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Beyond Screen Time: Content Type and Interaction Mode as Overlooked Determinants of Mobile Phone Addiction Among Children and Adolescents

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Abstract. The rapid integration of mobile phones into educational contexts has transformed how student access, process, and engage with learning materials. However, existing research has produced inconsistent findings, largely due to an overreliance on screen-time measures as the primary indicator of digital engagement. This study addresses this limitation by adopting a narrative systematic review of Scopus-indexed literature (2015–2025) to examine the educational impact of mobile phone use through the lenses of content type and interaction mode. The synthesis of eight selected studies reveals that educational outcomes are primarily shaped by the qualitative nature of digital engagement rather than usage duration. Specifically, educational and interactive content is associated with improved cognitive engagement, attention, and academic performance, whereas entertainment-oriented and passive content is linked to cognitive overload, reduced attention, and lower achievement. Furthermore, the findings highlight that interaction mode plays a critical role, with active engagement supporting deeper learning and fragmented or multitasking behaviors undermining it. The review also identifies contextual mediators, including sleep, mental health, and physical activity, which influence learning outcomes indirectly. Overall, the study proposes a multidimensional framework in which educational outcomes are shaped by the interaction between content type, engagement quality, and contextual factors. This research contributes to a more nuanced understanding of digital learning and provides implications for educators, policymakers, and future research.

Keywords: Mobile phone use; screen content type; interaction mode; digital learning; academic performance; cognitive engagement

INTRODUCTION

The rapid proliferation of smartphones has fundamentally transformed contemporary learning environments, positioning mobile devices as central tools in students' academic, social, and everyday lives. As highlighted in your manuscript, mobile phones are no longer peripheral technologies but integral components of learning ecosystems, enabling access to information, communication, and digital learning activities. However, they also provide continuous exposure to entertainment-oriented content, such as social media, gaming, and short-form videos, which may compete with instructional goals and influence students' academic engagement. Recent studies emphasize that the relationship between digital technology use and learning outcomes remains complex and inconsistent, particularly when measured solely through screen time [1], [2].

In response, educational technology research has increasingly shifted toward examining the qualitative dimensions of digital engagement, particularly the nature of content and modes of interaction. Evidence suggests that learning outcomes are more strongly influenced by how students engage with digital content rather than the duration of use [3], [4]. Active engagement, such as problem-solving, collaboration, and content creation, has been consistently associated with deeper learning and knowledge retention, whereas passive consumption may lead to shallow processing and reduced academic performance [5], [4]. Despite this growing recognition, existing studies often fail to systematically distinguish between different content types and interaction modes, resulting in limited explanatory power and inconsistent findings.

Building on this gap, the present study advances the argument that content type and interaction mode are critical but underexplored determinants of educational outcomes in mobile phone use. By moving beyond aggregated screen-time measures, this study adopts a more nuanced perspective grounded in learning sciences and digital pedagogy. Through a narrative systematic review of Scopus-indexed literature, this research aims to provide a comprehensive understanding of how different patterns of digital engagement

influence learning processes and outcomes while also identifying key gaps to inform future research and educational practice. To guide this study, the following research questions are proposed:

How do different types of screen content (e.g., educational, informational, and entertainment) influence students' learning outcomes?

How do interaction modes (active vs. passive engagement) shape students' cognitive engagement and academic performance?

What patterns and relationships emerge between content type, interaction mode, and educational impact across existing studies?

By addressing these research questions, this study seeks to advance current understanding of mobile phone use in education by shifting the analytical focus from quantitative measures of screen time to qualitative dimensions of digital engagement. Specifically, it emphasizes the importance of distinguishing between what students access (content type) and how they engage (interaction mode) in shaping learning outcomes. Through a narrative systematic review of Scopus-indexed literature, this study aims to develop a more nuanced and theoretically grounded perspective on digital learning, highlighting the conditions under which mobile phone use can either support or hinder educational processes. Ultimately, the findings are expected to contribute to the development of more effective pedagogical strategies, inform evidence-based educational policies, and guide future research toward a deeper exploration of meaningful and context-sensitive uses of digital technology in learning environments.

METHODS

Study area

Guided by contemporary review methodology frameworks, this study adheres to the core principles of systematic reviewing, including transparent documentation of search procedures, explicit inclusion and exclusion criteria, and structured synthesis of findings through a standardized extraction framework. The extraction grid was designed to capture key characteristics of each study, including theoretical orientation, research design, participant focus, methodological approach, and contributions to knowledge, in line with established evidence synthesis practices. The screening and reporting process was informed by the PRISMA guidelines, which are widely recognized as a benchmark for ensuring transparency, rigor, and replicability in review-based research.

To enable a comprehensive and analytically robust examination, this study adopts a narrative systematic review approach, integrating the flexibility of narrative synthesis with the methodological rigor of systematic procedures. This approach is particularly well-suited to investigating mobile phone use in education through the dimensions of content type and interaction mode, where existing research remains conceptually fragmented and methodologically diverse. By incorporating evidence from quantitative, qualitative, and mixed-method studies, the narrative synthesis allows for deeper interpretive analysis of complex educational phenomena, moving beyond reductive screen-time measures. This is essential in digital learning contexts, where variations in what learners consume and how they engage play a more decisive role in shaping educational outcomes than mere duration of use.

A comprehensive literature search was conducted exclusively using the Scopus database to ensure high-quality, peer-reviewed coverage across interdisciplinary domains, including education, technology, and applied social sciences. The search encompassed publications from 2015 to 2025, capturing a decade of rapid advancement in mobile learning and digital engagement. To enhance precision and coverage, the search strategy employed refined Boolean combinations, including "education" AND "screentime." This structured strategy ensured the retrieval of relevant studies aligned with the study's analytical focus on the qualitative dimensions of digital learning.

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A total of 200 records were initially identified through a structured search of the Scopus database, covering publications from 2015 to 2025 and employing keywords related to education and screen time. This time span was selected to capture the rapid expansion of mobile technologies and their integration into learning environments. During the initial screening phase, 53 studies were excluded due to their lack of relevance to child or adolescent populations, ensuring alignment with the study’s focus on school-aged learners. The remaining records (n = 147) were further screened based on their relevance to educational contexts, resulting in the exclusion of 97 studies that did not address learning-related variables. This filtering process reflects the growing recognition in the literature that educational outcomes cannot be meaningfully interpreted without situating digital technology use within pedagogical contexts [3], [6].

Following the screening process, 50 full-text articles were assessed for eligibility using predefined inclusion criteria. Of these, 42 studies were excluded because they did not sufficiently examine educational impact, such as academic performance, learning outcomes, or cognitive engagement. This step was critical to ensure that the final dataset focused on studies that provide empirically or theoretically grounded insights into the relationship between digital engagement and learning. Ultimately, 8 studies met all inclusion criteria and were included in the final synthesis. These selected studies form the analytical foundation for examining how variations in content type and interaction mode shape educational outcomes, supporting a more nuanced understanding beyond traditional screen-time measures and aligning with current directions in educational technology research that emphasize quality of engagement over quantity of use [3], [6].

Procedures

The study selection process was conducted through a structured multi-stage screening procedure to ensure the inclusion of relevant and high-quality studies. This process consisted of two primary stages: (1) title and abstract screening and (2) full-text review. The procedure was guided by predefined inclusion and exclusion criteria to ensure consistency, transparency, and methodological rigor throughout the review process.

During the initial screening stage, studies that did not meet the inclusion criteria were excluded based on their titles and abstracts. Particular attention was given to the relevance of the study population, ensuring a focus on children and adolescent learners, as well as alignment with educational contexts. In cases where abstracts provided insufficient information, full-text articles were examined to avoid the premature exclusion of potentially relevant studies. This approach minimized selection bias and ensured comprehensive coverage of the literature.

Following the preliminary screening, a full-text review was conducted on the remaining studies to confirm their eligibility. Each study was assessed based on its relevance to mobile phone use in education, with particular emphasis on content type, interaction mode, and educational impact. Studies that did not explicitly address learning outcomes, academic performance, or meaningful educational engagement were excluded at this stage. This process ensured that only studies with clear educational relevance and analytical value were retained.

The selected studies primarily included empirical research designs, such as quantitative, qualitative, and mixed-method approaches. Many of these studies investigated how different types of digital content (e.g., educational applications, videos, social media) and varying interaction modes (e.g., active engagement versus passive consumption) influence learning outcomes, student engagement, and cognitive processes. Studies with strong methodological designs and clear links to educational impact were prioritized to enhance the robustness of the review.

The overall study selection process is illustrated in Figure 1, which presents a flow diagram of literature identification, screening, eligibility assessment, and final inclusion. This structured process aligns with best

practices in systematic and narrative review methodologies and enhances the transparency and replicability of the study.

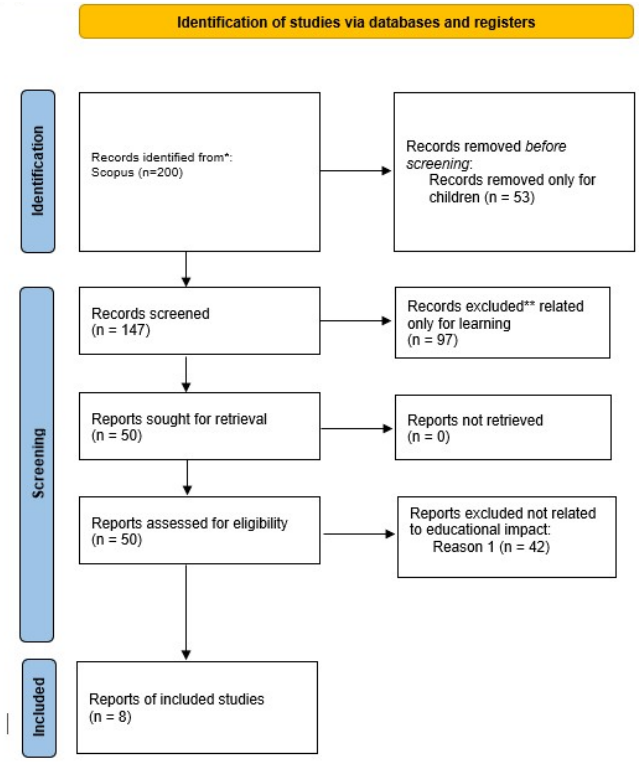

Figure 1. A flowchart of literature inclusion

Data analysis

A total of 200 records published between 2015 and 2025 were initially identified through a structured search of the Scopus database, focusing on studies related to education and screen time. These records represented a broad range of research on digital technology use in educational contexts, including both learning-oriented and non-learning-oriented applications.

Following the identification stage, all records underwent a systematic screening process based on titles and abstracts. During this phase, 53 studies were excluded due to their lack of relevance to child or adolescent populations. The remaining 147 studies were further evaluated for their relevance to educational contexts, resulting in the exclusion of 97 studies that did not address learning-related variables.

As a result, 50 full-text articles were assessed for eligibility. During this stage, 42 studies were excluded because they did not sufficiently examine educational impact, such as academic performance, learning outcomes, or student engagement. Ultimately, a total of 8 studies, as shown in table 1, met all inclusion criteria and were included in the final synthesis. These selected studies provide the foundation for analyzing how content type and interaction mode influence educational outcomes in mobile phone use.

Table 1. Beyond screen time literature

No	Author_Year	Education_Level	Age Group	Screen Content Type	Educational Impact	Key Findings	Notes
1	Adelantado-Renau et al., 2019	Adolescents	12-18	Mixed (screen media)	Academic performance	Higher screen time associated with lower academic performance	Meta-analysis
2	Wilhite et al., 2020	Children & Adolescents	6-18	Mixed lifestyle incl. screen	Educational outcomes	Balanced behavior linked to better academic outcomes	Lifestyle factors
3	Morita et al., 2016	Adolescents	12-18	General screen time	Academic achievement	Higher screen time negatively related to achievement	Fitness also relevant
4	Clemens et al., 2020	Children	6-12	Digital devices (mixed)	Cognitive development	Screen exposure influences cognitive abilities	Content matters
5	Howie et al., 2017	Children	6-12	General screen behavior	Academic performance	Excess screen time linked to poorer outcomes	Sleep moderates
6	Nagata et al., 2019a	Adolescents	12-18	Screen media (bedtime use)	Cognitive outcomes	Bedtime screen use negatively affects cognition	Sleep interaction
7	Nagata et al., 2019b	Adolescents	12-18	Screen media	Mental health & learning	Screen time linked to mental health issues impacting learning	Indirect effect
8	Marciano et al., 2021	Adolescents	12-18	Screen + lifestyle	Academic achievement	Balanced habits improve academic outcomes	Holistic factors

A standardized data extraction procedure was implemented to ensure consistency, accuracy, and transparency in collecting relevant information from the selected studies. This structured approach enabled the systematic organization of key variables and supported the synthesis of findings across diverse research designs and educational contexts. The data extraction framework was developed prior to the review process, guided by the research objectives and informed by established practices in systematic and narrative reviews [7], [8].

The framework was designed to capture both descriptive and analytical dimensions of the included studies, allowing for comprehensive comparison and interpretation. Specifically, the extraction process focused on identifying how different screen content types and interaction modes relate to educational impact, including academic performance, learning outcomes, and student engagement. To enhance reliability, the extraction

process was conducted systematically, and all extracted data were carefully reviewed and cross-checked to minimize inconsistencies and potential bias. The overall data extraction procedure is illustrated in Figure 2, which presents the key components and flow of the extraction process applied in this review. This structured approach aligns with best practices in evidence synthesis, ensuring methodological rigor and facilitating the identification of patterns and relationships across studies [9], [10].

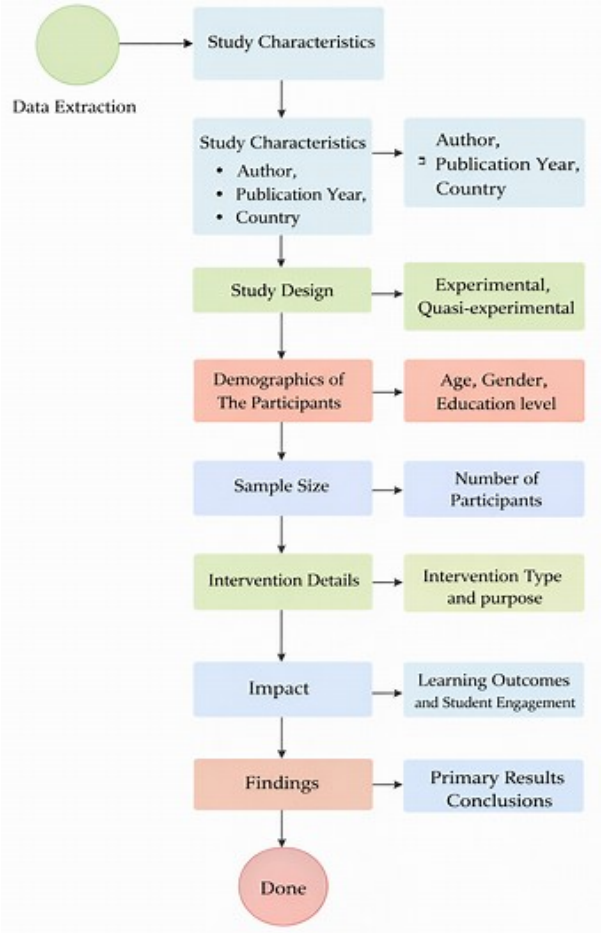

Figure 2. Flowchart of the data extraction process

The extracted data were systematically categorized into several key components, forming a structured dataset that supports rigorous analysis and synthesis. First, study characteristics were documented, including author(s), year of publication, and country of study, providing insights into temporal trends and geographical distribution. Second, study design was recorded, capturing methodological approaches such as experimental, quasi-experimental, survey-based, mixed-method, and case study designs, enabling assessment of research rigor and strength of evidence. Third, participant characteristics were extracted, including sample size, age group, and educational level (e.g., primary or secondary), allowing for meaningful comparison across different learner populations and contextual interpretation of findings.

In addition, the dataset focused on variables central to this study. Screen content type was categorized to distinguish between forms of digital content, such as educational applications, informational resources, social media, video-based content, and digital games, thereby differentiating learning-supportive and learning-competing usage. Interaction mode was classified into active engagement (e.g., collaboration, problem-solving, content creation) and passive consumption (e.g., watching or scrolling), highlighting differences in cognitive involvement. Furthermore, educational impact was documented through indicators such as academic performance, attention, motivation, and overall learning effectiveness. Finally, key findings from each study were synthesized, with particular emphasis on the relationships between content type, interaction mode, and educational outcomes, forming the basis for subsequent thematic analysis.

This comprehensive data extraction process enabled the identification of patterns, trends, and relationships across the selected studies, forming the foundation for the subsequent thematic synthesis. The structured dataset also supports the development of a more nuanced understanding of how mobile phone use influences learning, moving beyond traditional screen-time measures toward a focus on quality of engagement.

To enhance the rigor and credibility of the review, a systematic approach was implemented to minimize potential sources of bias throughout the research process. This approach incorporated clearly defined research questions, explicit inclusion and exclusion criteria, structured study selection procedures, and standardized data extraction methods, thereby ensuring methodological transparency and reducing the risk of selective reporting [11]. An extensive and comprehensive search strategy was conducted using the Scopus database to ensure broad coverage of high-quality, peer-reviewed studies. In addition, manual (hand) searching of reference lists was performed to identify relevant studies not captured through database searches, thereby enhancing the inclusiveness and representativeness of the review [12].

To further reduce selection bias, the screening and study selection processes were conducted by multiple independent reviewers. Any discrepancies in study inclusion, eligibility, or data extraction were resolved through discussion, and when necessary, a third reviewer was consulted to achieve consensus. This multi-reviewer approach improved objectivity, consistency, and inter-rater reliability [13]. Furthermore, transparency in reporting was ensured by systematically documenting each stage of the review process, including identification, screening, eligibility assessment, and final inclusion. These procedures collectively strengthened the methodological integrity of the study and supported a reliable synthesis of evidence on how screen content type and interaction mode influence educational outcomes.

RESULTS AND DISCUSSION

This section presents the findings of the narrative systematic review, synthesizing evidence from eight Scopus-indexed studies to examine how mobile phone use influences educational outcomes through the lenses of content type, interaction mode, and their interrelationships. Rather than treating digital engagement as a uniform or purely quantitative phenomenon, the analysis adopts a multidimensional perspective, recognizing that the educational impact of mobile technologies is shaped by qualitative differences in how students interact with digital environments. The findings are organized into three interrelated themes: (1) the influence of screen content types, (2) the role of interaction modes in shaping cognitive engagement and academic performance, and (3) the dynamic relationships between content, interaction, and broader contextual factors. Together, these themes provide a comprehensive understanding of how digital engagement operates within contemporary learning ecosystems and highlight the need to move beyond simplistic screen-time metrics toward a more integrated and theoretically grounded framework of digital learning.

The Influence of Screen Content Types on Students' Learning Outcomes

The synthesis of the eight Scopus-indexed studies reveals a consistent and theoretically significant conclusion: screen content type, not screen time itself, is the primary determinant of educational outcomes. Across the dataset, there is strong convergence toward the idea that digital media use cannot be treated as a homogeneous construct. Rather, the impact of mobile phone use on learning varies substantially depending on whether students engage with educational, informational, or entertainment-oriented content. This finding challenges the long-standing emphasis on screen duration as the dominant explanatory variable and instead highlights the importance of qualitative dimensions of digital engagement.

The meta-analysis conducted by Adelantado-Renau et al. [14] provides the most robust empirical support for this distinction. Drawing on a large body of international evidence, the study demonstrates that total screen time is not significantly associated with academic performance, thereby questioning the validity of time-based assumptions in educational research. However, when screen use is disaggregated by activity type, a markedly different pattern emerges. Specifically, television viewing and video gaming, both predominantly entertainment-oriented forms of content, are consistently associated with lower academic achievement, particularly in language and mathematics domains. These findings suggest that the negative effects of screen use are not universal but are concentrated in specific forms of engagement. The study attributes this relationship to the time displacement hypothesis, whereby engagement with entertainment content reduces the time available for cognitively beneficial activities such as reading, studying, and sleep.

Complementing this evidence, Clemente-Suárez et al. [15] provide a more nuanced cognitive perspective by examining how different types of digital content influence children's cognitive development. Their findings indicate that educational digital content, including learning applications, interactive simulations, and problem-solving platforms, can positively affect executive function, attention, and cognitive flexibility. These benefits are particularly evident when digital tools are used in structured and purposeful ways that promote active engagement. In contrast, entertainment-based content, especially when consumed passively or excessively, is associated with cognitive overload, reduced attention span, and diminished working memory capacity. This establishes a clear conceptual distinction between learning-supportive and learning-competing content, reinforcing the argument that content quality is central to understanding educational outcomes.

Despite these insights, several studies within the dataset [16], [17], [18] operationalize screen use as a generalized form of sedentary behavior, without differentiating between content types. This methodological limitation represents a significant constraint in the literature. By treating all screen activities as equivalent, these studies fail to capture the heterogeneity of digital engagement, leading to inconsistent or inconclusive findings. For example, when educational and entertainment uses are aggregated into a single variable, their opposing effects may cancel each other out, resulting in weak or non-significant relationships. Therefore, the absence of content-specific analysis not only limits explanatory power but also obscures the mechanisms through which digital media influences learning.

Further evidence from longitudinal studies by Nagata et al. [19], [20] extends this discussion by highlighting the role of social and entertainment-based content, particularly social media, texting, and streaming. These forms of content are characterized by high levels of emotional stimulation, continuous feedback loops, and prolonged engagement, which can contribute to problematic usage patterns. The findings show that such activities are associated with sleep disruption, increased psychological distress, and reduced well-being, all of which indirectly impair learning processes. Importantly, these effects are not limited to direct cognitive outcomes but operate through mediating pathways, including attention deficits, reduced motivation, and impaired self-regulation. This suggests that content type influences learning both directly (through cognitive processes) and indirectly (through behavioral and psychological mechanisms).

In addition, the systematic review by Carson et al. [21] and the study by Marciano and Camerini [17] emphasize that screen content must be understood within broader behavioral and ecological contexts. Entertainment-oriented screen use is often embedded within sedentary lifestyles, which are associated with lower levels of physical activity, poorer sleep patterns, and reduced academic performance. Conversely, balanced routines that include limited screen use, adequate physical activity, and sufficient sleep are consistently linked to more favorable educational outcomes. These findings highlight that the effects of screen content are not isolated but are influenced by interacting lifestyle factors, reinforcing the need for a holistic perspective.

Taken together, three overarching patterns emerge from the synthesis. First, educational content can support learning outcomes, particularly when it promotes active cognitive engagement and is aligned with instructional goals. Second, entertainment-oriented content is consistently associated with negative or mixed outcomes, primarily due to displacement effects, cognitive overload, and indirect impacts on well-being. Third, the lack of differentiation between content types remains a major limitation in existing research, contributing to inconsistent findings and limiting theoretical development.

In conclusion, the evidence strongly supports a paradigm shift from focusing on “how much screen time” to “what kind of content is consumed.” Content type should be understood not as a secondary or moderating variable but as a central explanatory mechanism in determining educational outcomes. Future research must adopt fine-grained content classification frameworks and integrate qualitative dimensions of digital engagement to better capture the complexity of mobile phone use in contemporary learning environments.

The Role of Interaction Modes in Shaping Cognitive Engagement and Academic Performance

Interaction mode emerges as a critical determinant of learning outcomes, particularly through its influence on cognitive engagement, attention regulation, and information processing. Across the synthesized studies, a consistent pattern is observed: the educational impact of digital media is not only shaped by what learners consume but also by how they engage with that content. This highlights the importance of moving beyond surface-level measures of technology use toward a more nuanced understanding of engagement quality and cognitive involvement.

Passive engagement, such as watching television, scrolling through social media, or consuming video-based content, is consistently associated with lower academic performance, reduced attention, and weaker cognitive outcomes [14], [15]. These forms of engagement require minimal cognitive effort and are often characterized by one-way information flow, where learners act as recipients rather than active participants. From a learning sciences perspective, such patterns align with the passivity hypothesis, which suggests that low levels of cognitive stimulation limit deep processing, reduce knowledge retention, and hinder the development of higher-order thinking skills. Moreover, passive engagement is often linked to prolonged exposure and habitual use, further amplifying its negative effects on attention span and academic focus.

In contrast, active engagement characterized by problem-solving, collaboration, interaction, and content creation is associated with enhanced cognitive processing and improved learning outcomes. As demonstrated by Clemente-Suárez et al. [15], interactive digital environments can support the development of executive functions, including working memory, cognitive flexibility, and goal-directed behavior. These findings are consistent with constructivist learning theory, which posits that knowledge is actively constructed through meaningful interaction with content and context. Active engagement encourages

learners to analyze, evaluate, and apply information, thereby promoting deeper understanding and long-term retention. Importantly, the benefits of active engagement are most evident when digital tools are used intentionally within structured learning environments, rather than for unregulated or recreational purposes.

However, the synthesis also reveals that the traditional binary distinction between active and passive engagement is overly simplistic. Several studies highlight the emergence of hybrid or semi-active interaction modes, which blur the boundaries between the two categories. For example, Nagata et al. [20] show that activities such as texting, social media interaction, and online communication, often considered interactive, can still produce negative cognitive and academic outcomes when they involve excessive use, emotional stimulation, or continuous multitasking. These forms of engagement, while interactive in nature, often lack depth, focus, and cognitive structure, resulting in fragmented attention and reduced learning efficiency.

A particularly important concept emerging from the dataset is media multitasking, as examined by Marciano and Camerini [17]. Media multitasking involves the simultaneous use of multiple digital platforms, such as switching between social media, messaging apps, and video content. This form of engagement is consistently associated with lower academic performance, primarily due to its impact on cognitive processes. From the perspective of cognitive load theory, multitasking increases extraneous cognitive load, thereby exceeding the capacity of working memory and impairing information processing. As a result, learners experience reduced comprehension, weaker memory consolidation, and diminished academic performance. This finding underscores that interactivity alone does not guarantee effective learning; the quality, focus, and coherence of interaction are equally important.

Further insights are provided by studies examining non-digital forms of active engagement, particularly physical activity. Research by Carson et al. [21] and Howie et al. [16] demonstrates that physically active students exhibit better cognitive functioning, attention, and academic achievement compared to their more sedentary peers. Physical activity enhances brain function, executive control, and emotional regulation, all of which contribute to improved learning outcomes. This evidence reinforces a broader principle: active engagement, whether digital or non-digital, supports cognitive development when it involves purposeful, sustained, and meaningful participation.

Taken together, the findings suggest that interaction mode should be conceptualized as a continuum of engagement quality, rather than a binary distinction between active and passive use. At one end of the continuum lies passive consumption, characterized by low cognitive involvement and limited educational value. At the other end lies deep, active engagement, involving high levels of cognitive processing, intentionality, and learning relevance. Between these extremes are various forms of semi-active and fragmented engagement, which may appear interactive but often lack the depth required for meaningful learning.

Three key insights emerge from this synthesis. First, passive engagement is consistently detrimental to learning, as it limits cognitive stimulation and promotes superficial processing. Second, active engagement supports cognitive development and academic performance, particularly when it is purposeful, structured, and aligned with learning objectives. Third, interaction mode is inherently multidimensional, with fragmented and multitasking behaviors producing negative effects despite their interactive nature.

In conclusion, the findings highlight the need to move beyond simplistic classifications of digital use and toward a more sophisticated understanding of engagement quality. Educational outcomes are not determined by whether learners use digital devices but by how they interact with digital content and the extent to which that interaction promotes meaningful cognitive engagement. Future research should therefore focus on developing robust measures of interaction mode, capturing dimensions such as attention, depth of processing, and task relevance. This shift is essential for advancing both theoretical and practical understanding of digital learning in contemporary educational environments.

Interrelationships Between Content Type, Interaction Mode, and Educational Impact

The synthesis of the eight Scopus-indexed studies demonstrates that content type and interaction mode are not independent variables but interdependent dimensions that jointly shape educational outcomes. Rather than exerting isolated effects, these factors operate in a dynamic, interactive, and context-dependent system, where their combined configurations determine the direction and magnitude of learning impact. This finding challenges reductionist approaches that examine digital engagement through single variables and instead supports a multidimensional framework of digital learning.

The most consistent pattern across the dataset is that passive engagement with entertainment-oriented content produces the most negative educational outcomes. This combination, characterized by activities such as television viewing, social media scrolling, and video consumption, is associated with lower academic performance, reduced attention, and increased cognitive overload [14], [17]. These effects can be

explained through multiple theoretical lenses. From a cognitive perspective, passive consumption limits deep processing and active meaning-making, resulting in superficial learning. From a behavioral perspective, such activities often involve prolonged and habitual use, which further exacerbates attentional decline and academic disengagement. Importantly, this combination represents the dominant pattern of digital engagement among adolescents, making it a critical area of concern for educators and policymakers.

In contrast, the synthesis reveals that active engagement with educational content produces the most positive educational outcomes. When learners interact with digital tools in ways that involve problem-solving, collaboration, and content creation, they are more likely to engage in higher-order cognitive processes, including analysis, evaluation, and application. Clemente-Suárez et al. [15] demonstrate that such forms of engagement support the development of executive functions, including working memory and cognitive flexibility, which are essential for academic success. These findings align with constructivist learning theory, which emphasizes that knowledge is constructed through active engagement with meaningful tasks and contexts. In this configuration, active educational digital technology functions as a cognitive tool that enhances learning rather than competing with it.

However, the relationship between content and interaction is not strictly binary. A third pattern emerges in which educational impact is mediated by indirect and contextual pathways, particularly through variables such as sleep, mental health, and physical activity. Longitudinal evidence from Nagata et al. [19], [20] indicates that engagement with certain types of content, especially socially and emotionally stimulating mediacan disrupt sleep patterns and increase psychological distress. These outcomes, in turn, negatively affect attention, motivation, and cognitive functioning, thereby impairing academic performance. Similarly, Carson et al. [21] highlight that excessive sedentary behavior, often associated with screen use, is linked to poorer educational outcomes when combined with insufficient physical activity and sleep. These findings suggest that the impact of digital engagement is often indirect and mediated, rather than immediate or linear.

Another key mechanism identified in the synthesis is behavioral displacement, whereby time spent on screen-based activities replaces time allocated to more beneficial behaviors. Adelantado-Renau et al. [14] provide strong evidence for this mechanism, showing that engagement with entertainment content reduces time available for studying, reading, sleeping, and physical activity. This displacement effect is particularly important in the context of limited daily time, reinforcing the need to conceptualize digital engagement within a 24-hour behavioral framework. In this framework, educational outcomes are influenced not only by what students do with technology but also by what they do less of as a result.

Importantly, the synthesis also reveals a significant limitation in the current literature: the lack of integrated models that simultaneously examine content type, interaction mode, and contextual factors. Most existing studies focus on one dimension in isolation, either screen time, content, or behavior, without accounting for their interdependence. This fragmented approach limits theoretical development and reduces the ability to explain complex and sometimes contradictory findings. As a result, there is a need for more comprehensive frameworks that capture the interactive and systemic nature of digital engagement.

Taken together, three overarching relationships emerge from the synthesis. First, content type and interaction mode jointly determine learning outcomes, with passive engagement in entertainment content producing the most negative effects, and active engagement in educational content producing the most positive effects. Second, educational impact is mediated by contextual and behavioral factors, including sleep, mental health, and lifestyle balance, highlighting the importance of indirect pathways. Third, current research lacks integrated and multidimensional models, which limits both explanatory power and practical applicability.

In conclusion, the findings suggest that understanding the educational impact of digital technology requires a shift toward a holistic and interaction-based framework, where content, interaction, and context are analyzed together rather than separately. Educational outcomes should be understood as the result of a complex interplay between what learners engage with, how they engage, and the broader conditions in which that engagement occurs. This perspective not only advances theoretical understanding but also provides a more robust foundation for designing effective educational interventions and policies in the digital age.

Discussion

The findings of this narrative systematic review provide robust evidence that the educational impact of mobile phone use is fundamentally qualitative rather than quantitative, shifting the analytical focus from screen-time duration to content type as a central explanatory mechanism. Across the synthesized studies, a clear distinction emerges between learning-supportive content (e.g., educational applications and informational resources) and learning-competing content (e.g., social media, gaming, and passive video

consumption). Consistent with meta-analytic evidence, overall screen time shows weak or inconsistent associations with academic performance, whereas content-specific engagement reveals strong and differentiated effects [14]. Educational content has been shown to enhance executive function, attention, and cognitive flexibility, particularly when aligned with instructional goals and active learning strategies [15]. In contrast, entertainment-oriented content is associated with cognitive overload, attentional fragmentation, and reduced academic achievement, largely explained by the time displacement hypothesis, where non-academic screen use replaces cognitively beneficial activities such as reading, studying, and sleep [17], [16]. Importantly, recent research emphasizes that these effects extend beyond direct cognitive outcomes, as excessive engagement with entertainment content is linked to sleep disruption and poorer mental health, which indirectly impair learning processes [19], [21]. These findings align with broader educational technology literature suggesting that learning outcomes are shaped more by the nature of digital engagement than by exposure duration [3], [4].

Beyond content, the findings highlight interaction mode as a critical mechanism shaping cognitive engagement and academic performance, providing deeper insight into how learners process digital information. Passive engagement characterized by one-way consumption such as watching videos or scrolling social media is consistently associated with lower cognitive activation, reduced attention span, and superficial information processing [14], [15]. These patterns align with the passivity hypothesis and multimedia learning theory, which argue that meaningful learning requires active cognitive processing rather than passive exposure [4]. Conversely, active engagement such as problem-solving, collaboration, and content creation supports higher-order thinking, knowledge construction, and long-term retention, consistent with constructivist learning principles [22]. However, the synthesis complicates the traditional active–passive dichotomy by identifying semi-active and fragmented interaction modes, particularly social media use and media multitasking, which often produce negative outcomes despite their interactive nature. Media multitasking, in particular, has been shown to increase extraneous cognitive load and reduce working memory efficiency, leading to diminished academic performance [17]. This aligns with cognitive load theory and emerging evidence that fragmented attention undermines deep learning [23]. Furthermore, studies on physical activity reinforce that meaningful engagement, whether digital or non-digital, supports cognitive functioning when it is sustained, purposeful, and cognitively demanding [21], [16]. Collectively, these findings suggest that interaction mode should be conceptualized as a continuum of engagement quality, rather than a binary distinction.

Taken together, the synthesis reveals that content type and interaction mode operate as interdependent and mutually reinforcing dimensions within a broader contextual ecosystem, jointly determining educational outcomes. The most detrimental pattern consistently observed is the combination of passive engagement with entertainment content, which leads to cognitive overload, attentional decline, and reduced academic performance. In contrast, the most beneficial configuration is active engagement with educational content, which promotes deep cognitive processing and meaningful learning. Importantly, these relationships are not linear but are mediated by contextual factors, including sleep, mental health, and physical activity, highlighting the importance of a 24-hour behavioral framework in understanding digital engagement [24], [21]. The concept of behavioral displacement further explains how screen use influences learning by replacing essential activities such as studying and sleeping [14]. Despite these insights, the literature remains fragmented, with limited integration of content, interaction, and contextual variables within a unified model [6], [25]. This study therefore advances the field by proposing a multidimensional framework of digital learning, where educational outcomes are a function of content type, interaction mode, and contextual conditions. Such a framework provides a more theoretically grounded and practically relevant understanding of mobile phone use in education, emphasizing that the impact of digital technologies depends not on their presence, but on how they are used, what they are used for, and under what conditions.

CONCLUSION

This study demonstrates that the educational impact of mobile phone use is fundamentally shaped by the type of content students engage with, rather than the duration of screen exposure alone. Evidence across the synthesized studies consistently shows that educational and informational content can support cognitive development, attention, and academic performance, particularly when aligned with instructional goals. In contrast, entertainment-oriented content, including social media, gaming, and passive video consumption, is more frequently associated with reduced academic achievement, cognitive overload, and attentional decline. These effects are explained not only by direct cognitive processes but also by behavioral displacement, where non-academic screen use replaces time for studying, reading, and other learning-supportive activities. Consequently, understanding digital learning requires a shift from measuring quantity of use to evaluating content quality and relevance.

In addition to content, the findings highlight that the mode of interaction plays a decisive role in shaping cognitive engagement and learning outcomes. Passive forms of engagement, characterized by minimal cognitive effort, are consistently linked to superficial processing and weaker academic performance. Conversely, active and purposeful engagement, such as problem-solving, collaboration, and content creation, fosters deeper learning and higher-order thinking. However, the analysis also reveals that interaction is not inherently beneficial; fragmented and multitasking behaviors, even when interactive, can undermine learning by increasing cognitive load and disrupting attention. This underscores that engagement quality, defined by focus, intentionality, and cognitive depth, is more critical than the presence of interactivity itself.

Furthermore, the findings reveal that educational outcomes are the result of a dynamic interplay between content type, interaction mode, and contextual factors, rather than isolated influences. The most detrimental pattern emerges when passive engagement is combined with entertainment content, leading to reduced attention, lower academic performance, and negative cognitive effects. In contrast, active engagement with educational content produces the most favorable outcomes, supporting meaningful learning and knowledge construction. Importantly, these relationships are often mediated by broader contextual factors, including sleep quality, mental health, and physical activity, highlighting that digital engagement must be understood within a holistic behavioral ecosystem. This integrated perspective advances current understanding by positioning digital learning as a multidimensional process shaped by interconnected cognitive, behavioral, and environmental factors.

Future research should build on these findings by developing integrated and multidimensional models that simultaneously examine content type, interaction mode, and contextual influences. There is a need for more fine-grained classification of digital content, as well as robust measures of engagement quality, including attention, cognitive load, and interaction depth. Longitudinal and experimental studies are particularly important to establish causal relationships and to explore how different patterns of digital engagement evolve over time. In addition, future studies should consider diverse educational contexts, age groups, and technological environments, including emerging platforms such as AI-driven and immersive learning systems. By adopting more comprehensive and theory-driven approaches, future research can provide deeper insights into how digital technologies can be effectively leveraged to support meaningful and sustainable learning outcomes.

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