



European
Commission

Screen Time and Educational Outcomes of Children and Adolescents

A complex, multifaceted relationship

NESET ad hoc report



Education and
Training

Please cite this publication as:

Nett, K. (2025). 'Screen Time and Educational Outcomes of Children and Adolescents: A complex, multifaceted relationship', *NESET ad hoc report*, Luxembourg: Publications Office of the European Union.

ABOUT NESET

NESET is an advisory network of experts working on the social dimension of education and training. The European Commission's Directorate-General for Education and Culture initiated the establishment of the network as the successor to NESET II (2015-2018), NESSE (2007-2010) and NESET (2011-2014). The Public Policy and Management Institute (PPMI) is responsible for the administration of the NESET network. For any inquiries please contact us at: info-neset@ppmi.lt.

Contractor:

PPMi

Part of the
Verian Group

PPMI, Part of Verian Group
Gedimino ave. 50, LT - 01110 Vilnius,
Lithuania
Phone: +370 5 2620338
Fax: +370 5 2625410
www.ppmi.lt
Director: Haroldas Brožaitis

AUTHOR:

- **Katharina Nett**, Psychologist & former policy assistant in Unit B2 Schools & Multilingualism

PEER REVIEWERS:

- **Dragana Avramov**, NESET Scientific coordinator
- **Cosmin Nada**, NESET Expert Committee member

LANGUAGE EDITOR:

- **James Nixon**, freelance editor

REPORT COORDINATOR:

- **Stéphanie Crêteur**, PPMI

EUROPEAN COMMISSION

Directorate-General for Education, Youth, Sport and Culture
Directorate A — Policy Strategy and Evaluation
Unit A.4 — Evidence-Based Policy and Evaluation

E-mail: eac-unite-a4@ec.europa.eu

*European Commission
B-1049 Brussels*

Screen Time and Educational Outcomes of Children and Adolescents

A complex, multifaceted relationship

Katharina Nett

LEGAL NOTICE

This document has been prepared for the European Commission however it reflects the views only of the authors, and the European Commission is not liable for any consequence stemming from the reuse of this publication. More information on the European Union is available on the Internet (<http://www.europa.eu>).

Luxembourg: Publications Office of the European Union, 2025

© European Union, 2025



The reuse policy of European Commission documents is implemented by the Commission Decision 2011/833/EU of 12 December 2011 on the reuse of Commission documents (OJ L 330, 14.12.2011, p. 39). Except otherwise noted, the reuse of this document is authorised under a Creative Commons Attribution 4.0 International (CC-BY 4.0) licence (<https://creativecommons.org/licenses/by/4.0/>). This means that reuse is allowed provided appropriate credit is given and any changes are indicated.

For any use or reproduction of elements that are not owned by the European Union, permission may need to be sought directly from the respective rightsholders.

Table of Contents

Table of Contents	5
Executive summary	6
Introduction	7
Methodological Note	8
Section I: Findings from Reviews	10
Section II: Evidence from Longitudinal Studies	13
Combined and independent influences of lifestyle behaviours	13
Type of screen time matters	13
Explanatory Power and Third Variables	14
Section III: Potential Underlying Mechanisms	17
Brain Development and Cognitive Functioning	17
Executive Function	19
Mental Health	20
Time Displacement	21
Discussion	23
Age-specific findings	23
Age-transversal findings	23
Implications	24
The key conclusions and recommendations	25
<i>References</i>	27
Annex: Overview of main results	32

Executive summary

In recent decades, the rise of modern technology has made screen use a daily necessity, exposing even young children to screens and making smartphones ubiquitous among adolescents. While these innovations offer numerous advantages, concerns have arisen about the potential negative effects of excessive screen time on lifestyle behaviours, physical health, socioemotional functioning, and academic performance.

This literature review explores the relationship between screen time and academic achievement in children and adolescents. To begin with the method, some limitations of the research fields and terms that need definition are addressed. The screened research results emphasize the variation in the purpose and quantity of screen use and the mediating and moderating factors. Although meta-analyses indicate a lack of association between overall screen time and academic performance, specific activities like watching TV and playing video games show a negative relationship. Separate screen time activities, especially social networks, impact academic achievement differently based on the type of engagement. Longitudinal studies highlight that screen time's impact on academic success is indirect, mediated by factors such as cognitive control, emotion dysregulation, and socioeconomic status. Further, screen time interacts with other health behaviours such as physical activity and sleep in its influence on academic achievement.

Several possible mechanisms were identified that suggest high screen time to be associated with changes in brain development and functioning in vulnerable developmental periods, changes in executive functioning, loss of sleep and decreased psychological well-being and mental health, which in turn may negatively affect academic performance.

In the discussion emphasis is placed on the importance of considering the nuances of screen time use in regard to its quality and beyond its quantity. Additionally, socioeconomic status as a large influence factor and its implications for academic inequalities is stressed alongside the discussion of other vulnerabilities. Further, the findings are embedded in the existing body of research and recommendations for policy makers and educational institutions are elaborated.

Introduction

In the last decades, due to rapid developments in modern technologies the use of screens in our lives has become pervasive. Infants are exposed to screens from as early as a few months old, either directly or through their parents' use, and the possession of a smartphone among adolescents as well as children is widespread. Millennials and Gen Z, or the so called "digital natives", use digital tools more than any generation before them and benefit from worldwide access to the internet and its functions such as social networks, information and entertainment. In education, the trend toward digitalization is equally visible, with more and more schools shifting toward a use of digital technologies for learning and teaching purposes.

While there are reasons to be enthusiastic about innovations such as globally accessible communication platforms and new possibilities for online education, some caution is warranted. Professionals in the field of youth development, education and health have been warning about the negative effects of screen time. Excessive use has become a rather common phenomenon with percentages by far exceeding the recommended limit of 2 hours per day for school aged children (Qi, Yan, & Yin, 2023). The negative effects this can entail span across a wide variety of lifestyle behaviours such as physical health and socioemotional functioning. In some cases addictive behaviour in relation to screen use may also occur. Internet Gaming Disorder has been officially recognized in the latest version of the International Classification of Diseases (ICD-11) (Darvesh, et al., 2020). While not yet officially recognized as a disorder, research has also been conducted on problematic behaviour with smartphones and particularly social media of young people finding somewhat large prevalences between 5-25% depending on classification and 14%-31% for individualistic vs collectivistic cultures (Cheng et al., 2021). These recent developments call for a deliberation of the effects of several online activities on children's and adolescents' lives.

In addition to rising screen time engagement and the question about its potential consequences, educators and policy makers have been worried about the dropping PISA results in Europe, indicating a decline in student performance on basic skills such as mathematics, reading and science (Schleicher, 2023). After a surge in the use of digital devices with stark increases in screen time during the COVID-19 pandemic, some countries such as France and Denmark have now taken active measures, such as smartphone bans during school hours, believing this will enhance student learning and academic performance.

However, before drawing hasty conclusions about the relationship between screen time and academic achievement, it is important to consider its effects in detail, taking into account variation in effects of purpose and quantity of screen use, as well as its differential effects on learning outcomes and salient moderating/mediating factors. To this end, this literature study aims to explore the relationship between screen time and academic achievement in children and adolescents.

Methodological Note

Literature

We first present a state-of-the-art overview that discusses the results of several literature reviews examining the direct link between screen time and academic achievement. Only recent systematic reviews and meta-analyses of the last ten years were included in this overview. Secondly, a more in-depth analysis on research results from longitudinal studies is conducted in order to strengthen the empirical basis for recommendations. Here, only longitudinal designs of the last ten years that examined screen time and academic achievement and followed students at least for one year were included. Moreover, for the purpose of increasing the relevance to the European school context, studies from countries outside of Europe, the US, Canada and Australia were neglected. Lastly, studies examining mechanisms of the relationship between screen time and academic achievement are reviewed in a narrative format to present a qualitative and more integrated picture of the subject. All types of study designs, including quantitative and qualitative studies as well as reviews were admitted. Equally to the longitudinal studies, for this latter section only studies as recent as the last 10 years were included. All studies included in this paper were focused on children between the ages of zero and eighteen years old, studies concerning university students were excluded, as the focus of this literature review was placed on infants, children and adolescents.

The search for relevant literature was conducted in a timeframe between March and July 2024 using the database Scopus. Search terms for reviews and longitudinal studies of Part I and Part II respectively included variations of "screen time"¹ and "academic achievement"². Influencing factors were identified by means of scanning literature reviews and book chapters and while searching for relevant literature using the previously mentioned search terms in the database. Some common factors that were extracted and specifically searched for included physical activity, sleep, cognitive and brain development, attention, memory, emotion (dys)regulation, mental health & well-being.

Limitations & Disclaimers

This report is a curated presentation of relevant findings from the literature. It is not a systematic review, as it has not followed the strict procedure with which it is typically associated and thus, certain findings may have been omitted. Further, most of the studies especially in the longitudinal review were conducted before the COVID-19 pandemic and thus cannot take into account the drastic changes in screen time behaviour and their consequences during this time frame. For an overview of this, it is recommended to consult this recent publication of the JRC by Schnepf et al. (2024).

This paper further reflects limitations of the analysed research. To begin with, many research papers use the term screen time as quite generic, not differentiating between types of activities or context of use. As a unification of the definition across studies is lacking, deriving specific claims can be difficult and conclusions unsatisfying (Kaye et al., 2020). This paper aimed to make such distinctions, wherever possible, but

¹ variations for screen time: "digital media use", "digital device use"

² variations for academic achievement: "academic performance", "education* performance", "education* outcomes", "school performance", "learning outcomes"

that was not always possible. This concerns for instance a differentiation between screen use in and outside of class, that could not always be guaranteed. For purposes of contextualisation it can however be stated, that generally the literature reviewed was concerned with screen use outside rather than inside of school.

Further, and very importantly, academic achievement depends on many factors. While screen time is one of them, its' influence needs to be considered in the prism of a variety of other factors, some more salient than screen time, which also shape the educational journeys of children and adolescents. Keeping this perspective in mind throughout the report could help the reader draw proportionate conclusions.

Definitions

Given that this paper uses some broad terms that are open to various interpretations, a short definition of important terms is provided here.

Academic achievement & Educational Outcomes

= are used as synonyms in this paper that describe the progress made towards the goal of acquiring educational skills, materials, and knowledge, usually spanning a variety of disciplines in an academic setting. (Bolt, 2011). It is noted that the operationalization of these concepts often results in the use of grade point average overall, or, in mathematics and reading specifically as subjects specifically, as a measurement in the literature. Broader definitions of educational outcomes that also take into account educational, societal, and life effects that result from receiving an education exist (Student Outcomes, 2013), however, these broader effects are not considered in this paper.

Screen time

= definitions can range from "sedentary screen-based behaviour" to "digital technology use" and have not yet been unified conceptually in the digital literature (Kayne, 2020). The definitions of these constructs are as varied as the instruments aiming to measure screen time in empirical studies. Some measurements focus purely on the hours spent on screen time, while others also consider types of screen time activities. Overall, the variety of data generated on screen time in studies varies significantly and hence, is difficult to compare. In this paper, screen time is very broadly defined as any type of activity involving a screen including TV, smartphone, PC/tablet and gaming devices, used for all kinds of purposes. These include predominantly entertainment, communication, Internet surfing and education.

Section I: Findings from Reviews

A literature search on reviews examining the relationship between screen time and educational outcomes revealed a skewed and incomplete state of research in the area. Using the search computation ("screen time" OR "digital device use" OR "digital media use" OR "digital screen media use") AND ("academic achievement" OR "academic performance" OR "school performance" OR "educational outcomes" OR "academic outcomes") limited to review articles, yielded 25 results. A closer examination of the themes reviewed in these results revealed a general tendency to examine different possible effects including physical health, mental health & well-being as well as academic achievement together. In comparison with health topics, academic achievement seemed to be less focused on in reviews in relation to screen time. Nonetheless, three particularly relevant reviews have been identified and will be discussed in the following paragraphs.

In a systematic review and meta-analysis, Adelantado-Renau, et al. (2019) presented literature examining the association between different types of screen time and academic outcomes. Overall, the meta-analysis of 58 studies revealed a lack of association between the amount of screen time spent on overall screen media and academic performance. Separate analyses for each screen-based activity showed an inverse relationship between watching TV and overall academic performance as well as language and mathematics specifically. Playing video games was also negatively associated with general academic performance. Separating analyses for children and adolescents, the time spent on screens had a greater association with academic scores for adolescents. In their paper, the authors stressed the heterogeneity of findings of individual cross-sectional studies with many studies finding opposite effects, which may explain the lack of a coherent association found in the meta-analysis. As the authors note, several important aspects such as purpose of screen use as well as context were not captured in their analysis, which needs further expansion to draw useful conclusions.

Based on previous criticism of a lack of attention to the quality of screen time engagement in research, Astatke et al. (2023) examined the purpose of screen time use as a crucial factor. They discussed that social network site (SNS) use was positively as well as negatively related to academic achievement in secondary school students depending on the manner of engagement. Some studies reviewed showed a positive relation to academic achievement for instance for the use of YouTube as well Facebook, which can be explained with informational and social resources relevant to learning that these sites can provide.

Also, negative relations of SNS were found. Non-education-related use, for instance to cope with boredom or use outside of the traditional academic spectrum such as to engage in political activities, was related to poorer grades in this study. Regarding the latter result, it should be noted that traditional measures of academic success relying solely on grades, as has been employed in this study, are not able to capture other aspects of education such as citizenship engagement and youth activism.

Additionally, excessive SNS use compared to moderate use was associated with overall worse academic performance, skipping class, displaced conventional learning activities and internet addiction. On top of the direct relation to academic performance, a row of moderating variables including for instance gender, sleep time, learning

environment, time management skills, school day and non-school day behaviors that influence the relation were identified by Astatke, Weng & Chen (2023). Additionally, three mediating factors encompassing sexually explicit material use, intention towards cyberbullying and internet addiction were found. While all of these are relevant, a separate discussion is out of the scope of this review.

For adolescents aged 11 to 15, girls' SNS use was found to result in lower English achievement, and for boys this was the case for SNS use before bedtime. Regardless of gender, SNS use before bedtime was related to overall lower achievement, these associations were however small. Further, time management skills influenced the relationship through, for instance, contained use of SNS for purposes of socialising. Lastly, undifferentiated use of SNS on school and non-school days was related adversely to academic performance, indicating that not only which device for what purpose, but also the point in time of use matter.

Examining the quality of the evidence reviewed, the authors conclude several problems severely limiting the conclusions that can be drawn. Similar to Adelanto-Renau et al. (2019) they note a lack of scientific consensus in the studies on the nature of the link between SNS use, which may reflect methodological problems in operationalising variables such as screen time use coherently across studies. Additionally, they note a lack of studies examining moderating and mediating variables, which confer a more nuanced picture of the effects. Rather, these variables are included only as confounders in the study design hence impeding an examination of their active role in the relationship. Lastly, an overrepresentation of cross-sectional studies and therefore a lack of causal evidence was criticised.

Equally criticising the aforementioned limitations and urging for specific technical improvements of measurements of variables, Oswald et al. (2020) focused their review on examining the effects of screen time and green time together, one as a risk and another as a protective factor for psychological outcomes. The latter aimed to capture mental health, well-being, cognitive functioning as well as academic achievement for children of all different age groups ranging from young children below five to eighteen-year-olds. Compared to the previous two reviews, Oswald et al. (2020) observed more consistency among the study results, which were presented by age group. According to the authors, a clear trend of screen time being linked to less favourable psychological outcomes and green time being linked to more favourable outcomes could be observed. Green time in this context is used as a broad term encompassing "exposure to or time spent in nature" (Oswald et al., 2020). Especially early childhood (>5years) and early adolescence (11-14) as crucial developmental phases showed more significant positive relationships, while results for school children (5-11) and late adolescents (14-18) were less significant.

For green time, a lot of inconsistency between the manner of measurement of the concept was found between studies. Generally, children and adolescents seemed to benefit from spending time in nature and some concepts such as green education contexts including education outside of the classroom, were positively linked to psychological outcomes. As the authors stressed, to be able to discern which attributes of green time specifically may be related to favourable psychological outcomes and how

engagement with them can be fostered, needs more systematic research, albeit first indications into a positive direction (Oswald et al., 2022).

Another interesting observation that merits discussion, was a disproportionate negative effect of screen time on students from lower socioeconomic background. At the same time this group was also found to benefit more from green time compared to advantaged SES students. As the authors note, an opportunity can be seized here to buffer the disproportionate negative effects for disadvantaged SES students by providing them with more natural environments to engage in their communities and schools (Oswald et al., 2020). In relation to this, the value of investigating screen time and green time in relation to each other in future studies to test potential buffer and restorative effects was emphasized.

Despite methodological limitations that impede a thorough synthesis of studies, the overall trend shows a negative impact of certain types of screen time on educational and psychological outcomes that might be influenced by various factors such as gender, sleep, socioeconomic status and time spent in nature. To explore the empirical literature beyond these limitations, it is wise to take a closer look at studies with a longitudinal empirical design. Thus, in the next section a synthesis of selected longitudinal studies will be conducted that could allow to observe the development of influence of screen time on academic achievement over time.

Section II: Evidence from Longitudinal Studies

Eleven relevant longitudinal studies have been identified that attempted to measure the relationship between screen time and academic achievement with data spanning a timeframe of at least one year.

The studies reviewed here examined age ranges of children from four years to eighteen years of age. A majority focused on the transition from childhood to adolescence between ages nine and fourteen years old.

Combined and independent influences of lifestyle behaviours

Several studies have examined the influences of lifestyle factors such as movement, nutrition, sleep and screen time on academic achievement, reasoning that it may often be a combination of those factors, rather than their isolated occurrence which impacts youth's school performance. In a one-year longitudinal study, Faught et al. (2019) investigated the relationship between adolescents' adherence in grades 9 to 11 to recommendations for diet, physical activity, screen time and sleep with academic achievement. They found that while screen time was the variable that was the least adhered to by adolescents among all behaviours, lower screen time was one of few variables that was consistently related to higher academic achievement. Additionally, strongest effect sizes were found when behaviours were adhered to over time, meaning they showed a positive relationship at baseline as well as follow up measures. Similarly, Ramer et al. (2022) examined the impacts of so called 24h movement behaviours, meaning the physical activity, sleep and recreational screen time you exhibit within a day, on the cognition of students in grades 5 to 9. While screen time was positively associated with poorer cognition and academic performance in grade 9, high levels of physical activity and sleep interacted with screen time and blunted the relationship. In their conclusion the authors further noted that the type of screen time and whether or not it elicits cognitive engagement were relevant in influencing cognitive functioning.

Examining the independent influences of physical activity and screen time on academic outcomes, Poulain et al. (2018) further support the notion that screen time can – not only in interaction with other lifestyle behaviours, but also independently – influence academic achievement. The performance of their sample of German students between the ages of 10 and 17 in mathematics was predicted by lower screen time mostly due to lower use of PC and internet. This was however not the case for language performance, which was not influenced by PC use. Their findings raise two interesting points: firstly, not all academic skills may be equally affected by screen time use and secondly, the different types and uses of screens may affect skills differently.

Type of screen time matters

In their four-year longitudinal study in a sample of Australian students between the ages of 10 and 14, Sanders et al. (2019) precisely followed this line of argumentation, looking at the differential effects of five distinct kinds of screen time behaviours and their relation to physical, socioemotional and educational outcomes. They discovered that overall passive screen time such as watching TV was associated with worse outcomes on all three measures. Findings of another longitudinal study align with this, showing a cumulative negative effect on literacy and numeracy skills of 10 to

11 year-olds that were watching TV for more than two hours a day over a prolonged period of time (Mundy et al., 2020). The learning losses amounted to four months for reading as well as for mathematics. In the same study, use of a computer for more than one hour per day over an extended period was equally associated with learning losses in numeracy of about 4 months. Screen time use for social activities had the most complex outcomes showing no effects on educational outcomes and a row of negative and nonsignificant effects for other indicators. Related to this, two other longitudinal studies reported very small associations with video chatting and texting that had low predictive power for academic achievement indicating that these activities do not significantly influence adolescents' engagement in schoolwork (Paulich et al., 2021; Tak & Catsambis, 2023). Screen time used for educational purposes, however, positively related to academic achievement.

Sanders et al. (2019) further examined interactive screen time which for instance includes video gaming. Here, they found a positive effect on educational outcomes, however negative ones for health and socioemotional indicators. This is contradicted by Mundy et al. (2020) who found no relationship between video game use and academic performance. This inconsistency reflects the general trend in the literature, that, as was observed by Tak & Catsambis (2023) in their longitudinal study, might reflect the negligible effect that video gaming specifically, and screen time in general has on academic achievement in comparison with other factors of influence.

Explanatory Power and Third Variables

The sometimes-small effect sizes found in longitudinal studies presented here indicate that the impact of screen time use on academic success may not be direct or strong. Instead, important factors may mediate and moderate this relationship, making it more indirect in nature. To explore this further, a selected number of studies exploring possible pathways leading from screen time to school performance will be examined in this section.

Cognitive Control

Aside from academic achievement, Dubuc et al. (2019), also measured cognitive control as an executive function that is regarded as a "determining factor of academic performance". An analysis of their longitudinal data showed that screen time was a better predictor of cognitive control than academic achievement, which was better explained by other variables such as sleep. This indicates that screen time may influence academic achievement indirectly via the route of cognitive control. However, it has also been discovered that sleep may be a moderator between screen time use and academic achievement, and thus demonstrates the variety of pathways to school success that screen time may be operating in (Syväoja, et al., 2018). This will be further elaborated upon in Section III.

Emotion Dysregulation

Another factor which has been examined in a four-year longitudinal study on young children entering school is emotion dysregulation. This concept refers to difficulties in controlling and managing emotional states, resulting in intense prolonged emotional reactions. Following a cohort for four years, Cerniglia et al. (2020) established emotion dysregulation as a mediating factor, that explained the relationship between screen use

and academic grades. Specifically, screen time use at four years of age predicted mathematic grades at the age of eight. Maternal scaffolding³ of children's media use acted as a buffer in preventing the negative effects of screen time as lack thereof was associated with worse outcomes. This indicates that the use of media might influence children's ability for self-regulation, which is relevant for managing learning. Interestingly, literacy scores were not mediated by emotion dysregulation, supporting the previous remark that not all academic outcomes are affected equally and through the same mechanisms by screen time.

Socioeconomic Status

In several studies, socioeconomic status has been measured as a confounding factor in the relationship between screen time and academic achievement. Two longitudinal studies have examined its role as a third variable, highlighting its cruciality in shaping this relationship (Bohnert & Garcia, 2023; Camerini et al., 2018). In their sample, Bohnert and Garcia (2023) focused on children and adolescents aged 9 to 18, while Camerini et al. (2018) focused on those transitioning from childhood to adolescence in the range between 10 to 15 years old. Both studies supported previous findings that engagement with screens for educational purposes had a positive effect on academic performance, while communication or entertainment use was related to poorer educational outcomes. Adding socioeconomic status to the relationship however showed a clear pattern of advantage of digital media access, use and academic outcomes for students from advantaged SES backgrounds. Bohnert & Garcia (2023) found a significant improvement of mathematics and English grades for the educational use of screens in advantaged SES students, that was not replicated in disadvantaged SES students. On the other hand, a positive relationship between externalising problems and the number of hours spent online was found for students from disadvantaged SES that did not apply to those from advantaged SES. Additionally, students from disadvantaged SES backgrounds had less access to digital devices, spent more of their screen time with entertainment, had overall worse academic outcomes and lower well-being (Bohnert & Garcia, 2023; Camerini et al., 2018).

These results reveal a strong pattern of disadvantage and additional vulnerabilities for students from disadvantaged socioeconomic backgrounds in relation to engagement with and outcomes of digital device use. Consequently, these differences can contribute to increased academic inequality and may threaten equity in students' learning journeys.

Interim Discussion

In summary, the longitudinal data on the relation between screen time and academic achievement paints a picture of complexity, emphasising the need for a holistic view on academic achievement. As such, we can recognize that screen time interacts with other health behaviours such as sleep, physical exercise and nutrition in affecting learning. Most beneficial outcomes are yielded when children adhere to all health

³ Scaffolding is a term associated with the developmental psychological theory on the "Zone of Proximal Development" (Ness, 2020). It describes the behaviour of a parental figure guiding their child in acquiring a certain skill through setting frame conditions and boundaries within which the child can freely explore and grow.

recommendations such as those suggested by individual countries and the WHO in relation to sleep, movement, screen use and nutrition, over an extended period of time.

Equally, the literature shows a need to break down the umbrella term screen time into different purposes of use which impact school achievement differentially with educational use leading to positive outcomes while use for entertainment, particularly internet and social media shows more negative effects. More nuanced distinctions also need to be made when it comes to academic outcomes, as several studies have found negative effects on mathematics, but not on language and vice versa depending on the study design.

Lastly, the lack of direct predictive power of screen time has documented the relevance of intermediate factors that influence academic achievement. Besides cognitive control and emotion dysregulation, socioeconomic status strongly influences the relationship, which aligns with the review of Oswald et al. (2020), that shows a similar pattern of disproportionate negative effect of screen time on students from disadvantaged SES including more time spent on entertainment and lower benefits from educational screen time. Taken together, they suggest that screen time is but a small drop in the ocean of factors influencing academic achievement. Decision makers should keep in mind how this variable interacts with other factors of more significance, such as social inequality, when creating policies for the educational context.

Section III: Potential Underlying Mechanisms

In this section, literature that provides a more qualitative understanding of how exactly screen time can influence academic achievement via different pathways will be discussed.

Brain Development and Cognitive Functioning

To understand the impact of screen time on academic achievement, it is necessary to examine how early exposure to screens may influence child development in crucial periods of infancy. From the age of zero to three years old, young children have high brain plasticity and are extremely susceptible to environmental influences on their development. While the World Health Organisation (2022) recommends absolute abstinence from screen time for children below two years of age, Courage (2018), reports 90% of children being exposed to screen media at least between one to two hours per day with an additional exposure of up to five hours from background television intended for adults. In the following sections, some tentative findings from literature that highlight the negative impact on brain development in different domains and have implications for academic achievement will be discussed.

Language Development

In an extensive review on the effects of screen time on child development, Panjeti-Madan and Ranganathan (2023) found that length of media exposure during the first six months of life correlated with lower cognitive and language development at fourteen months old. This negative pattern was also found for the exposure to adult-oriented content, such as background television. Generally, screen time, in particular watching TV was linked to lower communication scores in babies and toddlers. This may be due to a replacement of parental interaction with their children, which is a crucial driver of child learning and development at this age, with passive television viewing (Courage, 2018). Studies on the benefits of baby videos for language learning supported the notion that learning mostly took place when parents interacted with children during video viewing to give explanations and provide scaffolding (Courage, 2018). Thus, learning mostly took place due to direct interaction indicating that educational videos or television in early childhood do not have added value for development. Somewhat contradictory however are findings from another review by Srivastava & Patkar (2023) that observes a rather inverted U-shaped correlation between screen time and language development for children of age two. They argue that moderate screen use compared to none or too much showed the best language outcomes. These different outcomes may be due to the inclusion of studies with varying measurements of screen time that make comparison between studies difficult. A clear exemption from negative impacts was the participation of toddlers in video calls with remote family, which was found to have a positive effect on childrens' communication skills and the forming of social bonds (Panjeti-Madan & Ranganathan, 2023).

Studies examining relationships between brain structure and screen time in children, can offer some insights into potential underlying mechanisms of impeded language development. As such, brain areas relevant for language and literacy skills were found to be less developed in children with excessive screen time engagement (Neophytou et al., 2021; Srivastava, 2023).

In sum, language learning, especially during the crucial first few years of life, can be impeded by excessive screen time exposure of children.

Memory

Not only language learning, but also memory can be affected by screen time. Manwell et al. (2022) report worse reading comprehension when reading on digital sources compared to paper, which may potentially be due to impediment of mental representation of text when navigating virtually, multitasking or superficial text scanning. The latter seems to be more common when working with digital sources, while text on paper stimulates more depth processing (Manwell et al. 2022). In order to equally benefit from reading virtual sources, it is necessary to change processing orientation, a task which according to Manwell et al. (2022) requires metacognition and self-regulation, which may be harder for younger children. Further, screen time use was connected to a decline in explicit memory, which includes memory of events (episodic memory) as well as memory of facts (semantic memory). Similarly, Neophytou et al. (2021) link screen time to negative effects on memory, which is impeded by stress, particularly sensory overload, induced through media use.

Witnessing the shift to using more digital devices for reading and studying in schools, these findings underline the importance of reflecting on appropriate age for beginning to use digital devices in the classroom as well as which additional competences learners need to appropriately use them in order to benefit from their digital learning experience.

Chronic Stress

Looking further into underlying mechanisms of problematic screen time use, chronic stress has been proposed to lead to maladaptive brain development. Chronic stress is defined as a prolonged reaction due to frequent or very intense exposure to stressors that results in incapability of the body to activate relaxation systems (Russell & Lightman, 2019). The constantly heightened stress hormone levels accompanying this, can negatively impact the body's regenerative systems and thus, endangering health. As Neophytou et al. (2021) argue in their review, chronic sensory overstimulation due to premature exposure to screens can impede neurodevelopment. For very young children they cited evidence for impeded development in several cognitive domains such as language, attention, memory and learning. For adolescents, changes in neurophysiology of the brain were noted in relation to internet gaming disorder and excessive social media use.

The negative impacts of chronic stress caused by events such as adverse childhood experiences⁴ on brain development have been extensively researched and show detrimental effects especially for very young children (Smith & Pollak, 2020). Whether digital device use can be regarded as factor inciting a similar level of stress as postulated by the researchers is contentious and requires more empirical testing.

⁴ Includes the following stressful or traumatic events occurring in childhood: physical, emotional, sexual abuse; neglect; drug/alcohol abuse in the household; mental domestic violence; familial mental health issues; loss due to separation or divorce of parents; loss due to bereavement; incarceration of a family member, which disrupt a child's physical or psychological health and development (Collingwood, et al., 2024)

Executive Function

Attention

There is some evidence below the clinically relevant threshold of poorer executive functioning in preschoolers in relation to watching TV, however studies claiming a link between watching TV between ages of one and three and development of ADHD have been criticized on grounds of poor study design and lack of alternative explanations (Courage, 2018). The author notes that reasons for this may be complex and may depend on factors such as child temperament and parenting strategies as well as content of screen exposure. Background television, for instance, may distract children from their play, as their attention control is not very well developed at this age and could potentially overwhelm them. As Silva Santos et al. (2022) synthesised in their review, for children between the ages zero and six, screen time was more predictive of attention problems later, for school-aged children the likelihood of above average attention problems rose only for those using screens more than two hours per day.

Pre-adolescents (nine to twelve) use of screens was not related to attention problems. The authors explained this change in correlation with high brain plasticity at a young age which makes children more susceptible to negative external influences in development. Further, Manwell et al. (2021) review literature which presents multitasking as a habit of digital natives that impedes attention and leads to shallow information processing, rapid attention shifts, less executive control and worse academic performance.

In sum, research finds that attention capacity may be influenced by screen time, however whether this is causal is unclear and reflections on pathologization of this phenomenon are raised. While overstimulation at early age and multitasking in adolescents are mentioned, which mechanisms exactly drive the loss of attention remain unclear.

Reward and inhibition

Equally included in the area of executive functioning, reward and inhibition systems in the brain can be affected by screen time. Manwell et al. (2022) report structural brain changes including prefrontal cortex thinning associated with excessive gaming, as well as reduced hippocampal thickness and temporal lobe thickness with excessive social media use. While the former is important in processes such as inhibition and decision making, the hippocampus has been linked to memory function and the temporal lobe is a centre for language (Helmenstine, 2024).

Not only structural, but also functional changes can be found in relation to screen time. Evidence seems to support the notion of a dual system theory of excessive screen use (Manwell et al. 2022). Especially in adolescence, screen time can create an imbalance between the brain's reward system, which becomes hyperactive due to easily available gratifications of media use, and a hypoactive inhibition system (Oswald et al., 2020). As inhibition is typically a function located in the prefrontal cortex - an area of the brain that is only fully developed by the age of 25 - adolescents are particularly susceptible to the quick gratification and rewards that some digital media can offer them. Moreover, habitual engagement in reward and gratification seeking might in turn impede the proper development of the inhibition system, putting adolescents at risk of

overly using these types of digital media. An observational study with representative samples of children from nine European countries (Belgium, Estonia, Cyprus, Hungary, Italy, Germany, Poland, Spain and Sweden) aged eight to eighteen supports this interpretation (Sina et al., 2023). They found a positive relationship between smartphone exposure and impulsivity. As impulsivity results from a lack of inhibition, it can be seen as a specific example of a maladaptive association pattern related to excessive screen time.

Further interesting results from this study were associations found for media multitasking (Sina et al., 2023). Higher media multitasking was positively associated with impulsivity and cognitive inflexibility, with gender, age and family structure as moderating factors. Girls, adolescents and those living in a two parent household showed higher impulsivity with either high digital media use except smartphones, or high smartphone/internet use, medium TV and low PC use. This study reproduced a gender effect that has previously been observed in reviews as well. A possible explanation according to the authors is a higher smartphone and internet use in girls paired with more negative effects of smartphone and internet use on executive functioning, putting them at a higher risk (Sina et al., 2023).

Emotion Regulation

Emotion regulation has also been associated with excessive screen time use. Panjetti-Madan et al. (2023) concluded in their review that higher media use was associated with emotion dysregulation in early childhood. They warn parents from the dangers of using digital devices as a means of handling the emotions of their children as this may be detrimental to the development of healthy emotion regulation skills. What can be observed is a mutually reinforcing cycle in which difficult emotions are dealt with through digital media use, which at the same time impedes the learning of healthier mechanisms, leading to even more dysregulation.

Taken together this indicates that children and adolescents may be using screens as a means of coping with their emotion and life stressors, which may be qualified as a dysfunctional and unhealthy approach employed because of lacking alternative strategies. More use of screen time in this maladaptive way, may in turn contribute to increased emotion dysregulation, creating a mutually reinforcing mechanism.

Mental Health

While profound difficulties with emotion regulation alone may already pose complications to engage with study materials in a focused and persevering manner, the empirical link between emotion dysregulation and mental health holds a much larger implication for successful learning.

Among others, Hilty et al. (2023) reviewed a longitudinal study on Facebook use and well-being outcomes as well as loneliness. They report that four weeks of Facebook deactivation led to small increases in well-being, however no change for loneliness. Here it was relevant how exactly youth were using the social network: active use was associated with peer bonding and social capital, while passive use did not. Research on social media and its effect on users points towards the detrimental well-being effects of social upward comparison instilled by passively viewing posts on social media without actively participating (Orben et al., 2024). This supports the previous finding cited by

Hilty et al. (2023). In addition to differences in quality of use, also gender and the quantity of hours spent using social media were found to be relevant. As was previously mentioned, also Hilty et al. (2023) mentioned girls to be more negatively affected in their well-being for moderate to heavy consumption presumably due to increased use of smartphone, internet and social networking sites. Teenagers aged 13 to 15 years of which a not unsubstantial amount reported being heavy users (26.2% of girls, 11.9% of boys in sample) of more than five hours per day that were more likely affected by mental health issues regardless of gender (Twenge & Farley, 2021).

Beyond well-being in a broader sense, this review additionally examined studies with clinical populations affected by depression and anxiety. Here they aligned with other reviews indicating that negative effects of social media use accumulated after a threshold of 3 hours of daily use with social media and internet showing worse results on depressive and anxiety symptoms compared to TV and gaming. Additionally, girls aged 13 to 15 were disproportionately affected, confirming the gender effect also in a clinical sample of participants. Citing evidence from linguistic studies of Twitter posts, the authors highlighted associations between excessive social media use, depression, suicide and school burnout (Hilty et al., 2023). The latter describes a state of exhaustion due to study demands, coupled with cynical attitude toward school and feelings of inadequacy or low self-efficacy as a student (Jovčić & Simić, 2024). According to the evidence, the relationship between social media use and school burnout seemed to be bidirectional with each increasing the other in a vicious circle, thus strongly interfering with health and academic achievement.

In sum, it seems that the use of screens, particularly social media coincides with lower well-being and affective disorders, disproportionately affecting girls and heavy users. The relation of excessive screen time to school burnout underlines the relevance of supporting students in cultivating healthy relationships with their devices.

Time Displacement

Several reviews that examined a variety of studies have presented empirical findings that support the so-called "time displacement hypothesis". It postulates that children and adolescents spend increasingly more time in front of a screen during their leisure time, which leads to a displacement of other behaviours such as physical exercise, sleeping early or studying which are crucial for health and academic success (Marciano et al., 2022).

Sleep

Several reviews and studies provide support for time displacement as an explanation for the impact of screen time on academic achievement. As reviewed earlier in this paper, sleep may act as a moderator between screen time and educational success as measured in grade point average (GPA) (Syväoja, et al., 2018). A cross-sectional study by Hisler et al. (2020) with a sample of 13 to 15 year old students examined the impact of screen media use on sleep. They observed that heavy users of screen media were likely to sleep less and have a poorer quality of sleep, while the strongest associations were found for social media and internet as types of screen media. Four mechanisms of influence of screen media on sleep were proposed which apply to this sample: most strongly supported by the study is a procrastination of bedtime due to the use of screen media before going to sleep resulting in less overall

sleeping time. Further, heightened levels of excitement due to social interaction in media including excitement and frustration was another reason. Additionally, light emissions from the devices could prevent natural increase in melatonin, a hormone that increases during the day and prepares the body for sleep (Pinel & Barnes, 2014; pp 383-384). Lastly, incoming notification from devices may disrupt the process of falling asleep.

In order to grasp the implications of the lack of sleep produced by heavy digital device use before bedtime, it is important to understand the crucial role of sleep for youth's learning and daily functioning. Sleep fulfils many functions starting with physical restoration and immune function recovery during deep sleep phases, however most pertinent to learning is the memory consolidation that occurs during REM sleep (Mukundan et al., 2021). Moreover, and potentially more importantly, a lack of sleep impedes cognitive functioning during the day, greatly impairing ability to focus and concentrate, which is crucial for following classes in school as well as being able to focus on studying and homework (Pinel & Barnes, 2014; pp. 371-379).

Physical Activity

While too much sedentary time in general has been found to be unhealthy, in line with the time displacement theory, sedentary time spend on screens instead of studying or engaging in other health behaviours such as sleeping, or exercise may have a negative effect on academic success. Wilhite et al. (2022) for instance concluded from several studies reviewed that high physical activity combined with low sedentary time and high sleep had the best relation to academic outcomes. However, when sedentary time was non-screen related, the amount of physical activity became irrelevant suggesting that sedentary studying behaviour is the more important predictor of academic success. Nonetheless, Syväoja, et al. (2018) found that regardless of whether sedentary time was spent studying or not, GPA was positively influenced through physical activity (as measured in aerobic fitness) as a moderator.

All in all, negative impacts of screen time on school performance may become especially apparent when they act through the displacement of important health behaviours such as sleep and physical activity. As these lifestyle behaviours interact and influence each other, adhering to all recommended health guidelines for physical activity, sleep and screen time yields the best outcomes.

Discussion

This literature study reveals a complex relationship between screen time and academic achievement in children and adolescents. While the overall trend indicates that excessive screen time exceeding two to three hours of use per day is generally associated with poorer academic outcomes, particularly in subjects like mathematics, the picture is nuanced. Tables 1 & 2 in the annex provide an overview of research results sorted by age groups as well as per type of screen time activity will be summarized and contextualized in the following paragraphs.

Age-specific findings

Research focusing on infants shows that brain development in the areas of cognition notably language acquisition, executive functioning and emotion regulation may be negatively influenced by screen time, particularly television. One potential mechanism may be sensory overstimulation through premature exposure through screen time at this age. While this evidence points towards a potential impact of screen time on brain development, findings from other reports highlight the importance of gathering more scientific evidence before drawing conclusions. Gottschalk (2019), for instance questioned to which degree technology can “rewire” parts of children’s brains and stressed that, at this point, the literature cannot establish any causality, nor indicate underlying mechanisms. Additionally, this paper found that the lack of caregiver interaction through parental screen use may impede development at an early age. Learning of language and communication skills may however take place when caregivers use screens together with children and scaffold their engagement. This co-viewing process has equally been found as an opportunity for scaffolding in the literature (Gottschalk, 2019).

Research explicitly focused on children of elementary school age showed attention problems and decreased literacy and numeracy skills for excessive (>2h per day) screen time, particularly TV.

Research featuring adolescents focused more on gaming, social media and Internet use as screen time types. Evidence about the effects of video games on academic achievement was inconclusive. Higher use of screens was broadly associated with worse cognition and academic performance and specifically PC and Internet use with mathematics grades. Girls, students from disadvantaged SES and heavy users showed more vulnerability to negative effects of screen time including mental health and behavioural issues. Healthy lifestyle factors such as sufficient sleep and physical movement interacted with screen time and had a protective effect for academic achievement. The implications of using screens before sleeping and their negative impact on sleep quality have been noted in a recent report by the OECD as well (Gottschalk, 2019).

Age-transversal findings

Applicable to all ages, similar trends emerge for the purpose of screen time use. While passive consumption for non-educational purposes seems to be negatively related to academic achievement, educational use has been found to have a positive impact. This aligns with other literature on the topic such as a recent OECD report on the impacts of technology use on children, which equally stressed the importance of considering

differences in outcome according to type of screen time activity (Gottschalk, 2019). Another group of researchers distinguished in their study between negative influences of passive screen time versus positive influences of active screen time (Hu et al., 2020). Table 2 in the Annex presents a more detailed overview.

Additionally, this review noted that individuals engaging in screen time activity beyond a threshold of 2 hours per day and especially with more than 5 hours per day, showed worse outcomes in learning and academia, but also well-being and mental health. In relation to mental health, other studies find similar results with decreasing psychological well-being for moderate use starting from 1 hour per day and twice the likelihood of a diagnosis for depression or anxiety for heavy use of screens (7+ hours a day) with stronger effects in adolescents (Twenge & Campbell, 2018). Developmentally, these worse outcomes consisted of impacted cognitive development as well as executive functions. Here, notably attention and emotion regulation were impacted across all ages. These previous findings are linked to a recent NESET report on the effects of digital technology on empathy and attention capacity of children and adolescents (Flecha et al., 2020). The authors reported mobile devices, video games and computers to have a distracting effect on attention capacity for more than two hours of time spent on digital technology on school days for non-educational purposes, which aligns with several of the findings presented in this review. While socioeconomic status crystallized as a strong negative influence interacting with academic achievement and screen time use, a mitigating factor was found to be parental scaffolding of children's screen time use.

Implications

The crucial role of socioeconomic status

As some studies have shown, when SES is taken into account in the relation between screen time and academic achievement, its explanatory power far exceeds the effects of screen time. This taken together with repeated findings that children from lower socioeconomic background are more negatively affected by screen time is crucial to note. Moreover, when comparing the academic outcomes of educational screen time use between the groups, it was observed that students from advantaged SES significantly benefited from learning-oriented screen time use while those from disadvantaged SES did not. While more advantaged children may have many means of compensating for negative effects of screen time, or a different management thereof altogether, youth from more disadvantaged SES have less of these protection mechanisms at their disposal. This pattern of disproportionate effect on learning for children from disadvantaged SES parallels the findings of a recent study by the Joint Research Center (JRC) of the European Commission focused on learning losses after the COVID 19 pandemic (Schnepf et al., 2024). This raises the question: What role screen time use of different socioeconomic groups may have played in determining learning outcomes during the pandemic?

Other Risk Factors

Two other risk factors for negative impacts of screen time on learning are worth mentioning: social media use and emotion dysregulation difficulties. The former has been shown to be strongly linked to lower well-being and academic achievement.

Especially girls, who were found to use screens more for social activities online compared to boys, seem to be vulnerable to its effects.

Emotion dysregulation as a mediating factor is further quite concerning as it is not only essential for self-management, but also linked to the aetiology of mental health disorders. While longitudinal evidence points to its causal role in decreased academic achievement, it is uncertain whether emotion dysregulation is a cause or a consequence of screen time. As has been noted by several researchers in the presented studies, it is difficult to discern whether children and adolescents are using screens as a coping mechanism to deal with their emotions or whether screens are preventing them from learning adequate emotion regulation or both.

Protective Factors

Apart from socioemotional learning, also other factors have been identified which can protect children and adolescents from the adverse consequences of screen time. These included healthy lifestyle behaviours, in particular adhering to official national and international health guidelines for sufficient physical exercise and sleep. Especially the latter has received a lot of support in the literature showing that bedtime displacement due to screen use, especially with smartphones, can have an influence on daytime alertness and executive functioning crucial for schoolwork. Moreover, spending time in natural environments ("green time") was tentatively proposed as a potential protective factor for the negative effects of screen time. Particularly students from more disadvantaged SES benefitted more from spending time in nature. This may be related to more disadvantaged SES students having less access to green spaces in their neighbourhoods in general compared to advantaged SES, with additional exposure raising the potential for reductions in inequality (Böhme, Franke, & Gröschel, 2023).

Lastly, parental scaffolding of media use, was found to be positively linked with higher school achievement.

The key conclusions and recommendations

The number of hours spent with screens, the quality of engagement as well as personal characteristics of individual users and their environment are significant influences on academic outcomes. Schools and policy makers are actors that need to provide guidance for children empowering them to develop a healthy and beneficial relationship with their devices, while at the same time placing special protection mechanisms for those who are most vulnerable to the negative effects.

Recommendations for educational institutions

The cultivation of a healthy attitude to and good use of digital devices is crucial for children and adolescents during vulnerable development phases. Schools can support students by establishing and implementing empowering curricula that include digital literacy, and also encourage students to think more holistically and recognize the integral links between digital device use, their own health, and the health of their environment.

The influence that screen use outside of the school context appears to have on school achievement is evidenced. Schools need to further strengthen their collaboration with caregivers to raise their awareness of correct screen time management and the

importance of parental scaffolding in child media use. On top of advice for guiding childrens' screen intake, parents' and educators' awareness which signals their personal digital media sends to youth and how it may influence them, should be strengthened.

Given the crucial mediating role that emotion dysregulation plays in the relation between screen time and academic achievement, schools and educators should aim to strengthen emotion regulation skills of learners by including elements of social and emotional learning into curricula and lessons.

Recommendations for policy makers

To ensure a smooth implementation of digital and health literacy curricula in schools, policy makers should support the effort by allocating adequate funding for their development and implementation.

Given that different age groups of children engage in different types of digital activities and are not affected by their use in the same way, policy makers should work on establishing age-specific guidelines, not only for the quantity of screen time, but also considering different types of screen activities, developmental vulnerabilities as well as risk and protective factors.

Recognizing the pattern of interaction between social inequality and digital device engagement, policy makers should implement policies to prevent or address successive academic inequalities, ensuring benefits from digital device use are equally attainable for learners from all socioeconomic backgrounds.

The complexity of the relationship between screen time and academic achievement has indicated that there are a variety of influences next to screen time determining academic achievement. Keeping the improvement of educational outcomes for all learners as the ultimate goal of educational policy in mind, further research should be conducted that can help to discern the impact of screen time and weigh its' influence in comparison with other known determinants of educational outcomes. Factors, such as social inequality, remain highly relevant, and merit ongoing attention next to the newly emerging policy field of digital technologies.

References

- Adelantado-Renau, M., Moliner-Urdiales, D., Cavero-Redondo, I., Reyes Beltran-Valls, M., Martínez-Vizcaíno, V., & Álvarez-Bueno, C. (2019). Association Between Screen Media Use and Academic Performance Among Children and Adolescents: A Systematic Review and Meta-analysis. *JAMA Pediatrics*. doi:10.1001/jamapediatrics.2019.3176
- Astatke, M., Weng, C., & Chen, S. (2023). A literature review of the effects of social networking sites on secondary school students' academic achievement. *Interactive Learning Environments*, 31(4), 2153-2169. doi:https://doi.org/10.1080/10494820.2021.1875002
- Böhme, C., Franke, T., & Gröschel, L. (2023). *Umweltgerechtigkeit im Städtebauförderungsprogramm "Sozialer Zusammenhalt"*. Deutsches Institut für Urbanistik. Obtido de <https://backend.repository.difu.de/server/api/core/bitstreams/0012e99f-46bc-45c9-83da-1276e9b54303/content>
- Bohnert, M., & Garcia, P. (2023). Digital use and socioeconomic inequalities in adolescent well-being: Longitudinal evidence on socioemotional and educational outcomes. *Journal of Adolescence*, 95, 1179-1194. doi: 10.1002/jad.12193
- Bolt, N. (2011). Academic Achievement. Em S. Goldstein, & J. A. Naglieri, *Encyclopedia of Child Behavior and Development* (pp. 8-9). Boston, MA: Springer.
- Camerini, A.-L., Schulz, P. J., & Jeannet, A.-M. (2018). The social inequalities of Internet access, its use, and the impact on children's academic performance: Evidence from a longitudinal study in Switzerland. *new media & society*, 20(7), 2489-2508. doi:10.1177/1461444817725918
- Cerniglia, L., Cimino, S., & Ammaniti, M. (2021). What are the effects of screen time on emotion regulation and academic achievements? A three-wave longitudinal study on children from 4 to 8 years of age. *Journal of Early Childhood Research*, 19(2), 145-160. doi:10.1177/1476718X20969846
- Cheng, C., Lau, Y.-c., Chan, L., & Luk, J. W. (2021). Prevalence of social media addiction across 32 nations: Meta-analysis with subgroup analysis of classification schemes and cultural values. *Addictive Behaviors*, 117. doi:https://doi.org/10.1016/j.addbeh.2021.106845
- Collingwood, S., Knox, A., Fowler, H., Harding, S., Irwin, S., & Quinney, S. (2024). *The little book of adverse childhood experiences*. Obtido de National Education Union: <https://neu.org.uk/sites/default/files/2024-08/NEU3548%20Little%20book%20of%20adverse%20childhood%20experiences%20%28ACEs%29%20v2.pdf>
- Courage, M. L. (2017). Screen Media and the Youngest Viewers: Implications for Attention and Learning. Em F. C. Blumberg, & P. J. Brooks, *Cognitive Development in Digital Contexts* (pp. 3-28). London: Academic Press. doi:https://doi.org/10.1016/B978-0-12-809481-5.00001-8

- Courage, M. L. (2018). Chapter 1: Screen Media and the Youngest Viewers: Implications for Attention and Learning. Em P. J. Fran C. Blumberg, *Cognitive Development in Digital Contexts* (pp. 3-28). Elsevier Inc.
- Darvesh, N., Radhakrishnan, A., Lachance, C. C., Nincic, V., Sharpe, J. P., Ghassemi, M., . . . Tricco, A. C. (2020). Exploring the prevalence of gaming disorder and Internet gaming disorder: a rapid scoping review. *Systematic Reviews, 9*(68). doi:<https://doi.org/10.1186/s13643-020-01329-2>
- Dubuc, M.-M., Aubertin-Leheudre, M., & Karelis, A. D. (2019). Lifestyle Habits Predict Academic Performance in High School Students: The Adolescent Student Academic Performance Longitudinal Study (ASAP). *International Journal of Environmental Research and Public Health, 17*(243). doi:10.3390/ijerph17010243
- EU Parliament. (18 de January de 2023). Consumer protection in online video games: a European single market approach. *Official Journal of the European Union*. Obtido de <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52023IP0008>
- Faught, E., Qian, W., Carson, V., Storey, K., Faulkner, G., Veugelers, P., & Leatherdale, S. (2019). The longitudinal impact of diet, physical activity, sleep, and screen time on Canadian adolescents' academic achievement: An analysis from the COMPASS study. *Preventive Medicine, 125*, 24-31. doi:10.1016/j.ypmed.2019.05.007
- Flecha, R., Pulido, C., Villarejo, B., Racionero, S., Redondo, G., & Torras, E. (2020). *Effects of the use of digital technology on children's empathy and attention capacity*. Luxembourg: Publications Office of the European Union. doi:10.2766/947826
- Goldstein, A. N., & Walker, M. P. (2014). The Role of Sleep in Emotional Brain Function. *Annual Review of Clinical Psychology, 10*, 679-708. doi:<https://doi.org/10.1146/annurev-clinpsy-032813-153716>
- Gottschalk, F. (2019). *Impacts of technology use on children: Exploring literature on the brain, cognition and well-being*. Education Working Paper No. 195, OECD. doi:<https://dx.doi.org/10.1787/8296464e-en>
- Helmenstine, A. (20 de February de 2024). *Parts of the Brain and Their Functions*. Obtido de Science Notes: <https://sciencenotes.org/parts-of-the-brain-and-their-functions/>
- Hilty, D. M., Stubbe, D., J., M. A., Hoffman, P. E., Zalpuri, I., T., M. M., . . . Li, S.-T. T. (2023). A scoping review of social media in child, adolescents and young adults: reserach findings in depression, anxiety and other clinical challenges. *BJPsych Open, 9*(e152), 1-12. doi:10.1192/bjo.2023.523
- Hisler, G., Twenge, J. M., & Krizan, Z. (2020). Associations between screen time and short sleep duration among adolescents varies by media type: evidence from a cohort study. *Sleep Medicine, 66*, 92-102. doi:<https://doi.org/10.1016/j.sleep.2019.08.007>

- Hu, B. Y., Johnson, G. K., Teo, T., & Wu, Z. (2020). Relationship Between Screen Time and Chinese Children's Cognitive and Social Development. *Journal of Research in Childhood Education*. doi: 10.1080/02568543.2019.1702600
- Jovčić, N., & Simić, N. (2024). Beyond the Edge of Exhaustion: Redefining the Concept of School Burnout Syndrome Through Qualitative Reexamination of Secondary School Students' Experiences. *School Mental Health*, 16, 500-517. doi:https://doi.org/10.1007/s12310-024-09654-w
- Kaye, L. K., Orben, A., Ellis, D. A., Hunter, S. C., & Houghton, S. (2020). The Conceptual and Methodological Mayhem of "Screen Time". *International Journal of Environmental Research and Public Health*, 17(3661). doi:10.3390/ijerph17103661
- Manwell, L. A., Tadros, M., Ciccarelli, T. M., & Eikelboom, R. (2022). Digital dementia in the internet generation: excessive screen time during brain development will increase the risk of Alzheimer's disease and related dementias in adulthood. *Journal of Integrative Neuroscience*, 21(1), 1-15. doi:10.31083/j.jin2101028
- Marciano, L., Ostroumova, M., Schulz, P. J., & Camerini, A.-L. (2022). Digital Media Use and Adolescents' Mental Health During the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. *Frontiers in Public Health*, 9. doi: 10.3389/fpubh.2021.793868
- Mukundan, T., Trosman, I., Donskoy, I., & Sheldon, S. H. (2021). Sleep health in children and adolescents. Em F. J. Nieto, & D. J. Petersen (Edits.), *Foundations of Sleep Health* (pp. 133-147). Academic Press. doi:https://doi.org/10.1016/B978-0-12-815501-1.00010-7
- Mundy, L., Canterford, L., Hoq, M., Olds, T., Moreno-Betancur, m., Sawyer, S., . . . Patton, G. (2020). Electronic media use and academic performance in late childhood: A longitudinal study. *PLoS ONE*, 15(9). doi:10.1371/journal.pone.0237908
- Neophytou, E., Manwell, L. A., & Eikelboom, R. (2021). Effects of Excessive Screen Time on Neurodevelopment, Learning, Memory, Mental Health, and Neurodegeneration: a Scoping Review. *International Journal of Mental Health and Addiction*, 19, 724-744. doi:https://doi.org/10.1007/s11469-019-00182-2
- Ness, I. (2020). Zone of Proximal Development. Em *The Palgrave Encyclopedia of the Possible* (pp. 1-6). Palgrave Macmillan, Cham. doi:https://doi.org/10.1007/978-3-319-98390-5_60-1
- Orben, A., & Przybylski, A. K. (2019). The association between adolescent well-being and digital technology use. *Nature Human Behaviour*, 3, 173-182. doi:https://doi.org/10.1038/s41562-018-0506-1
- Orben, A., Meier, A., Dalgleish, T., & Blakemoore, S.-J. (2024). Mechanisms linking social media use to adolescent mental health vulnerability. *Nature Reviews Psychology*, 3, 407-423. doi:https://doi.org/10.1038/s44159-024-00307-y
- Oswald, T. K., Rumbold, A. R., Kedzior, S. G., & Moore, V. M. (2020). Psychological impacts of "screen time" and "green time" for children and adolescents: A systematic scoping review. *PLoS ONE*, 15(9). doi: https://doi.org/10.1371/journal.pone.0237725

- Panjeti-Madan, V. N., & Ranganathan, P. (2023). Impact of Screen Time on Children's Development: Cognitive, Language, Physical and Social and Emotional Domains. *Multimodal Technologies and Interaction*, 30.
- Panjeti-Madan, V. N., & Ranganathan, P. (2023). Impact of Screen Time on Children's Development: Cognitive, Language, Physical, and Social and Emotional Domains. *Multimodal Technologies and Interaction*, 7(52). doi:<https://doi.org/10.3390/mti7050052>
- Paulich, K. N., Ross, J. M., Lessem, J. M., & Hewitt, J. K. (2021). Screen time and early adolescent mental health, academic, and social outcomes in 9- and 10-year old children: Utilizing the Adolescent Brain Cognitive Development (ABCD) Study. *PLoS ONE*. doi:<https://doi.org/10.1371/journal.pone.0256591>
- Pinel, J. P., & Barnes, S. J. (2014). *Introduction to Biopsychology*. Essex: Pearson Education Limited.
- Poulain, T., Peschel, T., Vogel, M., Jurkutat, A., & Kiess, W. (2018). Cross-sectional and longitudinal associations of screen time and physical activity with school performance at different types of secondary school. *BMC Public Health*, 18(563). doi:10.1186/s12889-018-5489-3
- Qi, J., Yan, Y., & Yin, H. (2023). Screen time among school-aged children of aged 6-14: a systematic review. *Global Health Research and Policy*, 1-19.
- Ramer, J. D., Santiago-Rodríguez, M. E., Vukits, A. J., & Bustamante, E. E. (2022). The convergent effects of primary school physical activity, sleep and recreational screen time on cognition and academic performance in grade 9. *Frontiers in Human Neuroscience*, 16. doi:10.3389/fnhum.2022.1017598
- Russell, G., & Lightman, S. (2019). The human stress response. *Nature Reviews Endocrinology*, 15, 525–534. doi:<https://doi.org/10.1038/s41574-019-0228-0>
- Sanders, T., Parker, P. D., del Pozo-Cruz, B., Noetel, M., & Lonsdale, C. (2019). Type of screen time moderates effects on outcomes in 4013 children: evidence from the Longitudinal Study of Australian Children. *International Journal of Behavioral Nutrition and Physical Activity*, 16. doi:10.1186/s12966-019-0881-7
- Schleicher, A. (2023). *PISA 2022: Insights and Interpretations*. OECD.
- Schnepf, S., Volante, L., Klinger, D., Giancola, O., & Salimeri, L. (2024). *The Pandemic, Socioeconomic Disadvantage and Learning Outcomes*. Luxembourg: Publications Office of the European Union.
- Silva Santos, R. M., Guimaraes Mendes, C., Marques Miranda, D., & Romano-Silva, M. (2022). The Association between Screen Time and Attention in Children: A Systematic Review. *Developmental Neuropsychology*, 47(4), 175-192. doi:10.1080/87565641.2022.2064863
- Sina, E., Buck, C., Ahrens, W., Coumans, J., Eiben, G., Formisano, A., . . . I. Family consortium. (2023). Digital media exposure and cognitive functioning in European children and adolescents of the I. Family study. *nature portfolio*, 13(18855). doi: <https://doi.org/10.1038/s41598-023-45944-0>

- Smith, K. E., & D., P. S. (2020). Early life stress and development: potential mechanisms for adverse outcomes. *Journal of Neurodevelopmental Disorders*, 12(34), 1-15. doi:<https://doi.org/10.1186/s11689-020-09337-y>
- Srivastava, C., & Patkar, P. (2023). Digital Technology and Brain Development. *Journal of Indian Association for Child and Adolescent Mental Health*, 19(1), 21-26. doi:10.1177/09731342231178632
- Student Outcomes*. (2013). Obtido de The Glossary of Education Reform: <https://www.edglossary.org/student-outcomes/>
- Syväoja, H., Kankaanpää, A., Kallio, J., Hakonen, H., Kulmala, J., Hillman, C., . . . Tammelin, T. (2018). The Relation of Physical Activity, Sedentary Behaviors, and Academic Achievement Is Mediated by Fitness and Bedtime. *Journal of Physical Activity and Health*, 15(2), 135-143. doi:<https://doi.org/10.1123/jpah.2017-0135>
- Tak, S., & Catsambis, S. (2023). "Video games for boys and chatting for girls?": Gender, screen time activities and academic achievement in high school. *Education and Information Technologies*. doi:<https://doi.org/10.1007/s10639-023-11638-3>
- Twenge, J. M., & Campbell, W. K. (2018). Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. *Preventive Medicine Reports*, 12, 271-283. doi:<https://doi.org/10.1016/j.pmedr.2018.10.003>
- Twenge, J. M., & Farley, E. (2021). Not all screen time is created equal: associations with mental health vary by activity and gender. *Social Psychiatry and Psychiatry Epidemiology*, 56, 207-217. doi:<https://doi.org/10.1007/s00127-020-01906-9>
- Wilhite, K., Booker, B., Huang, B.-H., Antczak, D., Corbett, L., Parker, P., . . . Sanders, T. (2022). Combinations of Physical Activity, Sedentary Behavior, and Sleep Duration and Their Associations With Physical, Psychological, and Educational Outcomes in Children and Adolescents: A Systematic Review. *American Journal of Epidemiology*, 192(4), 665–679. doi:<https://doi.org/10.1093/aje/kwac212>
- World Health Organisation. (2022). *Pocket Book of Primary Health Care for Children and Adolescents: Guidelines for Health Promotion, Disease Prevention and Management from the Newborn Period to Adolescence*. Copenhagen: WHO Regional Office for Europe.
- Yerkes, M. A., Hopman, M., Stok, F. M., & De Wit, J. (2019). In the best interest of children? The paradox of intensive parenting and children's health. *Critical Public Health*, 31(3), 349-360. doi:<https://doi.org/10.1080/09581596.2019.1690632>

Annex: Overview of main results

Table 1. Main effects of screen time on academic achievement sorted by age group.

Age Group	Effects on Learning Outcomes	Reference
Young children (0-5)	Screen time in first 6 months correlated with lower cognitive and language development at 14 months	Panjeti-Madan and Ranganahan (2023)
	Lower communication scores in babies and toddlers linked to TV watching	
	Video calls with remote family had positive effects on communication skills	
	Higher media use associated with emotion dysregulation in early childhood	
	Moderate screen use at age 2 showed best language outcomes (inverted U-shaped correlation)	Srivastava & Patkar (2023)
	Brain areas relevant for language & literacy skills less developed in children with excessive screen time engagement	Neophytou et al. (2021); Srivastava & Patkar (2023)
	Learning from screen time such as baby videos most likely with parental scaffolding	Courage (2018)
	Screen time predictive of attention problems	Silva Santos et al. (2022)
Children (6-11)	Likelihood of above-average attention problems increased for those using screens more than 2 hours per day	Silva Santos et al. (2022)
	Lower literacy and numeracy skills for 10-11 year-olds watching TV >2 hours daily (4 months loss in reading, 1/3 year in math)	Mundy et al. (2020)
Adolescents		
12-15	Screen time negatively associated with cognition and academic performance in grade 9, however protected by physical activity and sleep	Ramer et al. (2022)
	Interactive screen time (e.g., video gaming) positively related to educational outcomes	Sanders et al. (2019)
	Positive relationship between externalizing problems and hours spent online for disadvantaged SES students	Bohnert & Garcia (2023) Camerini et al. (2018)
	Girls aged 13-15 disproportionately affected by negative mental health effects of social media use	Hilty et al. (2023)
	13-15-year-old heavy users (>5 hours/day) more likely affected by mental health issue	Twenge & Farley (2021)
	PC & Internet use negatively affected math performance (age 10 -17)	Poulain et al. (2018)
	15-18	Lower screen time consistently related to higher academic achievement in grades 9-11
	Social media use associated with school burnout in a bidirectional relationship	Hilty et al. (2023)

Table 2. Main effects on academic achievement by screen time activity.

Type of Activity	Effects on Academic Achievement	Reference
Education/studying/learning	Positive relationship with academic achievement	Sanders et al. (2019)
	Significant improvement in math and English grades for advantaged SES students	Bohnert & Garcia (2023) Camerini et al. (2018)
Television	Inverse relationship with overall academic performance, language, and mathematics	Adelantado-Renau, et al. (2019)
	Cumulative negative effect on literacy and numeracy skills for extended viewing (>2 hours/day)	Mundy et al. (2020)
Video gaming	Mixed results: some studies show negative association with general academic performance, others show no relationship	Adelantado-Renau, et al. (2019) Mundy et al. (2020)
	Positive effect on educational outcomes in some studies, but negative effects on health and socioemotional indicators	Sanders et al. (2019)
Social media/internet use	Complex outcomes with both positive and negative effects	Sanders et al. (2019)
	Small associations with video chatting and texting, low predictive power for academic achievement	Paulich et al. (2021); Tak & Catsambis (2023)
	Positive relationships found for use of YouTube and Facebook due to informational and social resources	Astatke et al. (2023)
	Negative effects associated with non-education-related use (e.g., coping with boredom)	
	Excessive use linked to worse academic performance, skipping class, and internet addiction	

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),
- at the following standard number: +32 22999696, or
- by email via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications

You can download or order free and priced EU publications from: <https://op.europa.eu/en/publications>. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1952 in all the official language versions, go to EUR-Lex at: <http://eur-lex.europa.eu>

Open data from the EU

The EU Open Data Portal (<http://data.europa.eu/euodp/en>) provides access to datasets from the EU. Data can be downloaded and reused for free, for both commercial and non-commercial purposes.

