The Impact of Electronic Device Screen Time on High School Students' Academic Achievement

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Abstract:

With the deep integration of digital technology into the educational field, the screen time of high school students has shown a significant increasing trend, making its relationship with academic achievement an essential topic for educational researchers. This paper explores the complex association between the two through a systematic literature analysis. The study finds a nonlinear "U-shaped" relationship between screen time and academic achievement. Specifically, students who use moderate amounts of time (1-3 hours per day on average) derive benefits from their time, having a positive or neutral impact on their academic performance, whereas students who use too much time (>4 hours) may suffer from the negative side effects of time displacement, attention loss, and sleep deprivation. In addition, students who use too little time (<1 hour) may lack the opportunity to take part in digital learning. Further research reveals that the type of content used is an important moderating variable, with educational content use associated with positive learning outcomes. In contrast, passive entertainment use may have adverse effects. Factors such as students' self-regulation ability and family environment significantly moderate this relationship. Based on the findings, this paper suggests that educational interventions should shift from restricting duration to guiding high-quality content use and cultivating digital literacy, helping students optimize learning outcomes in the digital age.

Keywords: Screen Time; Academic Achievement; High School Students; Educational Psychology; Digital Media; Social Media

1. Introduction

High school students are living in an era surrounded by digital screens. Electronic devices such as smartphones, tablets, and laptops have deeply integrated into educational settings, profoundly changing how knowledge is acquired and learning occurs. For this specific population, electronic devices have a distinct "double-headed sword" properties: they are powerful tools for learning, providing large amounts of resources and engaging learning opportunities, but they are also primary platforms for entertainment, these properties pose a risk of attention fragmentation and addiction. This dual nature makes the impact of screen time on academic achievement complex and critical. Early research often focused on a simple linear relationship between usage duration and academic performance. Still, recent studies suggest a more complex nonlinear association, moderated by multiple factors such as content type and individual differences. Therefore, an in-depth exploration of the internal mechanisms and boundary conditions through which screen use affects academic achievement is of significant theoretical and practical importance. This paper adopts a literature review method to systematically analyze the relationship patterns between screen time and academic achievement, focusing on the following questions: First, what is the nature of the association between the two? Is it a simple linear relationship or a more complex nonlinear one? Second, how does the type of content used moderate this relationship? Finally, how do individual characteristics and environmental factors influence the effects of screen use? This study aims to provide a scientific basis for educators and parents to help high school students achieve healthy growth and efficient learning in the digital age by addressing these questions.

2. Main Body

2.1 The Overall Trend of Screen Time's Impact on Academic Achievement: A Nonlinear „U-shaped" Relationship

Early research often assumed a simple linear negative correlation between screen use and academic achievement, meaning longer use time equated to poorer grades. However, a growing body of meta-analyses and longitudinal studies reveals that a nonlinear "U-shaped" relationship, also called the "Goldilocks Effect," is more plausible. Livingstone and Blum-Ross propose a curvilinear association whereby moderate screen exposure (1–2 hours per day) demonstrates no adverse effects and may confer educational benefits, while both minimal and excessive usage correlate with diminished outcomes, indicating a

non-monotonic dose-response relationship [1] Twenge and Campbell assert: This meta-analytic synthesis substantiates that individuals with elevated digital media consumption (surpassing 4 hours daily) demonstrate markedly diminished academic achievement and psychological well-being relative to minimal users (under 2 hours), establishing a clear dose-dependent association. [2] Based on this, let's categorize briefly. Firstly, at the low-use end (average daily screen time not exceeding 2 hours), insufficient screen use may mean students cannot fully utilize rich online educational resources and digital learning tools, potentially putting them at a disadvantage in tasks related to understanding content and concepts, or affecting information acquisition and real-life social support due to digital social disconnection. Secondly, this range is typically associated with neutral or slightly positive learning outcomes at the moderate-use end (average daily use not exceeding 3 hours). Moderate use allows students to engage in beneficial educational activities like researching materials, completing online assignments, exploring learning contexts, or other creative content production, without significantly encroaching on sleep, physical activity, and offline study time. Finally, at the excessive-use end (time spent >4 hours), this pattern has attracted significant research attention, and they consistently indicate that excessive use, particularly for non-academic purposes, is closely related to a significant decline in academic achievement. The mechanisms include: first, the time displacement effect, which crowds out critical time allocated initially for studying, reading, sleeping, and physical activities. Second, cognitive overload and attention fragmentation: continuous multitasking and fragmented information intake impair concentration and profound learning ability. Third, Przybylski and Weinstein discuss that nighttime device utilization, especially blue light exposure, can adversely affect the secretion of melatonin, delay the sleep onset, reduce the quality and duration of sleep, and have a negative impact on cognitive function and classroom attention the following day [3].

Therefore, viewing screen time simply as a "the more, the worse" variable is one-sided. Understanding its U-shaped relationship is the first step towards effective intervention.

2.2 The Impact of Differences in Screen Content Type

Merely studying the duration of electronic device use is far from sufficient. Odgers and Jensen emphasize that the nature of digital engagement demonstrates significant differential effects on academic performance; pedagogical screen-based activities correlate positively with grade point average, whereas leisure-oriented usage—specifi-

cally passive media consumption and social networking platform engagement—exhibits inverse associations with scholastic outcomes. [4] Understanding the differences in students' content is crucial, as it can lead to different outcomes. For instance, educational content promotes learning and knowledge acquisition and is generally associated with positive learning outcomes. Through active and creative use of this educational content—such as using educational software, programming, making videos, conducting online research, reading e-books, or participating in MOOCs—students can directly construct knowledge, develop critical thinking, and enhance digital literacy. Sometimes, schools adopt a "blended learning" model, utilizing online platforms to assign and submit homework and facilitate discussions. This type of screen use, directly related to the curriculum, is an indispensable part of modern education and directly promotes academic achievement.

On the other hand, students' use of electronic devices to browse entertainment content has advantages and disadvantages. Students can quickly obtain a large amount of information by browsing short videos or certain websites, stimulating the brain and achieving the purpose of rest and entertainment. However, problematic use, such as a student intending to check a teacher's notification but unconsciously getting sucked into a short video platform's information stream, continuously scrolling for an hour, forgetting the original purpose and the passage of time. This behavior directly displaces valuable study time. Problematic behaviors like frequent refreshing, social comparison, cyberbullying, and gaming addiction are significantly associated with decreased attention and learning motivation, increased anxiety and depressive symptoms, and reduced academic self-efficacy. Coyne and colleagues assert: Our longitudinal data demonstrate that elevated social media exposure not only correlates with but causally predicts subsequent escalation in depressive symptomatology and diminished academic self-efficacy among adolescent populations, establishing a deleterious cyclical pattern. [5] Valkenburg and colleagues demonstrated that the relationship between social media engagement and psychological well-being exhibits considerable heterogeneity, with differential effects contingent upon usage modalities—specifically, passive consumption versus active participation. Nevertheless, meta-analytic evidence consistently indicates that maladaptive, compulsive usage behaviors demonstrate robust negative correlations with academic performance outcomes [6]

Therefore, numerous studies indicate that the key issue often lies not in entertainment itself, but in the "mode" of use, particularly the distinction between "passive consumption" and "active creation/social interaction." Passive Consumption refers to aimlessly and uncritically receiving algorithm-pushed content, like mindlessly scrolling through social media feeds or continuously auto-playing short videos. This mode, due to its high accessibility and low cognitive investment, is more likely to lead to time wasting, cognitive laziness, and information cocoons. In contrast, Active Use requires higher cognitive engagement and purposefulness.

2.3 Individual Differences Moderating the Impact of Screen Use on Academic Achievement

Although substantial research confirms a significant association between screen time and academic achievement, it must be emphasized that this impact is neither homogeneous nor one-dimensional. Its ultimate effect is significantly moderated by individual intrinsic traits and external environmental factors, explaining why students with similar screen time durations can exhibit vastly different academic outcomes. Family socioeconomic status (SES) and individual self-regulation ability are particularly crucial among these moderating variables. Firstly, family socioeconomic status (SES), as a core external environmental factor, exerts a profound moderating influence primarily through the "Digital Divide." The Digital Divide goes far beyond the initial gap in access to digital devices and the internet (the "first-level digital divide"). In today's context, it reflects disparities in the quality and benefit of digital technology use (the "second-level digital divide"). Students from low-income families often face a "dual challenge" from this divide. The first challenge is the "access" divide. Although the penetration rate of basic networks has dramatically improved, low-SES families may still face issues like outdated equipment, insufficient quantity (e.g., siblings sharing one device), and slow or unstable internet connections. This hinders students' ability to use screen time for educational purposes (e.g., attending online courses, downloading large learning materials, smoothly watching instructional videos), even if they have the intention, putting them at a disadvantage from the start. The second, and more critical, challenge is the "usage" divide. Research indicates that in low-SES environments, often due to parents' limited availability for supervision (e.g., long working hours) or their own limited digital literacy, adolescents' screen time is more likely to be characterized by unrestricted, unguided entertainment consumption. Wang, Li, and Fan report that children from economically disadvantaged households demonstrate both elevated exposure to unregulated leisure screen media and a more pronounced inverse correlation between such exposure and academic performance on standardized assessments, consequently amplifying educational dispar-

ities [7]. For example, they might own a smartphone, but its primary use is for prolonged viewing of short videos or casual gaming, rather than for educational exploration. This usage pattern amplifies the negative impact of recreational screen time on their academic performance. When screen time is predominantly occupied by passive entertainment, it displaces study time and fails to yield any gains in digital skills or knowledge. In contrast, high-SES families are more likely to guide and supervise device use, consciously directing technology towards educational and developmental activities (e.g., learning programming, visiting virtual museum exhibitions). This significant disparity in usage quality fails to bridge academic gaps through technology. It may exacerbate existing educational inequalities, placing disadvantaged students in a more unfavorable position in the digital age. Secondly, at the level of individual intrinsic factors, self-regulation ability is a key psychological buffer against the adverse effects of screens. Students with strong self-regulation abilities typically possess good skills in goal setting, impulse control, and time management. In practice, such students demonstrate clear behavioral demarcation between academic engagement and recreational activities, implementing structured approaches such as "task completion preceding controlled leisure time"; they exhibit enhanced intentionality during digital device utilization, actively seeking educational resources while demonstrating resistance to extraneous stimuli and immediate gratification from entertainment applications. Conversely, students exhibiting diminished self-regulatory capacity are more susceptible to executive dysfunction characterized by "implementation intentions failing to override competing responses," whereby information-seeking behaviors become displaced by compulsive social media engagement throughout extended periods, resulting in maladaptive consumption patterns and problematic usage cycles [8]. For them, the screen is no longer a tool but a "black hole" that dominates their attention, naturally exerting a more substantial interfering effect on academics.

Therefore, understanding the impact of screen use cannot be separated from the socio-cultural context of the student and their own psychological resources. The Digital Divide and self-regulation ability collectively shape the accurate picture of screen use's impact, suggesting that any effective intervention must be context-sensitive and individually targeted.

3. Conclusion

This study, through a systematic literature review, has delved into the mechanisms through which screen time affects the academic achievement of high school students.

The research finds that the relationship between the two demonstrates significant complexity and multidimensionality. The main conclusions are as follows:

The investigation establishes a curvilinear U-shaped association between digital screen exposure and scholastic performance. Optimal engagement (1-3 hours daily mean) facilitates access to essential educational technologies and pedagogical resources, yielding beneficial or neutral effects on academic outcomes. Conversely, excessive exposure (>4 hours) impairs learning efficacy through temporal displacement mechanisms, cognitive fragmentation, and circadian disruption, whereas inadequate exposure (<1 hour) may preclude students from accessing critical digital pedagogical resources. These findings suggest that blanket restrictions or universal promotion of screen engagement may prove counterproductive; the optimal approach involves establishing personalized moderate usage parameters.

Second, the type of content used is a critical factor determining the direction of the impact. Educational and creative screen use (e.g., online course learning, digital content creation) can significantly promote learning effectiveness. In contrast, passive and entertainment-oriented use (e.g., mindlessly browsing short videos, addictive social media use) tends to produce adverse effects. This discovery suggests that, compared to merely controlling duration, greater attention should be paid to the quality of screen content and the type of activity.

Finally, individual differences and environmental factors play essential moderating roles. Students' self-regulation ability is an internal protective factor against the negative effects of screens. At the same time, family socioeconomic status exerts influence through avenues such as access to digital resources and guidance on usage. The existence of these moderating factors explains why the same screen use pattern can yield drastically different) outcomes in other students.

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