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# Beyond Distraction and Dependency: A Dual-Theoretical Framework of Cell Phone Use and Academic Performance

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## ABSTRACT

The relationship between cell phone use (CPU) and academic performance remains empirically inconsistent, with prior studies reporting negative, positive, and null effects. This study aims to develop an integrative theoretical framework capable of explaining these contradictions by identifying the underlying cognitive and self-regulatory mechanisms through which CPU operates. A theory-building narrative review was conducted using purposive searches across Scopus, Web of Science, PsycINFO, ERIC, and Google Scholar. The literature search covered studies published between January 2000 and January 2025 and focused on research examining CPU in academic contexts with cognitive or self-regulated learning (SRL) constructs. Relevant empirical and conceptual studies were synthesized to construct a dual-theoretical model. The analysis yields a dual-pathway framework in which CPU affects learning through two interacting mechanisms: (a) a cognitive-cost pathway, grounded in Switch Load Theory, where multitasking induces attentional fragmentation and cognitive overload; and (b) a self-regulatory pathway, derived from SRL Theory, where intentional phone use supports goal setting, monitoring, and motivational regulation. The model reconciles contradictory findings in prior research by demonstrating that CPU is neither inherently detrimental nor beneficial, but contingent on regulatory quality and contextual conditions. The study contributes theoretically by integrating cognitive and motivational perspectives within a single explanatory architecture and by proposing testable boundary conditions for future research. Practically, it informs digital well-being interventions, counseling practices, and educational policy by distinguishing disruptive from constructive phone use. Limitations include reliance on self-reported data in much of the existing literature and the scarcity of objective behavioral

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indicators, underscoring the need for multimodal methods in future empirical tests of the framework.

**Keywords:** Cell Phone Use; Switch Load Theory; Self-Regulated Learning; Information Processing; Academic Performance; Digital Multitasking

## 1. Introduction

The contemporary college experience is inseparable from cell phone use (CPU). Nearly all students carry smartphones into classrooms, labs, and study spaces, where they simultaneously serve as portals of distraction and as tools for academic organization<sup>[1,2]</sup>. The relationship between CPU and academic performance, however, remains contradictory. Studies have found negative correlations<sup>[3,4]</sup>, positive associations<sup>[5]</sup> and no significant effects at all<sup>[6]</sup>. These inconsistencies suggest that prevailing research models—often based on total CPU time—fail to capture the nuanced ways in which phones both hinder and help learning.

The central argument of this article is that CPU should be reconceptualized not simply as a quantity of use, but as a set of qualitative processes with distinct implications for performance. Specifically, CPU must be understood through the dual lenses of cognitive costs and self-regulatory benefits. On the one hand, frequent switching between academic and non-academic tasks imposes a measurable “switching cost” that undermines attention and efficiency<sup>[7]</sup>. On the other hand, the very same device can support metacognitive planning, motivational reinforcement, and behavioral structuring central to self-regulated learning (SRL)<sup>[8,9]</sup>. This duality demands a theoretical framework that can accommodate both negative and positive pathways of CPU’s influence. Building on Information Processing Theory<sup>[10,11]</sup> and Social Cognitive Theory<sup>[12]</sup>, this article introduces a dual-theory model that situates CPU multitasking under Switch Load Theory and CPU self-regulation under SRL Theory. Together, these perspectives enable a more comprehensive and actionable understanding of CPU in the academic context.

Despite the growing body of research on CPU and academic performance, the field remains theoretically fragmented and empirically inconsistent. Existing studies report negative, positive, and null effects of CPU, yet most rely on aggregate usage indicators such as total screen time or frequency of phone checking. Such measures obscure the underlying psychological mechanisms through which CPU operates and fail to distinguish between qualitatively different forms of engagement. A second limitation is the dominance of deficit-oriented perspectives,

which conceptualize smartphone use primarily in terms of distraction, addiction, or cognitive impairment. While these models capture important risks, they largely neglect the potential of phones to support adaptive, motivational, and self-regulatory learning processes. As a result, prior research offers limited theoretical tools for explaining why CPU sometimes undermines and sometimes enhances academic performance. Third, there is a notable absence of integrative theoretical frameworks capable of reconciling these contradictory findings within a single explanatory structure. Most existing models treat cognitive load and motivational regulation as independent or additive influences, rather than as interacting processes. Recent empirical and meta-analytic work from the past five years<sup>[2,13–16]</sup> further suggests that single-pathway models have reached an explanatory ceiling and that more nuanced, mechanism-based theorization is needed. Finally, existing research pays insufficient attention to boundary conditions and moderators, such as task complexity, SRL competence, academic discipline, and learning context, which likely shape when CPU becomes harmful or beneficial. Without accounting for these conditions, empirical findings remain difficult to generalize or translate into practice.

In response to these gaps, the present study aims to (a) develop a dual-theoretical framework integrating Switch Load Theory and SRL Theory, (b) explain contradictory findings through distinct cognitive-cost and self-regulatory pathways, (c) articulate testable propositions and boundary conditions, and (d) provide a theoretically grounded basis for clinical and educational interventions. In doing so, the study advances the field from descriptive correlations toward a mechanism-based and integrative theory of digital learning behavior.

## 2. Reconceptualizing CPU in the Academic Context

### 2.1. CPU as a Socio-Educational Construct

CPU has traditionally been examined through the lenses of distraction, dependency, and behavioral outcomes among students. Much of the earlier scholarship has framed it in deficit terms—emphasizing reduced attention span, academic under-

performance, or addictive tendencies<sup>[17]</sup>. However, recent perspectives suggest that CPU in academic contexts should not be seen merely as a disruptive factor but as a socio-educational construct shaped by digital infrastructures, peer cultures, and pedagogical affordances. The omnipresence of smartphones in classrooms and campuses reconfigures the meaning of learning spaces. Students no longer encounter education as confined to physical classrooms or library shelves; instead, their academic lives are entangled with mobile platforms that facilitate both formal and informal learning<sup>[18]</sup>.

The cell phone becomes a multi-purpose locus—for accessing readings, engaging in discussions, managing deadlines, and even participating in remote assessments<sup>[2]</sup>. Thus, CPU is not only a matter of individual habit but also a socially and institutionally mediated practice that reflects the broader digital ecology of higher education. Compared to earlier communication technologies such as landlines or even laptops, smartphones stand apart in their portability, personalization, and perpetual connectivity. They enable students to traverse spatial and temporal barriers—accessing global knowledge, maintaining social networks, and engaging in parallel tasks that collapse distinctions between academic and non-academic spheres. CPU, therefore, must be theorized not just as a behavioral variable but as a co-constructive force that shapes how learning, participation, and academic identity are enacted in contemporary education.

To enhance the empirical applicability of the dual-pathway framework, the principal constructs are defined below using operational indicators consistent with existing literature and validated measures employed in prior empirical work.

- **Cell Phone Multitasking**

CPU multitasking is operationalized as the frequency with which an individual switches between academic tasks and cell phone activities during class, lab, or study sessions<sup>[2]</sup>. In previous studies, this was measured using a ratio-scale index (0–40 times) capturing how often students checked or responded to texts, social media notifications, emails, reminders, commercial notifications, or online content during a 60 min academic activity. Higher scores indicate more frequent task-switching<sup>[2,19]</sup>. This definition reflects the core mechanism of switch-cost accumulation described in Switch Load Theory.

- **CPU Self-Regulation**

CPU self-regulation refers to the intentional use of mobile device functions to support planning, monitoring, and managing

academic tasks<sup>[2]</sup>. This includes the use of alarms, calendars, note-taking functions (e.g., Notes, Google Docs), timers, calculators, search tools, and communication functions for academic coordination (e.g., Google Docs), text messaging or emailing for clarification or collaboration). In previous studies, this was measured using a nine-item Likert scale (1 = “Never” to 4 = “Always”) assessing daily engagement with these SRL-related activities on cell phones. These items capture SRL-related behaviors (e.g., goal setting, time management, organization) consistent with Zimmerman’s SRL Theory<sup>[8,9]</sup>.

- **Cognitive Overload**

Cognitive overload refers to *a condition in which cognitive demands exceed the learner’s working memory capacity*, resulting in impaired encoding, reduced comprehension, and performance decline. Within this framework, cognitive overload is inferred through multitasking-linked indicators such as elevated task-switching frequency, attentional fragmentation, and decreased efficiency during academic work. These reflect the classic cognitive load mechanisms, where excessive extraneous load disrupts learning processes<sup>[20]</sup>.

- **Self-Efficacy**

Self-efficacy is defined as *an individual’s belief in their capability to plan, execute, and regulate actions necessary to achieve desired learning outcomes*<sup>[21]</sup>. Operationally, self-efficacy may be measured using self-report items, capturing students’ confidence in managing academic demands, monitoring progress, and sustaining effort<sup>[22]</sup>. In the context of CPU, self-efficacy influences whether phone-based tools are used strategically for learning or in ways that contribute to distraction.

## 2.2. From Distraction to Cognitive-Mediation Engagement

Early research on CPU in education largely emphasized its detrimental impact on concentration, note-taking, and classroom participation<sup>[2,20]</sup>. While these findings remain relevant, they represent only one side of the phenomenon. A narrow focus on distraction obscures the more complex psychological and cultural dimensions of CPU. Beyond mere interruptions, cell phones foster *cognitive-mediation*: they serve as gateways to information retrieval, collaborative knowledge construction, and real-time feedback that can enrich the learning process when leveraged effectively<sup>[16,23]</sup>. At the same time, CPU introduces

heightened states of cognitive and emotional arousal. Constant notifications, multitasking, and peer-driven interactions can sustain a sense of ambient vigilance, making it difficult for learners to maintain deep focus or reflective engagement<sup>[24]</sup>. The paradox is that the same device that extends educational opportunity can also erode attentional stability. In this sense, CPU embodies both affordances and risks, mediating between cognitive enrichment and cognitive overload. Moreover, the expectation of immediacy—instant responses from peers, instructors, or platforms—reshapes academic temporalities. CPU accelerates the rhythms of learning and institutional interaction, where delays are not only technical inconveniences but also perceived lapses in academic accountability. This “culture of immediacy”<sup>[25]</sup> positions CPU as an agent of acceleration in education, influencing not just learning outcomes but also student well-being and institutional credibility.

Taken together, these arguments call for a paradigmatic shift in how CPU is understood in academic contexts. It cannot be reduced to a measure of distraction or productivity alone; rather, it must be theorized as a socio-educational practice that mediates access, participation, and cognition. Recognizing this complexity enables more balanced and holistic interventions—ranging from classroom management strategies to institutional digital policies—that respond to both the risks and the transformative potentials of CPU in higher education.

### 3. Theoretical Framework

The theoretical foundation of this study draws on complementary traditions in cognitive and social-cognitive psychology to explain how CPU simultaneously impairs and enhances academic performance. Building on Information Processing Theory<sup>[26,27]</sup>, the framework conceptualizes learning as a function of limited cognitive capacity, emphasizing how constant task-switching during CPU generates mental overload and attentional fragmentation. This cognitive perspective is anchored in Switch Load Theory<sup>[28]</sup>, which elucidates the mechanisms through which frequent shifts between academic and non-academic activities incur performance costs. In parallel, the framework incorporates SRL Theory<sup>[29,30]</sup>, within the broader structure of Social Cognitive Theory<sup>[31]</sup>, highlighting the learner’s capacity for goal-setting, self-monitoring, and behavioral adaptation in managing digital engagement. Together, these perspectives yield a dual-theoretical model in which CPU

operates through two distinct yet interacting pathways: (a) a *cognitive-cost pathway*, where multitasking depletes attentional resources and undermines working memory, and (b) a *self-regulatory pathway*, where intentional, strategic phone use strengthens motivation, autonomy, and learning control. This integrated approach moves beyond the polarized “use vs. misuse” debate, situating CPU as a cognitive-mediational process shaped by both constraint and agency—one that reflects the evolving realities of digital learning in higher education<sup>[4,15,17,21]</sup>.

#### 3.1. Switch-Load Theory

Switch Load Theory frames task-switching as an inherently costly process, with losses arising from two sequential stages: goal-shifting and rule-activation<sup>[31]</sup>. While each switch appears trivial, cumulative switching across study sessions magnifies inefficiency, dilates response times, and erodes attention span. Even predictable task-switches—such as toggling between a lecture and a notification—produce delays and reduced accuracy. These effects intensify for complex or unfamiliar tasks, which dominate academic contexts. In practical terms, college students who check their phones repeatedly during lectures or study sessions accumulate significant switching costs. Such micro-distractions fragment concentration, impair encoding into long-term memory, and ultimately reduce academic outcomes. These findings align with broader insights from Information Processing Theory, which emphasizes the limits of working memory and the bottleneck of selective attention<sup>[26,27]</sup>.

#### 3.2. Self-Regulated Learning (SRL) Theory

SRL Theory shifts the focus from deficits to competencies. It has been conceptualized SRL as the learner’s ability to plan, monitor, and evaluate their own learning processes, mediated by metacognitive, motivational, and behavioral strategies<sup>[29,30]</sup>. While often portrayed as distractions, cell phones can also serve as instruments of SRL. Digital reminders and calendars support planning, productivity apps aid monitoring, and online communities foster motivation through autonomy and feedback. SRL Theory emphasizes learners’ proactive engagement in planning, monitoring, and regulating their own cognitive, motivational, and behavioral processes. Such strategies are closely tied to academic success and contribute to enhanced learner autonomy. In this sense, CPU may strengthen students’ agency by embed-

ding SRL strategies into everyday academic routines. Thus, while the switch-load perspective highlights CPU’s cognitive liabilities, the SRL perspective underscores its potential as a scaffold for academic self-management<sup>[29,30]</sup>.

### 3.3. CPU within Major Learning Traditions: A Dual-Theoretical Model

#### 3.3.1. Information Processing Perspective: A Cognitive-Scientific Lens

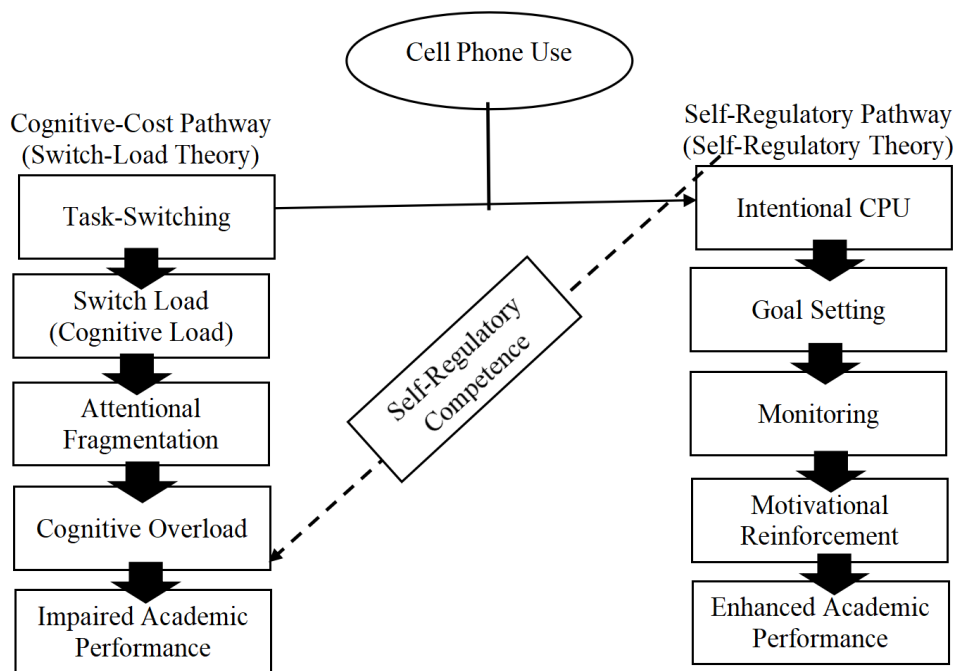
The proposed framework situates CPU within two foundational traditions of learning theory that illuminate distinct but complementary mechanisms of influence: Information Processing Theory and Social Cognitive Theory. The first tradition, rooted in the cognitive sciences, conceptualizes the human mind as a system constrained by the limited capacity of attention and working memory<sup>[26]</sup>. Within this view, Switch Load Theory explains how multitasking disrupts learning by imposing costs associated with goal-shifting and rule reactivation. These costs divert cognitive resources away from comprehension and consolidation, leading to attentional fragmentation and reduced efficiency. Over time, repeated task-switching results in cumulative cognitive interference, offering a principled explanation for why frequent phone-mediated multitasking undermines the depth and durability of learning. CPU multitasking thus represents a form of cognitive overload arising

from the misalignment between divided attentional demands and finite processing capacity.

#### 3.3.2. Social Cognitive Perspective: A Behavioral and Motivational View

In contrast, Social Cognitive Theory offers a behavioral and motivational lens through which CPU can be reinterpreted as a tool for agency and self-regulation. This framework emphasizes the reciprocal interaction among environment, personal agency, and behavior, positioning learners as active agents capable of monitoring and adapting their actions<sup>[12]</sup>. Within this tradition, SRL Theory specifies the micro-level processes—planning, monitoring, and evaluating—through which students can transform phone use into a resource for academic control. CPU can scaffold goal setting, time management, and motivational regulation through digital reminders, productivity applications, and feedback mechanisms<sup>[2,32]</sup>. By integrating cognitive and social-cognitive perspectives, the dual-theoretical model conceptualizes CPU as a dual-pathway mechanism: one pathway associated with cognitive fragmentation through excessive multitasking, and another linked to academic growth through strategic self-regulation. This synthesis highlights that the educational impact of CPU is contingent not on the device itself, but on the intentionality and regulatory quality of its use.

The dual-theoretical framework is visually summarized in **Figure 1** below.



**Figure 1.** Dual-Theoretical Model of Cell Phone Use and Academic Performance.

### 3.3.3. Dual-Theoretical Framework and Its Structural Elements

The visual model (Figure 1) synthesizes the dual-pathway framework by depicting both the cognitive-cost and self-regulatory mechanisms through which CPU affects academic performance. The cognitive-cost pathway, grounded in Switch Load Theory, represents a sequential process in which CPU multitasking increases task-switching, leading to heightened switch load, attentional fragmentation, and cognitive overload, ultimately impairing academic performance. This pathway captures the cumulative nature of cognitive interference.

In parallel, the self-regulatory pathway, rooted in SRL Theory, illustrates how intentional CPU use can promote academic benefit. This pathway begins with goal-directed phone use and proceeds through goal-setting, monitoring, and motivational reinforcement, culminating in improved academic engagement and performance. The model also represents an interaction between the two pathways, with self-regulatory competence moderating the relationship between multitasking and cognitive overload. This interaction reflects evidence that learners with stronger self-regulatory capacities experience reduced negative consequences of CPU-induced multitasking and are better able to sustain task focus. The figure thus clarifies that the two pathways are interdependent rather than independent, with the self-regulatory pathway exerting a compensatory influence on cognitive costs.

### 3.3.4. Boundary Conditions and Testable Propositions of the Dual-Pathway Model

While the dual-theoretical framework conceptualizes CPU as operating through both cognitive-cost and self-regulatory pathways, these mechanisms are not expected to exert uniform effects across all learners and contexts. Rather, the relative dominance of each pathway is contingent upon a set of moderating conditions that shape how cognitive load and regulatory agency interact in practice. Clarifying these boundary conditions is essential for translating the model into empirically testable and context-sensitive predictions.

Task complexity represents a primary moderator of the cognitive-cost pathway. According to Information Processing Theory, tasks that impose high intrinsic cognitive load—such as analytical problem solving, technical reasoning, or conceptual integration—place greater demands on working memory<sup>[26]</sup>. In such contexts, even minimal task-switching is likely to gen-

erate disproportionate switching costs, amplifying attentional fragmentation and impairing performance. Conversely, for low-complexity or routinized tasks (e.g., information retrieval, administrative activities), the cognitive-cost pathway may be attenuated, allowing limited multitasking without substantial performance decrements.

**Proposition 1.** *The negative association between CPU multitasking and academic performance will be stronger for high-complexity tasks than for low-complexity tasks.*

Prior SRL skill level constitutes a key moderator of the self-regulatory pathway. Learners differ substantially in their capacity for planning, monitoring, and behavioral control<sup>[9]</sup>. Students with well-developed SRL skills are more likely to use phones strategically—for scheduling, progress tracking, or academic coordination—thereby activating the adaptive pathway of the model. In contrast, students with weaker SRL competencies are less likely to regulate distractions effectively, making them more vulnerable to the cognitive-cost pathway.

**Proposition 2.** *The positive association between intentional CPU use and academic performance will be stronger among students with high SRL competence than among students with low SRL competence.*

Academic discipline further conditions the operation of both pathways. Disciplines characterized by sustained cognitive load and precision (e.g., engineering, medicine, mathematics) are likely to be more sensitive to multitasking-induced cognitive interference, whereas fields emphasizing discussion, collaboration, or project-based learning (e.g., education, humanities, social sciences) may provide more opportunities for productive, SRL-aligned phone use<sup>[31]</sup>.

**Proposition 3.** *The cognitive-cost pathway will exert a stronger negative effect in high-cognitive-load disciplines than in disciplines emphasizing collaborative or inquiry-based learning.*

Learning context represents an environmental boundary condition that shapes both attentional demands and regulatory affordances. In structured contexts such as lectures or examinations, CPU multitasking is more likely to conflict with task goals, whereas in flexible or self-paced environments (e.g., online or blended learning), phones may function as tools for navigation, coordination, and metacognitive support<sup>[32]</sup>. Thus,

the same usage behavior may activate different pathways depending on contextual constraints.

**Proposition 4.** *CPU multitasking will be more negatively associated with academic outcomes in highly structured learning contexts than in flexible or self-paced contexts.*

Collectively, these boundary conditions position the dual-

pathway model as a conditional theory, rather than a universal one (**Table 1**). CPU does not exert fixed effects on learning; instead, its impact emerges from interactions between task demands, learner competencies, disciplinary norms, and environmental structure. These moderators convert the model from a descriptive framework into a falsifiable and predictive theory, capable of guiding future experimental, longitudinal, and cross-contextual research.

**Table 1.** Overview of the Dual-Theoretical Model of CPU and Academic Performance.

Category	Construct	Example Measures	Predicted Effect
Independent Variable	CPU Multitasking	Task-switch frequency; phone checks per session	Academic performance (↓)
Independent Variable	CPU Self-Regulation	Academic app use; planning/monitoring scales	Academic performance (↑)
Mediator (Cognitive)	Task Switching	Switch counts; digital trace data	Cognitive load (↑)
Mediator (Cognitive)	Cognitive Load	Cognitive load scales; dual-task performance	Learning efficiency (↓)
Mediator (Cognitive)	Attentional Fragmentation	Attention control scales; reaction time	Performance (↓)
Mediator (SRL)	Goal Setting	Digital planner use; SRL subscales	Engagement (↑)
Mediator (SRL)	Monitoring	Self-monitoring scales; productivity apps	Performance (↑)
Mediator (SRL)	Motivational Reinforcement	Self-efficacy scales; peer feedback	Persistence (↑)
Dependent Variable	Academic Performance	GPA; test scores; course grades	Outcome
Moderator	Task Complexity	Task difficulty ratings	Strengthens multitasking cost
Moderator	SRL Competence	SRL inventories	Buffers cognitive cost
Moderator	Academic Discipline	Field of study	Alters pathway dominance
Moderator	Learning Context	Lecture vs. online	Shapes CPU impact

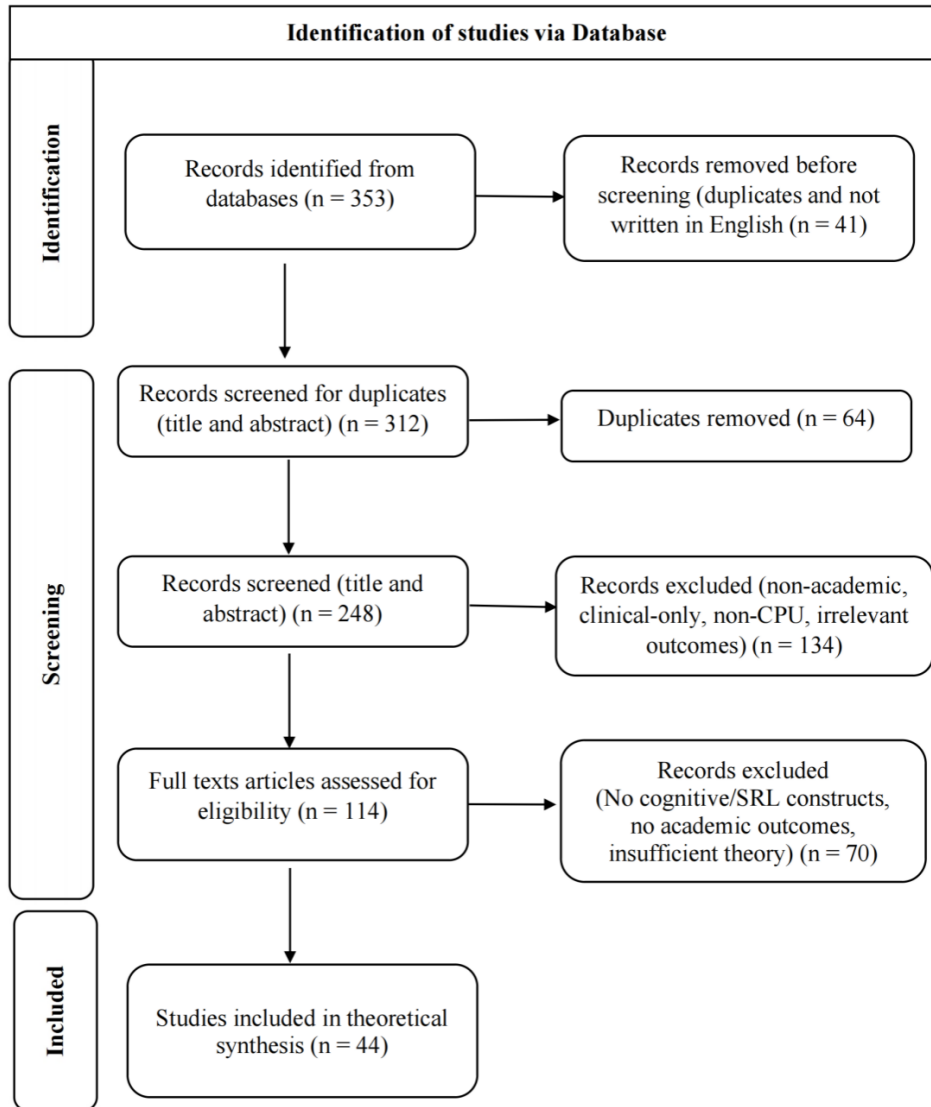
Note: CPU = Cell Phone Use; SRL = Self-Regulated Learning; GPA = Grade Point Average.

### 3.4. Linking to Empirical Evidence

#### 3.4.1. Literature Search Strategy

To ensure methodological transparency appropriate for a theory-building perspective, the study employed a purposive narrative review focused on synthesizing literature relevant to the dual-theoretical framework (**Figure 2**). This approach prioritizes conceptual integration over exhaustive coverage and aligns with established standards for theory-driven reviews<sup>[33]</sup>. Searches were conducted across Scopus, Web of Science, PsycINFO, ERIC, and Google Scholar for studies published between January 2000 and January 2025. Search terms targeted both pathways of the model, combining CPU-related keywords with constructs associated with cognitive load and self-regulation. Inclusion criteria emphasized peer-reviewed empirical studies examining CPU in academic contexts and reporting relevant cognitive or SRL-related outcomes. This purposive strategy ensured that the synthesis remained aligned with the mechanisms specified by Switch Load Theory and SRL Theory, allowing for theoretically coherent integration while maintaining empirical grounding.

Search terms were structured around the two pathways specified in the dual-theoretical model—cognitive costs of multitasking and self-regulatory benefits of intentional phone use. Keywords included variants of “cell phone use,” “smartphone use,” “mobile phone,” “digital multitasking,” and “media multitasking,” combined with cognitive constructs such as “cognitive load,” “task switching,” “switch load,” “working memory,” “attentional control,” and “cognitive interference.” Additional terms targeted self-regulatory and motivational constructs, including “self-regulated learning,” “SRL,” “metacognition,” “self-monitoring,” “behavioral regulation,” and “motivation,” along with outcome-related terms such as “academic performance,” “learning outcomes,” and “student achievement.” Boolean expressions such as “cell phone use AND academic performance,” “smartphone AND task switching AND cognitive load,” and “mobile phone AND self-regulated learning” were used to refine the search and identify studies relevant to the theoretical constructs under consideration (Please refer to **Appendix A** for a detailed list of core keywords and database-specific search strings used in the literature identification process).



**Figure 2.** PRISMA-style flow diagram illustrating the identification, screening, eligibility, and inclusion of studies in the narrative review.

Studies were included if they were peer-reviewed empirical works employing quantitative or mixed-methods designs, explicitly examined cell phone or smartphone use in educational or learning settings, measured cognitive, attentional, or self-regulatory processes relevant to Switch Load Theory or SRL Theory, and reported associations with academic performance or learning outcomes. Foundational theoretical works were incorporated selectively to support conceptual integration. Studies were excluded if they focused on non-academic or solely clinical/pathological contexts, examined general screen time without CPU-specific measures, lacked relevant cognitive or self-regulatory (SRL) constructs, were purely descriptive without theoretical linkage, were non-peer-reviewed, or pro-

vided insufficient methodological detail to support integration into the dual-pathway model.

This purposive narrative strategy was employed to ensure that the synthesis remained conceptually aligned with the cognitive-cost and self-regulatory pathways that anchor the dual theoretical framework. Rather than attempting to survey the full universe of CPU-related studies, the review deliberately concentrated on research capable of illuminating the mechanisms predicted by Switch Load Theory and SRL Theory. This approach allowed for theoretically coherent integration while maintaining empirical grounding in the most relevant and methodologically robust literature informing the proposed model.

### 3.4.2. Empirical Connection

The convergence of cognitive and self-regulatory perspectives indicates that CPU cannot be meaningfully evaluated through a unidimensional lens. Empirical findings consistently reveal a dual pattern: multitasking degrades attention and working memory, whereas intentional phone use can enhance learning management and motivation. This duality underpins the proposed framework, which interprets divergent findings as reflecting variation in regulatory quality rather than inconsistency.

Research has documented negative associations between CPU multitasking and academic performance, including lower GPA and reduced concentration<sup>[2,14,32,34,35]</sup>. These outcomes align with predictions from Switch Load Theory and the information-processing paradigm, which emphasize the cognitive costs of task-switching<sup>[31]</sup>. Experimental studies further suggest that restricting phone access improves learning outcomes, supporting the role of cognitive interference rather than overall usage<sup>[32,33]</sup>.

At the same time, other studies highlight the potential of phones to scaffold academic organization and motivation. Students who use mobile devices for time management and academic coordination tend to report better performance and engagement<sup>[36–38]</sup>. Meta-analytic evidence suggests that moderate, purpose-driven engagement may exert neutral or positive effects on learning<sup>[23,39]</sup>. Importantly, research indicates that self-regulatory strategies can mitigate the negative consequences of multitasking<sup>[13,40,41]</sup>. Taken together, the empirical record supports the dual-pathway logic: CPU can either amplify cognitive load or strengthen metacognitive control depending on the learner's regulatory competence and usage patterns.

### 3.4.3. Measurement Limitations and Methodological Implications

While the empirical literature provides valuable support for the dual-pathway framework, it is important to acknowledge several methodological limitations that constrain the precision and generalizability of existing findings. A primary concern relates to the widespread reliance on self-report measures of CPU multitasking, which are susceptible to recall bias, social desirability effects, and inaccurate estimation of task-switching frequency. Students often underreport or normalize habitual phone checking, leading to systematic measurement error in key independent variables. Similarly, many studies operationalize

SRL using coarse Likert-type scales, which, while psychometrically adequate, may lack the granularity needed to capture dynamic regulatory processes unfolding in real time.

Another limitation is the scarcity of objective behavioral indicators. Much of the current evidence is based on cross-sectional survey data, with limited use of digital trace logs, application usage records, or direct performance-based assessments. As a result, inferences about cognitive load, attentional fragmentation, and regulatory behavior often remain indirect, inferred from subjective perceptions rather than observed behavior. This constrains the ability to disentangle actual multitasking behavior from perceived distraction and to establish robust causal mechanisms.

To strengthen empirical tests of the dual-theoretical model, future research should adopt multimodal measurement strategies as a minimum standard. These may include (a) passive smartphone usage logs to capture real-time task-switching patterns, (b) attention-tracking or reaction-time tasks to index cognitive control and fragmentation, and (c) performance-based learning tasks to assess objective academic outcomes. Combining self-report, behavioral, and performance-based indicators would allow for more precise modeling of the cognitive-cost and self-regulatory pathways, reduce mono-method bias, and enhance the ecological validity of findings. Such methodological integration is essential for advancing the framework from conceptual synthesis toward a rigorously testable explanatory model.

### 3.5. Novelty and Theoretical Distinction of the Dual-Theoretical Model

The primary innovation of the present study lies not in the introduction of new empirical methods, but in the theoretical architecture through which existing constructs are integrated. Unlike prior research that typically examines CPU through single-pathway or deficit-oriented lenses, this study reconceptualizes CPU as a dual-pathway mechanism operating simultaneously through cognitive-cost and self-regulatory processes. By embedding Switch Load Theory within a broader self-regulatory framework, the model shifts the research perspective from descriptive associations toward a mechanism-based, interactional explanation of digital learning behavior. This integrative perspective enables the reconciliation of contradictory empirical findings and generates testable propositions that extend beyond conventional unidimensional analyses.

While prior models have linked cognitive and motivational processes<sup>[9,12]</sup>, they typically treat these systems as additive. The present model advances this tradition by proposing a reciprocal relationship between cognitive load and self-regulation in digital multitasking contexts. By embedding Switch Load Theory<sup>[7]</sup> within Social Cognitive Theory and SRL Theory<sup>[8,9,12]</sup>, CPU is conceptualized as a dual-pathway construct characterized by both constraint and adaptation. The model extends existing theory by reframing cognitive depletion as a potential trigger for regulatory compensation, situating CPU within a feedback loop between attention and agency, and offering a testable structure linking multitasking costs with SRL gains through mediators such as attentional control and motivational persistence<sup>[33,41]</sup>.

## 4. Contributions to the Field and Implications

### 4.1. Adding Value to Existing Research

The proposed dual-theoretical framework contributes to scholarship on digital learning, cognitive psychology, and educational technology by advancing conceptual, methodological, and applied understanding of CPU in academic contexts. It enriches the literature in four major ways.

#### 4.1.1. Mechanistic Clarity

Moving beyond descriptive associations, this framework elucidates *how* and *why* CPU influences academic performance. By situating CPU multitasking within Switch Load Theory and CPU self-regulation within SRL Theory, it identifies distinct cognitive and motivational pathways that explain both detrimental and beneficial outcomes. This mechanistic integration replaces generalized “screen-time” metrics with process-level explanations grounded in cognitive and behavioral theory.

#### 4.1.2. Resolution of Contradictions

The model reconciles long-standing inconsistencies in empirical findings, which alternately portray phone use as harmful, neutral, or beneficial. By differentiating between *multitasking costs* (reflecting cognitive interference) and *self-regulation benefits* (reflecting adaptive control), the framework unifies disparate results under a coherent theoretical lens. It transforms the “paradox of phone use” into a predictable continuum governed by cognitive load and self-regulatory competence.

### 4.1.3. Broadening the Empirical Base

While the dual-theoretical framework builds upon prior conceptual work by the author, it is equally grounded in the wider interdisciplinary literature on SRL, cognitive load, and digital multitasking. Foundational research on SRL has established that self-monitoring, feedback, and goal-setting are essential mechanisms of adaptive learning<sup>[38,39]</sup>. Parallel evidence from cognitive psychology and media studies indicates that excessive task-switching impairs attention and working memory, while deliberate engagement supports cognitive resilience<sup>[31,41,42]</sup>. Moreover, recent investigations demonstrate that technology-mediated environments can both disrupt and enhance metacognitive regulation depending on the learner’s control strategies<sup>[43,44]</sup>. These diverse contributions collectively support the dual-pathway proposition that cognitive depletion and self-regulation operate as interdependent processes in technology-based learning contexts.

#### 4.1.4. Clinical Value

From a mental health perspective, the framework provides clarity in distinguishing maladaptive and adaptive phone-use behaviors. CPU multitasking is identified as a risk factor for cognitive overload, attention dysregulation, and anxiety—symptoms often observed in academic stress contexts. Conversely, CPU self-regulation is conceptualized as a trainable protective factor that fosters time management, resilience, and self-efficacy. This distinction enables clinicians and counselors to design targeted interventions that reduce digital strain while cultivating constructive engagement through psychoeducational and behavioral programs.

#### 4.1.5. Non-Clinical Value

For educators, policymakers, and technology designers, the framework offers an actionable blueprint for constructive integration of mobile technology into academic environments. It advocates evidence-based differentiation between disruptive and purposeful phone use. Educators can embed phones into reflective learning and peer-collaboration tasks, while designers can create adaptive tools that support cognitive focus and metacognitive awareness. Collectively, these contributions advance the discourse from *restriction* toward *regulation and redesign*—emphasizing productive coexistence between technology and learning.

## 4.2. Clinical Implications

Clinically, this dual-theoretical model underscores that excessive CPU multitasking contributes to cognitive overload, stress, and mental fatigue. Counseling interventions can therefore address such patterns not merely as behavioral habits but as manifestations of attentional fragmentation and executive strain. Psychoeducational modules can teach students to recognize switch-load costs, structure focused digital routines, and cultivate mindful engagement. At the same time, clinicians can leverage phones as tools for SRL by promoting the use of goal-setting, monitoring, and reflection apps. Integrating SRL techniques within digital wellness programs can help students transform devices into *self-regulatory scaffolds* that strengthen autonomy, persistence, and control. This balanced approach—reducing cognitive interference while promoting strategic engagement—bridges therapeutic and educational practice under a unified digital well-being paradigm.

### Clinical Applications: Counseling and Psychotherapeutic Interventions

The dual-theoretical framework has direct relevance for clinical practice, especially in counseling and psychotherapeutic settings where students commonly present with symptoms linked to digital overload, attentional instability, academic burnout, and self-regulatory deficits. The cognitive-cost pathway, grounded in Switch Load Theory, highlights how constant task-switching and notification-driven vigilance generate cognitive strain, mental fatigue, and reduced executive functioning. Clinicians can translate these mechanisms into psychoeducational modules that help clients recognize signs of cognitive overload, understand the neurocognitive costs of multitasking, and develop strategies such as stimulus control (e.g., notification silencing), structured focus intervals, and environmental cue management to reduce switch-load accumulation.

In parallel, the self-regulatory pathway offers an actionable foundation for therapeutic interventions aimed at strengthening agency, goal-setting, and motivational regulation. Drawing on SRL processes, clinicians can guide clients in developing digital routines that embed goal-setting, monitoring, and reflection practices. For example, counseling sessions may incorporate the use of digital planners, habit-tracking apps, or reflective journaling tools to scaffold students' ability to regulate attention, track progress, and sustain motivation. Cognitive-behavioral techniques can further help clients restructure mal-

adaptive beliefs around immediacy and availability that often drive compulsive phone checking.

Importantly, the model also suggests that SRL-based training may moderate or buffer the negative impact of multitasking-induced cognitive overload. Clinicians can therefore design integrated interventions that combine cognitive-load reduction with intentional self-regulatory skill building. For instance, a student struggling with distractibility and academic procrastination may benefit from a combined approach that teaches (a) switch-load awareness and reduction strategies, and (b) structured SRL-based routines for planning, self-monitoring, and feedback. Digital wellness programs delivered through counseling centers can also incorporate focus-mode tools, time-blocking strategies, and app-based goal reminders to help students transform their phones from sources of distraction into instruments of self-regulation.

In addition to technology-mediated interventions, offline self-regulatory practices can further strengthen therapeutic outcomes by directly enhancing attentional stability and cognitive resilience. Mindfulness and meditation practices improve sustained attention, emotional regulation, and metacognitive awareness, thereby reducing vulnerability to distraction and cognitive overload. Similarly, yoga and regular physical activity support executive functioning, stress reduction, and self-control, which are foundational to effective SRL. When combined with SRL-based phone routines, these embodied strategies provide a complementary pathway for restoring cognitive balance, suggesting that optimal clinical interventions should integrate both digital self-regulation tools and offline behavioral practices to cultivate durable attentional and motivational capacities.

Overall, this clinically oriented extension of the framework supports a unified therapeutic approach: reducing cognitive interference while simultaneously strengthening metacognitive and motivational competencies. In doing so, counseling interventions become aligned with the dual-theoretical model's central premise—that the psychological impact of CPU is contingent not on the device itself, but on the intentionality and regulation guiding its use.

### 4.3. Non-Clinical Implications: Institutional and Curricular Digital Well-Being Programs

In educational and organizational contexts, the framework offers a roadmap for designing institutional and curricular

digital well-being programs that align with the cognitive and motivational realities of learners. Rather than relying on blanket phone bans, institutions can adopt differentiated policies that recognize the context-dependent nature of CPU. Structured use—such as designated digital engagement intervals, focus modes, and structured phone breaks—can enhance learning autonomy while minimizing distraction. Educators can implement classroom models that integrate SRL-based phone activities (e.g., reflective journaling, task tracking, peer discussion) alongside focused, phone-free study periods.

At the technological level, developers can embed cognitive-friendly design features such as adaptive focus modes, progress visualizations, and customizable reminders that reinforce attentional control and self-monitoring. Applications designed explicitly to support SRL—such as time-blocking tools, goal-tracking dashboards, and feedback visualization systems—can be formally integrated into curricula as learning supports rather than treated as external productivity aids.

At a systemic level, policy-makers and curriculum designers can integrate the dual-theoretical model into digital literacy and student success frameworks, helping learners balance the risks and benefits of mobile technology. By embedding SRL principles within institutional digital well-being initiatives, educational systems can cultivate self-aware, digitally literate learners equipped for sustainable academic engagement, cognitive resilience, and long-term self-regulatory competence.

## 5. Future Research

Future investigations should continue to refine and empirically validate the proposed dual-theoretical framework by systematically examining the distinct and interacting pathways through which CPU influences academic outcomes. Experimental, longitudinal, and mixed-methods designs are particularly well-suited to isolating switch-load effects from self-regulatory mechanisms. By applying such approaches, researchers can better establish causal relationships and determine how variations in task-switching frequency, intentionality of phone use, and individual self-regulatory competence jointly shape learning trajectories.

Beyond traditional self-report and performance-based measures, future research would benefit from incorporating multimodal neurocognitive and behavioral analytics. Attention-tracking technologies, app-usage logs, digital trace data, and

ecological momentary assessments can provide fine-grained evidence about real-time distraction patterns and regulatory behaviors. Integrating these behavioral and neurocognitive indicators will allow scholars to map the dynamic interplay between cognitive overload and adaptive SRL processes with greater precision. Cross-disciplinary collaborations—linking cognitive psychology, educational technology, human-computer interaction, and learning sciences—are essential for translating theoretical constructs into practical design-based interventions such as cognitive training tools, SRL-supportive applications, and digital mindfulness systems.

Cross-cultural and disciplinary variation represents another critical direction for future scholarship. The assumptions of the dual-theoretical model—particularly regarding self-regulation, attentional demands, and normative patterns of device use—may not generalize uniformly across global educational systems or disciplinary domains. Students in collectivist cultures, for example, may engage in more socially coordinated or peer-mediated forms of digital communication, potentially altering the balance between distraction and regulatory benefit.

Likewise, disciplines with high intrinsic cognitive load (e.g., engineering, medicine) may experience more pronounced multitasking costs compared with fields emphasizing collaborative or inquiry-based learning. Institutional digital norms, device policies, and socio-economic factors also shape how students integrate CPU into academic routines. Future studies should therefore test the model across culturally diverse, socio-economically varied, and discipline-specific contexts to assess the stability, boundary conditions, and potential adaptations of the dual-pathway framework. Such work will clarify whether the cognitive-cost and self-regulatory pathways operate consistently across settings or whether culturally shaped SRL practices, values, and academic expectations influence CPU's academic impact.

Taken together, these directions invite a broader rethinking of how technology and learning interact—not as fixed relationships but as contextually embedded processes shaped by cognitive capacity, self-regulatory agency, and environmental affordances. As empirical refinements accumulate, the smartphone may increasingly be understood not merely as a distractive device but as a trainable partner in academic growth and digital well-being. By shifting attention from restriction to regulation, future research can help educational and clinical practitioners cultivate healthier digital habits that align with

the dual-theoretical model's core premise: that the academic impact of CPU depends less on the device and more on the intentionality and regulation behind its use.

## 6. Discussion

This study addressed three central aims: (1) to explain why empirical findings on CPU and academic performance remain inconsistent, (2) to identify the psychological mechanisms underlying these effects, and (3) to develop an integrative framework capable of guiding future research and intervention. The dual-theoretical model responds to these aims by conceptualizing CPU as a conditional, mechanism-driven phenomenon rather than a unidimensional behavioral variable.

With respect to the first aim, the framework provides a coherent explanation for the contradictory patterns reported in prior studies. Research emphasizing distraction and multitasking typically reports negative associations between CPU and academic outcomes<sup>[17,34]</sup>, whereas other studies document neutral or context-dependent effects<sup>[37,38]</sup>. The present synthesis demonstrates that these inconsistencies reflect fundamentally different psychological processes rather than empirical instability. The cognitive-cost pathway aligns with findings showing that task switching depletes attentional resources and disrupts working memory<sup>[32,33]</sup>, while the self-regulatory pathway aligns with evidence that structured and intentional phone use can support learning organization and motivation<sup>[28,36]</sup>. Thus, the model reframes inconsistency as a product of theoretical incompleteness rather than conflicting data.

Regarding the second aim, the framework advances existing research by specifying mediating mechanisms instead of relying on aggregate usage indicators. Much prior work operationalizes CPU through total screen time or frequency of use<sup>[3,17]</sup>, implicitly assuming linear effects. However, media multitasking research consistently shows that cognitive costs arise from switching itself rather than from device presence<sup>[7,33]</sup>. In parallel, SRL research demonstrates that learning outcomes depend more on regulatory quality than on technological medium<sup>[9,32]</sup>. By integrating these perspectives, the model shifts explanatory focus from surface-level behavioral metrics to psychologically grounded mechanisms.

The third aim—developing an integrative framework—addresses a major gap in the literature: the absence of interactional models. Most prior studies treat cognitive load and moti-

vational regulation as independent or additive predictors<sup>[29,31]</sup>. The dual-theoretical framework departs from this logic by modeling CPU as a system in which cognitive strain and regulatory agency dynamically interact. This synthesis aligns with meta-analytic findings that CPU effects are moderated by purpose and context<sup>[13,33]</sup>, but extends these findings by offering a formal theoretical explanation for such moderation.

Critically, the framework also departs from deficit-oriented perspectives that dominate much of the field. Addiction-based and distraction-focused models implicitly assume that increased CPU is inherently harmful<sup>[17]</sup>. The present analysis challenges this assumption by demonstrating that high levels of CPU can coexist with positive outcomes when embedded within strong self-regulatory routines<sup>[2,36]</sup>. This misalignment suggests that earlier models may have conflated behavioral frequency with psychological dysfunction, thereby underestimating the role of learner agency.

At a structural level, the framework responds to gaps identified in recent reviews. Uncapher et al.<sup>[33]</sup> and Amez and Baert<sup>[13]</sup> both highlight the lack of coherent theoretical integration and the overreliance on self-report measures. The present model addresses these concerns by offering a mechanism-based architecture and by explicitly foregrounding measurement limitations. The emphasis on multimodal indicators aligns with these critiques and positions the framework as methodologically forward-looking.

Finally, the model generates new interpretive insights regarding boundary conditions. Prior studies rarely theorize why CPU effects vary across disciplines, tasks, or learning environments<sup>[37]</sup>. By foregrounding task complexity, SRL competence, and learning context, the framework reframes CPU as an interaction between environmental demands and individual capacities. This interpretation aligns with findings that heavy multitaskers show poorer cognitive control<sup>[33]</sup>, but extends them by suggesting that such deficits are not fixed and may be mitigated through regulatory training<sup>[15,41]</sup>.

Overall, the discussion demonstrates that the dual-theoretical framework does not merely reorganize existing findings but provides a higher-order synthesis that explains why previous results appeared fragmented. By uniting cognitive and motivational perspectives, the model transforms CPU research from a debate about technology effects into a theory of regulated digital cognition.

## 7. Conclusions

This study developed a dual-theoretical framework to reconceptualize CPU in academic contexts as a dynamic interaction between cognitive constraints and self-regulatory agency. Rather than treating CPU as a unidimensional behavioral variable, the framework positions it as a conditional psychological process whose academic effects depend on how attentional resources and regulatory mechanisms are engaged.

The primary theoretical contribution lies in shifting the field from descriptive associations toward mechanism-based explanation. Much existing research has focused on surface-level indicators such as frequency of use or screen time, often leading to polarized interpretations of CPU as either harmful or beneficial. The present framework moves beyond this binary by specifying two interacting pathways: a cognitive-cost pathway grounded in task-switching and attentional fragmentation, and a self-regulatory pathway grounded in goal setting, monitoring, and motivational control. This dual structure provides a principled explanation for why similar levels of CPU can produce divergent academic outcomes across learners and contexts.

A second major contribution is conceptual integration. By embedding Switch Load Theory within Information Processing Theory and situating SRL within Social Cognitive Theory, the study unites two major learning traditions that have largely developed in parallel. This synthesis does not introduce new constructs, but reorganizes established ones into a coherent explanatory architecture. In doing so, it bridges the long-standing divide between cognitive and motivational accounts of digital learning and offers a unified theoretical language for future scholarship.

At a practical level, the framework reframes how CPU should be interpreted in educational and clinical discourse. Instead of conceptualizing smartphones primarily as sources of distraction, the model highlights their role as potential instruments of agency when embedded within intentional regulatory routines. This perspective challenges technologically deterministic narratives and supports a shift from device-centered control toward learner-centered regulation. The core implication is that digital well-being is not achieved through restriction alone, but through the cultivation of attentional control, metacognitive awareness, and motivational resilience.

More broadly, the study contributes to a growing theoretical movement that treats technology not as an external

force acting upon learners, but as part of an extended cognitive system shaped by psychological capacities and environmental affordances. From this perspective, CPU becomes neither inherently detrimental nor inherently beneficial, but a mirror of how cognitive resources and self-regulatory skills are distributed in digitally saturated environments.

In conclusion, the central insight of this study is that the academic significance of CPU lies not in the device itself, but in the regulatory architecture governing its use. By reconceptualizing smartphones as both sources of cognitive strain and instruments of adaptive control, the dual-theoretical framework offers a psychologically grounded understanding of digital learning behavior. It positions CPU not as a problem to be eliminated, but as a phenomenon to be regulated—and in doing so, establishes a conceptual foundation for a more balanced and agency-centered theory of technology in education.

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## Conflicts of Interest

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## AI Use Statement

During the preparation of this work, the author used OpenAI in order to check grammar and style. After using this tool/service, the author reviewed and edited the content as needed and takes full responsibility for the content of the publication.

## Appendix A

**Table A1.** Core Keywords Used across Databases.

Concept Domain	Keywords
Device	cell phone, smartphone, mobile phone, digital device
Multitasking	multitasking, media multitasking, task switching, digital multitasking
Cognitive	cognitive load, switch load, working memory, attention, attentional control
Self-Regulation	self-regulated learning, SRL, metacognition, self-monitoring
Outcomes	academic performance, learning outcomes, student achievement

**Table A2.** Database-Specific Search Strings and Boolean Variants Used in the Narrative Review.

Database	Search Strings
Scopus/Web of Science	("cell phone" OR smartphone OR "mobile phone") AND (multitasking OR "task switching" OR "media multitasking") AND ("academic performance" OR "learning outcomes")
PsycINFO	("smartphone use" OR "cell phone use") AND ("cognitive load" OR "working memory" OR attention) AND ("self-regulated learning" OR SRL)
ERIC	("mobile learning" OR "cell phone use") AND ("academic achievement") AND ("self-regulation" OR metacognition)
Google Scholar	"cell phone use" AND "academic performance"; "media multitasking" AND "learning"; "smartphone" AND "self-regulated learning"
Boolean Variants (all databases)	"cell phone use" AND academic; smartphone AND multitasking; mobile phone AND cognitive load; smartphone AND SRL; media multitasking AND memory

Note: Search strings were adapted slightly across databases to account for platform-specific syntax and indexing conventions. Quotation marks indicate exact phrase matching; Boolean operators were used to combine conceptual domains.

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