Mindfulness as a Service (MaaS) 2.0: Evolving the Framework for Digital Emotional Literacy in K-5 Populations

M.C. Davis, Fellow CDT Harvard, DSc Candidate Capitol Tech, ED NM-CCCR

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M.C. Davis

Fellow, Center for Digital Thriving, Harvard Graduate School of Education Doctor of Science Candidate in Cyberpsychology, Capitol Technology University Executive Director, New Mexico Center for Cybersecurity and Cyberpsychology Research (NM-CCCR)

ORCID: 0009-0005-9313-9494

Correspondence: michael@merek.io

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ABSTRACT

The Mindfulness as a Service (MaaS) framework, originally proposed by Davis, Duffy, Elicio, and Owen (2023) as a convergence of cybersecurity best practices and mindfulness-based interventions for children ages 6–9, has undergone substantial theoretical and empirical development. This paper presents MaaS 2.0 — an expanded architecture that integrates five interconnected frameworks: interoceptive awareness as a mechanism for digital emotional literacy, Digital Bonding Patterns (including the novel fifth pattern, the Phantom Tether), satisficing heuristics in digital behavior, creative atrophy as a consequence of sustained AI-mediated creative processes, and Relational-Cultural Theory applied to digital contexts. The target population has expanded from ages 6–9 to K–5 (ages 5–11), reflecting developmental research suggesting that digital behavioral patterns crystallize earlier than previously understood. MaaS 2.0 introduces the Digital Wellness Assessment (DWA), an exploratory measurement instrument designed to capture children's self-reported interoceptive signals during technology use. Drawing on applied research through the MindfulBytes program and emerging directions from the Harvard Center for Digital Thriving fellowship, this paper articulates how the marriage of cybersecurity architecture and embodied mindfulness practice offers a developmentally grounded, evidence-informed path toward digital emotional literacy in elementary-age populations.

Keywords: digital emotional literacy, interoceptive awareness, mindfulness, cybersecurity education, K-5, digital bonding patterns, digital wellness, MindfulBytes

1. INTRODUCTION: FROM MaaS TO MaaS 2.0

In 2023, the Mindfulness as a Service (MaaS) narrative emerged from a fundamental observation: the cybersecurity industry had spent decades building sophisticated technical defenses for digital systems

while largely ignoring the human systems — particularly children's developing minds — that interact with those systems daily. The original MaaS white paper (Davis, Duffy, Elicio, & Owen, 2023) proposed a practical framework uniting cybersecurity best practices with mindfulness-based solutions, targeting children ages 6–9 across four focus areas: child technology education, technical best practices for child-centric applications, child cognitive psychology, and child behavioral decision theory.

Three years of applied research, academic inquiry, and direct engagement with children have revealed that while the original MaaS framework identified the correct problem — the absence of developmentally appropriate digital literacy grounded in self-awareness rather than restriction — it underestimated both the depth of the mechanisms involved and the breadth of the population affected.

MaaS 2.0 is not a replacement of the original framework. It is an evolution. The core premise remains: that mindfulness-based approaches, when integrated with cybersecurity literacy, can cultivate digital agency in children. What has changed is our understanding of how that cultivation occurs, what it must address, and who it must reach.

This paper presents five theoretical expansions that transform MaaS from a conceptual proposal into an empirically grounded, developmentally situated research program. Each expansion emerged from the intersection of scholarly inquiry and direct observation of children interacting with technology — a methodology that privileges what children actually experience over what adults assume they experience.

2. THE ORIGINAL MaaS ARCHITECTURE: WHAT WE BUILT

The original MaaS framework rested on the convergence of two domains that rarely intersect: cybersecurity governance (NIST Cybersecurity Framework, ISO 27001/27002, CMMC) and mindfulness-based interventions (MBSR, MBCT). The insight was structural: the same organizational thinking that protects digital infrastructure — identify, protect, detect, respond, recover — could be translated into a developmental vocabulary for teaching children to protect their cognitive and emotional infrastructure during technology use.

The four pillars of the original framework addressed distinct but interconnected needs. Child Technology Education focused on making STEM and cybersecurity concepts accessible to early elementary students. Technical Best Practices for Child-Centric Applications examined the design obligations of platforms that serve young users. Child Cognitive Psychology Studies drew on developmental literature to understand how children process digital stimuli. And Child Behavioral Decision Theory explored how children make choices in digital environments, drawing on bounded rationality and heuristic models.

What the original framework accomplished was significant: it named the gap between technical cybersecurity and human developmental need, proposed a structured approach to bridging that gap, and called for a funded pilot study to test its premises. What it did not yet possess were the mechanistic explanations for how mindfulness operates in digital contexts, the measurement instruments to capture

its effects, or the theoretical depth to account for the full range of children's digital experiences.

MaaS 2.0 supplies these.

3. THE SHIFTING LANDSCAPE: WHAT HAS CHANGED (2022–2026)

The digital environment confronting children in 2026 differs meaningfully from the landscape that informed the original MaaS framework. Several developments demand updated theoretical engagement.

The acceleration of generative AI. The widespread adoption of large language models and generative AI tools has introduced a new category of digital interaction for children — one in which the technology does not merely present content but produces it, responds conversationally, and simulates relational engagement (Bender et al., 2021; Turkle, 2022). This shift requires frameworks that account not only for content consumption but for relational dynamics between children and responsive digital systems.

Earlier digital socialization. Research increasingly suggests that meaningful digital behavioral patterns emerge before age six (Rideout & Robb, 2020; Livingstone et al., 2023). The original MaaS focus on ages 6–9 reflected available literature at the time; current evidence supports expanding the target range to K–5 (ages 5–11) to capture the full developmental window during which digital habits, preferences, and coping strategies crystallize.

The embodied cognition turn. Developmental psychology has increasingly embraced embodied cognition frameworks that position bodily experience as foundational to cognitive and emotional processing (Gallagher, 2023; Fogel, 2022). This convergence creates fertile ground for the interoceptive awareness mechanisms central to MaaS 2.0.

Mental health indicators. Longitudinal data continue to demonstrate associations between certain patterns of technology use and mental health outcomes in children and adolescents (Twenge et al., 2022; Orben et al., 2024), while simultaneously revealing that the relationship is more nuanced than simple screen-time metrics suggest. The field has moved toward understanding quality and pattern of engagement rather than quantity alone — a shift that aligns precisely with the MaaS philosophy of awareness over restriction.

The limitations of restriction-based approaches. Increasing evidence suggests that screen-time limits and content-filtering approaches, while necessary at certain developmental stages, do not cultivate the internal capacities children need to navigate digital environments independently (Livingstone & Helsper, 2023). MaaS 2.0 positions itself explicitly within the alternative paradigm: building capacity rather than building walls.

4. MaaS 2.0: THE EXPANDED THEORETICAL ARCHITECTURE

4.1 Interoceptive Awareness as Mechanism for Digital Emotional Literacy

The most significant theoretical advance in MaaS 2.0 is the identification of interoceptive awareness as the primary mechanism through which mindfulness-based digital literacy operates.

Interoception — the perception of internal bodily signals including heartbeat, respiration, gastrointestinal sensation, and muscle tension — has been well-established in the adult clinical literature as foundational to emotional awareness and self-regulation (Craig, 2015; Garfinkel et al., 2015; Murphy et al., 2017). What MaaS 2.0 proposes is the application of this construct to children's digital experiences: that children can learn to recognize internal body signals as early warning systems for unhealthy digital engagement patterns.

The thesis is mechanistic rather than aspirational. When a child experiences the pull to check a device, the agitation of a game's reward cycle, or the discomfort of social comparison on a platform, these experiences register first in the body — as accelerated heartbeat, shallow breathing, stomach tension, or restlessness — before they register in conscious thought. Interoceptive awareness training teaches children to notice these signals as signals, creating a temporal gap between impulse and action that is the functional definition of digital agency.

This is not metacognition alone. While metacognitive approaches ask children to think about their thinking, the interoceptive model asks children to feel what their bodies are telling them before they think at all. The body, in this framework, is the first language of digital literacy.

The developmental appropriateness of this approach is supported by research demonstrating that interoceptive accuracy and awareness develop throughout childhood and can be enhanced through targeted training (Koch & Pollatos, 2014; Murphy et al., 2019). Elementary-age children possess sufficient interoceptive capacity to identify and report bodily signals when given developmentally appropriate vocabulary and structured reflection opportunities.

4.2 Digital Bonding Patterns

The second theoretical expansion extends attachment theory into the domain of human-technology relationships. Drawing on the foundational work of Bowlby (1969/1982) and Ainsworth (1978) and informed by contemporary digital psychology, MaaS 2.0 identifies five Digital Bonding Patterns that characterize children's relational orientations toward technology.

Secure Digital Attachment describes a relationship with technology characterized by comfortable engagement and comfortable disengagement. The child uses devices with purpose, derives satisfaction from digital activities, and transitions away from screens without distress. Technology is a tool that serves the child rather than a relationship the child serves.

Anxious Digital Attachment manifests as preoccupation with digital access, distress during separation from devices, and a persistent felt sense that one might be missing something. The child seeks reassurance through frequent checking and experiences disproportionate emotional responses to digital

social cues.

Avoidant Digital Attachment appears as superficial engagement coupled with emotional withdrawal. The child may use technology extensively but maintains psychological distance from digital relationships and content, neither fully engaging nor fully disengaging.

Disorganized Digital Attachment presents as contradictory behavioral patterns — simultaneous desire for and aversion to digital engagement, unpredictable responses to technology-related stimuli, and difficulty establishing coherent digital routines.

The Phantom Tether — the fifth pattern and an original contribution of this research program — describes the persistent felt sense of connection to a device or platform even when the device is not present or in use. It manifests as phantom notification sensations, unconscious checking behaviors, and a subtle but pervasive sense of incompleteness without the device. The Phantom Tether is distinct from anxious digital attachment in that it operates below conscious awareness; the child does not worry about the device so much as feel it, even in its absence. This pattern has particular significance for understanding how digital environments can create relational dynamics that persist beyond the boundaries of actual use.

These five patterns are not diagnostic categories but descriptive frameworks. They provide vocabulary for researchers, educators, and children themselves to identify and articulate the relational dynamics of technology use. In the MindfulBytes program, children are invited to notice which patterns resonate with their own experience — not to be labeled, but to develop self-knowledge.

4.3 Satisficing Heuristics in Digital Behavior

Herbert Simon's (1956) concept of satisficing — the tendency to select the first option that meets a minimum threshold of acceptability rather than optimizing across all available options — has been extensively applied to adult decision-making but insufficiently explored in children's digital behavior.

MaaS 2.0 proposes that children's digital choices are governed substantially by satisficing heuristics, and that these heuristics interact with interoceptive signals in ways that have not been previously articulated. When a child scrolls through content options, selects a game, or responds to a social notification, the decision is rarely deliberative. Instead, the child's body provides a rapid, pre-conscious assessment — a felt sense of "good enough" — that drives selection before reflective evaluation can occur.

This framing has two important implications. First, it explains why cognitive-behavioral approaches to digital literacy (e.g., "think before you click") have limited efficacy with young children: the thinking occurs after the body has already made its assessment. Second, it suggests that interventions targeting the body's assessment process — through interoceptive awareness training — may be more developmentally appropriate and mechanistically sound than those targeting cognitive deliberation alone.

The satisficing framework also illuminates how digital platforms exploit children's decision-making architecture. Autoplay features, infinite scroll mechanisms, and algorithmically curated content feeds

are designed to satisfy the "good enough" threshold continuously, preventing the natural dissatisfaction signals that would otherwise prompt disengagement. When the body never registers "this is no longer satisfying," the child never generates the interoceptive signal that would initiate a transition away from the screen.

4.4 Creative Atrophy and the Creative Hollowing

The emergence of generative AI has introduced a phenomenon that the original MaaS framework could not have anticipated: the progressive deterioration of creative generative capacity through sustained reliance on AI-mediated creative processes.

Creative atrophy, as defined within MaaS 2.0, is not about tool use. Children have always used tools to create — crayons, blocks, musical instruments, software. Creative atrophy describes the specific erosion of the capacity to generate unprompted creative output when a responsive system is available to generate on the child's behalf. It is the difference between a child who uses a drawing program to create an illustration and a child who asks an AI to generate an illustration — and who, over time, loses confidence in (and eventually access to) the internal generative process that would have produced one independently.

The mechanism is one of disuse. Creative capacity, like physical strength, requires regular exercise. When a generative AI provides immediate, high-quality creative output in response to a prompt, the child's own generative muscles — the toleration of ambiguity, the willingness to produce imperfect first attempts, the iterative process of revision — atrophy from underuse. The result is what we term the Creative Hollowing: a state in which the structures of creativity (interest, taste, judgment) remain intact while the generative engine (the capacity to produce from within) diminishes.

This framework has particular urgency for K–5 populations because the elementary years represent a critical window for creative development. Children who do not exercise creative generative capacity during this developmental period may find it significantly more difficult to develop later.

4.5 Relational-Cultural Theory in Digital Contexts

Jean Baker Miller's (1976) Relational-Cultural Theory (RCT) provides a lens for evaluating the relational quality of children's digital experiences. RCT distinguishes between growth-fostering relationships — characterized by mutual empathy, mutual empowerment, and increased clarity — and growth-limiting relationships — characterized by disconnection, diminished vitality, and relational images that constrain future engagement.

MaaS 2.0 applies this distinction to children's relationships with digital technologies and the entities they encounter through those technologies. A child's interaction with a responsive AI chatbot, for instance, may exhibit features of relational engagement — reciprocity, responsiveness, emotional attunement — while lacking the mutuality and vulnerability that characterize genuinely growth-fostering relationships. The child may experience the felt sense of connection without the developmental benefits that connection typically provides.

This framework is not anti-technology. Some digital interactions do foster genuine relational growth — collaborative creative projects, meaningful communication with distant family members, participation in communities of shared interest. The RCT lens provides a principled basis for distinguishing between digital experiences that contribute to relational development and those that simulate relational engagement while providing neither mutual growth nor authentic connection.

For K–5 populations, this distinction is particularly consequential because young children are still developing the capacity to differentiate between authentic and simulated relational experiences. The felt sense of connection is real even when the relational substance is absent — and the long-term effects of building relational expectations on simulated foundations remain an open and urgent question.

5. THE DIGITAL WELLNESS ASSESSMENT (DWA)

The theoretical frameworks described above require measurement. MaaS 2.0 introduces the Digital Wellness Assessment (DWA), an exploratory instrument designed to capture children's self-reported interoceptive signals, digital bonding patterns, and creative engagement indicators in the context of technology use.

The DWA is designed as a developmentally appropriate self-report measure for K–5 students. It employs visual analog scales, body-mapping exercises (in which children indicate where in their bodies they feel specific sensations during technology use), and structured reflection prompts adapted for varying literacy levels.

It is essential to state clearly what the DWA is and what it is not. The DWA is an exploratory instrument in the early stages of development. It has not been validated through large-scale psychometric testing. Its constructs are theoretically grounded but empirically preliminary. The DWA represents a direction of measurement, not a completed measurement tool. Current research efforts focus on establishing construct validity, refining items based on children's actual language and responses, and conducting pilot administrations in partnership with elementary schools.

The DWA is designed to measure constructs that existing instruments do not capture. Screen-time tracking measures quantity. Content-rating systems measure appropriateness. Behavioral checklists measure observable actions. What is missing — and what the DWA aims to provide — is a window into the child's internal experience of technology use: what the body notices, what the relationship feels like, and whether the creative impulse is growing or receding.

6. MINDFULBYTES: FROM FRAMEWORK TO PRACTICE

MindfulBytes is the applied research program through which MaaS 2.0 is operationalized in elementary school settings. Developed by NM-CCCR and currently being implemented in partnership with schools

in New Mexico, MindfulBytes translates the theoretical architecture described above into a developmentally appropriate curriculum for K–5 students.

The core philosophy of MindfulBytes can be stated simply: children do not need less technology — they need better awareness of how technology makes them feel. This is not a screen-time reduction program. It is not a digital safety lecture. It is a program that teaches presence — the capacity to notice, in real time, what one's body and mind are experiencing during digital engagement — as the foundation for digital agency.

MindfulBytes sessions are structured around three moments: before-screen, during-screen, and after-screen. Before-screen exercises establish a body-awareness baseline through brief interoceptive check-ins — children are asked to notice their breathing, their heartbeat, the state of their muscles. During-screen activities integrate awareness practices into actual technology use, asking children to pause periodically and reconnect with bodily signals. After-screen reflections capture what changed — what the body noticed, what feelings arose, what the child would do differently.

A foundational operating principle of MindfulBytes is that children are the experts on their own experience. The program employs co-design methodology in which children's language is treated as data, not paraphrased into adult frameworks prematurely. When a child describes a sensation as "my tummy goes buzzy when I can't stop watching," that language is preserved and valued as a precise phenomenological report — because it is one.

This principle — body before mind, signal before interpretation, child before adult framework — distinguishes MindfulBytes from conventional digital literacy curricula that begin with adult concepts (privacy, security, digital footprint) and translate them downward. MindfulBytes begins with what children already know: what their bodies feel.

7. EMERGING DIRECTIONS: THE HARVARD CDT FELLOWSHIP

The author's current fellowship at the Center for Digital Thriving at Harvard Graduate School of Education (2025–2026) has provided an institutional context for advancing several elements of the MaaS 2.0 framework. While it would be premature to report findings from this ongoing work, it is appropriate to describe the directions being explored.

The fellowship has focused on the co-design methodology of MindfulBytes — specifically, on how to structure sessions that invite children's authentic participation in the development of digital wellness practices rather than positioning them as passive recipients of adult-designed curricula. Co-design sessions conducted in partnership with elementary schools in New Mexico are generating data about children's own language for describing their digital experiences, their interoceptive vocabulary, and their natural strategies for self-regulation during technology use.

The fellowship has also provided valuable engagement with the CDT research community, including collaborative refinement of MindfulBytes session design, feedback on measurement approaches, and

connection to broader research on children's digital thriving. This cross-pollination between applied community-based research and academic institutional knowledge represents exactly the kind of bridge that MaaS was designed to build.

Key questions currently under investigation include: How do children's interoceptive reports during technology use compare to physiological measures? What language do children naturally use to describe digital bonding patterns when they are not given adult vocabulary? And how does the co-design process itself function as a form of digital wellness intervention — that is, does the act of being asked to notice and articulate one's digital experience change the experience itself?

8. FROM NIST TO NERVOUS SYSTEM: THE CYBERSECURITY BRIDGE

The original MaaS framework drew explicitly on cybersecurity governance standards — NIST, ISO 27001/27002, CMMC — as structural analogs for personal digital safety. MaaS 2.0 maintains and deepens this connection while acknowledging that the analogy operates at multiple levels.

At the most accessible level, the cybersecurity-to-personal-safety translation remains powerful. The NIST Cybersecurity Framework's five functions — Identify, Protect, Detect, Respond, Recover — map with surprising precision to the developmental capacities MindfulBytes cultivates. Identify: know what digital assets (attention, emotion, creativity) you are protecting. Protect: establish practices that safeguard those assets. Detect: notice when something feels wrong — when the body sends a signal that engagement has shifted from nourishing to depleting. Respond: have strategies ready for when that signal arrives. Recover: know how to return to baseline after a difficult digital experience.

At a deeper level, the cybersecurity bridge reveals something about the nature of the threat itself. In enterprise cybersecurity, the most sophisticated attacks do not target the technology directly — they target the human operating the technology, through social engineering, phishing, and manipulation of trust relationships. Similarly, the most consequential risks to children in digital environments are not technical but psychological: the manipulation of attention through reward scheduling, the exploitation of social comparison through algorithmic curation, and the erosion of creative agency through generative AI convenience.

This parallel is not merely rhetorical. The author's 22 years of cybersecurity practice in the U.S. Navy produced a consistent observation: the most effective security postures are those that cultivate human awareness rather than relying exclusively on technical controls. Firewalls protect networks. Awareness protects people. MaaS 2.0 applies this hard-won operational principle to the most vulnerable population in the digital ecosystem.

9. DISCUSSION AND FUTURE DIRECTIONS

MaaS 2.0 represents a transition from conceptual framework to empirical research program. The original MaaS narrative identified the need; MaaS 2.0 proposes the mechanisms, introduces measurement, and reports on applied implementation. Several directions merit attention as this work continues.

Psychometric development of the DWA. The Digital Wellness Assessment requires systematic validation — establishing construct validity, test-retest reliability, and developmental sensitivity across the K–5 age range. This work is planned as a component of the author's doctoral research at Capitol Technology University.

Longitudinal tracking. The most compelling evidence for MaaS-based interventions will come from longitudinal data demonstrating that children who develop interoceptive awareness of their digital experiences show different behavioral trajectories over time compared to those who receive conventional digital literacy education or no intervention. Such studies require multi-year partnerships with school districts and sustained funding.

Cross-cultural applicability. The current MindfulBytes implementation is situated in New Mexico schools serving diverse populations. Understanding how interoceptive awareness practices translate across cultural contexts — where relationships to technology, the body, and mindfulness may differ significantly — is essential for responsible scaling.

The generative AI question. The creative atrophy framework requires dedicated empirical investigation. How rapidly does creative generative capacity decline in children who rely heavily on AI tools? Is the process reversible? At what developmental stage is the risk greatest? These questions are urgent given the pace of AI adoption in educational settings.

Integration with existing curricula. MindfulBytes is designed for classroom integration, not standalone delivery. Future work must address how interoceptive digital literacy practices can be woven into existing STEM, social-emotional learning, and health education curricula without adding to an already-burdened school day.

The parent and family dimension. Children's digital experiences are embedded in family systems. MaaS 2.0 has focused primarily on the child's individual experience; future iterations must account for family digital dynamics, parental modeling, and the home environment's role in shaping digital bonding patterns.

10. CONCLUSION

MindfulBytes does not make children immune to technology. It teaches them to notice.

This sentence captures the evolution from MaaS to MaaS 2.0. The original framework proposed that cybersecurity principles and mindfulness practices could be united in service of children's digital wellbeing. MaaS 2.0 specifies how: through interoceptive awareness that gives children access to their

body's real-time assessment of digital experience, through Digital Bonding Patterns that provide vocabulary for the relational dynamics of technology use, through satisficing frameworks that explain why children's digital decisions outrun their deliberative capacities, through creative atrophy research that names what is at stake when generative AI displaces generative imagination, and through Relational-Cultural Theory that distinguishes genuine connection from its digital simulation.

We are not in the business of building armor for children. We are in the business of teaching them to feel the weather — so they can dress themselves, for the rest of their lives.

The weather is digital. The capacity to feel it is ancient, embodied, and available to every child who is taught to listen to what their body already knows.

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