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The Critical Thinker in the Age of Algorithmic Reality: The ETAPE Model

Abstract: Traditional models of critical thinking focus on cognitive skills such as reasoning and evidence evaluation, but these frameworks were developed for more stable information environments. This article argues that the contemporary critical thinker must be reconceptualized beyond purely cognitive dimensions. The article proposes the ETAPE model, comprising five interconnected dimensions: Epistemic Awareness, Tolerance of Uncertainty, Algorithmic Competence, Perpetual Connection management, and Emotional Resilience. This framework reconceptualizes critical thinking as an epistemic, emotional, and technological practice of self-regulation in digital environments. The analysis shows that key challenges are infrastructural, algorithms and attention economies actively shape cognition, creating tensions between individual responsibility and systemic constraints, vigilance and exhaustion, human judgment and AI augmentation. The article concludes that critical thinking must be understood as cognitive endurance in environments optimized to undermine it, pointing to directions for future research and policy.

Keywords: critical thinking, ETAPE model, epistemic cognition, algorithms, uncertainty, emotional resilience, AI, digital environments.

Introduction

Scarcity of information was once the primary challenge faced by the classical critical thinker: how can one adequately evaluate claims in the absence of sufficient knowledge? Contemporary societies, however, are defined by epistemic abundance and the rapid circulation of information, which, paradoxically, intensifies the difficulty of distinguishing truth from manipulation. The conditions under which individuals form beliefs, assess evidence, and construct meaning are increasingly shaped by the blurred boundaries between online and offline environments. Available data indicate that individuals worldwide spend up to 6.38 average hours online daily (Statista 2024), often on social networks and engaging in practices such as doomscrolling (Sharma et al. 2022), while a significant proportion report exposure to fake news and disinformation (Statista 2022). At the same time,

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these patterns coexist with rising levels of news avoidance and anxiety (Andersen et al. 2024), suggesting a complex informational landscape where global data consumption and creation are projected to triple in just four years, surging from 173.4 zettabytes in 2025 to an estimated 527.5 zettabytes by 2029 (Statista 2025).

Traditional approaches to critical thinking have predominantly focused on cognitive dimensions such as reasoning, argument analysis, interpretation, evidence evaluation, and logical consistency (Dewey 1910; Ennis 1989; Paul 1981; Facione 1990). While these frameworks remain fundamental, they were largely developed within relatively stable informational environments, characterized by slower communication flows, clearer institutional authority, and more limited access to information. Therefore, this question emerges:

What does it mean to be a critical thinker in the 21st century?

This paper argues that the profile of the contemporary critical thinker must be reconsidered beyond purely cognitive frameworks. The article proposes the ETAPE model, a conceptual framework that redefines critical thinking through five interconnected dimensions: Epistemic Awareness, Tolerance of Uncertainty, Algorithmic Competence, Perpetual Connection management, and Emotional Resilience. Together, these dimensions reflect the transition from a traditional model centered primarily on rational analysis toward a more complex understanding of critical thinking as an epistemic, emotional, and technological practice of self-regulation.

1. A brief account of critical thinking

The idea of critical thinking has its roots in philosophy. Starting from Socrates, who is renowned for his "Socratic questioning" method, through which he led those who deemed themselves wise to recognize the flaws in their own reasoning independently. (Paul et al. 1997) As well as Aristotle, who laid the foundations of logic through the syllogism and the valid forms of reasoning. (Schreiber 2003) The concept was further enriched by the contributions of Francis Bacon, who identified the inherent tendencies of the human mind to fall into error, which he termed 'Idols' (Bacon 1950), as well as by René Descartes, who established the foundation of modern inquiry through the method of systematic doubt (Descartes 1964). Critical thinking, as we know it today, has its origins in the scientific works of American philosopher John Dewey, who defines reflective thinking as: 'active, persistent, and careful consideration of any belief or supposed form of knowledge in the light of the grounds that support it and the further conclusions to which it tends.' (Dewey 1910) Through his definition, Robert Ennis provides a broader perspective for analyzing critical thinking, stating that it is reasonable, reflective thinking focused on deciding what to believe or do. (Ennis 1989)

The literature commonly conceptualizes the critical thinker as an individual who possesses a combination of knowledge, dispositions, and skills. Knowledge provides the conceptual and informational foundation necessary for evaluating claims and arguments (Barnett 1997). Equally important are dispositions, understood as a person's consistent internal motivation to respond to situations in particular ways, while remaining open to change (Facione 2000). Without such dispositions, critical thinking risks becoming either self-serving or fundamentally flawed (Paul 1981). Richard Ennis identifies several core dispositions, including a commitment to seeking truth and justifying one's beliefs, the ability to represent positions clearly and honestly, and respect for the dignity and worth of others (Ennis 1996). Critical thinking also entails a set of cognitive skills, such as the ability to interpret, analyze, evaluate, explain, and draw reasoned conclusions from information (Facione 2005). These skills are particularly important when dealing with complex or ambiguous content, where meaning is not immediately apparent (Greene & Yu 2016). In this sense, critical thinking functions as an overarching set of knowledge, skills, and dispositions that focus on the rational processes of the mind.

2. The critical thinker today: the ETAPE model

While these foundational approaches continue to offer an essential framework for understanding critical thinking, the transformations brought by digital technologies, algorithmic mediation, information overload, and emotionalized communication environments require an expanded conceptualization of what it means to think critically today. In response to these changes, the present paper proposes the ETAPE model as a multidimensional framework for understanding the contemporary critical thinker.

Epistemic Awareness

Epistemic cognition encompasses the dispositions, beliefs, and cognitive skills through which individuals evaluate and distinguish between knowledge, belief, doubt, and uncertainty (Greene & Yu 2016). A classical account of critical thinking presupposes that individuals are aware of what they know, what they do not know, and the limits of their own information-processing capacities; in other words, that they engage in metacognition. In the contemporary informational environment, however, this requirement becomes more demanding: critical thinkers must also understand how their cognitive processes operate, including the role of biases, particularly under conditions of information overload (Arnold et al. 2023).

Another essential characteristic is epistemic humility (Kidd 2016). The contemporary critical thinker recognizes the limits of their knowledge,

avoids the illusion of expertise, and acknowledges the instability and contestability of truth in digital environments (Levinson 2024). The widespread accessibility and democratization of information have contributed to an increased tendency for individuals to overestimate their understanding across domains, reinforcing what has been described as an illusion of knowledge or explanatory depth (Machery 2015). Epistemic humility thus functions as a safeguard against such distortions.

In addition, the contemporary critical thinker must exercise epistemic vigilance. Research suggests that individuals are generally inclined to trust information unless prompted by contextual cues to adopt a more critical stance (Sperber et al. 2010). In today's media landscape, this default tendency toward trust is increasingly inadequate. Instead, critical thinkers must adopt a more consistently evaluative posture toward information sources, develop the capacity to detect manipulation, and remain aware of the limits and proper application of their evaluative skills.

Tolerance of Uncertainty

The contemporary information environment is characterized by unprecedented levels of uncertainty. (Ferguson et al. 2024) Although access to information and to expert validation has increased, the sheer volume of content and the democratization of its production allow a wide range of actors to circulate claims, often without verification, generating a pervasive sense of epistemic instability. As a result, individuals may experience difficulty in determining what is true or reliable. At the same time, constant connectivity accelerates the pace at which new information emerges, requiring critical thinkers to tolerate ambiguity, manage contradictions, and resist premature closure (Sears & Parsons. 1991).

Importantly, uncertainty does not necessarily indicate a lack of knowledge, but rather an awareness of its limits. Individuals who recognize the boundaries of their understanding are more likely to engage in reflective thinking, while the moderate negative emotions associated with uncertainty can motivate adaptive strategies, such as seeking more nuanced information and carefully evaluating competing claims. These processes ultimately contribute to greater resilience to disinformation (Kont et al. 2026).

However, this adaptive stance is challenged by a fundamental cognitive tendency: the need for closure. Individuals are often motivated to seek definitive answers and stable interpretations, even when these are overly simplistic or insufficiently justified (Alter 2017). In digital environments, where information is abundant and rapidly evolving, this tendency becomes particularly pronounced. The desire for certainty can lead individuals to favor clear, emotionally satisfying explanations over complex or ambiguous ones, thereby increasing susceptibility to misleading narratives. This dynamic helps explain the appeal and virality of conspiracy theories, which

frequently provide simple and definitive answers to complex societal issues (O'Brien et al. 2025).

Algorithmic Competence

A critical thinker must be attentive to the context and environment in which information is produced and consumed. In digital settings, this entails understanding the algorithmic infrastructures that shape online experiences. Algorithms can be defined as structured sets of rules and instructions that govern how content is sorted, classified, and presented within a user's informational feed (Narayanan 2023). Social media platforms rely extensively on such systems, having shifted from the chronological organization of early web environments to models driven by engagement and perceived relevance. Their primary objective is to maximize user attention and interaction by continuously tracking behavioral signals, such as clicks, viewing time, and other forms of engagement, and prioritizing content accordingly (Narayanan 2023).

In the absence of such understanding, users become more susceptible to manipulation and distortion. Algorithmic curation can limit users' perceived agency by selectively presenting information based on inferred preferences, thereby shaping how they interpret reality. This dynamic gives rise to what has been described as algorithmic authority, whereby individuals tend to trust highly visible, popular, or system-recommended content, including outputs generated by artificial intelligence (Palese 2026).

At the same time, the conditions for establishing truth have become increasingly complex. Advances in artificial intelligence have enabled the proliferation of deepfakes and synthetic media, blurring the boundary between authentic and fabricated content (Romero Moreno 2024). As a result, visual or audiovisual evidence can no longer be treated as inherently reliable. The contemporary critical thinker must therefore operate in an environment where traditional markers of credibility are destabilized.

Algorithmic competence extends further in the context of emerging AI tools. The growing availability of such technologies encourages the outsourcing of cognitive functions, including memory, information retrieval, verification, and even analysis (Enam et al. 2025). In this sense, AI can function as a form of epistemic prosthesis, augmenting human cognition while simultaneously raising concerns about dependence and diminished autonomy. This development introduces a fundamental tension: to what extent does the individual remain in control of their own cognitive processes in an increasingly automated epistemic environment?

Perpetual connection

The phrase "the Internet used to be a place" has increasingly circulated as a reflection of the transformation of digital life. In earlier stages, engagement with the Internet was spatially and temporally bounded: individuals would access it from a fixed location, dedicate a specific period to information seeking or communication, and then return to offline activities. With the widespread diffusion of smartphones and the democratization of access, however, connectivity has become continuous, fundamentally reshaping the conditions under which individuals engage with information.

One consequence of this shift is the growing expectation of constant awareness. Individuals feel compelled to remain continuously informed, monitoring news, tracking events, and maintaining ongoing communication across global networks. Periods of disconnection, whether lasting hours or days, are often accompanied by the experience of FOMO (fear of missing out), defined as the persistent concern that important information or events are being missed (Akbari et al. 2021). This dynamic contributes to increased time spent online, though such engagement is not necessarily meaningful or reflective. Practices such as "doomscrolling," characterized by prolonged exposure to rapidly consumed and often distressing content, exemplify a mode of interaction in which information is quickly forgotten and poorly integrated (Sharma et al. 2022). This continuous oscillation between online and offline states has been described as "presence collapse," a condition marked by perpetual availability alongside diminished capacity for cognitive withdrawal and sustained attention (Bodinger-deUriarte 2019).

A second consequence concerns the cognitive and emotional effects of information overload. The constant influx of content has been associated with phenomena such as news fatigue, burnout, and anxiety (Chan & Chen 2024; Harren et al. 2021; Lopes et al. 2022). Individuals increasingly operate in a state of continuous partial attention, with focus fragmented across multiple stimuli and rapidly shifting between topics. This pattern undermines the depth of reflection required for critical thinking (Gazzaley & Rosen 2016). Empirical evidence suggests that the average duration of sustained attention on screen-based tasks has declined significantly, from approximately 2.5 minutes in 2004 to under one minute in recent years (Mark 2023).

In response, practices such as "digital detox", intentional periods of disconnection aimed at restoring cognitive balance, have gained prominence (Radtke et al. 2022). Yet such efforts are often accompanied by heightened anxiety, FOMO, and a perceived loss of relevance, generating an internal tension between the need for cognitive recovery and the pressure to remain continuously connected. This tension further complicates the conditions under which contemporary critical thinking can be effectively exercised.

Emotional Resilience

Critical thinking has traditionally been associated with cognitive activity, although some scholars have challenged the strict separation between rationality and emotion, arguing that the two are inherently intertwined in practice (Thayer-Bacon 1993). In the contemporary context, the ability to understand and regulate emotions has become increasingly central to critical thinking. Digital environments are particularly conducive to the manipulation of affect, especially negative emotions such as fear, anger, and panic, which can impair judgment and reduce individuals' capacity for reflective evaluation. Intense negative emotional responses may indicate a lack of strategies and knowledge required to navigate a polluted information environment, and are therefore associated with lower resilience to disinformation (Kont et al. 2026). These emotional dynamics are often amplified by algorithmic systems that prioritize emotionally charged content to maximize engagement and virality (Ruckenstein 2023). As a result, individuals are frequently exposed to stimuli designed to provoke strong reactions, making emotional regulation more difficult.

This challenge is further intensified in high-stress contexts, such as geopolitical conflict, where exposure to disinformation can heighten fear and uncertainty (Vintilă et al. 2023). Emotional contagion is amplified by platform dynamics, potentially contributing to states of learned helplessness, increased apathy, and cynicism (Wilkie et al. 2026). Within this landscape, a tension emerges between skepticism and cynicism: while critical thinking requires questioning and doubt, excessive distrust may lead to disengagement or conspiratorial thinking (Tsfati & Barnoy 2025). The proliferation of conspiracy theories further exacerbates this imbalance, offering emotionally compelling but epistemically weak explanations (Douglas & Sutton 2023).

At the same time, the digital environment produces additional paradoxes. Despite unprecedented connectivity, individuals report increasing levels of loneliness, alongside rising anxiety and depressive symptoms (Matthews et al. 2025; Baker & Algorta 2016). These emotional conditions can further undermine individuals' capacity for sustained, reflective thought.

In this context, critical thinking must be reconceptualized to include emotional intelligence as a core component. The contemporary critical thinker must be able to recognize and interpret their emotional responses, identify their triggers, regulate their intensity, and respond thoughtfully rather than react impulsively.

Conclusions

The ETAPE model suggests that critical thinking can no longer be adequately conceptualized as a purely cognitive competence. Instead, it

emerges as a form of situated self-regulation across epistemic, technological, and affective dimensions. What is at stake is the continuous management of the conditions under which evaluation becomes possible. In this sense, critical thinking shifts from a skill one applies to content toward an ongoing practice of navigating environments designed to shape cognition itself.

A key implication of this reconceptualization is that many of the challenges faced by contemporary critical thinkers are no longer internal, but infrastructural. Algorithmic systems, attention economies, and platform architectures actively compete with and reshape human cognitive capacities. This raises a fundamental tension: critical thinking is expected to function as an individual responsibility, while the informational environments in which it operates are structurally optimized to undermine it. The burden of epistemic vigilance is thus unevenly distributed, often exceeding what can reasonably be expected from individuals alone.

This leads to a second issue: the risk of over-individualizing failure. If critical thinking is framed exclusively as a personal deficit (lack of skills, dispositions, or effort), systemic influences such as algorithmic amplification, persuasive design, or information overload remain insufficiently addressed.

Moreover, the integration of emotional and epistemic dimensions introduces a paradox at the core of contemporary critical thinking. The same sensitivity that enables individuals to detect complexity, uncertainty, and manipulation can also increase vulnerability to anxiety, fatigue, and disengagement. Thus, the "better" critical thinker is not necessarily the one who knows more, but the one who can sustain functioning under conditions that constantly challenge emotional stability. This reframes critical thinking as a matter of endurance as much as of reasoning.

Finally, the expansion of AI as an epistemic actor raises unresolved questions about cognitive autonomy. As individuals increasingly rely on algorithmic systems not only to access but also to interpret information, the boundary between human judgment and technological mediation becomes progressively blurred. The ETAPE model leaves a question: whether the future of critical thinking lies in augmenting human cognition through external tools, or in preserving forms of independent judgment that resist full automation. This tension remains open and suggests a key direction for future research.

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