

International Journal of Agriculture Extension and Social Development

Volume 8; Issue 12; December 2025; Page No. 159-164

Received: 09-08-2025
Accepted: 16-09-2025

Indexed Journal
Peer Reviewed Journal

Digital stress and cognitive overload in adolescents: Neurodevelopmental and psychosocial pathways to mental health

¹Vinutha U Muktamath, ²Sapthagiri TV, ²Hanna Sunkara and ²Yogita Simpiger

¹Scientist, All India Co-ordinated research Project-WIA, Department of Human Development & Family Studies, University of Agricultural Sciences, Dharwad, Karnataka, India

²Ph.D. Scholars, Department of Human Development & Family Studies, College of Community science, University of Agricultural Sciences, Dharwad, Karnataka, India

DOI: <https://www.doi.org/10.33545/26180723.2025.v8.i12c.2741>

Corresponding Author: Vinutha U Muktamath

Abstract

Adolescence is a critical developmental period characterized by profound neurobiological, psychological and social transitions. The extensive integration of digital technology has fundamentally altered the developmental landscape of contemporary adolescence, creating a primary "ecological niche" for youth. While digital connectivity offers avenues for social support and information retrieval, it concurrently imposes significant demands on the developing brain. This review integrates cognitive load theory with developmental neuroscience and social-comparison frameworks to examine mechanisms by which contemporary digital environments affect adolescent cognitive and emotional functioning. The article synthesizes empirical evidence (2019-2025) on key drivers multitasking and media-switching, algorithmic social feedback, constant notifications, social comparison, FOMO (fear of missing out) and academic demands in online learning and their associations with adverse mental health outcomes, including with attention dysfunction, sleep disruption, emotional dysregulation, anxiety and depressive symptoms.

Keywords: Adolescents, digital stress, cognitive overload, social media, mental health, emotional dysregulation

1. Introduction

Adolescence, commonly defined as the period from approximately 10 to 19 years of age, is a phase marked by rapid brain maturation, heightened social sensitivity and the establishment of lifelong behavioral patterns (Loh and Kanai., 2014) ^[7]. It is also the life stage most immersed in digital environments, including social media platforms, instant messaging, video streaming, online learning and gaming (Moisala *et al.*, 2016) ^[8]. The rapid proliferation of smartphones and social media platforms has ushered in an era of "permanent connectivity" fundamentally reshaping daily life, learning and social relationships (Nesi and Prinstein., 2015) ^[9].

For adolescents, whose neural architecture is in a critical state of plasticity, the digital environment is not merely a tool but a primary ecological niche (Odgers and Jensen., 2020) ^[10]. While these technologies offer benefits such as connectivity, information access and educational opportunity they also generate unique stressors (Odgers and Roberts., 2020) ^[11]. Contemporary scholarship has shifted focus from the mere duration of "screen time" toward the *quality* of engagement and the psychological costs of the attention economy (Ophir *et al.*, 2020) ^[12].

Two emerging constructs are central to understanding this shift: digital stress and cognitive overload.

- Digital Stress refers to the subjective experience of strain, pressure or anxiety resulting from engagement

with digital technologies. This includes the pressure to maintain an online persona, the anxiety of availability ("availability stress"), the Fear of Missing Out (FOMO, peer-norm pressures, notification overload, and continuous connectivity (Paulus, 2023) ^[13].

For example, in a longitudinal study of 1,185 adolescents (Mean age = 15.97 yrs), perceived friends' social-media norms and features (e.g., "visualness") predicted digital stress conceptualised as entrapment and disappointment, which in turn predicted friendship conflict six months later (Angelini and Gini., 2025) ^[11]. In another study (Siakas, *et al.*, 2024) ^[17] of finish adolescents, digital stress from social media/ICT use was linked with anxiety. Digital stress is thus relational (peer availability, responsiveness), temporal (constant connectivity), cognitive (expectation monitoring) and emotional (disappointment, entrapment).

- Cognitive Overload or information overload occurs when the volume of information processing required by digital multitasking and stimuli exceeds the adolescent's available cognitive resources (attention, working memory) (Przybylski, 2013) ^[14]. In digital contexts, this may arise from continuous incoming notifications, simultaneous use of multiple apps/media (media multitasking), rapid switching of tasks (task-switching costs), fragmented attention (continuous partial attention) and high information

density. For example, heavy media multitaskers show poorer cognitive control and attention switching in lab tasks. (Levitin,2024)^[6]

In adolescents, whose executive control systems are still developing, the capacity to manage multiple streams of stimuli, resist distraction and sustain attention may be limited, making them more vulnerable to overload effects.

- **Interrelation:** The synergy of these two factors contributes significantly to the rising prevalence of internalizing disorders among youth (Reinecke *et al.*, 2017)^[15]. This review integrates cognitive load theory with developmental neuroscience and social-comparison frameworks to examine the mechanisms by which contemporary digital environments affect adolescent functioning (Siakas. *et al.*, 2024)^[17].

2. Materials and Methods

This review adopted a narrative synthesis approach to examine the intersection of digital technology usage, adolescent neurodevelopment, and mental health outcomes. A comprehensive literature search was conducted across electronic databases (e.g., Google Scholar, PubMed, and PsycINFO) prioritizing empirical evidence published between 2019 and 2025 to capture the most recent trends in digital engagement. Search strategies utilized combinations of key terms including 'Adolescents,' 'Digital stress,' 'Cognitive Overload,' 'Social media,' 'Mental health,' and 'Emotional dysregulation'. The selection process prioritized studies that extended beyond simple screen-time metrics to investigate underlying mechanisms such as multitasking, algorithmic social feedback, and social comparison. Additionally, seminal theoretical works—specifically those regarding Cognitive Load Theory and Social Comparison Theory—were included to provide the necessary foundational context for interpreting modern digital interactions

3. Theoretical Foundations

Adolescent digital engagement is examined through the lenses of cognitive science and neurobiology. The interaction between developing neural systems and digital interface demands is reviewed to provide a basis for understanding current mental health trends.

3.1 Adolescent Neurodevelopment and Vulnerability

Adolescence features ongoing maturation of the prefrontal cortex (PFC), the brain region responsible for executive functions such as impulse control, decision-making and attentional regulation. Concurrently, there is a heightened sensitivity of the limbic systems (Fig 1) and hence the brain becomes extra reactive to pleasure and social feedback during this time (Sweller, 2011 and Tafesse,2024)^[18, 19].

This developmental mismatch creates a unique window of vulnerability. Adolescents may be disproportionately sensitive to the social rewards and novelty signals produced by digital platforms (e.g., "likes," notifications), increasing susceptibility to compulsive engagement and reward-driven attention capture. The fragmentation of attention inherent in digital environments challenges the developing PFC, potentially impeding the maturation of deep cognitive control (Twenge *et.al.*,2018 and Vorderer *et.al.*,2016)^[20, 21].

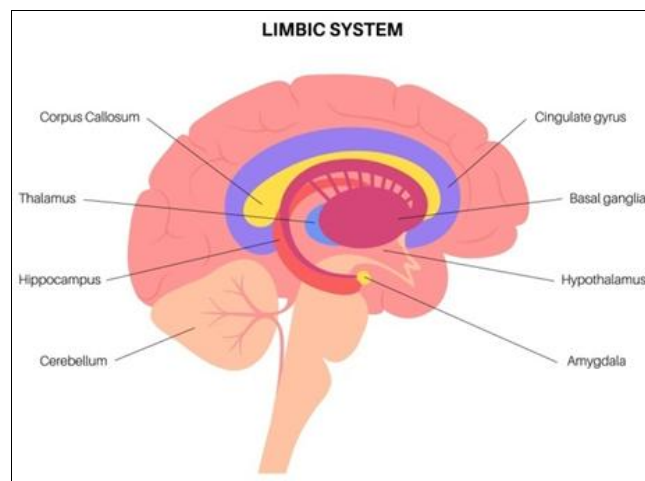


Fig 1: Anatomical Structures of the Human Limbic System

3.2 Cognitive Load Theory in Digital Contexts

Cognitive Load Theory (CLT) posits that working memory capacity is limited. For learning and effective functioning to occur, extraneous cognitive load must be minimized to allow for the processing of intrinsic and germane loads (Sweller, 2011 and Moisa *et al.*,2016)^[18, 8].

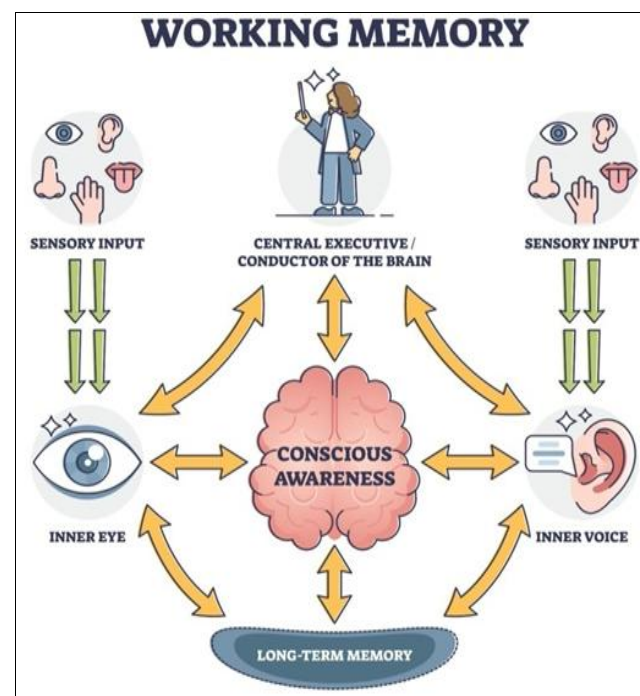


Fig 2: Schematic Representation of the Working Memory Model and Information Processing Flow

Digital environments often act as "hyper-stimuli," presenting dense streams of text, audio, and visual cues that create high extraneous cognitive load. Features that encourage rapid switching between tasks or require simultaneous management of social feedback fragment attention (Fig 2). For adolescents, this overload can impede the transfer of information to long-term memory, resulting in shallower processing of information and a reduced capacity for sustained focus in non-digital environments (Sweller, 2011, Ophir, 2009 and Moisa *et al.*,2016)^[18, 12, 8].

3.3 Social-Comparison and Socio-Emotional Frameworks

Social media platforms amplify opportunities for upward social comparison. Festinger's Social Comparison Theory is intensified in the digital realm, where metrics of validation (likes, views) are quantifiable and visible. Adolescents frequently engage in upward social comparison comparing themselves to perceived superiors or idealized a peer image which has been consistently linked to lower self-esteem and increased depressive symptoms. Furthermore, the "implicit social contract" of digital communication fosters an "always-on" vigilance, preventing psychological detachment and recovery (Festinger, 1954, Nesi *et al.*, 2015 Reinecke *et al.*, 2017) [3, 9, 15].

4. Sources and Mechanisms of Digital Stress and Cognitive Overload

Several mechanisms explain how digital engagement translates into psychological and cognitive strain.

4.1 Multitasking and Attentional Depletion

Digital environments are designed to capture attention through variable reward schedules. According to Cain *et al.*, 2016 [2], adolescents frequently engage in "media multitasking," or the simultaneous consumption of multiple media streams (e.g., toggling among apps, screens, and classroom inputs).

Research indicates that the human brain does not effectively multitask rather, it engages in rapid "task-switching" (Ophir, 2009) [12]. This switching incurs a "switch cost" in terms of metabolic energy and depletes neural resources, leading to cognitive fatigue. Laboratory studies show that media multitasking is associated with greater attentional lapses, lower sustained concentration, and decreased efficiency in working-memory tasks (Moisala *et al.*, 2016 and Cain *et al.*, 2016) [8, 2]. The subjective sense of overload often accompanies these performance effects, correlating with academic distress.

4.2 Constant Notifications and Attentional Capture

Push notifications and intermittent rewards act as attentional "interruptors" that fragment cognitive time (Reinecke *et al.*, 2017) [15]. Repeated interruptions increase perceived workload and stress, degrade sustained concentration, and may cumulatively reduce the capacity for high-quality learning and emotion regulation (Levitin, 2014) [6]. This "continuous partial attention" prevents the deep focus required for complex cognitive tasks and emotional processing (Moisala, *et al.*, 2016) [8].

4.3 Algorithmic Social Feedback and Social Comparison

Algorithms optimize for engagement by amplifying emotionally salient content (Angelini and Gini, 2025) [1]. Digital stress is partly driven by the demands of peer reciprocity and social media norms. Adolescents feel pressure to reply quickly, be constantly available, and maintain an idealized online image (Reinecke *et al.*, 2017) [15]. When peers' responses are not forthcoming, feelings of entrapment or disappointment may result, leading to

relational stress (Odgers, 2020) [10].

4.4 Sleep Disruption

Sleep is perhaps the most critical mediator between digital use and mental health. Digital use—especially at night can delay sleep onset, reduce sleep quality, and shortens total sleep duration,

- **Mechanism 1:** The emission of short-wavelength (blue) light from screens suppresses melatonin production, disrupting circadian rhythms.
- **Mechanism 2:** The content of digital media induces cognitive arousal, making sleep onset difficult. This relationship is bidirectional: digital stress causes sleep loss, and sleep loss reduces emotional resilience, making adolescents more susceptible to digital stress the following (Hale, L and Guan, 2015) [4].

4.5 Information Overload and Emotional Regulation Burden

Continuous exposure to streams of information (news, social media updates, educational content) may exceed adolescents' capacity to process and integrate, leading to cognitive fatigue and "techno stress". The increased burden on emotion regulation monitoring multiple channels and managing responses depletes coping reserves, increasing vulnerability to mood dysregulation (Jindal *et al.*, 2025) [5].

5. Empirical Evidence on Adolescent Mental Health Outcomes

There is an expanding body of literature exploring associations between digital stress/cognitive overload and adolescent mental health. While causality remains challenging to establish, recent empirical studies (2019-2025) highlight significant correlations.

5.1 Anxiety and Depression

A robust correlation exists between heavy social media use and internalizing symptoms. A critical review of screen media activity in youth found significant associations between screen activity and mental health issues, especially anxiety and depression (Paulus, 2023) [13]. Longitudinal studies have noted increases in depressive episodes among adolescents coincident with the mass adoption of smart phones (Twenge *et al.*, 2018) [20]. Specifically, digital stress (conceptualized as entrapment and disappointment) has been shown to predict friendship conflict and internalizing symptoms over time (Angelini and Gini, 2025) [1].

5.2 Cognitive and Academic Outcomes

Excessive digital platform usage correlates with poorer well-being and increased stress in student populations (Tafesse, 2024) [19]. Adolescents reporting high multitasking patterns show more academic distress and weaker cognitive control in experiments (Ophir, 2009) [12]. The fragmentation of attention due to digital overload is linked to deficits in executive functions, which are crucial for self-regulation and goal-directed behavior (Cain *et al.*, 2009) [2].

5.3 Summary of Key Studies

Table 1: Summary of Key Empirical Studies on Digital Stress and Cognitive Overload

Study	Sample & Context	Key Constructs	Findings Relevant to Adolescents
Angelini & Gini (2025) ^[1]	1,185 Italian adolescents	Friends' social-media norms, digital stress	Perceived norms and "visualness" of social media predicted digital stress (entrapment/disappointment), which predicted friendship conflict 6 months later.
Siakas <i>et al.</i> (2024) ^[17]	Finnish adolescents and parents	ICT/social-media use, digital stress, anxiety	Digital stress related to ICT use was associated with higher anxiety levels in both adolescents and parents.
Tafesse (2024) ^[19]	University students	Digital overload, coping mechanisms, well-being	Excessive digital engagement was associated with reduced well-being; coping mechanisms moderated this association.
Jindal <i>et al.</i> (2025) ^[5]	Youth (Review)	Information overload, cognitive fatigue	Exposure to information streams led to attentional fragmentation and cognitive fatigue ("technostress").
Twenge <i>et al.</i> (2018) ^[20]	U.S. Adolescents	Screen time, depressive symptoms	Sharp increase in depressive symptoms and suicide-related outcomes linked to new media screen time.
Nesi and Prinstein (2015) ^[9]	Adolescents	Social comparison, depressive symptoms	Upward social comparison on social media consistently linked to lower self-esteem and depressive symptoms.

6. Proposed Conceptual Framework

Based on the synthesized literature, the conceptual framework linking digital antecedents to mental health outcomes is proposed (Figure 3).

- **Antecedents:** The process begins with digital inputs, including peer pressures (e.g., availability norms), device characteristics (e.g., notifications), and high information load.
- **Proximal Processes:** These inputs trigger two main states: Digital Stress (emotional strain like FOMO) and Cognitive Overload (exceeding processing capacity). These two states reinforce each other; overload can cause stress, and stress reduces cognitive capacity.

- **Mechanisms:** These states activate specific negative pathways, such as fragmented attention, sleep disruption, Executive dysfunction, increased emotional burden (Psychological and Cognitive) and Social comparison, Emotional exhaustion (Psychosocial).
- **Outcomes:** These mechanisms cumulatively lead to adverse outcomes like anxiety, depression, learning difficulties, low self esteem and digital burnout.
- **Moderators:** The impact is buffered or amplified by contextual factors like family support, school policies, and individual resilience.
- **Feedback Loops:** Poor mental health outcomes can cycle back to reduce cognitive resources, making the adolescent more vulnerable to future stress.

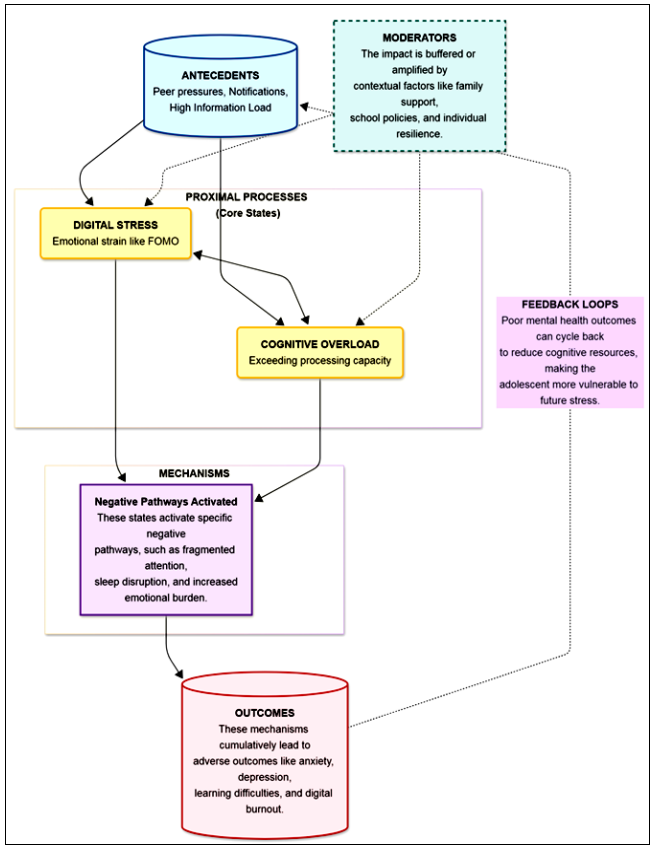


Fig 3: Proposed Conceptual Model of Digital Stress and Cognitive Overload in Adolescence

7. Implications for Practice and Policy

7.1 Implications for Adolescent Development

Adolescents are still refining attention-regulation and identity formation. Digital stress may redirect coping resources away from adaptive growth, while cognitive overload may impair learning and self-regulation. A developmental lens suggests that early adolescence may be a particularly vulnerable phase, and persistent overload may have cumulative effects on developmental trajectories.

7.2 Family Systems Perspectives

Within family contexts, digital stress may influence parent adolescent communication. Adolescents experiencing digital stress may become emotionally withdrawn or engage in conflict over device use. Families may inadvertently reinforce overload via high availability expectations. Conversely, family support and parental monitoring of screen use can act as protective moderators.

7.3 Educational and School Contexts

Schools are critical sites for intervention. Teachers must understand how cognitive overload (due to simultaneous digital learning and social media use) impairs academic achievement. Policies limiting multitasking, promoting face-to-face interaction, and scheduling "offline" periods may mitigate risks.

7.4 Intervention Strategies

Interventions should move beyond simple "screen time"

quotas to focus on quality of engagement and "digital hygiene". Strategies include:

- **Digital Literacy:** Teaching mindfulness, boundary setting (e.g., limiting late-night use), and recognizing signs of cognitive overload.
- **Platform Design:** Encouraging developers to build features that reduce continuous partial attention (e.g., "do not disturb" modes).
- **Clinical Screening:** Mental health services should screen for digital stress and provide coping strategies such as digital detox protocols.

8. Discussion

Two distinct but interrelated pathways emerge from this analysis: digital stress and cognitive overload. While digital stress imposes an emotional burden through availability pressure and social comparison, cognitive overload depletes the neural resources required for self-regulation through multitasking and 'switch costs' (Ophir *et al.*, 2009) ^[12]. Crucially, these states are not isolated events but function as a reinforcing feedback loop. As illustrated in the proposed conceptual framework, the cognitive fatigue resulting from fragmented attention undermines emotional resilience, while heightened emotional stress (such as FOMO) further taxes working memory. This cycle is often exacerbated by sleep disruption, which acts as a critical mediator, reducing the adolescent's capacity to cope with digital demands the following day (Odgers and Jensen, 2020) ^[10]. Consequently, the digital environment functions as a complex 'ecological niche' that can fundamentally alter developmental trajectories by chronically overwhelming the adolescent's emerging cognitive and emotional control systems.

9. Limitations and Future Research Directions

While the evidence base is growing, limitations exist. Most studies are cross-sectional, limiting causal inference. Measurement instruments for digital stress and cognitive overload lack standardization. Furthermore, much research relies on Western-centric samples; little is known about these phenomena in low- and middle-income contexts (e.g., India), where digital access and family norms differ.

Future research should focus on longitudinal designs to tracking digital stress and mental health over time to establish causality. It is equally important to expand research beyond Western countries to understand how these problems affect teens in diverse cultures and places with fewer resources. Scientists also need to pinpoint why some adolescents are resilient, looking at protective factors like strong real-life friendships and self-control skills. Finally, research frameworks must be constantly updated to keep pace with rapid technological changes, such as the rise of artificial intelligence and immersive media. Addressing these areas will ensure our understanding of youth mental health stays relevant as the digital world evolves.

10. Conclusion

In the current landscape of pervasive connectivity, adolescents encounter escalating burdens associated with digital stress and cognitive overload. These factors contribute to adverse mental health outcomes, including anxiety, depressive symptoms, and attentional deficits. The association is nuanced; it is driven less by mere access to

technology and more by specific interaction patterns such as multitasking, social comparison, and expectations of constant availability. While cognitive overload strains the maturing executive functions of the adolescent brain, digital stress creates a significant emotional burden. Consequently, safeguarding youth mental health necessitates a comprehensive approach involving families, schools, and policymakers to mitigate these risks as technology advances.

Conflict of Interest

No conflict of interest among authors.

References

1. Angelini F, Gini G. Digital stress and friendship conflict in adolescence: The role of perceived norms and features of social media. *Front Digit Health*. 2025;7. doi:10.3389/fdgth.2025.1497222.
2. Cain MS, Leonard JA, Gabrieli JD, Finn AS. Media multitasking in adolescence. *Psychon Bull Rev*. 2016;23(6):1932-41.
3. Festinger L. A theory of social comparison processes. *Hum Relat*. 1954;7(2):117-40.
4. Hale L, Guan S. Screen time and sleep among school-aged children and adolescents: A systematic literature review. *Sleep Med Rev*. 2015;21:50-8.
5. Jindal M, Sood VV, Notay IK, Nagpal A, Bangia A. Digital overload and cognitive fatigue among adolescents: Understanding the cognitive costs of constant connectivity. *Int J Novel Res Dev*. 2025;10(11):655-62.
6. Levitin DJ. *The organized mind: Thinking straight in the age of information overload*. New York: Dutton; 2014.
7. Loh KK, Kanai R. Higher media multi-tasking activity is associated with smaller gray-matter density in the anterior cingulate cortex. *PLoS One*. 2014;9(9):e106698.
8. Moisala M, Salmela V, Hietajärvi L, Salo E, Carlson S, Salonen O, *et al.* Media multitasking is associated with distractibility and increased prefrontal activity in adolescents and young adults. *NeuroImage*. 2016;134:113-21.
9. Nesi J, Prinstein MJ. Using social media for social comparison: Longitudinal associations with depressive symptoms, rumination, and concern for popularity. *J Clin Child Adolesc Psychol*. 2015;44(6):925-35.
10. Odgers CL, Jensen MR. Adolescent mental health in the digital age: Facts, fears, and future directions. *J Child Psychol Psychiatry*. 2020;61(3):336-48.
11. Odgers CL, Roberts S. Adolescent mental health in the digital age: Facts, fears, and future directions. *Pediatrics*. 2020;146(2):e20201164. doi:10.1542/peds.2020-1164.
12. Ophir E, Nass C, Wagner AD. Cognitive control in media multitaskers. *Proc Natl Acad Sci U S A*. 2009;106(37):15583-7.
13. Paulus MP. Screen media activity in youth: A critical review of mental health research. *J Adolesc Health*. 2023;72(4):564-75. doi:10.1016/j.jadohealth.2022.11.004.
14. Przybylski AK, Murayama K, DeHaan CR, Gladwell

- V. Motivational, emotional, and behavioral correlates of fear of missing out. *Comput Hum Behav.* 2013;29(4):1841-8.
15. Reinecke L, Vorderer P, Knop K. Permanent connectivity, time pressure, and the fear of missing out as determinants of communication load and stress. *Inf Commun Soc.* 2017;20(1):1-18.
16. Schmidt M, Frank L, Gimpel A. How adolescents cope with technostress: A mixed-methods approach. *Int J Electron Commer.* 2021;25(2):154-80. doi:10.1080/10864415.2021.1887696.
17. Siakas D, Siakas N, Siakas K, Lampropoulos G. Exploring digital stress of Finnish adolescents and their parents. *Children.* 2024;11(12):1472. doi:10.3390/children11121472.
18. Sweller J. Cognitive load theory. *Psychol Learn Motiv.* 2011;55:37-76.
19. Tafesse W. Digital overload, coping mechanisms, and student well-being in higher education. *SAGE Open.* 2024;14(3). doi:10.1177/21582440241236087.
20. Twenge JM, Joiner TE, Rogers ML, Martin GN. Increases in depressive symptoms, suicide-related outcomes, and suicide rates among U.S. adolescents after 2010 and links to new media screen time. *Clin Psychol Sci.* 2018;6(1):3-17.
21. Vorderer P, Krömer N, Schneider FM. Permanently online-permanently connected: Explorations into the effects of social media use. Routledge; 2016.