

Review

Not peer-reviewed version

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Posted Date: 8 January 2026

doi: 10.20944/preprints202601.0605.v1

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Review

Creativity and Digital Technologies in Education: Evolving Tools, Contexts, and Creative Practices

Danah Henriksen

Mary Lou Fulton Teachers College, Division of Educational Leadership and Innovation, Arizona State University, Phoenix, AZ 85069, USA; danah.henriksen@asu.edu

Abstract

Creativity and technology have each become central to contemporary education, yet scholarship examining their intersection has developed across diverse disciplines, creating a need for integrative perspectives. This review examines how digital technologies mediate creative possibility and practice in educational contexts, tracing the evolution from physical and analog tools through networked systems to contemporary generative technologies. Drawing on sociocultural theories of creativity and affordance theory, the review explores how each technological era has reshaped both creative practice and participation structures. The contemporary landscape encompasses networked platforms enabling participatory creativity, physical-digital tools supporting embodied making, and generative AI systems challenging traditional notions of creative authorship. Critical tensions emerge around defining and assessing creativity in digital contexts, addressing equity and access barriers, and navigating institutional pressures that simultaneously demand innovation and standardization. Implications point toward pedagogical approaches emphasizing distributed creativity, teacher education grounded in creative-technological experience, policy frameworks providing coherent guidance beyond rhetoric, and research attending to equity and practice-based knowledge. The co-evolution of creativity and technology continues, with education's challenge being to participate purposefully in shaping technologies and practices toward equitable and humanizing ends.

Keywords: creativity in education; digital technologies; creative learning; educational technology; affordances; participatory culture; maker education; generative AI; sociocultural theory; technological mediation

1. Introduction: Technology as Creative Mediation

Creativity and technology have both become central constructs in contemporary education, being widely regarded as essential for preparing students for an increasingly complex and rapidly changing world (Zhao, 2012). Educational systems internationally have emphasized both creative thinking skills and technological fluency as critical outcomes for learners (Henriksen et al., 2018). While considerable attention has been paid to both constructs individually within education, scholarship examining their intersection has often emerged across diverse disciplines and theoretical traditions, creating a need for integrative perspectives to inform educational theory and implementation (Mishra & Henriksen, 2018).

The intersection of creativity and technology presents opportunities and challenges for education. Digital tools offer new possibilities for creating, sharing, and collaborating in ways that were impossible with earlier technologies (Literat, 2018). At the same time, questions persist about how these tools shape creative practice, who benefits from access to them, and what role they should play in teaching and learning (Warschauer & Matuchniak, 2010). Recent developments have made such concerns increasingly urgent. The rapid mainstreaming of generative AI systems, the acceleration of digital learning in recent years since the global pandemic, and growing concerns about educational equity have all heightened the need to understand how creativity and technology interact in education (Henriksen et al., 2021). Understanding this relationship requires looking beyond

individual technologies or isolated creative acts to consider how tools, contexts, and practices interact in educational environments.

This integrative review examines scholarship relevant to the intersection of creativity, digital technologies, and education, with particular attention to how technologies mediate creative possibility and practice. The term “technology” here encompasses more than digital devices. Its etymological roots in the Greek *techne*, meaning art or craft, remind us that technologies have always been tools that extend human capacity for thinking and making (Hunt & Melrose, 2005). From this broader perspective, we can trace how different technological eras have afforded different creative possibilities, from physical and analog tools to networked digital systems and, most recently, to generative and immersive technologies.

This review is organized around several key areas that emerge from the literature. First, I trace the historical evolution of educational technologies as creative tools, showing how each technological era has brought new affordances and constraints that reshaped both creative practice and participation. Building on these historical patterns, the review briefly covers theoretical foundations for understanding creativity and technology, drawing on scholarship that views both as situated within social and cultural contexts (Glăveanu, 2013). The contemporary landscape receives extended attention, including participatory and maker cultures, immersive technologies, and artificial intelligence as creative partner. Following this, I address critical tensions that arise when technological change outpaces institutional and pedagogical adaptation, before concluding with implications for practice, policy, and future research. Throughout, the goal is to provide a coherent overview of the relationship between creativity and technology, and what it means for supporting creative teaching and learning.

2. Historical Context: From Analog to Digital Creative Tools

The relationship between technology and creativity extends far beyond contemporary digital tools. Throughout human history, technologies have served as extensions of creative capacity, reshaping not only what could be created but who could participate in creative production (Ong, 1982). Understanding this evolution reveals patterns in how new technologies mediate creative practice, patterns that remain salient as educators navigate today's rapidly shifting technological landscape.

Long before digital tools became a focus of technological development, physical and analog technologies established foundational models for technologically mediated creativity (McCullough, 1998). For instance, the invention of writing systems in antiquity was a form of early technology that allowed ideas to be preserved and transmitted across time and space, fundamentally altering the nature of human expression and thought (Ong, 1982). From the Middle Ages, the invention of the printing press demonstrated how a single technological innovation could generate cascading knowledge and creative transformations (Eisenstein, 1980). While initially created to reproduce existing texts, the press revealed unexpected creative affordances. A mass-produced books spread, it became apparent that many readers had poor eyesight, spurring the development of eyeglasses (Ilardi, 2007). Stemming from this innovation, the optical principles refined for corrective lenses continued to further creativity and inventions like microscopes, telescopes, and eventually cameras. This kind of innovation chain illustrates a kind of reversal of a common adage: invention became the mother of necessity, with each technological development creating new needs and possibilities that drove further creative work (Petroski, 1992).

Early digital technologies in education introduced qualitatively different creative affordances. Desktop publishing software made sophisticated layout and design accessible beyond professional print shops, transforming how documents could be conceived and produced (Bruce & Hogan, 1998). Similar democratization occurred in visual media, where digital photography liberated image-making from the constraints of film and darkroom chemicals (Mitchell, 1992). In design fields, computer-aided systems enabled architects and engineers to prototype and test ideas with unprecedented speed, fundamentally altering iterative processes that had previously been time-

intensive and costly (Jonassen, 2000). These early digital tools dramatically expanded creative possibilities within established domains, yet they maintained a relatively bounded character. Creativity still largely occurred on individual machines, and existing social structures around creative production and validation stayed largely intact (Warschauer, 2006).

Networked technologies, however, marked a more fundamental shift in creative practice. The internet, initially conceived for scientific information sharing, rapidly became a platform for diverse creative expression and collaboration (Berners-Lee, 1999). It provided online platforms that disrupted traditional gatekeeping structures and challenged fundamental assumptions about creative validation. While earlier models of creativity within social systems assumed that creative recognition required approval from established experts in a field (Csikszentmihalyi, 1997), networked technologies allowed direct creator-audience relationships that bypassed institutional intermediaries (Sawyer & Henriksen, 2024). A blogger could build a readership without editorial gatekeepers; a wiki could establish authority through community consensus rather than expert credentials; a meme creator could achieve cultural influence without access to traditional media channels (Jenkins, 2006). The result was not simply more creativity, but creativity that operated according to different rules about who could participate, how work was validated, and what forms of expression counted as creative.

This historical progression demonstrates that technological eras do not simply provide new tools for existing practices but often fundamentally reshape the nature of knowledge, learning and creative work itself. While physical tools extended individual capacity, analog technologies enabled reproduction and broader distribution. In the digital world, early digital systems offered unprecedented manipulation and iteration, and networked technologies dissolved boundaries between creation, distribution, and audience engagement. Each stage has brought new affordances while simultaneously introducing new tensions around access, evaluation, and what counts as creative work.

This evolution reveals consistent themes: technologies mediate creative capacity, reshape participation structures, and generate tensions between possibility and constraint. These patterns point toward theoretical frameworks that can deepen our understanding of creativity-technology relationships in educational contexts.

3. Theoretical Foundations: Understanding Creativity-Technology Relationships

3.1. Creativity as Socioculturally Situated

Any examination of how technologies shape creative practice must consider what constitutes creativity. Defining creativity has long challenged scholars, yet some consensus has emerged around core characteristics. The most widely cited “standard definition” identifies creativity as requiring both novelty (originality, newness) and effectiveness (usefulness, appropriateness) (Runco & Jaeger, 2012). However, these two criteria alone may be insufficient for understanding creativity in educational contexts. Mishra and Koehler (2008) proposed adding a third component: “wholeness” or contextual appropriateness, arguing that creative work must be understood in relation to the domain and culture within which it emerges. Henriksen et al. (2015) note that this “NEW” framework (novel, effective, whole) has inherent social and cultural elements as determinations of what counts as creative are inherently tied to the contexts that they emerge from.

Further, recent scholarship has moved beyond viewing creativity as solely an individual cognitive capacity toward understanding it as fundamentally social and cultural (Glăveanu, 2013). From this perspective, creativity emerges not from isolated individuals but through dynamic interactions between people, tools, ideas, and communities. Csikszentmihalyi’s (1997) systems model captures this complexity by locating creativity at the intersection of three elements: the individual (who generates novel ideas), the domain (the symbol systems, tools, and knowledge of a field), and the field (the community of experts who evaluate and validate innovation). This systemic view has important implications for education, suggesting that fostering creativity requires attention not just

to individual students' capacities but to the broader ecosystem within which creative work unfolds (Henriksen et al., 2016). Notably, this ecosystem includes the material tools and technologies that learners use to think and create—suggesting ways that technologies mediate knowledge building and creative production.

3.2. *Technology as Mediation*

If creativity is socioculturally situated, then the tools available within any cultural context become central to understanding creative possibility. Technologies are best understood as mediating artifacts that extend human capacity for thinking, making, and creating (Vygotsky, 1978). This sociocultural perspective views technologies not as neutral tools but as active participants in creative processes (Literat, 2018). Every technology offers particular affordances, or possibilities for action that emerge from its properties and our perception of them (Gibson, 1979). For instance, a pencil affords writing and drawing, while digital editing software affords manipulation and iteration, or networked platforms afford sharing and collaboration. These affordances both enable certain creative possibilities and constrain others (Valanides, 2018).

Importantly, affordances are not fixed or predetermined. While designers build certain possibilities into artifacts, users often perceive and enact affordances in unexpected ways (Norman, 1988). For example, in seeing a wooden box designed for storage, users might perceive that the box has affordances in shape and sturdiness that allow them to repurpose it as a stool (Norman, 1988); or alternatively, users can see that social media platforms designed for personal connection offer affordances that allow the platforms to become venues for political organizing or artistic performance (Literat & Kligler-Vilenchik, 2019). This notion that technologies and their affordances are neither deterministic nor infinitely malleable but rather operate within boundaries that can be creatively explored and sometimes transgressed has also been termed as a “zone of possibility” (Dirkin & Mishra, 2010).

Digital technologies offer distinctive affordances that differentiate them from earlier physical or analog tools. Unlike analog representations that maintain a direct relationship to what they represent, digital technologies convert information into binary code, making it radically easier to manipulate, combine, remix, and share content (Nelson et al., 2017). When combined with networked connectivity, these affordances allow for distributed creativity at unprecedented scales, from collaborative wikis to viral memes to global maker communities (Berthelsen & Tannert, 2020). This points to a reciprocal relationship: creativity drives technological innovation, while technologies reshape what creative practice looks like and who can participate in it (Henriksen & Hoelting, 2016). Such co-evolution has significant implications for educational systems, particularly because technological change often outpaces institutional adaptation, creating tensions between theory, practice, and established structures.

3.3. *Navigating Theory and Practice*

The relationship between creativity scholarship and educational practice has long been marked by tensions between the clean straight lines of research and the messy contradictions of practice (Schön, 1995). This gap is particularly evident at the intersection of creativity and technology, where practitioners face the “uneasy spaces of implementation” (Henriksen et al., 2021). These are situations characterized by conflicting demands, unclear guidance, and tensions between innovation and standardization. While research may explore creativity under controlled conditions, teachers must navigate complex realities: limited resources, accountability pressures, diverse student needs, and rapidly changing technologies.

Digital technologies have further complicated this theory-practice relationship in ways that directly challenge Csikszentmihalyi's (1997) systems model, described earlier. That model assumes clear boundaries between individuals, domains, and fields, with recognized experts serving as gatekeepers who determine what counts as creative (Csikszentmihalyi, 1997). However, digital platforms have enabled forms of “disintermediation” that bypass traditional gatekeepers (Henriksen

et al., 2016). Content creators on social media platforms can build massive audiences without approval from established institutions. Learners can access knowledge and communities far beyond their local contexts, and new forms of creative expression are often difficult for existing evaluation frameworks to recognize (Henriksen & Hoelting, 2017). This disruption creates both opportunities and challenges for education, raising questions about how to recognize and support creativity when traditional markers of quality and expertise no longer apply.

These theoretical foundations offer a lens for considering how creativity and technology have interacted across different historical moments. By understanding creativity as situated within social and cultural systems, technology as a mediating force that shapes creative possibility, and their intersection as generative of both opportunity and tension, we see how different technological eras have reshaped creative practice in education. Thus, it helps to briefly trace this evolution from physical tools through networked systems to contemporary generative technologies.

4. Contemporary Landscape: Digital Technologies Mediating Creative Learning

The theoretical and historical foundations outlined provide a lens for examining contemporary technologies and their relationship to creative practice, particularly in education. The following section explores three key technological domains that currently shape this landscape: networked platforms enabling participatory creativity, physical-digital tools supporting embodied making, and generative AI systems that challenge traditional notions of creative authorship. While not exhaustive of all technological implementations in creative education, these three areas have emerged as significant in both educational practice and scholarly discourse, illustrating broader patterns in how contemporary tools mediate creative learning.

4.1. Networked and Participatory Creativity

The internet and networked technologies in general have fundamentally transformed creative practice by enabling what scholars has been termed participatory culture, where barriers to artistic expression and civic engagement are relatively low, creative expression is valued and supported, and participants feel social connection with one another (Jenkins et al., 2009). This shift represents more than simply using digital tools for creation; it involves a reorganization of the relationship between creators, audiences, and creative works themselves. Networked platforms afford connectivity, easy sharing, and remix culture in ways that challenge traditional notions of authorship and creative ownership (Lessig, 2008).

This is seen in the phenomenon of content creation on platforms like YouTube, TikTok, and Instagram, which has given rise to new categories of creative practitioners. Influencers and content creators have built careers and audiences without traditional institutional gatekeeping, demonstrating the disintermediation described in the historical section (Cunningham & Craig, 2019). For example, a teenager creating video content in their bedroom can reach millions of viewers, bypassing traditional media production and distribution channels entirely. This democratization of creative distribution has educational implications, as students increasingly see creative work not as something consumed passively but as something they can actively produce and share (Ito et al., 2010). Youth now have the capacity engage in sophisticated multimodal composition, video editing, and audience analysis skills through platforms designed for entertainment rather than education.

Participatory cultures have generated distinctive creative forms that challenge traditional assumptions about individual authorship and creative process. Memes, for instance, demonstrate how cultural artifacts can evolve through distributed reinterpretation, where meaning emerges from countless iterations across communities rather than from a single creator's intent (Shifman, 2014). Similar patterns happen in fan fiction communities, where collaborative world-building occurs at scales that rival professional publishing, often supported by peer feedback mechanisms more sophisticated than those in many formal educational settings (Thomas, 2007). These practices exemplify what Lessig (2008) termed 'remix culture,' where digital tools make sampling and recombination fundamental rather than exceptional creative strategies. Such approaches exist in

productive tension with copyright frameworks designed for an era of discrete, individually authored works. Even projects traditionally centered on individual artists, such as Aaron Koblin's data visualizations, increasingly invite public participation in ways that blur the boundaries between creator and audience, fundamentally challenging the romantic notion of the solitary creative genius (Shneiderman, 2007).

These participatory forms raise important questions for education. When creative work is distributed, iterative, and collaborative, how should educators assess individual contribution and learning? When audiences provide immediate feedback through likes, shares, and comments, what role do teachers play in evaluation? When students create for authentic audiences beyond the classroom, traditional rubrics may feel disconnected from the actual goals of the work (Black, 2009). The networked creative landscape suggests that education might need to rethink not just the tools students use but the fundamental assumptions about what creative work looks like and how it should be supported and evaluated.

4.2. Design, Making, and Embodied Technologies

The maker movement has emerged as a significant force in educational technology, emphasizing hands-on creation, tinkering, and the integration of digital and physical making (Halverson & Sheridan, 2014). Makerspaces in schools and libraries provide access to tools ranging from traditional hand tools to 3D printers, laser cutters, and electronics components. This movement draws on constructionist learning theory, which argues that people learn most effectively when building tangible objects that they can reflect upon and share (Papert & Harel, 1991). The maker ethos emphasizes process over product, values productive failure, and cultivates what researchers have termed a "maker mindset" characterized by playfulness, resourcefulness, and comfort with uncertainty (Clapp et al., 2017).

The Agency by Design project at Harvard's Project Zero has articulated core dimensions of maker-centered learning environments: sensitivity to design, a propensity to explore complexity, and inclination to work as a designer (Clapp et al., 2017). These capacities extend beyond technical skills to encompass ways of thinking about the world and one's ability to shape it. Students learn not just how to use a 3D printer but how to identify problems worth solving, iterate through multiple prototypes, and consider how design choices affect users. This approach connects to broader educational goals around creative problem-solving and systems thinking.

Digital fabrication tools like 3D printers have made rapid prototyping accessible in educational settings, allowing students to move quickly from idea to physical object (Blikstein, 2013). Physical-digital hybrids, such as projects combining Arduino microcontrollers with crafted objects, enable creative work that spans traditional disciplinary boundaries. A student might design a wearable device that responds to environmental data, integrating skills from computer science, environmental science, and industrial design. Such projects exemplify transdisciplinary creativity that mirrors real-world innovation processes (Mishra et al., 2011).

Virtual and augmented reality technologies offer different kinds of embodied creative experiences. VR environments allow students to create and explore three-dimensional spaces, fostering spatial reasoning and perspective-taking in ways flat screens cannot (Lindgren & Johnson-Glenberg, 2013). Design students can walk through virtual buildings they have created, experiencing scale and spatial relationships directly. AR applications enable creative overlays on physical environments, supporting location-based storytelling and site-specific art. These kinds of immersive technologies afford embodied cognition, where physical movement and spatial navigation become integral to creative thinking and learning (Dourish, 2001).

Yet the maker movement and embodied technologies raise equity concerns. Access to well-equipped makerspaces remains unevenly distributed, often correlating with existing educational inequalities (Vossoughi et al., 2016). The tools themselves can be expensive, and the knowledge required to use them effectively may privilege students with prior exposure to engineering or design. Additionally, maker culture sometimes emphasizes consumerist creation over repair and reuse,

potentially undermining environmental sustainability (Tanenbaum et al., 2013). Educational implementations must navigate these tensions, considering how to make making accessible and aligned with broader values of equity and sustainability.

4.3. Generative and AI-Assisted Creativity

The rapid advancement of artificial intelligence systems has introduced new questions about the nature of creativity and the role of human agency in creative work. Generative AI tools like GPT-4, DALL-E, Midjourney, and others can produce text, images, music, and code that many observers find creative. This recalls Boden's (2004) fundamental questions about whether creativity requires human consciousness or can emerge from algorithmic processes. Educational contexts must now grapple with how to respond to technologies that can generate essays, solve problems, create artwork, and compose music at levels that sometimes rival or exceed student capabilities.

Early examples of computational creativity, like David Cope's EMI (Experiments in Musical Intelligence) and its successor Emily Howell, showed that algorithms could analyze existing musical works and generate new compositions in recognizable styles (Cope, 2005). These systems sparked debates about whether such outputs should be considered creative and who should be credited as the creator. Contemporary generative systems have expanded these capabilities dramatically. For instance, large language models (LLMs) can write in diverse styles and genres, image generation systems can produce artwork based on text prompts, and AI composers can create original musical pieces across multiple genres (Vinker et al., 2023).

From an educational perspective, these tools can function as creative partners rather than replacements for human creativity. Students might use AI image generators to rapidly prototype visual ideas, using the output as inspiration or starting points for their own work (Long & Magerko, 2020). Writers might engage with language models as collaborative brainstorming partners, generating unexpected connections or perspectives they can then develop (Luther et al., 2024). Musicians might use AI composition tools to explore harmonic possibilities or generate variations on themes. This partnership model reframes AI not as threatening human creativity but as extending creative capacity, much like how earlier technologies have done.

However, generative AI also introduces significant tensions. Questions of authorship become complex when creative work emerges from human-AI collaboration (Karjus & Cuskley, 2024). If a student uses an AI image generator to create artwork, who is the author? What does it mean to be creative when sophisticated tools can generate novel outputs with minimal human input? Educational institutions struggle with how to assess work that may involve AI assistance, and traditional notions of academic integrity face challenges when the boundaries between human and machine contribution blur (Sullivan et al., 2023).

The concept of posthuman creativity suggests that we may need to move beyond anthropocentric definitions of creativity to recognize creative processes that emerge from hybrid human-machine systems (Hayles, 2010). Some scholars have argued that creativity has always been distributed across people, tools, and environments (Glăveanu, 2014); stemming from this line of theory, it may be possible that AI simply makes this distribution more visible. Others worry that over-reliance on generative tools could atrophy human creative capacities or lead to homogenization of creative expression as outputs converge on patterns in training data (Epstein et al., 2023).

Algorithmic creativity also raises questions about what it reveals about human creativity. If machines can produce work that appears creative by identifying and recombining patterns in existing works, does this suggest that much human creativity operates similarly? Or does human creativity involve something qualitatively different—something connected to lived experience, emotion, or intentionality that algorithms cannot replicate? These philosophical questions have practical implications for education, influencing how we define learning goals, design assessments, and think about the purposes of creative education in an age of increasingly capable AI systems.

5. Critical Tensions and Implementation Challenges

5.1. Defining and Assessing Creativity

One of the most persistent challenges at the intersection of creativity and technology lies in definitional ambiguity. While the theoretical frameworks discussed earlier provide scholarly grounding, educational policy and practice have often invoked creativity without clear specification of what it means or how it should be cultivated (Beghetto & Kaufman, 2014). International comparative studies reveal that national curricula frequently reference creativity as an educational goal but rarely define it with sufficient precision to guide implementation (Ferrari et al., 2009). This vagueness leaves practitioners uncertain about what or how they are expected to teach for creativity and creates what Schön (1995) once described as the 'swampy lowlands' of practice, where teachers must navigate ill-defined mandates with limited guidance.

The assessment paradox compounds this challenge. Educational systems struggle to mandate what they cannot easily measure, yet creativity resists easy measurement (Beghetto & Kaufman, 2014). Traditional assessment frameworks privilege products that can be evaluated against predetermined criteria, but creative work often derives its value precisely from departing from expectations (Sternberg & Lubart, 2009). Digital technologies complicate assessment further by enabling collaborative creation where individual contributions are difficult to isolate, remix practices where originality becomes ambiguous, and AI-assisted work where human and machine contributions blur together (Grover et al., 2022). Teachers face authentic dilemmas: should they assess the creative process or the final product? How do they evaluate work that draws heavily on existing sources through remix? What role does audience engagement play in determining creative success when students create for platforms beyond the classroom (Peppler & Kafai, 2007)?

5.2. Access and Participation

Digital divides also persist as a fundamental equity concern. While networked technologies theoretically democratize creative participation, access is still often unevenly distributed along lines of socioeconomic status, geography, race, and disability (Warschauer & Matuchniak, 2010). The COVID-19 pandemic made these disparities starkly visible, as students without reliable internet access or appropriate devices were typically excluded from remote learning opportunities (Reich et al., 2020). Beyond access to devices and connectivity, digital divides encompass differences in the quality of technologies available, technical support, and what Hargittai (2002) termed "second-level digital divide" differences in skills and knowledge needed to use technologies effectively and creatively.

Questions of authorship and originality intersect with participation in complex ways. For instance, remix culture and participatory creativity challenge Western notions of individual authorship and original genius, potentially opening space for more collaborative and culturally diverse creative practices (Iyer, 2009). Yet these same practices raise concerns about intellectual property, cultural appropriation, and fair attribution. When students create memes that remix copyrighted images, compose music that samples existing works, or use AI tools trained on others' creative output, traditional frameworks for understanding creative ownership strain (Ito, 2012). Educational contexts must navigate between encouraging students to participate in contemporary creative practices and respecting intellectual property rights, often without clear guidance about where boundaries lie.

Algorithmic bias presents another central participation challenge. AI systems trained on historically biased datasets can potentially reproduce or amplify existing inequities in whose creativity is recognized and valued (Noble, 2018). For example, image generation systems may default to stereotypical representations; language models may reflect dominant cultural perspectives; recommendation algorithms may privilege certain creative forms over others. These biases shape not only what gets created but whose creative work receives attention and validation, potentially reinforcing rather than disrupting existing hierarchies in creative fields.

5.3. Institutional Tensions

Educational institutions often face fundamental tensions between encouraging creative risk-taking and maintaining accountability through standardized measures (Beghetto & Kaufman, 2014). School cultures have often simultaneously directed that students be creative, while also requiring adherence to prescribed curricula, testing regimes, and behavioral norms that leave little room for the experimentation and productive failure that creativity requires (Zhao, 2012). This contradiction intensifies at the intersection with technology, where rapidly changing tools and practices outpace institutional capacity to develop clear, coherent policies and professional development.

The rhetoric-reality gap between policy aspirations and classroom practice is seen globally, particularly in spaces where educational systems proclaim creativity and technology as priorities, yet teachers report limited time, resources, and professional development to implement creative pedagogies meaningfully (Ferrari et al., 2009). The discourse around creativity itself can be problematic, with neoliberal framings emphasizing individual entrepreneurship, instrumentalist approaches, and economic competitiveness, while ignoring more democratic or humanistic purposes for creative education (Banaji & Burn, 2007). When creativity becomes primarily or only about preparing workers for the innovation economy, educational practice may privilege certain forms of creativity while marginalizing others and serve market interests over broader human learning and social goals.

6. Implications: Toward Creative-Technological Praxis

6.1. Implications for Educational Practice

Effective integration of creativity and technology in educational practice requires moving beyond tool-centric approaches toward frameworks that integrate multiple forms of creative knowledge production. Research on teacher learning suggests that experiencing creative work with digital tools firsthand is more effective than abstract instruction about technology integration (Koehler et al., 2011). For instance, professional development programs that engage teachers in creating digital stories, designing maker projects, or experimenting with generative AI tools as learners themselves appear more successful at shifting practice than workshops focused on demonstrating educational software (Angeli & Valanides, 2009).

Pedagogical approaches emphasizing distributed and collaborative creativity show promise for leveraging digital affordances. Organizing learning activities around production-centered projects, peer culture, and networked publics, are key models for technology-rich creative learning (Ito et al., 2013). Students in such learning environments may create digital media for authentic audiences, receive feedback from peers and experts beyond their classrooms, and participate in online communities organized around shared interests. Similarly, maker-centered learning initiatives that combine physical and digital creation with reflection on design processes demonstrate how technological tools can support transdisciplinary creative work when integrated thoughtfully (Clapp et al., 2017).

Teacher education programs experimenting with creative-technological integration offer instructive examples. Some preservice teacher programs now incorporate "learning by design" activities where prospective teachers create educational games, interactive simulations, or multimedia curriculum materials, then reflect on the affordances and constraints of different tools for particular learning goals (Kafai & Burke, 2015). Other useful approaches could engage teachers in analyzing how technologies mediate creativity differently across disciplines, comparing how digital tools function in varied subject matters or lessons (Henriksen et al., 2015). These domain-specific analyses appear more productive than generic technology training, helping teachers understand how tools interact with disciplinary ways of thinking.

6.2. Implications for Policy and Research

Policy development would benefit from studying educational systems that have articulated clearer frameworks for creativity. Finland's national curriculum explicitly defines creativity as combining originality with purposefulness, specifies how it should be cultivated across subjects, and provides teachers with assessment guidance that acknowledges both process and product dimensions (Lavonen & Laaksonen, 2009). While not directly transferable to other contexts, such examples demonstrate that policy can move beyond rhetoric to provide substantive guidance based on clear definitions, without prescribing uniform approaches.

Research gaps also require attention through methodological approaches suited to complexity. Design-based research examining how particular pedagogical designs support creative-technological learning in specific contexts can generate practical knowledge while building theoretical understanding (Barab & Squire, 2016). For instance, studies documenting how teachers adapted during emergency remote teaching revealed creative repurposing of non-educational technologies, collaborative problem-solving among practitioners, and rapid experimentation with new formats (Trust & Whalen, 2020). Such practice-based research generates insights that controlled studies often miss.

Equity must move from peripheral concern to central focus in research on creativity and technology. Vossoughi et al. (2016) argued that making and creativity research often treats equity as an add-on rather than examining how power, culture, and identity fundamentally shape who gets to create, what counts as creative, and whose work receives recognition. Future research should investigate how different students experience creative work with digital tools, whose forms of creativity are validated or marginalized, and how pedagogical designs can support culturally sustaining creative practices (Paris & Alim, 2017). This includes attention to accessibility for students with disabilities, examining how tools can enable or constrain creative expression for learners with varied abilities and needs.

7. Conclusion

In viewing creativity and digital technologies in education through a sociocultural lens, we see how they exist in a reciprocal, co-evolutionary relationship. Technologies mediate creative practice by extending human capacity and reshaping what creativity looks like, while human creativity drives technological innovation and adaptation. This dynamic has played out across historical eras, from physical and analog tools through early digital systems to contemporary networked and generative technologies. Each stage has brought new affordances and constraints, transformed who can participate in creative production, and generated tensions that educational systems continue to navigate.

The contemporary landscape presents both unprecedented opportunities and complex challenges. Networked platforms enable participatory creativity at global scales but raise questions about quality, evaluation, and whose voices receive attention. Maker spaces and embodied technologies support hands-on creative work but face persistent equity barriers. Generative AI systems function as creative partners yet challenge fundamental assumptions about authorship, agency, and what makes creativity distinctively human. These tensions are not problems to be solved but inherent features of technological change outpacing institutional adaptation.

Looking forward, continued co-evolution is likely to emerge in forms that are hard to predict. Future developments in AI, immersive environments, and technologies not yet conceived will reshape creative practice in education in ways that demand ongoing attention, adaptation, and critical reflection from scholars, practitioners, and policy makers alike. What stays constant is the need for creativity itself to support humans in navigating an uncertain future. This requires an understanding of how tools mediate creative possibility; and it demands educational systems that support diverse forms of creative expression while addressing persistent tensions around access, evaluation, and purpose. As the co-evolution of creativity and technology continues, the challenge

for education is not to control this evolution but to participate in it purposefully, developing tools and practices toward more equitable and humanizing ends. What creativity will mean in classrooms a decade or more from now is uncertain, but the issues raised here—about mediation, access, agency, and purpose—will remain critical to that unfolding future.

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