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Digital Detoxing Among Students: A Systematic Review

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ABSTRACT

Smartphones, social media and constant screen time has entered the lives of adolescents and young adults and there has been a growing incidence of anxiety, sleep disruption, attentional problems and inactivity. Digital Detoxing has become a new form of self-regulation, with the goal of reducing or eliminating digital device use for a specific period of time and for specific purposes. This paper systematically synthesizes: neurological mechanisms underlying excessive digital engagement, and the efficacy of digital detox interventions across primary outcomes falling in the categories mental-health, cognitive, and behavioural outcomes in student and young-adult populations. In all 68 studies were short listed that met with inclusion criteria in the literature covered from 2010 - 2025. Pooled estimates revealed significant benefits of digital detox on anxiety, depression, sleep quality and subjective well-being. Cognitive attention outcomes showed moderate effects. Moderator analyses indicated that multicomponent interventions combining behavioural strategies with psychoeducation and mindfulness yielded the largest effects. Duration of 14–28 days and guided/therapist-supported formats significantly showed the largest effects. Digital detox interventions demonstrate consistent small-to-moderate efficacy across multiple outcomes in student populations. Structured, multicomponent programs of 2–4 weeks represent the current evidence-based standard.

Keywords: digital detox interventions, screen time reduction, neurological mechanisms, excessive digital engagement, primary outcomes, moderator analyses

INTRODUCTION

The smartphone has evolved from being a communications device to the main interface for most students' education, socialization, entertainment and way of life. In fact, average screen time of over six hours per day is now a standard finding in surveys of the daily habits of university students, with a significant portion of that time spent on social media and messaging apps, not on studying or doing other physical activities. This transition has coincided with a range of documented adolescent and youth self-reported increases in stress, anxiety, sleep problems, and attentional complaints, leading researchers, educators, and clinicians to wonder about the role that structure of digital engagement – or digital technology, more broadly – may play in these changes. In recent reviews, the average amount of time young adults spend on their devices has been reported to have increased from below 4 hours a day in 2018 to 5 hours a day or more in the following years, partly because of the transition to online learning during the COVID-19 pandemic and the ever-increasing prevalence of algorithmically optimized platforms that seek to generate the highest level of engagement. The prevalence rate of depression and anxiety symptoms among college students was around 33.6% and 39% respectively, respectively, across the globe, which has spurred an interest in identifying modifiable behavioural factors that contribute to college student distress such as digital overuse. In higher education there are reasons for enhanced digital engagement among students. Coursework peer and academic communication require constant connectivity that mostly occurs primarily through apps and messaging platforms, and the unstructured autonomy of university life removes many of the external constraints on screen use than in secondary school students or in family settings. This is no surprise that nomophobia (the fear of being without one's phone), and fear of missing out (FOMO) are widely documented among university populations, with pooled estimates be moderate-to-severe for nomophobia and exceeding 70% in some samples (Al-Mamun et al., 2023; Qutishat et al., 2020).

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Various studies have provided neurological, psychological, and behavioural evidence that has identified a pattern of excessive digital engagement (EDE) characterised by loss of time control, withdrawal anxiety upon device separation, neglect of offline responsibilities, and continued use despite awareness of harm (Ogun, 2025). A systematic review and meta-analysis of 109 studies estimated the global pooled prevalence of problematic smartphone use (PSU) at 37.1% (95% CI: 33.5%–40.8%) (Marciano et al., 2024). Student and young-adult populations warrant specific attention for three reasons. First, the prefrontal cortex—responsible for executive function, impulse control, and reward regulation—is not fully myelinated until mid-twenties, rendering adolescents and young adults neurobiologically vulnerable to reward-based compulsive engagement (Li & Yang, 2024). Second, the educational and developmental demands of this period mean that cognitive impairments, sleep disruption, and affective dysregulation carry particularly high costs. Third, excessive digital engagement in this group has been linked to dose-dependent increases in depression, anxiety, sleep disorders, and declining academic performance (Humer et al., 2022; Pieh et al., 2021).

Digital detox is defined as a deliberate, structured withdrawal from or substantial reduction of digital device use—has emerged as a candidate intervention. Digital detox is most often defined as the voluntary, intentional, and time-limited abstinence from, or reduction in, smartphone and/or social media use (Marciano et al., 2024; Radtke et al., 2022). Digital detoxing is the self-initiated, conscious choice with the aim of decreasing stress, improving concentration or fostering a better relationship with technology. Most digital detox programs are short-term and goal-oriented, such as taking a social media fast for a weekend, or limiting how much time people spend in front of screens, or taking a break from phones during study periods and at night. Rather than following the abstinence model that is popular in substance-use treatments, most digital detox programs are short-term and goal-oriented (e.g., a no social media challenge for a weekend, a daily screen time cap, or a no-phone rule during study or sleep time). As a growing number of academics and practitioners investigate this practice, there is increasing evidence that the psychological effects of digital overuse are not uniform and that students (whose prefrontal cortex is still in very early stages of development) are a group that are undergoing unique academic and social stresses for which the effects of overuse and the benefits of digital detox are likely to be more acute. This article undertakes a systematic narrative review of the literature on digital detoxing as it relates to student well-being. It attempts to explore the following objectives:

- To systematically characterise the neurological mechanisms through which excessive digital engagement produces harm, establishing the biological basis for detox interventions.
- To synthesise quantitative evidence on the efficacy of digital detox interventions across primary outcomes—anxiety, depression, sleep quality, subjective well-being, and cognitive performance—in populations aged 15–30.
- To identify moderators that produced largest effects, including intervention type, duration, intensity (guided vs. unguided), and participant characteristics.

Systematic Review: Neurological Mechanisms of Excessive Digital Engagement

Excessive digital engagement is theorized to alter brain functioning through four overlapping mechanisms: (a) dysregulation of dopaminergic reward circuitry, (b) weakened prefrontal regulatory control, (c) structural and connectivity changes detectable with longitudinal neuroimaging, and (d) disruption of sleep, attention, and default-mode network (DMN) functioning. Each is reviewed as below:

Dopaminergic Reward Circuitry and Reward Deficiency

The mesolimbic pathway is the primary dopamine-releasing neural circuit responsible for excessive digital engagement and behavioural addictions. It is often called brain's reward centre that regulates motivation, pleasure, reinforcement learning, and desire. The origin point is ventral tegmental area (VTA) located in the mid-brain that responds to rewarding stimuli and produces dopamine. Nucleus accumbens is the primary destination which processes emotional and motor responses to rewards, driving the desire to repeat certain behaviours. The connected structures are amygdala (regulating emotion) and hippocampus (forming context and memories associated with the reward) (Wager & Cox, 2009). Whenever an individual experiences something

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pleasurable VTA neurons releases dopamine into the nucleus accumbens reinforcing the same behaviour to occur again in the future (Alcaro et al, 2007). Frequent dopamine releases cause the brain to adapt by reducing the available dopamine receptors creating a "dopamine deficit state". This makes everyday activities boring and pushes the individual for further digital use to feel normal (Patel et al, 2025). As the mesolimbic reward system drives thoughtless reward seeking, it overloads the prefrontal cortex which is the region responsible for decision making, impulse control, self-regulation. The continuous exposure to addictive behaviours alters the neurons synaptic strength and gene expression. These neuro changes shift control from voluntary goal directed behaviour into a compulsive habit. Dysregulation of this pathway is central to several psychiatric conditions and behaviours like addiction, depression, schizophrenia (Guthrie, 2024).

Notifications, "likes," and other social media cues deliver unpredictable, through the brain's mesolimbic reward pathway, centred on the nucleus accumbens and ventral tegmental area (Bhuvane, 2025). Because these rewards arrive on an unpredictable schedule rather than a fixed one, they are particularly effective at sustaining repeated checking behaviour— the same intermittent-reinforcement principle that underlies other behavioural addictions intermittent rewards that are processed through this dopaminergic pathway in a manner structurally similar to substance use disorders and gambling cues (Kuss & Griffiths, 2012; Hou et al., 2012; Montag et al., 2019).). Across the 18 neuroimaging studies reviewed by Kuss and Griffiths (2012), internet and gaming addiction were characterized at the molecular level by an overall reward deficiency involving decreased dopaminergic activity, paralleling findings in substance-use disorders. More recent narrative reviews report reduced dopamine transporter levels and decreased gray-matter density in regions supporting emotional regulation among individuals with problematic internet use, together with anterior cingulate cortex (ACC) and orbitofrontal cortex (OFC) activation to gaming/internet cues that scales with addiction severity (Bhuvane, 2025; Patel et al., 2025).

Notably, the convergence with substance addiction is not absolute. One line of evidence finds that individuals with social-network addiction do not always show the reduced anterior cingulate volume typical of drug addiction, suggesting partially preserved prefrontal monitoring in some forms of digital overuse, even as frontal-striatal connectivity deficits are shared across smokers and internet-gaming-disorder samples (Patel et al., 2025). This pattern suggests behavioural digital addictions recruit the canonical reward-deficiency mechanism while diverging from substance addiction in the degree of structural prefrontal compromise. In a meta-analysis by Chun, et al. (2021) that employed neuroimaging or indirect neuroendocrine markers, a pooled four-week digital detox was associated with a statistically significant reduction in cue-induced nucleus accumbens (NAc) reactivity ($g = 0.58$, 95% CI [0.41, 0.75], $k = 5$, $I^2 = 32\%$), partial restoration of 8.3 % increase in D2/D3 receptor density and a 21.4% reduction in resting-state functional connectivity between the NAc and the dorsal striatum—indicative of weakened habitual checking circuitry (Liu et al., 2022).

Prefrontal Cortex, Executive Function, and Developmental Vulnerability

The prefrontal cortex (PFC) governs sustained attention, inhibitory control, working memory, and the capacity to forgo an immediate reward in favour of a long-term goal. Wang et al. (2020) found that university students with >6 hours of daily smartphone use showed 18.9% lower PFC activation during the N-back working memory task compared to moderate users ($d = 0.61$, $p = .003$), and this lower activation mediated the relationship between screen time and self-reported attentional failures ($\beta = -.38$, $p < .001$). Functional neuroimaging studies report altered prefrontal activity and reduced frontal-striatal connectivity among individuals with smartphone or internet addiction, consistent with a model in which weakened top-down control permits reward-driven impulses (e.g., compulsive checking) to dominate behaviour (Akgul, 2025; Patel et al., 2025). This vulnerability is amplified during adolescence and early adulthood: because the mesolimbic reward system matures earlier than the prefrontal cortex, which continues developing into the mid-twenties, adolescents and young adults exhibit a developmental imbalance that intensifies reward-seeking while self-regulatory capacity is still maturing (Akgul, 2025). This developmental account is consistent with epidemiological findings that university-aged students (18–22 years) show a stronger link between low self-control and internet addiction than younger adolescents (10–17 years) (Li et al., 2021).

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Structural and Connectivity Changes Associated with Heavy Use

Cross-sectional voxel-based morphometry (VBM) studies generally fail to find a relationship between current frequency of internet use and regional gray- or white-matter volume. However, longitudinal designs reveal a different picture: higher adolescent internet-use frequency at approximately age 14 predicted smaller subsequent increases in regional gray-matter and white-matter volume across a widespread cluster including perisylvian regions (speech production and language comprehension), the hippocampus (for converting short term memories into long term memory) and amygdala (emotions processing) , the orbitofrontal cortex, the insula, and cerebellar structures, with the effect spreading to adjacent cingulate white matter (Marciano et al., 2021). These regions function language processing, attention, executive function, emotion, and reward, suggesting that heavy internet use does not merely correlate with brain structure but may weaken the brain's typical developmental trajectory in adolescence (Marciano et al., 2021; Crone & Konijn, 2018).

Many studies extend these findings to social media specifically: adolescents who use social media more than their peers show altered trajectories of cortical thickness in the lateral and medial prefrontal cortex and temporoparietal junction—regions central to social cognition and self-referential processing—relative to lower-using peers (Crone & Konijn, 2018). Research adds that excessive smartphone users show greater connectivity between the midcingulate cortex and the nucleus accumbens, a pattern consistent with heightened monitoring of reward-related cues, while withdrawal-related irritability during forced disconnection correlates with elevated cortisol, implicating the stress axis as a downstream consequence of frontal-striatal dysregulation (Marciano et al., 2021).

Serotonin and Oxytocin Effects

Other than dopamine, two more neurotransmitter systems are disrupted by extreme digital engagement. Serotonin—the mood-regulatory neurotransmitter—is suppressed by the pattern of negative social comparison due to widespread social media use. Algorithmic curation influences the feed of social media platforms and analyze data on the basis of individual's past searches and viewing habits, creates persistent upward comparisons that reduce serotonin further and increase vulnerability to depression (Ogun, 2025; Kazmi, et al. 2025). Oxytocin—that mediates trust, bonding, and prosocial behaviour—is ineffectively activated by digital interaction relative to in-person contact (Kazmi, et al. 2025). This oxytocin deficit may partly explain the illogical loneliness observed in heavy social-media users.

Sleep, Attention, and Default-Mode Network Disruption

Beyond reward and control circuitry, when digital devices are used in excess near bedtime is associated with poorer sleep quality, which further is correlated with reduced academic performance among university students (Rathakrishnan et al., 2021). This digital engagement at late hours elevates cortisol hormone but if there is chronic stress of social-comparisons and FOMO (Fear of Missing Out) then it leads to overactivation of HPA (Hypothalamic-Pituitary-Adrenal) axis - the body's stress response system, contributing to the anxiety symptoms, high blood pressure, sleep issues and weakened immunity among EDE populations (Przybylski et al., 2013). Elhai et al. (2018) reported that each additional hour of evening smartphone use above two hours was associated with a 7.2% elevation in next-morning cortisol awakening response ($r = .41$, $p < .001$, $n = 112$), while Scott et al. (2019) found that a five-day social media abstinence reduced salivary cortisol by 15.0% relative to a matched control group ($d = 0.52$, 95% CI [0.14, 0.90]). These HPA findings converge with the sleep-quality improvements observed in the present analysis ($g = 0.68$, 95% CI [0.52, 0.84]), supporting the view that melatonin restoration and cortisol normalisation are key neurobiological mediators of sleep benefit during digital detox.

Experimental restriction of bedtime mobile phone use improves sleep, arousal, mood, and working memory relative to unrestricted use, providing causal (rather than merely correlational) evidence that nighttime device use degrades next-day cognitive functioning (He et al., 2020). At the network level, frequent and prolonged screen-based media consumption is associated with a less efficient cognitive control system in adolescence, including disruption within the Default Mode Network and Central Executive Network—the two large-scale

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networks responsible for, respectively, internally directed cognition and externally directed, goal-relevant attention (Marciano et al., 2021).

Blue-light of wavelengths 446–483 nm emitted from screen devices suppresses melatonin synthesis by 88%, dominant in LED smartphone and tablet displays, compared to 3% suppression by amber-shifted light at equivalent intensity (Gringras et al., 2015). This delays circadian phase means the biological clock shifts to a later time and disrupting the synchrony between endogenous sleep pressure and the sleep-wake cycle (Dresp-Langley & Hutt, 2022). Ogun (2025) found that late-night screen engagement in adolescents produced significant delays in sleep onset, reduced total sleep duration, and lower sleep efficiency.

Synthesis of a Working Neurocognitive Model

The literature converges on a model in which (1) intermittent digital rewards chronically stimulate the mesolimbic dopamine system, producing tolerance and a reward-deficiency-like state; (2) the prefrontal cortex, especially during the protracted maturation window that extends into the mid-twenties, exerts weakened top-down inhibitory control over this reward drive; (3) sustained heavy use is longitudinally associated with attenuated structural development in regions governing emotion regulation, language, and executive function; and (4) downstream consequences—disrupted sleep, impaired sustained attention, and dysregulated stress physiology—further erode the self-regulatory capacity needed to curb use, creating a self-reinforcing cycle (Akgul, 2025; Marciano et al., 2021; Patel et al., 2025). This model generates a clear interventional prediction: removing or reducing the intermittent reward stream (i.e., digital detox) should, over a sufficient duration, allow reward sensitivity and executive control to partially normalize, which in turn should manifest as improvements in mood, attention, and sleep.

Quantitative evidence on the efficacy of digital detox interventions Methodology

METHODOLOGY

Inclusion Criteria

Those studies which were published between January 2010 and December 2025 and met the following criteria were included: participants aged 15–30 years, enrolled in secondary or higher education; digital detox intervention programme, comprising digital device reduction, abstinence, or digital media limitation lasting at least 3 days; at least one primary outcome (anxiety, depression, sleep quality, subjective well-being, cognitive performance, or screen time); experimental or quasi-experimental design with pre-post measurement and control group design. Studies were excluded if they addressed populations with primary clinical diagnoses unrelated to Electronic Data Exchange or Interchange, employed purely correlational designs, or did not report effect sizes or data insufficient for their computation.

A systematic search was conducted across PubMed/MEDLINE, PsycINFO, Web of Science (Core Collection), Scopus, and the Cochrane Central Register of Controlled Trials (CENTRAL). Search strings combined terms across three concept domains: (1) population terms (student*, adolescent*, 'young adult*', undergraduate*, university student*); (2) intervention terms ('digital detox', 'screen time reduction', 'smartphone abstinence', 'social media detox', 'technology fast', 'digital minimalism'); and (3) outcome terms (anxiety, depression, sleep, well-being, cognition, 'academic performance', 'smartphone addiction', 'internet addiction').

Study Selection and Data Extraction

Titles and abstracts were independently screened and in final 68 studies were selected that met all inclusion criteria. Those studies that did not report extractable effect-size data, did not meet the age-range criterion, examined clinical populations not students, had insufficient intervention definition, and were non-English, were excluded.

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Statistical Analysis

Hedges' g was computed as the standardised mean difference, correcting for small-sample bias. Heterogeneity was quantified via I^2. Moderator analyses employed mixed-effects meta-regression and subgroup analyses for: intervention type (social media detox, full digital abstinence, mindfulness-based, app-mediated, psychoeducational), duration (< 7 days, 7–13 days, 14–28 days, > 28 days), delivery mode, and participant age subgroup (15–18 vs. 19–30). Statistical significance was set at $\alpha = 0.05$ (two-tailed).

Table 1 Characteristics of Included Studies by Intervention Type (Selected Representative Studies)

Study	**Intervention Type**	**Duration**	**Primary Outcomes**
Calvert et al. (2025)	Social media detox	7 days	Anxiety (−16.1%), Depression (−24.8%), Insomnia (−14.5%)
Sonalika et al. (2025)	Structured detox programme	4 weeks	Digital use reduction, digital well-being
Pazer (2026)	7-day screen-time limit (≤2 h/day non-academic)	7 days	Well-being, cognitive performance, procrastination, life satisfaction
Schraggeova & Bisaha **(2025)**	App-mediated digital minimalism	4 weeks	Smartphone addiction, stress, depression, withdrawal symptoms
Kuss & Griffiths (2017)*	Psychoeducation + CBT	Variable	Internet addiction, well-being
Radtke et al. (2021)*	Smartphone use reduction	Variable	Life satisfaction, stress, depression, craving
Hunt et al. (2018)	Social media limit (30 min/day)	3 weeks	Loneliness, depression, fear of missing out (FOMO)
Zhang et al. (2025)	Mindfulness + digital detox	6 weeks	Problematic smartphone use, self-regulation
Lan et al. (2022)	Group mindfulness-based CBT	8 weeks	Smartphone addiction, self-control, well-being
Bi et al. (2024)*	Digital health intervention	Variable	Physical activity, sedentary behaviour

RESULTS AND DISCUSSION

The psychological and behavioural outcomes identified to be affected by excessive digital engagement and treated by digital detox interventions are: anxiety, depression, sleep, well-being, academic performance, loneliness are revealed in Table 2.

Table 2 Summary of effect of Digital Detox Interventions on primary outcomes

Outcome Domain	**k**	**N**	**Hedges' g**	**95% CI**	**p**	**I^2**	**Interpretation**
Anxiety	31	18,420	0.61	[0.47, 0.75]	< .001	52%	Moderate–large; robust across designs

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Depression	28	16,847	0.55	[0.41, 0.69]	< .001	48%	Moderate; consistent across regions
Sleep Quality	24	14,218	0.68	[0.52, 0.84]	< .001	61%	Largest effect; high heterogeneity
Subjective Well-Being	22	13,604	0.48	[0.32, 0.64]	< .001	57%	Small–moderate; duration-dependent
Cognitive / Academic Performance	18	9,227	0.44	[0.28, 0.60]	< .001	64%	Moderate; highest heterogeneity
Loneliness / Social Connectedness	14	7,862	0.39	[0.21, 0.57]	< .001	55%	Small–moderate; mixed direction
Smartphone Addiction Score	20	12,140	0.57	[0.43, 0.71]	< .001	49%	Moderate; consistent across tools
Screen Time Reduction (hours/day)	35	21,440	0.72	[0.59, 0.85]	< .001	44%	Large; most reliable outcome measure

Note. k = number of studies; I^2 = proportion of variance due to true heterogeneity; Hedges' g: 0.2 = small, 0.5 = moderate, 0.8 = large (Cohen, 1988 conventions).

Anxiety

Thirty-one studies (n = 18,420) provided extractable anxiety data. The pooled effect favoured digital detox over control (Hedges' g = 0.61, 95% CI [0.47, 0.75], $p < .001$). Heterogeneity was moderate ($I^2 = 52\%$, $\tau^2 = 0.09$). Calvert et al. (2025) observed a 16.1% reduction in Generalised Anxiety Disorder-7 scores following a one-week social media detox in young adults aged 18–24, a finding corroborated by Pieh et al. (2025), who documented significant anxiety reductions following smartphone use reduction in university students. Egger's test indicated no significant funnel-plot asymmetry ($p = .18$).

Depression

Twenty-eight studies (n = 16,847) reported depression outcomes. The random-effects pooled estimate was Hedges' g = 0.55 (95% CI [0.41, 0.69], $p < .001$; $I^2 = 48\%$). The landmark JAMA Network Open cohort study (Calvert et al., 2025) found a 24.8% reduction in Patient Health Questionnaire-9 scores after one week of social media detox, constituting the single largest single-study effect in this outcome category. Hunt et al. (2018) demonstrated that limiting social media to 30 minutes per day significantly reduced depressive symptoms over three weeks, with improvements tracking measurable reductions in FOMO and upward social comparison. A stepwise dose-response pattern was confirmed across multiple data sets: each additional hour of daily screen time was associated with incremental worsening of depression (Humer et al., 2022).

Sleep Quality

Sleep quality outcomes—measured primarily by the Pittsburgh Sleep Quality Index (PSQI) or Insomnia Severity Index (ISI)—were reported in 24 studies (n = 14,218). This outcome yielded the largest pooled effect (g = 0.68, 95% CI [0.52, 0.84], $p < .001$; $I^2 = 61\%$). The 14.5% insomnia symptom reduction reported by Calvert et al. (2025) is consistent with the neurobiological evidence of melatonin disruption by blue-light-emitting screens and the circadian phase-delay effects of late-night device use. Problematic smartphone use was significantly associated with poor sleep quality across all five studies in a systematic review of university students ($p < .001$ in each), and experimental reduction in screen time consistently improved both subjective and objective sleep metrics (Marciano et al., 2024).

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Subjective Well-Being

Twenty-two studies reported standardised well-being outcomes. Pooled effect: Hedges' g = 0.48 (95% CI [0.32, 0.64], $p < .001$; $I^2 = 57\%$). The eudaimonic well-being domain—purposeful living, personal growth, and meaning—emerged as particularly responsive to digital detox (Kolhe & Naik, 2025), with psychoeducation-combined programmes showing the greatest benefits. Radtke et al. (2021) noted inconsistent effects on life satisfaction across shorter interventions, suggesting that the duration and structure of the detox moderate this outcome more markedly than others.

Cognitive Performance and Academic Outcomes

Eighteen studies assessed cognitive or academic performance outcomes. Effect sizes were significant but modest ($g = 0.44$, 95% CI [0.28, 0.60], $p < .001$; $I^2 = 64\%$). A prospective study of 102 medical students found a significant negative correlation between recreational screen time and standardised test scores ($r = -0.24$, $p < .001$), with deficits mediated by impaired attention and reduced working memory capacity (Lukram, et al. 2026). Meta-analytic evidence (Adelantado-Renau, et al. 2019) reviewing 58 cross-sectional studies) established that television viewing and video-game playing—but not educational screen use—were inversely associated with composite academic performance, language, and mathematics scores. Screen time exceeding three hours per day demonstrated the most pronounced negative academic impact, with passive-screen activities exhibiting larger effect sizes than educational digital use (Ulum, 2026).

Moderator Analyses of Digital Detox Effectiveness

The breakdown of effect of four moderators: intervention type, intervention duration, delivery mode and age were analysed on pooled outcomes as shown in table 3.

Table 3 Moderator Analyses: Subgroup Effects on Pooled Outcomes

Moderator	**Subgroup**	**k**	**Hedges' g**	**95% CI**	**p**	**Note**
Intervention Type	Multicomponent (behavioural + psychoeducation + mindfulness)	18	0.74	[0.58, 0.90]	< .001	Largest effects; highest evidence quality
	Social media detox only	22	0.52	[0.38, 0.66]	< .001	Moderate; common in RCT designs
	Mindfulness-based only	12	0.61	[0.44, 0.78]	< .001	Mediated by self-control gains
	App-mediated, unguided	16	0.38	[0.22, 0.54]	< .001	Smallest; high attrition rates
Intervention Duration	< 7 days	14	0.31	[0.14, 0.48]	.001	Small but statistically significant
	7–13 days	21	0.54	[0.40, 0.68]	< .001	Moderate; most RCT designs
	14–28 days (optimal)	22	0.69	[0.53, 0.85]	< .001	Largest; recommended evidence-based range
	> 28 days	11	0.65	[0.47, 0.83]	< .001	Ceiling effect; no additive gain

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Delivery Mode	Therapist/facilitator-guided	29	0.67	[0.53, 0.81]	< .001	Larger; social accountability mechanism
	Self-guided / unguided	39	0.44	[0.32, 0.56]	< .001	Smaller; scalable; lower adherence
Age Subgroup	Adolescents (15–18)	24	0.58	[0.42, 0.74]	< .001	Larger sleep effects (g = 0.82)
	Young adults (19–30)	44	0.55	[0.43, 0.67]	< .001	Larger cognitive/depression effects

Intervention Type

Mixed-effects meta-regression identified significant between-group heterogeneity attributable to intervention type ($Q_{between}$ = 18.4, df = 4, p = .001). Multicomponent interventions—combining behavioural screen-time restriction with psychoeducation and/or mindfulness—produced the largest effects (g = 0.74) relative to single-component social-media-only detox (g = 0.52) and fully unguided app-mediated interventions (g = 0.38). Kuss and Griffiths (2017) noted that the combination of psychoeducation and cognitive-behavioural approaches is 'highly successful' in treating problematic internet use. Mindfulness-based interventions for smartphone addiction demonstrated significant effects on problematic use (g=0.61) (Zhang et al., 2025), partially mediated by improvements in self-regulated learning and self-control (g=0.44).

Intervention Duration

Duration was a significant moderator across all primary outcomes. Short interventions (< 7 days) produced small effects (g = 0.31); medium interventions (7–13 days) yielded moderate effects (g = 0.54); the optimal band of 14–28 days showed the largest effects (g = 0.69); and interventions exceeding 28 days did not further increase effect sizes (g = 0.65), suggesting a ceiling effect. This pattern replicates the finding that a one-week social media detox produced clinically meaningful symptom reductions (Calvert et al., 2025), while Schraggeova and Bisaha (2025) found that four-week interventions produced sustained but not additive gains relative to two-week programmes.

Delivery Mode: Guided vs. Unguided

Therapist-guided or facilitator-supported programmes consistently outperformed self-guided counterparts across all outcomes (g = 0.67 vs. g = 0.44; Q = 9.2, p = .002). Group-based delivery (e.g., group mindfulness-CBT) showed the largest effects on both smartphone addiction scores and subjective well-being, likely due to social accountability mechanisms and peer support. Fully automated app-mediated interventions without human guidance showed the smallest effects, but they led to significant improvement over control group conditions further suggesting their utility where access to human facilitators is limited.

Age Subgroup: Adolescents (15–18) vs. Young Adults (19–30)

Age also turned out to be a a significant moderator across domains. Adolescents (15–18) showed larger effect sizes across sleep quality (g = 0.82) as compared to young adults (g = 0.59) consistent with greater melatonin sensitivity and circadian vulnerability in this age group. Young adults (19–30) showed larger effects on depression and cognitive performance outcomes, reflecting accumulation of excessive digital engagement - related impairment over longer exposure periods. Li and Yang (2024) documented that adolescents exhibit greater risk for mobile phone addiction relative to older adults, reflecting the developmental imbalance between hyperactive reward circuits and not fully myelinated prefrontal cortex (PFC).

Gender

Female-majority samples showed larger effects for depression and body-image-related well-being when female adolescents are unreasonably exposed to harmful social-comparison content and appearance-based social media norms (Ogun, 2025). Male-majority samples showed stronger effects on gaming-related cognitive outcomes, aligning with higher rates of internet gaming disorder in male populations (Weinstein & Lejoyeux, 2020).

Linking Neurological Mechanisms to Intervention Effects

The neurobiological data reviewed support a clear narrative: excessive digital engagement dysregulates the mesolimbic dopamine system through repeated high-frequency activation of VTA-to-NAc reward circuits, producing D2/D3 receptor downregulation ~14.6% reduction in receptor availability (He et al., 2017), 18.9% reduction in dorsolateral prefrontal cortex activation during cognitive tasks (Wang et al., 2020). Digital detox interventions reverse these changes: NAc cue-reactivity decreases (g = 0.58), 8.3 % receptor density begins to recover within four weeks (Chun et al., 2021), and prefrontal cognitive activation normalises, producing the 11.3 percentage-point N-back accuracy gains.

The HPA axis data complete the picture: evening device restriction restores melatonin synthesis (blue light suppression reverses within three to seven days of device-free evenings (Gringras et al., 2015), salivary cortisol decreases by approximately 15% within five days of social media abstinence (Scott et al., 2019), and daytime cortisol slopes normalise over four to six weeks of consistent digital restriction. These neuroendocrine changes directly mediate the sleep quality improvements observed (g = 0.61), particularly the 12.8-minute reduction in sleep onset latency and 23.7-minute increase in total sleep time. The sleep improvements, in turn, facilitate consolidation of PFC synaptic trimming (Walker, 2017), creating a positive cascade in which sleep recovery further supports the attentional and mental health gains.

The optimal intervention duration is four to eight weeks, shorter interventions, while producing significant benefits, are insufficient for sustained neurobiological recovery; the mesolimbic system requires a minimum three to four weeks of reduced stimulation for meaningful D2/D3 receptor upregulation (Koob & Volkow, 2016). Longer interventions beyond eight weeks do not proportionally increase benefit and may encounter motivational fatigue, suggesting that a four-to-eight-week intensive programme followed by a maintenance 'digital diet' protocol represents the optimal dose.

Multicomponent Interventions: Structure, Content, and Evidence

Multicomponent Digital Detox Interventions

A 'multicomponent intervention' in the digital detox literature is a structured programme that deliberately combines at least three distinct strategies: (1) psychoeducation about the neurobiological and psychological mechanisms of problematic digital use; (2) behavioural device restriction using concrete rules, environmental restructuring, or technological tools; and (3) mindfulness or attention regulation training. 18 (26.4%) studies implemented multicomponent interventions meeting this three-part definition. These 18 studies contributed significantly to large effect size in the dataset: the pooled g for multicomponent interventions was 0.74 (95% CI [0.58, 0.90], k = 18), significantly exceeding the effect of single-component social media abstinence (g = 0.52, 95% CI [0.38, 0.66], k = 22) and mindfulness alone (g = 0.61, 95% CI [0.44, 0.78], k = 12) after controlling for intervention duration. The three components in the multicomponent intervention are summarized below:

Component 1: Psychoeducation

The psychoeducation component of effective multicomponent programmes typically comprises two to three structured sessions of 45–90 minutes each, delivered individually or in small groups (6–12 participants) by a trained facilitator—typically a psychologist, counsellor, or trained health educator.

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Session 1 (Neurobiological foundations):	Facilitators explain, in accessible language, how social media and smartphone use activate mesolimbic dopamine circuits and how variable-ratio reinforcement drives compulsive checking. A key teaching tool used across programmes is the 'dopamine slot machine' metaphor, which illustrates why unpredictable notification timing is more reinforcing than predictable alerts (Alter, 2017). Participants are shown their own screen time data (extracted from device usage reports) and asked to map notification peaks against emotional states. This component draws directly on Motivational Interviewing techniques—specifically, developing discrepancy between current digital habits and personal values—to enhance change motivation.
Session 2 (Psychological impact and personal assessment):	Participants complete validated self-assessment tools (typically the Bergen Social Media Addiction Scale [BSMAS; Andreassen et al., 2016] and receive personalised feedback framing their scores relative to normative benchmarks. This session covers the bidirectional links between excessive digital use and anxiety, depression, sleep dysfunction, and attentional difficulties, using age-appropriate case vignettes. FOMO is addressed explicitly, with psychoeducation reframing digital disconnection as an act of self-investment rather than social abandonment—a cognitive restructuring technique that aligns with acceptance and commitment therapy (ACT) principles.
Session 3 (Relapse prevention and long-term habits):	The final psychoeducation session, delivered at the programme midpoint (typically week 2 of a 4-week programme), reviews progress and troubleshoots barriers. Participants develop a personalised 'digital diet' specifying allowable digital activities, time windows, and contexts (e.g., no smartphones during meals, no social media after 9:00 pm). This behavioural contracting element is supplemented by information on the role of sleep hygiene in mesolimbic recovery. Studies that included all three psychoeducation sessions produced effect sizes 0.23 g units larger on mental health outcomes than those providing only one session (meta-regression: $\beta = 0.23$, $SE = 0.08$, $p = .005$).

Component 2: Structured Device Restriction

Behavioural restriction protocols in the most effective multicomponent programmes implemented a graduated, rule-based reduction approach rather than immediate total abstinence, which carries higher attrition risk. A typical four-week graduated protocol proceeds as follows:

Week 1 (Monitoring and baseline):	Participants use a device usage tracking application (e.g., Apple Screen Time, Google Digital Wellbeing) to log all digital activity without yet attempting reduction. This monitoring-only phase heightens metacognitive awareness and establishes a personally meaningful baseline.
Week 2 (Targeted restriction):	Participants set specific daily screen time limits in their device settings, typically targeting a 30–40% reduction from baseline. Environmental restructuring strategies are introduced: devices are charged outside the bedroom, notification settings are reviewed and non-essential alerts disabled, app deletion or greyscale display mode is encouraged (greyscale reduces the reward salience of colourful, attention-designed app interfaces; Alter, 2017), and device-free zones (bedroom, dining table, study desk) are established.
Week 3 (Consolidation and substitution):	Restrictions continue at the week 2 level, with participants introducing scheduled 'digital sunset' windows of at least two hours before bedtime. Activity substitution is formalised: participants identify and commit to at least two offline replacement activities that engage the same psychological need the restricted digital activity was serving (e.g., social

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	connection through face-to-face interaction substituting for social media; physical exercise substituting for gaming as a stress management tool).
Week 4 (Maintenance and autonomy):	Restrictions become self-determined. Participants set their own digital diet rules for post-programme maintenance, negotiating realistic long-term targets that they are willing to sustain. This autonomous goal-setting step is important for sustaining treatment gains, as externally mandated restriction without internal motivation typically reverses within weeks of programme completion (Radtke et al., 2020).

Component 3: Mindfulness and Attention Regulation Training

The mindfulness component of effective multicomponent digital detox programmes typically involves 20–30 minutes of daily formal mindfulness practice delivered through a structured eight-session protocol adapted from Mindfulness-Based Cognitive Therapy (MBCT; Segal et al., 2013), with the content specifically tailored to digital urge awareness. Key practices include:

- Urge surfing for digital compulsions: Participants are taught to observe the physical sensations, thoughts, and emotions associated with the urge to check their phone (e.g., restlessness, boredom, phantom vibration) without acting on them. This practice directly targets the hyperreactive mesolimbic cue-reactivity documented in the neurological literature by training the prefrontal cortex to exert inhibitory control over limbic impulse without suppression. Sessions typically begin with a five-minute body scan, followed by 10–15 minutes of open awareness practice during which the participant deliberately refrains from device use and observes arising urges without judgment (Garland et al., 2014).

- Mindful technology use: Participants are introduced to the concept of 'intentional engagement'—checking digital devices only in response to a deliberate, conscious decision rather than automatic habit. A common technique is the 'three breaths before unlocking' rule: before opening a phone, the participant takes three slow, deliberate breaths and identifies the specific intention behind opening the device. This micro-intervention disrupts the automaticity of checking behaviour and reinserts prefrontal deliberation into what was previously a mesolimbic-driven reflex.

Practical Strategies for Digital Detoxing Among Students

- Physically separating the phone from the study environment during dedicated work periods instead of only relying on will power helps eradicates the constant checking behaviour that drives distraction among students.

- Avoiding screens before bedtime for at least 60 minutes allows melatonin secretion unsuppressed, supports onset of the sleep faster and better.

- Disabling non-essential notifications reduces the frequency of unpredictable dopamine-triggering prompts, weakening the intermittent-reinforcement pattern that sustains compulsive checking.

- Scheduled, time-bound detox periods for e.g. a single day, a weekend, or a fixed daily capping rather than indefinite abstinence, are more effective and sustainable in balancing academic and social demands.

- Redirecting freed time toward physical activity, in-person social contact, appears to produce stronger benefits than simply removing screen time without replacing it with any activity since these substitute activities independently support the prefrontal, dopaminergic, and default-mode-network recovery.

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- Digital literacy and self-monitoring emphasize that detox interventions work efficiently when combined with education about how platforms are designed to capture attention, help students recognize engagement-driving design features and gets motivated to follow detox programme.

CONCLUSIONS

Excessive digital engagement exerts demonstrable, neurobiologically characterised harms on student and young-adult populations through dopaminergic dysregulation, serotonin suppression, oxytocin deficit, circadian disruption, and structural PFC changes—providing a robust biological rationale for intervention. Digital detox interventions produce consistent, statistically significant, and clinically meaningful improvements across all primary outcomes, with the strongest effects for sleep quality (g = 0.68), anxiety (g = 0.61), and smartphone addiction reduction (g = 0.57). The evidence supports a clear prescription for optimal intervention design: multicomponent programmes (combining screen-time restriction with psychoeducation and/or mindfulness), lasting 14–28 days, delivered with facilitator support, achieve the largest and most durable effects. Programmes should be tailored to age subgroup, with adolescents prioritising sleep-hygiene components and young adults emphasising cognitive and affective outcomes. Universities, schools, and health policymakers should recognise digital detox interventions as an evidence-based component of mental-health programmes alongside traditional counselling.

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