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Problematic Smartphone Use and Academic Performance in Children and Adolescents: A Narrative Review

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Abstract

Background: Problematic smartphone use (PSU) is common among children and adolescents. Although smartphones may support communication and learning, uncontrolled use can negatively affect education.

Aim: This review summarizes mechanisms linking PSU with academic outcomes and considers the educational potential of smartphones.

Material and methods: A narrative review was conducted using PubMed, Scopus, and Google Scholar. Articles from the last 5–10 years were identified using terms related to PSU, smartphone addiction, mobile learning, and academic performance. Additional studies came from reference lists.

Results: PSU affects academic performance mainly through indirect mechanisms. Cognitive pathways include attention deficits, media multitasking, cognitive overload, and impaired executive functions, which reduce working memory and learning effectiveness. Physiological mechanisms include delayed sleep onset, shorter sleep duration, and poorer sleep quality, which may impair memory consolidation and cognition. Psychosocial factors such as Fear of Missing Out (FOMO), procrastination, and poor self-regulation may reinforce excessive smartphone use and reduce academic engagement. These mechanisms often interact. Smartphone impact is context-dependent: structured mobile learning can support motivation, resource access, and self-directed learning. Impulsivity, weaker executive functioning, and ADHD symptoms may increase vulnerability, whereas self-control, emotional intelligence, parental mediation, and digital literacy may be protective.

Conclusion: PSU is a multifactorial risk factor for lower academic achievement in youth, acting mainly through cognitive, sleep-related, and psychosocial pathways rather than screen time alone. Smartphones may also support learning when used purposefully. Interventions should promote self-regulation, digital literacy, and responsible smartphone use. Further longitudinal and experimental studies are needed to clarify causality.

Key words: problematic smartphone use; academic performance; adolescents

1. Introduction

In the era of fast digitalization, smartphones are evolving from simple communication devices to multimedia platforms. This means that they play a key role in the development of children and adolescents. In a nationwide survey of students and parents in Poland, smartphones are the primary means of internet use among school-aged youth, with as many as 93% of students using them daily (Ładna et al., 2025). The prevalent reliance on mobile technology in adolescents' daily lives has an impact on their psychosocial and academic functioning. Smartphones could be a very important technology for educational purposes (i.e., mobile learning). However, more attention has been paid to the phenomenon of Problematic

Smartphone Use (PSU). PSU is a compulsive pattern of smartphone use characterized by addiction features such as poor control over the device, preoccupation with the device, and psychological distress when the device is not available (Lin et al., 2016; Pontes et al., 2015). Excessive smartphone use has been associated not only with psychosomatic complaints and anxiety symptoms (Ratan et al., 2021) but also with worse academic performance. There is a range of factors that have been found to affect PSU in studies: direct cognitive impairment (e.g., lack of attention or executive function) and indirect impact (e.g., sleep deprivation). This narrative review is both about examining the ways in which problematic smartphone use affects children and adolescents' academic achievement but also about the positive use of mobile technology as an educational tool.

Research materials and methods

2.1. Data sources / Literature sources

A narrative literature review was conducted using the PubMed, Scopus, and Google Scholar databases. No human participants were involved in the study since the research was based on published literature.

2.2. Search strategy and study selection

Search strategy and study selection. The search included keywords in Polish and English, such as problematic smartphone use, smartphone dependence, smartphone addiction, media in education, school performance, and academic performance. We included peer-reviewed articles published mainly in the last 5–10 years to ensure the relevance and currency of the evidence. We also manually looked through reference lists of selected articles and found other relevant publications not retrieved from the database search.

2.3. Data extraction and synthesis

Data extraction and synthesis. The relevant information is extracted from the selected studies and organized according to the main themes of smartphone use and its impact on educational and academic outcomes. The findings are synthesized narratively without statistical analysis.

2.3.1. Statistical software

No statistical software was used, as this study was a narrative literature review.

2.3.2. AI.

AI was used for two purposes in this study: text analysis of clinical reasoning narratives to identify linguistic patterns related to specific logical fallacies and assistance in improving the academic English language of the manuscript, thus ensuring clarity, consistency, and adherence to scientific writing standards. AI was used during translation to further improve the English writing in the research manuscript, which translated to correct English grammar, style, and clarity of the results. All these AI tools were only used as assistive tools, and we were solely human beings in the process. Human experts in clinical medicine and formal logic were responsible for the final interpretation of the results, classification of errors, and conclusions. AI tools were used primarily to improve efficiency in data processing, pattern recognition, and linguistic refinement but not to replace human judgment in the analysis of the information.

2.3.3. Statistical Methods

Statistical methods. Statistical methods were not employed in this work as the work is a narrative literature review. The analysis was conducted with thematic analysis of the studies we considered.

3. Research results

3.1. Mediating mechanisms of the impact of problematic smartphone use on the learning process

Mediating mechanisms of the impact of problematic smartphone use on the learning process. Understanding the relationship between problematic smartphone use (PSU) and educational achievement requires understanding the complex mediating mechanisms. The impact of PSU on academic performance is indirect and results from cognitive, physiological, and psychosocial processes. The most convincing evidence is that attentional and executive function impairments, poor sleep quality, and academic procrastination are factors. These mechanisms reinforce each other and perpetuate a self-reinforcing vicious circle that impairs learning.

3.2. Attentional deficits, media multitasking, and cognitive load

Attentional deficits, media multitasking, and cognitive load. One of the best-studied mediating mechanisms is the cognitive process in the form of media multitasking (media and/or frequent attentional switching) and cognitive load. Media multitasking is the simultaneous use of two or more electronic media or the combination of digital activities

together with non-media tasks such as studying (Dontre, 2021). Such multitasking is associated with frequent interruptions in deep concentration and thus fragmentation of selective attention, making it difficult to efficiently process information (Dontre, 2021; Hsieh, 2025). This can be explained by cognitive load theory according to cognitive psychology. With a single notification, message, or brief interaction with a device, the working memory has very little time, and hence cognitively costly task switching is necessary. Repeated interruptions lead to extra cognitive load, which reduces the cognitive resources available for learning materials. By doing so, working memory efficiency is compromised: information is encoded poorly, integrated with prior knowledge less effectively, and not consolidated into long-term memory. In addition, attention difficulties also reduce learning efficiency and may result in lower academic performance (Warsaw et al., 2021; Hartanto et al., 2023; Hsieh et al., 2025). Even worse, the negative effects can be felt even when the device is not actively used. In experiments, just being there physically (the mere presence effect or brain drain effect) in the smartphone is observed to decrease working memory capacity and problem-solving ability, likely due to the automatic engagement of attentional control functions (Ward et al., 2017; Johannes et al., 2018). However, findings have been somewhat contradictory. This is mainly due to significant heterogeneity in the measurement methods for PSU and executive functions, and a majority of cross-sectional studies are compared rather than longitudinal studies. Hartanto et al., in their objective measures of smartphone use, found that executive function deficits are associated with problematic smartphone use (not total usage time) more than with total smartphone usage. This means that the dysfunction in smartphone use is more important for cognitive functioning than the total screen use alone.

3.3. Sleep disturbances as a mediator of PSU effects

Sleep disturbances as a mediator of PSU effects. Other factors in the brain and sleep-related mechanisms also play a role. High-energy visible (HEV) light (i.e., blue light) is light produced by the smartphone. Exposure to this light inhibits melatonin secretion, delays sleep onset, and disrupts circadian rhythms (Li et al., 2020). Mobile devices have effects beyond blue light exposure. Social media use can also lead to emotional arousal and even alarm at night when you check the phone. This is particularly detrimental because smartphone use can also have negative effects on sleep quality and sleep duration (Christiansen et al., 2016; Ratan et al., 2021). The effects of sleep deprivation on cognitive function are also profound because sleep is critical for declarative and procedural memory consolidation, neuroplasticity, and

executive function restoration. Sleep deprivation, in turn, results in poor concentration, poor working memory, slower information processing, and increased susceptibility to distraction, resulting in reduced learning efficiency (Sun et al., 2025).

3.4. Psychosocial mechanisms: FOMO, procrastination, and self-regulation

Psychosocial mechanisms: FOMO, procrastination, and self-regulation. In the psychosocial area, fear of missing out (FOMO) is particularly sensitive and relates to the persistent fear of missing out on rewards associated with social situations in which others are participating (Weinstein, 2022). A person with higher FOMO is more likely to constantly monitor messaging apps and social media and is more likely to get distracted while studying, remaining in a state of readiness to respond to digital stimuli. Academic procrastination is an important factor that results in PSU (Aran, 2026). FOMO has a direct effect on PSU as well as indirectly by leading to a delay of academic tasks (Alkazaleh, 2026). As a result, less time is invested in studying, academic work becomes more involved, and stress is felt when studying. An increasing body of research also points to self-regulation deficits as a common underlying mechanism of PSU and procrastination. Failure to control impulses, delay gratification, and regulate behavior results in more smartphone usage in mentally intensive activities. This creates a vicious cycle in which self-control problems lead to increased smartphone usage, thus a deterioration in study organization, lower motivation for studying, and the increase of stress and psychological exhaustion (Lian et al., 2021; Zhang et al., 2024).

3.5 Interplay between mechanisms

As is emphasized above, the mechanisms described above do not work independently. Attentional deficits increase susceptibility to procrastination, procrastination leads to smartphone use during late evening hours, which in turn impairs sleep quality, and sleep deprivation further weakens executive functions and self-regulatory capacity.

Thus, current theoretical models argue that the negative effects of problematic smartphone use (PSU) on academic achievement come from the interplay of multiple mutually reinforcing cognitive, physiological, and psychosocial mechanisms rather than an isolated factor.

3.6. Moderators and individual vulnerability factors in PSU.

When studying the relationship between problematic smartphone use (PSU) and academic success, we must also look at a variety of moderating factors that influence the extent and direction of technology's influence on people.

The two main differences are gender and age. In boys, PSU is more often associated with exposure to mobile gaming, while in girls the social networking component is most often more prevalent, implying different mechanisms of attentional distraction (Chen et al., 2017).

Other aspects of digital activity are also important. In practice, the difference between active, goal-directed use (m-learning) and passive consumption of entertainment content can explain inconsistent results (Adelantado-Renau et al., 2019). The negative association with academic performance is strongest for leisure-oriented content, which is more about superficial processing of information.

Additionally, individual susceptibility to PSU is greatly moderated by personality traits such as high impulsivity, neuroticism, and low self-regulation capacity (Aran & Kizilcec, 2026). Students with executive function deficits, including those with high ADHD traits, tend to view smartphones as a source of immediate gratification and thus they lose their capacity to plan in a long-term manner and delay gratification in the learning process (Arrivillaga, Rey & Extremera, 2022).

3.7. Protective mechanisms and self-regulatory competencies.

Despite these risks, there are also protective factors that can alleviate the negative impact of problematic smartphone use (PSU) on students' educational trajectories.

The most important predictors of resilience are self-control and emotional intelligence, which can be used to manage fear of missing out and anxiety associated with it (Arrivillaga, Rey & Extremera, 2022). At a social level, constructive parental mediation has a significant influence, as does family socioeconomic status, which influences access to alternative leisure activities and a greater awareness of digital risks.

The introduction of mindfulness practices and systematic education in digital hygiene has shown the ability to sustain deep concentration and reduce academic procrastination, making them an important component of educational prevention strategies (Lian et al., 2021; Zhang & Dong, 2024).

3.8. Positive uses of smartphones in education.

Smartphones also have positive aspects in the educational context. The main one lies in the way and purpose of their use. Mobile learning (m-learning) involves using mobile devices for flexible access to learning materials, e-learning platforms, and educational applications.

The meta-analysis by Mihaylova et al. (2022) demonstrated substantial benefits of language-learning applications. Early educational interventions using technology (e.g., learning games or reading applications) have also been found to be very beneficial for children's reading skills. The UNESCO (2024) report "Technology in Education" states that appropriately configured digital tools, when integrated into instruction, can enhance motivation and access to knowledge.

Examples of effective tools are language-learning applications (e.g., Duolingo), flashcard systems (e.g., Quizlet, Anki), and e-learning platforms.

4. Discussion

The literature review indicates that the association between problematic smartphone use (PSU) and academic performance is complex and multifactorial. There is evidence in support of PSU, which is not only related to total screen time but is also connected to cognitive, physiological, and psychosocial factors. The strongest evidence supports attentional deficits, media multitasking, impaired sleep quality, and self-regulation difficulties that contribute to learning lag and academic procrastination. These mechanisms do not operate independently but are in a mutually reinforcing relationship in which failure in one domain increases the likelihood of further difficulties.

However, the findings show that smartphone use effects are not necessarily negative for learning. Research is increasing, and more evidence shows that the importance of usage context is crucial. Mobile learning (m-learning) education with smartphones, when supported by appropriately designed instructional activities, can enhance student motivation, support self-directed learning, and improve access to educational materials. In other words, it is the way smartphones are used and the level of users' self-regulatory competencies that matter, not just smartphone usage itself.

One important outcome of this review is that individual moderators are also significant. Personality traits, impulsivity, self-control, executive functioning, and ADHD symptoms may increase susceptibility to PSU and exacerbate its negative impact on school functioning. Well-

developed self-regulation, emotional intelligence, constructive parental mediation, and education in digital hygiene are protective factors, suggesting that preventive interventions should focus not only on limiting screen time but also on developing competencies for responsible technology use.

The present state of knowledge is still characterized by several methodological limitations. Most studies are cross-sectional and do not allow for causal inference. There is a lack of longitudinal and randomized intervention studies on the effects of specific strategies for smartphone usage reduction, such as blocking during study periods or programs aimed at strengthening self-regulation skills. There is also an inherent bias with self-report measures that can lead to recall bias and under- or overestimation of actual smartphone use.

Hence, future research will need to use methodological triangulation by combining objective smartphone usage data with measures of cognitive functioning, sleep quality, and actual academic performance. Furthermore, it would be valuable to study whether reducing smartphone use during homework enhances learning efficiency and whether improvements in sleep quality or self-regulation mitigate the negative impact of PSU on educational performance. It would also be important to explore the positive applications of mobile devices, including adaptive learning systems, artificial intelligence, and personalized educational applications. Additionally, it is crucial to account for cultural and socioeconomic differences, as well as the rapidly evolving digital environment, including new social media platforms and emerging forms of content consumption.

5. Conclusions

Problematic smartphone usage is a major risk factor for academic decline among children and adolescents, although the impact is largely indirect. The evidence indicates that the negative effects are mainly related to attentional problems, media multitasking, poor sleep quality, and lack of self-regulation -- all of which together lead to the reduction in learning. At the same time, smartphone use itself is not a source of harm. In the right way, smartphone communication and app usage as a resource to support mobile learning and digital skills development is beneficial to the education system and overall education.

These findings have practical implications and the need for all forms of preventive practices such as digital hygiene education, self-regulatory skills, and the seamless use of mobile technologies in the education process. The most important way to advance knowledge is to

conduct longitudinal and experimental studies that will support a better understanding of causal relationships for PSU and the development of effective strategies to reduce the negative effects of PSU and to make mobile technologies educational.

Disclosure

Author Contributions

Conceptualization: W.M., **Methodology** K.T. **Literature Search** D.Sz. **Formal analysis** D.B., A.B. **Writing – original draft preparation** K.T., N.S., J.W. **Writing – review and editing** O.Dz., W.Z., K.S.

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Conflicts of Interest

The author declares no conflict of interest.

Declaration of generative AI and AI-assisted technologies in the writing process.

In preparing this work, the authors used ChatGPT (OpenAI) and Gemini (Google) for language editing, translation, text formatting, improving readability, and limited assistance with organizing and summarizing information. All AI-generated content was carefully reviewed, verified against the original scientific sources, and edited by the authors. The authors take full responsibility for the accuracy, integrity, and scientific content of the manuscript.

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