

Stagnation of Critical Capacities in Childhood in the Digital Age: Between Screen Use, Displacement of Activities, and Educational Response

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ABSTRACT:

This article examines recent studies on how technology is affecting children's critical capacities, particularly in contexts with high exposure to screens and artificial intelligence. Drawing from longitudinal research, systematic reviews, and conceptual essays, it shows that intensive use of digital devices correlates with less time spent on social play, shared reading, and activities that traditionally strengthen critical thinking, such as traditional games, deep reading, and practical projects at home and school. Methodologically, the work combines a narrative review of recent scientific literature (2019–2025) on child development, executive functions, screen use, and critical thinking with an interpretive analysis that integrates empirical findings and pedagogical proposals. The conclusions indicate that the technologized environment has favored the displacement of high cognitive-value activities, potentially resulting in relative stagnation of reasoning, self-regulation, and evidence-based decision-making skills in children. However, the article emphasizes that critical thinking is a modifiable skill, and educational institutions—through inquiry-based methodologies, guided discussion, and dialogic reading—and families—by promoting traditional play, shared reading, and critical use of AI—can mitigate this impact and reclaim spaces for deep thinking in childhood.

Keywords: critical thinking, childhood, digital technologies, screens, executive functions, dialogic reading, traditional games, displacement hypothesis, cognitive load theory, critical AI use.

Introduction

In recent decades, contemporary childhood has unfolded in an increasingly technology-mediated environment, where screens, video games, entertainment platforms, and more recently artificial intelligence systems are part of the daily routine for most children and youth (Greenfield 2019; George, Baskar, and Balaji Srikanth 2024; Adeyemi 2025). While these tools offer new possibilities for information access and social interaction, a growing body of evidence suggests

that their intensive use, without adequate educational mediation, is associated with a delay in achieving certain higher-level cognitive skills, including critical thinking (Greenfield 2019; George et al. 2024; Gerlich 2025). The development of these capacities, so central to 21st-century education, is therefore conditioned by technology use decisions in both family and school settings.

Several studies indicate that increased screen time in early childhood displaces activities traditionally

key to developing reasoning, self-regulation, and problem-solving capacities, such as peer play, physical play, shared reading, and unguided symbolic play (Jones et al. 2022; Mutz et al. 1993; Mutz et al. 2020; George et al. 2024). In particular, a longitudinal study with over 3,800 children aged 12 to 36 months shows that screen time is associated with less peer play, which in turn correlates with higher risk of delays in various developmental areas, including regulation and social interaction competencies (Jones et al. 2022). These findings support the displacement hypothesis: screens do not merely accumulate as additional time but substitute high cognitive-value practices that previously occupied most of the child's day (Mutz et al. 2020; George et al. 2024; Mutz et al. 1993).

At a broader cognitive level, recent reviews have documented that alongside the rise of digital devices and AI, there is an observed reduction of cognitive effort in reasoning, memory, and everyday problem-solving tasks, interpreted as stagnation of critical thinking skills, complex problem-solving, and creativity (George et al. 2024; Gerlich 2025; Vedeckina 2021). A meta-analysis integrating over 60 studies concludes that in the last three decades, deductive reasoning, inference, argument evaluation, and conclusion formulation skills have declined on average by 10 to 15%, linked to routine use of technological shortcuts like calculators, browsers, digital assistants, and AI systems (George et al. 2024). This trend is reinforced by decreasing cognitive load: when technology handles memory, search, and calculation functions, individuals tend to exert less effort in these processes, potentially leading to progressive atrophy of the implicated neural networks (George et al. 2024).

In this context, schools face the task of not only incorporating technology in a balanced way but designing explicit strategies to compensate for underdeveloped critical capacities, promoting inquiry practices, argumentation, dialogic reading, and role-playing games that demand justification of decisions, source review, and comparison of alternatives (Vedeckina 2021; Rivera-García 2025; George et al. 2024).

Theoretical Background and Conceptual Framework

The development of critical thinking in childhood is currently understood as a gradual process mediated by language, social interaction, and specific educational practices that require children to formulate questions, justify responses, compare alternatives, and evaluate information quality (Vedeckina 2021; Adeyemi 2025; Rivera-García 2025). From developmental psychology, critical thinking is not a fixed capacity but a network of skills built on executive functions like inhibition, cognitive flexibility, and working memory, reinforced in contexts confronting children with complex decisions, uncertainty, and diverse perspectives (Vedeckina 2021; Greenfield 2019).

In this framework, critical thinking is conceptualized as the ability to interpret, analyze, and evaluate information and arguments; formulate inferences; solve problems; and make evidence-based decisions, rather than relying on immediate memory or rote repetition (Vedeckina 2021).

Educational literature insists that critical thinking is not merely a product of general intelligence but crucially depends on experience: the more text analysis, idea discussion, and open problem-solving are practiced, the greater the sophistication of these skills (Vedeckina 2021; Rivera-García 2025).

Likewise, executive function development theory shows that digital technology use, particularly in high-stimulation, low self-regulation formats, can interfere with training these functions, essential components of critical thinking (Vedeckina 2021; Mutz et al. 2020). Fast-paced attention games, short videos, and constant multitasking favor immediate decisions often without deep reflection, while activities like sustained reading, extended role-play, and school research projects demand attention maintenance, planning steps, and reviewing outcomes, associated with greater executive function and critical thinking development (Vedeckina 2021; Rivera-García 2025).

From Vygotsky's sociocultural theory perspective, critical thinking is a social construction mediated by language, dialogue, and cultural practices (Vedechkina 2021; Greenfield 2019). Interactions with adults and peers who pose open questions, request explanations, invite reflection, and model reasoning are key for developing criticality in childhood (Vedechkina 2021; Rivera-García 2025). Practices like "dialogic reading," circle discussions, group problem-solving, and collaborative research projects fit this tradition, as the child actively participates in meaning and argument construction (Vedechkina 2021; Adeyemi 2025).

Displacement Hypothesis

From the displacement theory perspective—originally developed to explain television's impact on leisure and social participation (Mutz et al. 1993)—screen time has expanded beyond mere addition to the day, actively displacing high cognitive- and social-value activities like peer play, shared reading, traditional games, deep reading, and family/school projects that foster critical thinking and self-regulation (Jones et al. 2022; Vedechkina 2021; Rivera-García 2025; George et al. 2024).

Table 1. Displacement Hypothesis Evolution

Theory Aspect	Original Conceptualization	Contemporary Use in High-Tech Contexts
Central Definition	The original theory posits that time spent on television not only adds to the day but displaces other leisure activities like reading, physical play, and social participation (Mutz et al. 1993).	Now applied to general digital screens (TV, smartphones, tablets, video games), asserting screen time substitutes social play, shared reading, and high cognitive-value activities (Jones et al. 2022; Vedechkina 2021; George et al. 2024).
Focus on "Screen Time" Variable	Analysis unit was television time as substitute for other social/cultural activities (Mutz et al. 1993).	Now measures total screen time (including social media, games, browsing), analyzing links to less play, reading, and deep thinking in family/school activities (Jones et al. 2022; Vedechkina 2021; George et al. 2024).
Displaced Activities	Originally, TV displaced reading, family play time, community activities (Mutz et al. 1993; Mutz et al. 2020).	Now emphasizes displacement of peer play, shared reading, traditional games, deep reading, practical projects in family/school—all fostering critical thinking and self-regulation (Jones et al. 2022; Rivera-García 2025; Vedechkina 2021).
Evaluated Outcome Axes	Classically, focused on reduced social participation, weakened social capital, leisure time changes (Mutz et al. 1993; Mutz et al. 2020).	Now targets cognitive/socioemotional development, highlighting risks of delays in language, executive functions, sociability, and critical thinking effects in childhood (Jones et al. 2022; Vedechkina 2021; George et al. 2024).
Relation to Critical Thinking	Initially focused on leisure time/social participation impact, without explicit critical thinking	Now integrates critical thinking/executive function frameworks, proposing screen-displaced high-value activities undermine reasoning practice, argument analysis, evidence-based

Theory Aspect	Original Conceptualization	Contemporary Use in High-Tech Contexts
	analysis (Mutz et al. 1993; Mutz et al. 2020).	decisions (Vedechkina 2021; George et al. 2024; Rivera-García 2025).

Table 1 illustrates Displacement Theory's evolution from TV's leisure/social impact to a key framework for digital screen use in modern childhood, emphasizing substituted activities' cognitive consequences (Mutz et al. 1993; Jones et al. 2022; George et al. 2024).

Cognitive Load Theory

In cognitive load theory, excessive technology use, especially AI/digital assistants, can reduce perceived cognitive load by handling memory, search, and reasoning functions (George et al. 2024; Gerlich 2025). While convenient, this leads to less deep information processing, fewer opportunities to practice argument critique, source evaluation, and alternative hypothesis formulation (George et al. 2024; Adeyemi 2025).

}AI systems represent the most advanced iteration of this reduction mechanism. Unlike calculators or search engines — which automate discrete cognitive tasks — AI assistants automate the entire reasoning process: they receive a question, generate an argument, synthesize

sources, and produce a conclusion, leaving the child or adolescent with no cognitive residue from the process (Gerlich 2025). Gerlich (2025) identifies this as cognitive offloading: the habitual delegation of reasoning, synthesis, and argument construction to external systems, producing not merely a failure to develop critical capacities but an active atrophy of capacities previously in development. Critically, this mechanism operates through the same germane load pathway as all other forms of digital displacement — but with greater efficiency and therefore greater developmental risk: the more seamlessly AI performs cognitive tasks, the less productive struggle the child experiences, and the less neural architecture for deep reasoning is consolidated (Gerlich 2025; George et al. 2024).

Table 2. Cognitive Load Theory

Theory Aspect	Original Conceptualization	Contemporary Use in High-Tech Contexts
Central Definition	People have limited working memory capacity; task design must avoid memory overload to promote learning (Sweller 1988; Sweller, van Merriënboer, & Paas 1998).	Screens/AI reduce perceived cognitive load by automating not only memory but search and reasoning also, limiting high-level skill practice (George et al. 2024; Gerlich 2025; Vedechkina 2021).
Cognitive Load Types	Intrinsic (content complexity), extrinsic (presentation), germane (schema-building) (Sweller 1988).	Digital formats increase extrinsic load (multitasking/notifications) while reducing germane load via automation (George et al. 2024; Gerlich 2025).
Task Design Focus	Reduce extrinsic load, optimize germane load for deep learning (Sweller 1988; Sweller et al. 1998).	Avoid passive tech use; promote critical reading, source verification, argument construction to maintain germane load (Vedechkina 2021; George et al. 2024; Rivera-García 2025).

Theory Aspect	Original Conceptualization	Contemporary Use in High-Tech Contexts
Skill Practice Effects	Excess load impairs learning; proper germane load builds reasoning/problem-solving (Sweller 1988).	AI/tech induces decreasing cognitive load, reducing critical thinking/argument evaluation practice (George et al. 2024; Gerlich 2025; Vedeckina 2021).
AI-Specific Offloading	Not addressed — AI did not exist as a consumer tool (Sweller 1988)	AI automates the complete reasoning cycle — question, synthesis, argument, conclusion — producing cognitive offloading: habitual delegation of thought to external systems, causing active atrophy of reasoning neural networks (Gerlich 2025; George 2024)
Relation to Critical Thinking	Focused on efficient instruction; germane load supports higher-order reasoning implicitly (Sweller 1988).	Links to critical thinking: low germane load from AI weakens deep analysis/evidence evaluation (George et al. 2024; Vedeckina 2021; Rivera-García 2025).

Table 2 illustrates Cognitive Load Theory's evolution from instructional design principles to analyzing digital tech/AI impacts, where automation reduces germane load and critical thinking practice (Sweller 1988; George et al. 2024).

Evidence of Critical Capacity Underdevelopment Linked to Technology

Recent studies document a relative stagnation in childhood critical capacities linked to intensive digital technology use, particularly screens and AI, where skills fail to reach expected developmental milestones (George et al. 2024; Gerlich 2025). A 2025 SBS Swiss Business School study shows intensive AI use correlates with critical thinking scores below developmental potential, especially in 17- to 25-year-olds, while longitudinal data from 3,894 children aged 1480-1486 years ties screen time to reduced peer play and delays in communication, socialization, and regulation (Jones et al. 2022; Gerlich 2025). A 2024 meta-analysis of over 60 studies reveals a 1480-1486% decline in deductive reasoning, inference, argument evaluation, and evidence-based conclusions over three decades, driven by technological shortcuts that reduce cognitive effort (George et al. 2024).

Fast-paced screen and AI formats promote passive acceptance over deep processing, impairing inhibition and sustained attention

essential for argument scrutiny (Vedeckina 2021). Critically, this displaces high-value activities—peer play (Jones et al. 2022), shared reading, traditional games fostering cooperation and problem-solving (Rivera-García 2025), and dialogic reading with open questions for active reasoning (Vedeckina 2021)—limiting critical capacity development. A 4th-grade quasi-experimental study confirms traditional games outperform digital alternatives in boosting critical and creative thinking (Rivera-García 2025).

Educational and Family Responses

Schools and families can counteract the effects of excessive screen time by prioritizing structured opportunities for deep thinking and critical skill development. These include inquiry-based learning activities where children pose and investigate questions, guided discussions led by teachers or parents to explore complex ideas, dialogic reading during which adults ask predictive and analytical questions like "What might happen next?" or "Why did the character make that choice?", and traditional games such as board games or physical play that build

cooperation and problem-solving. When using AI, families and schools should promote critical engagement—such as having children verify AI-generated information against other sources, analyze data outputs, or debate the accuracy of AI responses, rather than passively accepting answers. Research demonstrates that this active technology integration enhances critical thinking skills more effectively than traditional methods alone (Vedechkina 2021).

Conclusions

Modern digital environments dominated by technology have replaced essential cognitive development activities that children traditionally engaged in. Rather than participating in social play, interactive, classic games, focused reading, or hands-on tasks; children now devote more hours to prolonged screen exposure and AI applications (George et al. 2024; Jones et al. 2022; Vedechkina 2021).

This substitution pattern corresponds with developmental stagnation, meaning key abilities do not mature according to anticipated timelines, specifically affecting children's logical thinking, emotional control, and decisions grounded in evidence. Comprehensive meta-analyses and long-term research consistently reveal performance gaps in logical deduction, drawing conclusions from evidence, and assessing arguments across recent decades, primarily resulting from reduced mental effort caused by unreflective technology use (George et al. 2024; Gerlich 2025).

However, critical thinking is not an innate trait but a malleable skill forged through purposeful experiences, social interactions, and systematic practice (Vedechkina 2021; Rivera-García 2025).

Schools can counteract stagnation with reflective pedagogies that actively build analytical competencies: inquiry-based learning (students generate questions and collect evidence), guided argumentation (structured debates assessing competing views), dialogic reading (text

discussions prompted by analytical questions), and problem-based role-playing (simulations requiring source validation and justification). These approaches cultivate rigorous information evaluation, perspective comparison, and evidence-driven conclusions (Vedechkina 2021; Adeyemi 2025).

Importantly, the emergence of AI as a routine tool in children's and adolescents' daily lives intensifies rather than resolves this challenge. AI systems do not merely reduce germane cognitive load — they eliminate it entirely for whole reasoning tasks, producing what Gerlich (2025) terms cognitive offloading: the habitual delegation of thinking to external systems that, over time, actively atrophies the neural networks critical thinking depends on. Unlike calculators, which automate computation while leaving reasoning intact, AI automates the reasoning process itself — making the deliberate cultivation of critical practice not merely beneficial but urgent. Schools and families that treat AI as a substitute for thought rather than a tool to be questioned are accelerating the very stagnation this article documents. The appropriate response is not prohibition but critical engagement: teaching children to interrogate AI outputs, verify AI-generated arguments against primary sources, and use AI as a starting point for reasoning rather than its endpoint (Gerlich 2025; Vedechkina 2021; George 2024).

Families can reinforce school efforts through daily home practices fostering deep cognition: traditional play (board games, tag), shared reading (narrative discussions), and hands-on projects (cooking, gardening) (George et al. 2024; Rivera-García 2025).

Ultimately, success lies not in eliminating technology but restructuring daily routines so cognitively demanding practices eclipse passive consumption, safeguarding childhood critical capacity development.

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