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Electronic Devices and Students' Cognitive Learning Risk: A Review of Attention, Memory, Comprehension, and Self-Regulation

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***Abstract*: Electronic devices have become common in modern classrooms, homes, and study environments. Laptops, tablets, smartphones, and learning platforms can support access to information and flexible learning. However, growing evidence suggests that unmanaged device use may place students' learning at risk in cognitive ways. This article reviews recent literature from 2015 to 2026 on how electronic devices affect students' attention, working memory, reading comprehension, academic performance, sleep, and self-regulation. Using a qualitative literature-review method, the article analyzes 20 recent and accessible academic and policy sources. The results show that electronic devices do not automatically damage learning, but they become risky when they create distraction, media multitasking, shallow reading, fragmented attention, sleep loss, and overdependence on quick digital feedback. The discussion argues that schools should not simply ban technology or accept it without limits. Instead, teachers and policymakers should use evidence-based digital rules, protect deep-learning time, teach digital self-regulation, and match devices to clear learning purposes.**

***Keywords*: Electronic devices, cognitive learning, attention, memory, multitasking, screen reading, students, digital distraction.**

1. Introduction

Electronic devices are now deeply connected to students' learning lives. Many students use laptops, tablets, smartphones, and online platforms to search for information, complete assignments, communicate with teachers, and access learning materials. Digital tools can support learning when they are used with clear educational goals. For example, mobile devices can increase access to learning resources and may improve learning performance when they are carefully integrated into teaching (Sung, Chang et al. 2016). The OECD also emphasizes that digital technologies can support engagement and personalized learning, but their effectiveness depends on careful implementation rather than simple access to devices (Pisa 2023, Forsström, Njå et al. 2025).

However, electronic devices may also put students' learning at risk, especially in cognitive ways. Cognitive learning refers to mental processes such as attention, memory, comprehension, reasoning, and self-control. When students study with electronic devices, they may face notifications, entertainment Apps, social media, games, multitasking, and fast switching between tasks. These interruptions can reduce attention and make it harder for students to encode information into long-term memory (Ravizza, Uitvlugt et al. 2017, Glass and Kang 2019).

International policy reports also warn that technology in education must be used carefully. UNESCO's 2023 Global Education Monitoring Report states that technology can be useful, but excessive or inappropriate use can harm learning; it also notes that proximity to mobile devices can distract students and negatively affect learning in many countries (Antoninis, Alcott et al. 2023). OECD PISA-related evidence similarly shows that students who are distracted by digital devices tend to perform worse academically, suggesting that the problem is not only device ownership but also the learning environment created by device use (van der Vlies 2020).

A. Electronic Devices as Both Learning Tools and Cognitive Risks

Research on educational technology shows a mixed picture. On one hand, mobile devices can support learning by providing access to multimedia, interactive activities, and personalized instruction. On the other hand, the same devices can become sources of distraction when students use them for non-learning purposes. The OECD's 2025 review concludes that access to technology alone does not guarantee learning improvement; digital tools must be connected to strong teaching design (van der Vlies 2020, Pisa 2023, Shek, Chau et al. 2025).

This mixed evidence is important. The central issue is not whether electronic devices are "good" or "bad." Instead, the issue is whether devices are used in ways that support cognitive effort or interrupt it. Students learn best when they can focus, process information deeply, practice retrieval, and connect new ideas with prior knowledge. Electronic devices may weaken these processes when they encourage divided attention, surface-level reading, or constant task switching.

B. Attention and Classroom Distraction

Attention is one of the most important cognitive conditions for (Glass and Kang 2019) also found that allowing electronic devices for nonacademic purposes during lectures reduced later

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exam performance. Their study suggests that electronic-device distraction may not always reduce immediate quiz performance, but it can damage longer-term retention. This means students may feel that they understand during class yet remember less later.

(Attia, Baig et al. 2017) similarly reported that students believed laptop and cellphone use affected their concentration and ability to learn. (Aivaz and Teodorescu 2022) found that college students experienced digital distractions in both online and face-to-face learning contexts. Together, these studies suggest that electronic-device distraction is not limited to one age group or one classroom format.

C. Media Multitasking and Working Memory

Media multitasking happens when students use more than one media source or digital activity at the same time. For example, a student may listen to a lecture while checking messages, browsing social media, and typing notes. Although students may feel that they are multitasking successfully, cognitive psychology suggests that attention is limited. Switching between tasks uses mental resources and can reduce the quality of learning.

(Parry and le Roux 2019) reviewed interventions related to media multitasking and cognitive control. Their review shows that media multitasking is connected to concerns about executive functioning, attention control, and learning behavior. (Parry and le Roux 2021) later argued that the relationship between media multitasking and cognitive control is complex, but the concern remains strong because heavy media multitasking may be linked to weaker attention control.

(Cardoso-Leite, Buchard et al. 2021) also found links among media use, attention, mental health, and academic performance in children and adolescents. This suggests that device use may affect learning not only through distraction but also indirectly through attention problems and emotional well-being.

D. Smartphones, Academic Performance, and Learning Effectiveness

Smartphones are especially risky because they are portable, personal, and constantly connected. (Amez and Baert 2020) reviewed research on smartphone use and academic performance and found that much of the literature points to a negative association between frequent smartphone use and academic success.

(Wang and Hsieh 2023) studied smartphone use among elementary school students and found that smartphone use was related to perceived academic performance and learning effectiveness. This is important because it shows that smartphone-related learning concerns are not limited to university students. Younger students may have even weaker self-regulation, making them more vulnerable to distraction.

(- Kaminske, - Brown et al. 2022) found that cellphone notifications harmed attention and increased the time needed to complete tasks. This means that even short interruptions can affect cognitive performance. The risk is not only active phone use; alerts and notifications may also distract attention and weaken learning flow.

E. Screen Reading and Comprehension

Electronic devices also affect learning through reading. Reading on screens is not always worse, but many studies show that screen reading can reduce comprehension, especially for longer, informational, or time-limited texts. (Delgado, Vargas et al. 2018) conducted a meta-analysis comparing paper and digital reading. They found that paper reading often produced better comprehension, especially for expository texts.

This matters for students because many school texts are informational. If students read science, history, or academic passages on screens while also facing scrolling, hyperlinks, notifications, or split-screen activities, comprehension may become shallower. Screen reading can encourage skimming and quick movement through text rather than slow, careful processing.

F. Sleep, Memory Consolidation, and Next Day Learning

Electronic devices may also harm learning indirectly through sleep. Sleep is important for attention, memory consolidation, and emotional regulation. (Hale and Guan 2015) reviewed screen time and sleep among school-aged children and adolescents and found that screen use was generally linked to shorter sleep duration and poorer sleep outcomes. (Hale and Guan 2015, Hale, Kirschen et al. 2018) also reported that most studies found associations between screen media use and delayed bedtime or reduced total sleep time.

This creates a cognitive learning risk because tired students have more difficulty focusing, remembering, and regulating behavior the next day. Therefore, device use at night may affect school learning even if the device is not used during class.

G. School Phone Policies and their Limits

Many schools have responded to device-related distraction by banning or restricting smartphones. However, evidence suggests that phone bans alone may not solve the problem. (Goodyear, Randhawa et al. 2025) found that restrictive school phone policies were not clearly associated with better mental well-being, phone use, sleep, classroom behavior, or academic performance, although higher phone and social media use itself was associated with worse outcomes.

This finding suggests that school rules are useful but incomplete. Students may reduce phone use during school but continue heavy use outside school. Therefore, schools need broader strategies, including digital literacy, family cooperation, sleep education, classroom routines, and direct instruction in attention management.

2. Materials and Methods

This article uses a qualitative literature-review method. It does not collect original surveys or experimental data. Instead, it reviews and synthesizes recent academic studies and policy reports related to electronic devices and students' cognitive learning risks.

The sources were selected using four criteria. First, each source had to be published between 2015 and 2026. Second, the source had to focus on electronic devices, smartphones, laptops, screen reading, digital distraction, media multitasking, sleep,

attention, memory, academic performance, or educational technology. Third, the source had to be reliable and accessible, meaning that it came from peer-reviewed journals, open-access databases, major educational organizations, or official policy reports. Fourth, the source had to contribute directly to understanding the risks of electronic-device use.

The analysis followed a thematic review process. The selected studies were grouped into six themes: attention and distraction, media multitasking, smartphone use, screen reading, sleep and memory, and school policy. After grouping the studies, the article compared findings across sources and identified common patterns.

3. Results and Discussion

A. Electronic Devices Increase the Risk of Divided Attention

The first major result is that electronic devices can divide students' attention. When students use laptops, tablets, or phones during class, they may move between learning content and unrelated digital activities. (Ravizza, Uitvlugt et al. 2017) found that nonacademic laptop internet use was negatively related to class performance. (Glass and Kang 2019) also found that device access during lectures reduced later exam performance.

This suggests that electronic-device distraction may be especially harmful for long-term learning. Students may believe that they are following the lesson, but their attention is divided. As a result, information may not be processed deeply enough to become stable memory.

Notifications and device presence interrupt cognitive flow

The second result is that small interruptions can affect attention. (- Kaminske, - Brown et al. 2022) found that phone notifications harmed attention and increased task-completion time. This supports the idea that even short digital interruptions can break concentration.

For students, this is important because learning often requires sustained attention. Reading a difficult passage, solving a math problem, writing an essay, or listening to a teacher's explanation all require mental continuity. Notifications interrupt this continuity and force the brain to restart the learning task.

B. Media Multitasking Weakens Self-Regulated Learning

The third result is that device use can weaken students' self-regulated learning. Self-regulation means the ability to control attention, manage time, resist temptation, and stay focused on a goal. Parry and le Roux (2019, 2021) show that media multitasking is linked to concerns about cognitive control. (Rosen, Carrier et al. 2017) also found that executive functioning and technology-related behaviors were connected to academic performance.

This means that electronic devices may be especially risky for students who already struggle with self-control. A highly motivated student may use a laptop only for notes, while another student may quickly move to games, videos, or social media. Therefore, device risk depends partly on students' self-regulation skills.

C. Screen Reading May Reduce Deep Comprehension

The fourth result is that screen reading can reduce comprehension in some learning situations. Delgado et al. (2018) found that paper reading often supports better comprehension than digital reading, especially for informational texts. This is important because school learning often requires students to understand complex explanations, not simply read quickly.

Screen reading may encourage students to skim, scroll, and jump between information. These habits can be useful for quick searching, but they may be harmful when students need deep understanding. Therefore, electronic devices may put reading-based learning at risk when students are not taught how to read slowly and carefully on screens.

D. Heavy Device Use May Harm Learning Through Sleep Loss

The fifth result is that electronic devices may harm learning indirectly through sleep. (Hale and Guan 2015, Hale, Kirschen et al. 2018) show that screen use is often associated with shorter sleep and delayed bedtime. Poor sleep can reduce attention, memory, mood, and learning readiness the next day.

This means that the cognitive risk of electronic devices is not limited to classroom use. A student who uses a phone late at night may come to school tired, less focused, and less able to remember new information.

E. Device Restriction Alone is Not Enough

The sixth result is that banning phones or devices may reduce some distractions, but it is not a complete solution. (Goodyear, Randhawa et al. 2025) found that restrictive school phone policies alone were not clearly associated with better academic or well-being outcomes. This does not mean phone rules are useless. Rather, it means that rules must be combined with stronger learning routines, digital literacy, self-regulation training, and home-school cooperation.

The findings show that electronic devices put students' learning at risk mainly through cognitive overload and fragmented attention. Devices create many possible learning interruptions: notifications, social media, and games, videos, messaging, multitasking, and fast switching between tasks. These interruptions reduce the mental space students need for deep learning.

However, the evidence does not support a simple anti-technology position. Electronic devices can support learning when they are used with clear goals, strong teacher guidance, and limited distractions. For example, digital tools can help students access information, practice skills, receive feedback, and learn at different speeds. The problem begins when device use replaces attention, memory work, reading effort, and classroom interaction.

A key educational implication is that schools should protect "deep learning time." During reading, writing, problem solving, and direct instruction, students may need device-free or notification-free periods. This is especially important for younger students and students with weak self-regulation. Teachers can also set clear rules, such as "screens down during

explanation," "one tab only," or "phones away during reading."

Another implication is that digital literacy should include cognitive self-management. Many digital-literacy programs teach students how to search for information or avoid online danger. These are useful, but students also need to learn how digital devices affect attention, memory, sleep, and learning. They should understand why multitasking feels productive but often weakens learning.

Schools should also think carefully about when paper may be better than screens. For long reading passages, difficult texts, brainstorming, planning, and memory-based review, paper may sometimes support deeper processing. This does not mean all digital reading should stop. It means teachers should match the medium to the learning goal.

Finally, parents and schools should work together on sleep-related device habits. If students use phones late at night, classroom learning may suffer the next day. Therefore, schools can include sleep education, homework design that does not require late-night screen use, and parent communication about healthy device routines.

4. Conclusion

In conclusion, electronic devices put students' learning at risk when they divide attention, weaken self-regulation, reduce deep reading, interrupt memory formation, and harm sleep. The best response is not simply banning all devices. The best response is balanced digital discipline: use technology when it clearly improves learning, remove it when it distracts, and teach students how to control their attention in a digital world.

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