONIN, J. C. As contribuições da educomunicação para a formação de sujeitos críticos. **Revista Ibero-Americana de Estudos em Educação**, v. 17, p. 1897-1837, 2022. Available at: <https://periodicos.fclar.unesp.br/iberoamericana/article/view/16599/14096>. Accessed in: 10 Oct. 2024.

SILVA, M. P.; AGUIAR, P. A.; JURADO, R. G. As tecnologias digitais da informação e comunicação como polinizadoras dos projetos criativos ecoformadores na perspectiva da educação ambiental. **Revista Polyphonia**, v. 31, n. 1, p. 182-204, 2020. DOI: <https://doi.org/10.5216/rp.v31i1.66957>.

SILVA, M. P.; SIMÃO, V.L.; ALVES, A. G.; SANTOS, B. S. Design universal como possibilidade de inserção de tecnologias educacionais inclusivas. **Humanidades & Inovação**, v. 8, n. 43, p. 270-283, 2021. Available at: <https://revista.unitins.br/index.php/humanidadesinovacao/article/view/5522>. Accessed in: 10 Apr. 2026.

VIEIRA PINTO, A. **O conceito de tecnologia**. Rio de Janeiro: Contraponto, 2005.

WHITTEMORE, R.; KNAFL, K. The integrative review: updated methodology. **Journal of Advanced Nursing**, n. 52, p. 546-553, 2005. DOI: 10.1111/j.1365-2648.2005.03621.x.

CRedit Author Statement

- ☐ **Acknowledgements:** CNPq and FAPESC.
 - ☐ **Funding:** Conselho Nacional de Desenvolvimento Científico e Tecnológico – CNPq and Fundação de Amparo à Pesquisa e Inovação do Estado de Santa Catarina – FAPESC.
 - ☐ **Conflicts of interest:** There are no conflicts of interest.
 - ☐ **Ethical approval:** The authors followed ethical principles at all stages of this study.
 - ☐ **Data and material availability:** The data and materials used in this work are not available for access.
 - ☐ **Author contributions:** The first author prepared the integrative review with guidance and supervision from the second author. The third and fourth authors collaborated on the organization and critical review of the manuscript.
-