

POSTHUMAN PEDAGOGICAL KNOWLEDGE: RETHINKING TPACK IN THE AGE OF INTELLIGENT MACHINES

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Abstract :

The Technological Pedagogical Content Knowledge (TPACK) framework has long guided teachers' understanding of how technology, pedagogy, and content knowledge intersect in effective teaching. However, as education enters an era increasingly shaped by artificial intelligence, automation, and algorithmic mediation, the assumption that technology serves merely as an instructional tool becomes inadequate. This paper rethinks TPACK through a posthumanist lens, arguing that technology must be understood as an active, co-constitutive agent in the teaching-learning process. Drawing on theories from posthumanism and critical digital pedagogy, the paper reconceptualizes TPACK as a dynamic assemblage of human and non-human actors where agency, cognition, and meaning are distributed across networks. The proposed Posthuman TPACK model reframes teacher knowledge as relational, emergent, and situated within socio-technical entanglements rather than individual mastery. This theoretical shift invites educators, researchers, and policymakers to rethink teacher education and curriculum design beyond human-centered paradigms, acknowledging the ethical, cognitive, and ontological implications of learning in a posthuman age.

IndexTerms - Posthuman Pedagogy, Critical Digital Pedagogy, Artificial Intelligence in Education

1. Introduction

The contemporary landscape of education is being profoundly reshaped by the accelerating rise of artificial intelligence (AI), automation, and algorithmic decision-making systems. Classrooms are no longer spaces of solely human interaction, instead, they are digitally mediated ecosystems where intelligent technologies such as learning management systems, adaptive platforms, and generative AI tools actively shape teaching and learning processes. As technology becomes more embedded and autonomous, the traditional boundaries separating human cognition and machine agency have become increasingly blurred.

Within this evolving context, the Technological Pedagogical Content Knowledge (TPACK) framework has long served as a cornerstone for understanding how teachers integrate technology effectively with pedagogy and content. Originally developed by Mishra and Koehler (2006), TPACK extends Shulman's (1986) concept of Pedagogical Content Knowledge (PCK) by adding the technological dimension to teacher expertise. The framework emphasizes that effective technology integration arises from the dynamic interplay among content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). However, despite its influence, TPACK remains rooted in a human-centered epistemology, where technology is conceived as a neutral instrument under the deliberate control of the teacher.

This instrumentalist view of technology, while suitable for earlier stages of digital integration, becomes increasingly inadequate in the era of intelligent machines. Today's educational technologies do not merely assist teachers. They also analyze data, predict learner behavior, and influence pedagogical choices, functioning as co-participants in the educational process. Such developments challenge the foundational assumptions of TPACK, raising critical questions about agency, authorship, and cognition in the digital age.

Therefore, this paper seeks to reconceptualize the TPACK framework through the lens of posthumanist philosophy, which decouples knowledge and agency from exclusively human origins. Posthumanist theorists such as Rosi Braidotti (2013) and N. Katherine Hayles (1999) argues that the human subject is entangled with non-human actors such as machines, environments, and material systems in a web of distributed cognition. Applying this perspective to TPACK invites a paradigm shift: from viewing technology as an instrument for human mastery to understanding it as a co-agent that participates in meaning-making and pedagogical decision-making.

Accordingly, this study is guided by two theoretical research questions:

1. How can posthumanist theory reframe the understanding of teacher knowledge within the TPACK framework?
2. What are the implications of viewing technology as a co-agent rather than a tool for teaching and learning?

By addressing these questions, the paper aims to develop a Posthuman TPACK model that redefines teacher knowledge as relational, distributed, and co-constructed through human–technology assemblages. This rethinking not only extends the theoretical foundations of TPACK but also prompts educators to reconsider the ethical and pedagogical dimensions of teaching in a world increasingly shaped by intelligent machines.

2. Theoretical Background

Posthumanism, as articulated by scholars such as Rosi Braidotti (2013), N. Katherine Hayles (1999), and Donna Haraway (1991), challenges the humanist paradigm that situates the human being at the center of knowledge, power, and moral agency. In contrast to Enlightenment notions of the autonomous, rational subject, posthumanism proposes a relational ontology in which humans and non-humans exist in mutually constitutive relationships. From this perspective, knowledge is not the product of isolated human cognition but the outcome of entangled processes that include technological, material, and affective agencies.

This philosophical stance disrupts the conventional dichotomy between humans as active subjects and technologies as passive instruments. Instead, posthumanism advances the idea of distributed agency, wherein cognition, creativity, and decision-making emerge through the dynamic interplay of human and non-human actors. In education, this implies recognizing that technologies are epistemic collaborators that participate in the shaping of what counts as knowledge, how it circulates, and how it is interpreted.

Within educational theory, posthumanism reframes learning as a networked and emergent process, rather than a linear transfer of knowledge from teacher to learner. This reconceptualization aligns with Actor–Network Theory (Latour, 2005) and Assemblage Thinking (Deleuze & Guattari, 1987), which both emphasize the fluid interrelations among heterogeneous entities. Teaching and learning, seen through these lenses, unfold within assemblages composed of teachers, students, digital systems, environments, and material infrastructures. Education thus becomes an event of intra-action (Barad, 2007), in which meaning arises through relations rather than pre-existing categories of human intention or technological function.

For example, in digitally mediated classrooms, AI systems, learning analytics platforms, and adaptive technologies continually interact with teachers and students, influencing instructional design, assessment, and pedagogical identity. These interactions illustrate how technologies co-create pedagogical realities, generating new configurations of authority, cognition, and representation. Consequently, the teacher’s role evolves from that of an instructor who deploys tools to that of a relational mediator, navigating an extended socio-technical ecology in which knowledge is co-constructed rather than transmitted.

Central to posthumanism is an ethical imperative to rethink responsibility, subjectivity, and agency in an era where technologies actively participate in learning processes. As Braidotti (2013) asserts, posthuman ethics resists hierarchies and domination, advocating for symbiotic coexistence between human and non-human actants. Within education, this translates into a shift from mastery-based pedagogy to one of ethical entanglement, where educators must remain reflexive about the ways digital systems influence cognition, representation, and access.

Posthuman ontology also implies that teaching and learning are emergent phenomena, arising from the interactions of diverse agents rather than being determined solely by human will. The classroom becomes a living assemblage of relations, a dynamic space where human and technological participants collaboratively enact and transform knowledge. In this sense, teacher knowledge is reimagined not as a personal asset but as relational expertise situated within a constantly evolving socio-technical environment.

By decentering human agency and foregrounding technological co-participation, posthumanism offers a powerful philosophical foundation for rethinking the Technological Pedagogical Content Knowledge

(TPACK) framework. It calls for a Posthuman TPACK model that understands knowledge as distributed, entangled, and ethically situated within networks of human and non-human actors. In this reformulation, technology ceases to be an external aid and becomes an integral agent in pedagogical processes, shaping how teachers design, deliver, and interpret learning experiences.

Such a posthuman interpretation moves beyond viewing teachers as gatekeepers of knowledge and instead positions them as co-creators within intelligent systems. This transformation has profound implications for teacher education, curriculum design, and digital pedagogy, urging scholars and practitioners alike to reconceptualize teaching as a collaborative act embedded in the hybrid ecology of humans and machines that defines learning in the age of AI and automation.

3. Discussion

In response to the first research question, conceptual analysis demonstrates that posthumanist theory fundamentally reframes the understanding of teacher knowledge within the TPACK framework. Teacher knowledge can no longer be conceived as an individual, static possession. Instead, it emerges relationally through the ongoing interactions among human and non-human actors within socio-technical learning environments. Teachers exercise their expertise not solely through the deployment of technological tools, but through negotiating meaning, interpreting algorithmic feedback, and collaborating with intelligent systems to shape learning experiences. Knowledge, in this posthumanist perspective, becomes a dynamic capability that is context-sensitive, adaptable to evolving technological affordances, and ethically responsive to the complex entanglements of pedagogy, content, and technology. Such a reconceptualization emphasizes that teacher knowledge is not a property to be acquired or mastered in isolation, but a relational, co-constructed expertise that unfolds continuously as part of hybrid learning ecologies.

Addressing the second research question, positioning technology as a co-agent rather than a neutral instrument profoundly reshapes pedagogy, instructional decision-making, and teacher preparation. In human-machine learning networks, agency is distributed, requiring teachers to engage in continuous interpretation, calibration, and negotiation alongside intelligent systems. Pedagogical practice becomes a co-creative process, where content, instructional strategies, and technological inputs are inseparably intertwined, and learning outcomes emerge from the collaborative interplay of all participants. This shift necessitates the development of relational literacy, defined as the capacity to critically evaluate, collaborate with, and mediate the contributions of intelligent systems in pedagogical contexts. Moreover, it foregrounds ethical responsibility, compelling teachers to critically navigate algorithmic biases, transparency, and socio-political implications inherent in technologically mediated learning environments. Consequently, teaching is reframed as an emergent and adaptive practice, where both human and non-human actors shape knowledge production, decision-making, and the construction of learning realities.

Together, these insights indicate that a Posthuman TPACK framework offers a more accurate and ethically attuned model for conceptualizing teaching in the age of AI. By centering relationality, reflexivity, and co-emergence, teacher expertise is repositioned within distributed knowledge ecologies rather than as the exercise of individual mastery. This reconceptualization has practical significance for teacher education, suggesting that preparation programs should cultivate ethical engagement, adaptive decision-making, and collaborative interaction with intelligent technologies. Likewise, research should expand beyond measuring technology integration toward examining how technological co-agency transforms pedagogical identity, ethics, and instructional practice. Overall, a Posthuman TPACK perspective situates teachers as participants in hybrid learning ecologies, highlighting the entangled and emergent nature of knowledge within contemporary digitally mediated classrooms.

4. Summation

This study illustrates that posthumanist theory reconceptualizes teacher knowledge within the TPACK framework as relational, emergent, and co-constructed through interactions with human and non-human actors. Recognizing technology as a co-agent rather than a neutral tool reframes teaching as a co-creative, adaptive, and ethically accountable practice, in which agency, pedagogy, and content are distributed across socio-technical networks. Such a perspective underscores the necessity for relational literacy, ethical reflexivity, and adaptive expertise in teacher education, while encouraging research to move beyond

conventional metrics of technology integration toward examining the transformative effects of human-machine collaboration on pedagogical identity and practice. Ultimately, the Posthuman TPACK framework positions teachers as active participants in hybrid learning ecologies, emphasizing that knowledge is entangled, emergent, and collaboratively produced within the complex socio-technical assemblages that define contemporary educational landscapes.

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