Introduction: Growing up in a Digital Environment

In many parts of the world, children are growing up surrounded by digitally mediated communication, gaming and a plethora of information and entertainment on screens. Children today live in a digitally connected world. Irrespective of the type of digital device used, the screen is the key portal that connects the user with the digital world.

The screen has become the gateway to entertainment, social interaction, information and education. In the recent context of social distancing in the face of the COVID-19 pandemic, screens have become even more embedded in our everyday lives for both adults and children.

While we cannot overstate the need to address the digital divide within and across countries, the children and young people of today—the digital natives—are practically born with a screen in their hands. For example, over 75% of 450 French parents of infants (ages 5-40 months) have reported that their young children use some touch-screen technology (Cristia and Seidl 2015),
while over 66% of children aged 3-8 years have been reported to use their parents’ mobile touch-screen devices in five Southeast Asian countries (Unantenne 2014).¹

Unsurprisingly, the overwhelming majority of young people are internet users across the world, with a notable exception of the African continent (see Figure 1). There is no denying that the increasingly mobile and connected digital devices are becoming an integral part of the daily lives of the younger generation. Just as the book and the printed medium was an integral part of the 20th century, the digital media is the preferred choice in the 21st century especially among the younger generation.

In fact, there is a generational divide when it comes to the use of digital technology. In a recent study on the use of digital technology during the COVID-19 pandemic, it was found that the users with the maximum time spent on digital devices were the GEN Z followed by the Millennials (see Figure 2 below).

¹ In these studies, ‘touch-screen technology’ and ‘mobile touch-screen devices’ refer to tablets and smartphones.
In recent years, young children’s and adolescents’ time spent on screens has attracted considerable public and policy attention, with concerns around the effects of screen time on physical and mental health and educational outcomes. What is the impact of the increased use of digital devices on the well-being of learners and in particular young children and adolescents is a key question on the minds of parents and many decision makers. However, we must acknowledge that these questions are generally posed by policymakers who belong to the Baby Boomer generation who incidentally have the lowest time usage of digital technology as indicated in Figure 2.

With the COVID-19 crisis, the use of digital technology for teaching and learning has taken on a new alignment, which has a completely new meaning and imperative for policymakers, researchers and educators alike across the globe. The annual total internet usage worldwide jumped from a 2.6% average over the past 14 years to a growth of 5.4% just in 2020 (ITU 2020). The average daily time spent on the internet for all age groups (16-64) was around 7 hours a day (GWI 2020).

In the face of a paramount need to address continuous learning and learner well-being at the times of social distancing and uncertainty, this paper aims at providing a ‘state of the art’ review of the knowledge on the use of screen-based media devices and learner well-being, drawn primarily from peer-reviewed literature on the topic.

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4 Screen-based media devices (SBMD) include mobile phone, tablet, laptop, television etc. (Mireku et al. 2019).
Reframing the Debate: Screen Time and Learner Well-being

There are always hypes and concerns surrounding new technology. While changing technologies certainly have some effects on us, these effects—both negative and positive—can often be exaggerated during the early stages of diffusion of a new technology. Even before the COVID-19 pandemic hit the world, there were concerns about screen time as related to ‘learner well-being’ (See Box 1) that includes social skills deficits, deteriorating physical and mental health, and aggression of young children and adolescents.

**Box 1: Defining ‘screen time’ and ‘learner well-being’**

**Definition of screen time:** Screen time refers to time spent on screen-based media devices, including TV and both mobile and stationary digital devices of different sizes, such as smartphones, tablets and computers.

**Definition of learner well-being:** The notion of learner well-being in this paper entails both learning outcomes (cognitive) and health outcomes (mental such as social and emotional development and physical health).

The American Academy of Pediatrics (AAP) revised its screen time guidelines in 2016 to recommend no use of screen media except for video-chatting for children under 18 months, and ‘high-quality’ programming for children of 18-24 months of age and 1 hour daily screen limit for 2 to 5 year olds, with parental co-viewing. Similarly, regarding pre-school exposure to screens, the Canadian Paediatric Society (2017) recommends no screen time for children under 2 years old, a 1-hour daily limit for 2-5-year olds and avoiding screens for an hour before bed.

It has been pointed out that screen time guidelines are not always evidence-based, and that it is not possible to give limits or thresholds on screen time given that the effects of screen time depend so much on context (Viner, Davie and Firth 2019; Stiglic and Viner 2019).

There are general tendencies in the media and paediatric communities to overstate the risks of prolonged screen time. It is important to bring to the fore what we know and do not know about the use of digital media devices and learner wellbeing and the gaps in research and practice we need to address.

With social distancing restricting our ability to have face-to-face interaction, for many of us, screens are our lifelines and our window into the outside world. Both the negative and positive effects of using screen devices need to be considered in reframing the overgeneralized and oversimplified screen-time debate and advancing public debate and evidence-informed policymaking on the use of screen-based digital media devices for young children and adolescents.
Approach

This paper provides a rapid scoping review of recent systematic reviews (including a review of reviews and meta-analyses) and research studies on the effects of the use of screen-based digital media devices on learner well-being (including learning gains). The purpose is to scope a body of health literature on screen time, clarify definitions and conceptual boundaries of screen time, and identify gaps in the research.

This scoping review draws primarily on a core set of 22 articles on screen time recently published in peer-reviewed journals as its main source of information (see Appendix I). Aside from two articles, they were all published within the last 10 years, and the majority of them were published within the last 5 years. While the majority of these 22 studies cover North American and European countries, they include focused studies undertaken in Australia, Thailand, Turkey, Iran, and China.

The core set of articles includes five systematic reviews (one Review of Reviews and two meta-analyses) which together cover 377 studies in total. The total number of participants in the 22 studies covered in the present review amounts to 3.77 million (see Appendix I). Rubrics were designed and used to highlight analytical foci and key messages and draw key recommendations from these articles (see Appendix II).

In addition, the paper draws on peer-reviewed literature which does not explicitly focus on screen time but on relevant topics such as learning through different media and instructional effectiveness of computer games. It also covers reports by international organizations that might not have been peer reviewed, taking into account their influence in national and international policymaking.

Methodological limitations of the current review

Due to the rapid nature of this scoping review, this paper is not based on a comprehensive literature search but draws on a selection of studies that have explored the topic of screen time, and only studies in English were included. Although Carson’s (2016) systematic review of sedentary behaviour and health indicators covered 235 studies from 71 countries, most literature reviewed for this paper focuses on data from North America and Europe (see Appendix I), and thus generalizability of research findings and their applicability to the rest of the world might need to be cautiously evaluated.

As a result of the prevalence of remote working and distance learning in the context of the COVID-19 pandemic, it is speculated that averages of daily screen time have drastically increased. For example, a newspaper reported that screen time for children doubled after the first lockdown was introduced in India based on a survey conducted with parents of children.
aged 5 - 15 years. Given the importance of observing social distancing measures, it may not be practical to follow the screen time guidelines developed in the pre-COVID-19 times. This paper however was not able to cover research on screen time in the context of COVID-19, as few studies have been published by the time the paper was completed.

What is the current ‘state of the art’ of the knowledge on screen time?

While there is an emerging body of high-quality studies, research on screen time suffers from conceptual, theoretical and methodological limitations that make the evidence collected so far inadequate in terms of guiding policy. As will be discussed below in Key Insights 2 and 3, ‘screen time’ is not a sensible construct as an object of study. Consequently, studies that take it at face value are likely misleading because of the confounding of more important variables (Key Insight 4).

Not only is the geographic coverage of screen-time literature largely restricted to North America and Europe, most studies are limited in terms of deriving causal relationships, as they are correlational or associational in nature. Many studies use cross-sectional data, which is helpful for hypothesis generation, but not suitable for hypothesis testing and for capturing the long-term outcomes. Furthermore, most studies control and account for a limited set of background variables, with insufficient consideration of children’s broader life context, which risks overestimating the effect of screen time (‘positive confounding’) or observing association between screen time and well-being outcomes when in fact there might be none.

As UNICEF’s literature review covering research conducted between 2005 and 2017 on the impact of digital technology use on children’s well-being (Kardefelt-Winther 2017) has pointed out, research in this area tends to focus on screen harm and the hypothetical idea of addiction to technology, rather than investigating why some children spend more time on screen-based media devices than others and when more screen time under what conditions might have an effect—positively or negatively—on their well-being.

Perhaps more fundamentally, not only is there insufficient evidence base to determine when screen time becomes excessive, determining ‘excessive use’ itself depends on the context in which screen-based media devices are used and is shaped by what is perceived to be ‘normal’ or ‘moderate’ use of such devices. Furthermore, in addition to generational differences on what is considered ‘normal’ use, views and opinions on ‘how much screen time is too much’ and ‘which use is appropriate’ will change over time and according to changing contexts. In this respect, it is telling that WHO supported video games as a healthy means of physical distancing in the middle of the COVID-19 pandemic.

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5 COVID-19 Impact: Screen time up by 100% for children, 15 June 2020, The Economic Times
and social connection in the COVID-19 context, while it added “gaming disorder” as a classification in alongside others related to addictive behaviour.6

“...not only is there insufficient evidence base to determine when screen time becomes excessive, determining ‘excessive use’ itself depends on the context in which screen-based media devices are used and is shaped by what is perceived to be ‘normal’ or ‘moderate’ use of such devices.

Key insights and recommendations from the review

This section presents key insights that we highlight from the literature review, followed by some key recommendations. The key recommendations are a combination of recommendations emerging directly from the literature and recommendations we propose based on the key insights.

Key Insights

1. Digital technology will continue to grow and advance and its use in education will continue to increase.

The advances made in digital technology over the past two decades within the educational sector have been phenomenal, including the development and use of artificial intelligence. There is no doubt that digital technology will have significant impacts on the lives of the current and future generations and its use in education will continue to increase. The recent COVID-19 pandemic has given a renewed significance to digital learning tools.

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6 The WHO is recommending video games as an effective way to stop the spread of COVID-19, one year after adding ‘gaming disorder’ to its list of addictive behaviours, 2 April 2020, Business Insider Australia,
Gaming fosters social connection at a time of physical distance, 14 April 2020, The Conversation,
In 2017, more than 98% of homes in the United States (US) with young children had a mobile-screen device, as compared to 52% six years earlier; similar trends have been observed in France, Australia and in many parts of Asia (Straker et al. 2018; Rideout 2017). The use of internet by school going children is rapidly increasing year by year (see Figure 3), and young children and adolescents are using digital media at ever-increasing rates. For instance, in 2016, about 75% of teenagers in the US owned a smartphone and 76% were connected to at least one social media site (AAP 2016).

Adapting to the increased use of digital devices at home, at school, at work and in society at large will certainly require changes not only in parenting but also in how education and learning are organized. The current situation is rather uncommon as children are often more comfortable in using digital devices and applications than adults. To foster constructive dialogues around screen time, especially in the current context of social distancing, it is crucial to listen to and take into account children’s voices.

2. **A high level of policy incoherence exists between the health and education sectors on the impacts of screen time**

Education authorities encourage the use of digital technology by children to prepare them for the digital world, although it is not uncontested within the education sector itself. In contrast, health authorities discourage young children from using these devices based on concerns for

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7 For example, in China, the Ministry of Education in 2018 together with seven other government departments launched an action plan to address the problem of nearsightedness in primary and secondary school students. This plan forbids students from bringing electronic devices to class, and requests teachers not to depend on electronic devices in teaching and giving homework (Ministry of Education of the People’s Republic of China 2018). The Republic of Korea announced its intention of going fully digital in school education, but in spite of a well-planned schedule put forward in the 1990s, Korea held back its plan to roll out the fully digital learning environment. Reasons for postponing the plan included the harmful effects of students’ overexposure to digital devices (Harlan 2012, as cited by Smart and Jagannathan 2018, p.59).
their cognitive, emotional and social wellbeing (Straker et al. 2018). This has led to policy incoherence between education and health guidelines and recommendations regarding children’s use of digital technology.

Health officials and professionals often seek to minimize screen time with an assumption that screen time is sedentary, passive and displacing beneficial activities that are important for well-being outcomes. On the other hand, digital education guidelines often look at active screen time that involves interactive activities linked to learning outcomes.

Given the digital imperative especially in the face of COVID-19, there is a need for cross-sector coordination and alignment of different goals and preoccupations of different sectors, with the notion of learner well-being at the heart of the screen time debate. Caution must be exercised when interpreting research on the negative effects of screen time as well as the positive effects of digital learning.

More evidence disentangling prolonged screen time from other factors affecting health and educational outcomes in young children and adolescents is clearly required. It is however important to note that a whole child approach emphasizing the sensible balance across good sleep, face-to-face social interaction, digital use, and physical exercises should remain a core component of recommendations for promoting learner well-being.

3. Quality Content is more important than screen time. Many studies do not distinguish between the entertainment use of screen-based media devices (primarily television viewing time) and educational use of digital media devices such as computers, game consoles and smart phones.

Traditionally, studies on screen time have focused on television, and many studies do not make a distinction between time spent on watching TV for pure entertainment and time spent on education related content. The same observation is valid for mobile digital screen devices for education such as computers, game consoles and smart phones versus these being used for entertainment. Given the elusive notion of ‘screen time’, one of the problems is over-generalization of harmful effects of screen time without taking into account the enormously diverse use of screen-based media devices.

The term ‘screen time’ is itself misleading and overly simplistic. Distinguishing between passively absorbing what is on the screen and actively engaging with it is critical to understanding the overall impacts of screen time. For example, a seminal 3-year ethnographic investigation of informal learning through digital media use following over 800 youth in the US (Ito et al. 2009) identified three major ways they engage actively with digital technology and captured them in what came to be known as HOMAGO (Hanging Out, Messing Around, Geeking Out) framework (see Box 2).

**Box 2: HOMAGO framework on digital media and learning**

HOMAGO is a concept that emerged out of the findings of the Digital Youth Project, a 3-year ethnographic investigation of informal learning of over 800 youth in the US, funded by MacArthur Foundation as part of the Digital Media and Learning Initiative (Ito et al. 2009). HOMAGO refers to:
In screen time research, the non-differentiation across television and digital devices screen time is problematic (Straker et al. 2018). For example, in a study focusing on 6-15 year-old children in the US, a negative association was found between physical and functional strength and television viewing but not with computer or video game use (Edelson et al. 2016; van den Heuvel et al. 2019; Christakis et al. 2009). These results demonstrate a need for a deeper and more nuanced understanding of screen time.

Literature on screen time and impacts has tended to focus on health outcomes and primarily with screen time associated with entertainment use. For example, a meta-analysis on screen time and Attention Deficit Hyperactivity Disorder (ADHD) symptoms found that television viewing or gaming among children of 4–17 years of age was modestly associated with later ADHD symptoms (Nikkelen et al. 2014, Tanama et al. 2019, Christakis et al. 2004). However, there have been an equal number of studies which have questioned the validity of many of these studies and have demonstrated that no correlation has been found between screen time and ADHD (McBee et al. 2021, Camerer et al. 2018, Foster et al. 2010, Huber et al. 2018, Kostyrka-Allchorne et al. 2017).

Relationship between screen time and cognitive outcomes has been less investigated. According to Anderson and Subrahmanyam (2017), studies show that for children less than 2 years, TV has negative impacts on language and executive functions, while for preschool children it is found to have both positive and negative outcomes. A large pool of research shows that educational TV programs could have positive impact on cognitive development, with examples such as Sesame Street. Beyond preschool, research tends to look at only entertainment program consumption and therefore cognitive outcomes have not been well explored.

4. The cognitive, health and socio-emotional outcomes are influenced by the age and other individual characteristics of users as well as the content and the context of media device use.

There are studies that report negative impacts of screen time on cognitive development such as language learning (see Key Insight 3), but there are also many studies that show positive or null associations (Drummond and Sauer 2014; Regondola and Barbado 2017). A recent meta-analysis of studies on the association between screen media use and academic performance among young children and adolescents found no association between the two (Adelantado-Renau et al. 2019). This could be partially the result of several aspects of the overall screen media time measure that are not captured.

Different studies give support to impact of screen time on children’s wellbeing based on different hypotheses of the potential relationship (see Box 3).

**Box 3: Four hypotheses of the impact of screen time on children’s well-being**
UNICEF’s literature review on the impact of digital technology on children’s well-being identified four main hypotheses explored in research on digital technology use and user well-being (Kardefelt Winther 2017). This typology is useful in terms of examining research on the impact of screen time on learner well-being.

1. The **displacement hypothesis** suggests that screen time is replacing or displacing opportunities for positive activities such as face-to-face interaction, exercise, sleep which are important for well-being.

2. The **rich-get-richer hypothesis** suggests that those who already have strong in-person social networks and social skills will benefit more from digital media use in terms of social interaction than those who have weaker social connections.

3. The **social compensation hypothesis** suggests that digital media use will be beneficial to those who are socially anxious and isolated as it compensates for lacked social skills and allows them to feel more at ease in interacting with others.

4. The **stimulation hypothesis** suggests that digital media use stimulates communication with existing friends, leading to mostly positive outcomes.

We must keep in mind that both positive and negative outcomes of screen time tend to be highly contextual and dependent on the design of activities children engage in through screen devices. A 2015 study on cognition and media concludes that there is no clear consensus and that effects likely depend on the age, type of content and other contextual factors (Anderson and Kirkorian 2015). Focusing on screen time without adequately considering the internal and external attributes may severely limit the value of the conclusions drawn.

The lack of association between screen media use and well-being outcomes, as well as the lack of agreement among studies, could be partially attributed to the measure of screen time which fail to take into account: (i) internal attributes of children that include: (a) age of children; and (b) gender; and (ii) external attributes such as (a) purpose and content of programming (e.g. educational versus entertainment); (b) the context in which young children and adolescents use screen media; and (c) active versus passive media (e.g. interactive media versus the older one-way media). As illustrated below, there is an ostensibly contradictory body of evidence on the associations between these factors and well-being outcomes.

**Internal Attributes:**

**Age of children:** For children less than 2 years, TV has negative impacts on language and executive functions. In preschool children it is found to have both positive and negative outcomes. A 2020 meta-analysis study found positive association across screen use and stronger language skills for older children (Madigan et al. 2020). However, children (average age 12) who watch mainly entertainment programs tend to have reduced reading achievements and executive functions like focus and attention regulation (Ibid.).

**Gender:** A meta-analysis on media use and ADHD-related behaviours in young children and adolescents found no significant interactions between screen time and gender (Nikkelen et al. 2014). According to the evidence-focused literature review by Kardefelt Winther (2017) for...
UNICEF, few significant gender differences were found in relation to the impact of children’s digital technology use on their mental well-being.

However, more recently, studies looking at newer uses of digital screen devices such as social media showed gendered impact of screen time on mental health outcomes. One study that has received much media attention suggested that adolescents were 13% more likely to experience high levels of depression symptoms if they used social media at least once per day, and 34% more likely to have at least one “suicide-related outcome” if they used an electronic device three or more hours per day, compared to two or fewer hours per day (Twenge et al. 2018). The correlation between time spent on social media and depression symptoms was only evident for female participants. Also important to note is that the time spent on social media was only related to higher depression symptoms for adolescents who did not engage much in face-to-face socializing. This would seem to be aligned with the “rich get richer” hypothesis elaborated in Box3.

External Attributes

**Content:** A recent systematic review and meta-analysis of associations between screen use and child language skills found that ‘better-quality’ screen use (defined by ‘educational programs’ and ‘co-viewing’) was correlated with stronger child language skills (Madigan et al. 2020), which suggests that content (as well as the social context of viewing—see below) does matter in improving learning outcomes. One of the studies reviewed by Anderson and Subrahmanyam (2017), albeit a small-scale experiment involving a group of 18 children and a comparison group of 11 children (4 years of age), revealed after 3 months a literacy skill gain of 11 standard score points for the experimental group exposed to educational software while only 4 points for the comparison group exposed to entertainment software and a mathematics skill gain of 8 points for the education group while only 1 point for the entertainment group.

> “...content (as well as the social context of viewing) does matter in improving learning outcomes.

There is an ongoing effort to demonstrate educational benefits of computer games, in addition to visionary work by pioneers who highlighted the potential of gaming to revolutionize education such as Paul Gee (2007) and Jane McGonigal (2011). For example, a recent report highlighted that more than a third of 4,626 respondents (ages 11-16) reported that playing games made them better readers (Picton et al. 2020). A cross-sectional study based on data from the School Children Mental Health Europe project conducted in six European Union countries (youth ages 6–11, n = 3,195) found video gaming beneficial for cognitive functioning (Kovess-Masfety et al. 2017). A recent review of experimental studies of instructional effectiveness of computer games found that games can increase student learning of academic material in science, mathematics and second-language learning (Mayer 2019; see Table 1). These results indicate that content and pedagogy play an important role in ensuring screen time be maximised for learning outcomes.

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8 Suicide-related outcomes include a) significant sadness or hopelessness; b) seriously considering suicide; c) having a suicide plan; and d) making a suicide attempt.
Table 1: Effect of computer games on cognitive skills

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Experiments in which effects were observed</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science</td>
<td>12 out of 16 experiments</td>
<td>0.7</td>
</tr>
<tr>
<td>Mathematics</td>
<td>4 out of 6 experiments</td>
<td>0.5</td>
</tr>
<tr>
<td>Language</td>
<td>4 out of 5 experiments</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Source: Adopted from Mayer 2019, Table 4.

Note: An effect size greater than 0.4 is considered significant.

Social context of viewing: A 2019 study showed how increased TV viewing was associated with language delays in early childhood (Madigan et al. 2019). However, one study observed that this could be attributed to the reduced child-parent interaction and play which is critical for early development (Christakis et al. 2009). A 2017 national study by Common Sense Media covering a representative sample of over 1,400 parents across the US revealed that on average 46% of children under 2 years of age had used a mobile media device at least once, but the average time spent watching TV or videos on a mobile device amounted only to five minutes per day (Rideout 2017). In another study, with a sample size of 350 children from low-income urban population in the US, it was found that 96.6% of children were found to use mobile devices (Kabali et al. 2015). The same study reported that 70% of parents were giving children devices to keep them occupied while doing household chores while 65% used these devices to keep the children calm. These findings might suggest that increased screen time on mobile devices by young children can be linked to reduced time interacting with parents and negative well-being outcomes (see below).

Active vs passive: Studies which have shown language impairments caused by increased screen time and in particular to children below the age of two have primarily used television screen time—a passive one way process—as the key explanatory variable. However, studies which looked at computers and other educational digital media—an active two way interactive process—found mixed effects on cognition.

As Kardefelt-Winther (2017) summarizes in UNICEF’s literature review on the impact of digital technology use on children’s well-being, many studies show the use of digital media devices brings benefits to children, by opening new opportunities for social interaction and active creative expression. This points to the benefits of active screen time, but not all active screen time may lead to positive outcomes; content and educational outcomes are key if digital devices are to be beneficial for wellbeing.

Computer games with content developed with educational outcomes as the objective can provide promising examples of active screen time. While there is an emerging body of literature that suggests computer games can be as effective as or more effective than conventional media for particular instructional domains, more research is needed in which the control group is exposed to exactly the same academic material as the game group (Mayer 2019). It is important to keep in mind that positive education outcomes of active screen time are highly contextual and depend on the design of digital games and other activities children can engage in through screen devices (see Schrier 2018 for discussion of the use and design of game-based learning).
Key Recommendations

1. Addressing the holistic development and well-being of the whole child

Policy should address the holistic development and well-being of the whole child and support informed decision making by parents, caregivers, and professionals. This requires a re-examination of the diverse perspectives derived from health and education literature, with a view to provide consistent, neutral, and evidence-informed messages to parents and school administrators (Straker et al. 2018). Many of the apparent connections between screen time and screen harm may be mediated by lost opportunities for positive activities (socialising, exercise, sleep) due to displacement by screen time.9

Recommendations addressing the holistic development and well-being of the whole child include the following:

a. **Screen time guidelines should address the importance of adequate physical activity, healthy nutrition, good sleep hygiene, and nurturing social environment in promoting children’s well-being outcomes.** These factors would contribute together with activities related to screen time to produce overall health effects (Ashton and Beattie 2019). Positive activities such as socializing and physical exercise can also be conducted via screen devices, for example through the use of social media, playing active video games, or taking online exercise classes.10 Careful attention also needs to be paid to areas where screen time seems to have direct negative impact on physical health. Obesity and myopia (near-sightedness), which were already major public health concerns prior to the COVID-19 pandemic, are cases in point. For example, the increase in the consumption of high-density foods while using screen media appears to be related to being distracted from feelings of satiety or fullness (Robinson et al. 2017). While current evidence is not conclusive, increased digital screen time appears to be associated with myopia onset and progression in children (Wai WONG et al. 2020).

b. **Interventions on screen-based media use should include curtailed use within an hour before bedtime and particularly in darkness.** Parents, teachers, health professionals and adolescents should be made aware of the associations between night-time screen-based media devise use (including TV watching) and sleep outcomes, as these may impact on cognitive function and educational attainment (Mireku et al. 2019).

c. **Health and education professionals as well as parents and caregivers should encourage screen-based activities that are beneficial to individual children** based on their developmental stages and individual characteristics and needs, rather than categorically limiting screen time. Children can benefit from spending time in the

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9 Kardefelt Winther’s (2017) literature review found little support for the displacement hypothesis, when it is understood as a hypothesis that screen harm is proportional to exposure (also see Box 2).
10 In the midst of the COVID-19 pandemic, WHO tweeted that active video games and online exercise classes can be means to stay active and healthy at home. See https://twitter.com/WHO/status/1242738384772239360?s=20
digital space. For digital natives whose identity, existence, and reality are almost unimaginable without digital devices, a forced reduction in screen time may lead to curtailment of positive activities such as interacting with friends during school closures or engaging in creative play that are important for their well-being. Instead, focus on finding a menu of different activities with children that they like to do, or guide them to make choices as to how they spend their time online or otherwise. If there are underlying problems which prompt excessive screen time, it is critical to address those problems rather than imposing a reduction in screen time.

2. Improving the quality of screen-based activities

Research shows that the quality of the content and for parents or caregivers to be there to help children process what is on screen are important factors that can lead to positive well-being outcomes, especially for young children.

a. **Policy should support the development of high-quality educational content for digital devices.** For example, there is evidence to support a hybrid form of learning, such as the introduction of touch-screen devices while reading traditional books in early childhood education (Anderson and Subrahmanyam 2017). However, clear information on appropriate digital technology use for educational purposes is still limited.

b. **Parents are encouraged to participate in screen time activities for children from early childhood to at least the early years in school.** Online interaction is a valid form of interaction, and positive relationships can be formed and encouraged online. However, for children to develop the skills and resilience to cope with the world, they need regular interaction in the physical world. This is especially true for young children who need regular offline play and interaction with other people. Family involvement can play an important role in having children engage with technology in positive ways to ensure development process of children growing up in a digital age (Madigan et al. 2019). Parental involvement is also important in terms of facilitating home-based learning during school closures and also at normal times. Authorities should consider measures to enable parents to make a living and take care of and educate their children during lockdowns, such as reduced work hours for the same wages and online support to parents.

3. Encouraging further research and strengthening research-policy-practice nexus

Given the rapid increase in the use of digital screen devices by young children and adolescents internationally, notably for new content areas such as social media, there is a need for more and better research as well as for strengthening the research-policy-practice nexus. The following recommendations are suggested to strengthen the literature to guide policymaking in the use of digital media.
a. **Promote further research to disaggregate the notion of ‘screen time’ and deepen the understanding of the impact of the contexts and content of digital devices on learner well-being**, particularly in relationship to mobile digital devices. With its reliance on self-reporting of the total daily or weekly time spent on screen and the ensuing low quality of measurement available in current data sources, there is limited high-quality (robust and transparent) evidence for harmful impacts of screen time. Aggregate measures of ‘screen time’ are conceptually problematic and need to be reconsidered, as they ignore the different screen devices used by children and how they engage with what is on the screen. This might lead to ending the use of the construct ‘screen time’, except in the restricted sense of its impact on vision or sleep quality.

b. **Conduct a long-term follow up while controlling for confounding variables, and produce longitudinal data** to gain a better understanding of screen time and its positive and negative impacts (Ashton and Beattie 2019; Straker et al. 2018; Anderson and Subrahmanyam 2017). Little is known about the cumulative effects of spending much time on digital screen media from a young age, and it is particularly important to study the long-term consequences of digital media use. This requires more longitudinal studies for confirmatory (hypothesis-testing) research. It also requires including more control variables so as not to exclude variables that have established effects on well-being outcomes. Fully taking into consideration that children’s experiences with screen media cannot be studied in vacuum in isolation from their life contexts, researchers should tighten research design to control and account for socio-demographic and other variables and increase the likelihood of having true (un-confounded) results. At the same time, it is important to be mindful that the rapid evolution of digital technology is still ongoing and even accelerating, and that there is a risk that longitudinal studies become obsolete by the time they conclude due to dramatic changes in the context of media use. One cannot easily gather evidence of long-term effects when the constructs keep changing as the research is conducted.

c. **Support research studies by a team of multi-disciplinary experts and where possible multi-stakeholder groups** to provide a more holistic understanding of the multi-dimensional impacts that might emerge from digital media use by young children and adolescents. Not only quantitative studies but also qualitative studies should be encouraged, as qualitative data can generate more nuanced and context-specific insights based on children’s voices, which in turn can contribute to generating hypotheses and building theories along with cross-sectional studies. Multi-disciplinary collaboration and close partnerships between health and education ministries, schools and parents are necessary to strengthen the research-policy-practice nexus.

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11 Kardefelt-Winther (2017) also recommends strengthening reproducibility of research and the reliability of findings by encouraging researchers to register their hypotheses prior to data collection and then share the raw data and analysis code with each publication, following an ‘Open Science’ approach (for example through the Open Science framework—see https://osf.io/).
Conclusion

Time spent on screens—from social media to computers and television—is a major part of everyday life and a necessary part of education today and into the foreseeable future. One of the problems is over-generalization of harmful effects of screen time without taking into account the enormously diverse use of screen-based media devices. Different uses have different effects. On the same media platform (for example on YouTube and/or Instagram), different content will have different effects. Furthermore, the same content could have different effects on different people or on the same person in different time frames or in different environments or under different conditions of usage. Technology is used in varied ways, with wide-ranging motivations, to access an enormous amount of diverse content. Certain uses affect certain people in a negative way, while certain uses affect certain people in a positive way.

The risks from screen exposure should not be overstated. The evidence is relatively weak overall, and the magnitude of impact of screens is small on key health outcomes. The existing screen time guidelines tend to focus on risks, without recognizing the potential benefits of digital screen use in education. Currently the literature takes little account of the increasing demands for homework to be undertaken on computers nor the needs for school lessons to be delivered online, although these will likely be taken up as important research topics given the COVID-19.

Collaboration across the health and education sectors, inter-disciplinary research, and school-family partnerships will be the key to advancing policy and practice around screen time in a digital age. Another key point we must take into consideration is the role of the younger generation. We now know for sure that the Generation Z, Millennials and to a smaller extent Generation X are all primarily digital natives. They thrive in the digital world and therefore any policy referring to use of digital media must involve the voices of youth and their concerns and wants in the wide-ranging use of digital technology in their lives—for entertainment, socialising, learning and more.

Acknowledgements and Disclaimer

We would like to thank Karen (Kat) Schrier and John Sabatini for their insightful comments on an earlier version of this research brief. We also thank Kriti Singh for finding post-2020 data on digital device use.

The analysis, conclusions, and recommendations contained in this paper are solely a product of the individual authors and are not the policy or opinions of, nor do they represent an endorsement by UNESCO or UNESCO MGIEP.
Bibliography


### Appendix I: Types and designs of study, geographic coverage, and participants of the studies covered in the present review

<table>
<thead>
<tr>
<th>Title of the Study</th>
<th>Type</th>
<th>Study Design</th>
<th>Region</th>
<th>Participants Age</th>
<th>Number of Studies covered</th>
<th>Total Number of Participants (N)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen time and sleep among school-aged children and adolescents: a systematic literature review (Hale and Guan 2014)</td>
<td>Systematic Review</td>
<td>Investigatory (identify associations)</td>
<td>Studies from several countries included in review</td>
<td>5-17 year olds</td>
<td>67</td>
<td>401,869</td>
<td>Covered in Stiglic and Viner 2019 but numbers not included</td>
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<tr>
<td>Systematic review of sedentary behaviour and health indicators in school-aged children and youth: an update (Carson et al. 2016)</td>
<td>Systematic Review</td>
<td>Literature Review</td>
<td>Studies from 71 countries included in review</td>
<td>5-17 year olds</td>
<td>235</td>
<td>1,657,064</td>
<td>Covered in Stiglic and Viner 2019 but numbers not included</td>
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<tr>
<td>Effects of screen time on health and wellbeing of children and adolescents : a systematic review of reviews (Stiglic and Viner 2019)</td>
<td>Systematic Review</td>
<td>Review of Reviews (RoR)</td>
<td>Majority studies under review undertaken in United States</td>
<td>0-18 year olds</td>
<td>13</td>
<td>1,046,165</td>
<td>N is sum of only 4 reviews where it was reported. Other 9 do not report total number of subjects.</td>
</tr>
<tr>
<td>Associations between screen use and child language skills: A systematic review and meta-analysis (Madigan et al. 2020)</td>
<td>Meta Analysis; Systematic Review</td>
<td>Investigatory (identify associations)</td>
<td>US</td>
<td>Average age of participants was 12 years</td>
<td>42</td>
<td>18905</td>
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<tr>
<td>A meta-analysis of the effect of media devices on sleep outcomes (Carter et al. 2016)</td>
<td>Meta Analysis</td>
<td>Investigatory (identify associations)</td>
<td>North America, Europe, Asia, and Australasia</td>
<td>6 - 19 year olds</td>
<td>20</td>
<td>125198</td>
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<tr>
<td>Cross-sectional study of use of electronic media by secondary school students in Bangkok, Thailand (Kiatrungrit and Hongsanguansri 2014)</td>
<td>Focussed Paper</td>
<td>Cross sectional</td>
<td>Thailand</td>
<td>Adolescents (secondary grade students)</td>
<td>1</td>
<td>768</td>
<td>Included in Carson et al. 2016</td>
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<tr>
<td>Mobile telephone use is associated with changes in cognitive function in young adolescents (Abramson et al. 2009)</td>
<td>Focussed Paper</td>
<td>Cross sectional</td>
<td>Australia</td>
<td>7th Grade students</td>
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<td>Symptoms and cognitive functions in adolescents in relation to mobile phone use during night (Schoeni et al. 2015)</td>
<td>Focussed Paper</td>
<td>Cross Sectional</td>
<td>Switzerland</td>
<td>12-17 year olds</td>
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<td>439</td>
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<td>The problematic use of Information and Communication Technologies (ICT) in adolescents by the cross sectional JOITIC study (Muñoz-Miralles et al. 2016)</td>
<td>Focussed Paper</td>
<td>Cross sectional</td>
<td>Spain</td>
<td>12 - 20 years olds</td>
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<td>5,538</td>
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<tr>
<td>A latent class analysis on adolescents media use and associations with health-related quality of life (Foerster and Rui 2017)</td>
<td>Focussed Paper</td>
<td>Investigatory (identify associations)</td>
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<td>Adolescents (7th - 9th Graders)</td>
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<td>Behavioral correlates of television viewing in young adolescents in Turkey (Ozert et al. 2011)</td>
<td>Focussed Paper</td>
<td>Investigatory (identify associations)</td>
<td>Turkey</td>
<td>Adolescents (7th - 8th grade students)</td>
<td>1</td>
<td>581</td>
<td>Included in Carson et al. 2016</td>
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<tr>
<td>Does recreational computer use affect high school achievement (Bowers and Matthew 2013)</td>
<td>Focussed Paper</td>
<td>Investigatory (identify associations)</td>
<td>US</td>
<td>10th Grade students</td>
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<tr>
<td>Study</td>
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<td>Data Collection</td>
<td>Participants</td>
<td>Average Age of Participants</td>
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<td>Internet use, videogame playing and cell phone use as predictors of children’s body mass index (BMI), body weight, academic performance, and social and overall self-esteem (Jackson et al. 2011)</td>
<td>Focussed Paper</td>
<td>Investigatory (identify associations)</td>
<td>US</td>
<td>Average age of participants was 12 years</td>
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<td>Included in Carson 2016</td>
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<tr>
<td>Night-time screen-based media device use and adolescents’ sleep and health-related quality of life (Mireku et al. 2019)</td>
<td>Focussed Paper</td>
<td>Investigatory (identify associations)</td>
<td>UK</td>
<td>11-12 year olds</td>
<td>1</td>
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<tr>
<td>Physical fitness, physical activity, sedentary behavior and academic performance among adolescent boys in different weight statuses (Esmaeilzadeh and Kalantari 2013)</td>
<td>Focussed Paper</td>
<td>Investigatory (identify associations)</td>
<td>Iran</td>
<td>15 - 17 year olds</td>
<td>1</td>
<td>538</td>
<td>Included in Carson 2016</td>
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<tr>
<td>The impact of media use on sleep patterns and sleep disorders among school aged children in China (Li et al. 2007)</td>
<td>Focussed Paper</td>
<td>Investigatory (identify associations)</td>
<td>China</td>
<td>Elementary Grade Children, Mean age = 9 years</td>
<td>1</td>
<td>19,299</td>
<td>Included in Hale and Guan 2014</td>
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<td>Association between screen time and children’s performance on a development screening test (Madigan et al. 2019)</td>
<td>Focussed Paper</td>
<td>Longitudinal Study</td>
<td>Canada</td>
<td>Data collected at 2, 3 and 5 years of age for each participant</td>
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<td>A large-scale test of the Goldilocks Hypothesis: quantifying the relations between digital-screen use and the mental well-being of adolescents (Przybylski and Weinstein 2017)</td>
<td>Focussed Paper</td>
<td>Two part study: exploratory and confirmatory</td>
<td>UK</td>
<td>15 year olds</td>
<td>1</td>
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<td>Covered in Stiglic and Viner 2019 but numbers not included</td>
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<tr>
<td>Association between adolescent well-being and digital tech use (Orben and Przybylski 2019)</td>
<td>Focussed Paper</td>
<td>Specification Curve Analysis (identify associations) on data from 3 large scale social datasets</td>
<td>US and UK</td>
<td>12 - 18 year olds</td>
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<td>Screens, teens and psychological wellbeing: evidence from three time use diary studies (Orben and Przybylski 2019)</td>
<td>Focussed Paper</td>
<td>Two part study: exploratory and confirmatory</td>
<td>Ireland, United States, United Kingdom</td>
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<td>Comment</td>
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<td>NA</td>
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<td>Digital screen media and cognitive development (Anderson and Subrahmaniam 2017)</td>
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<td>Mainly infants and toddlers</td>
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## Appendix II: Analytical foci and key conclusions of the studies covered in the present review

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<tr>
<th>Factor</th>
<th>Study</th>
<th>Evidence/Data</th>
<th>Sample</th>
<th>Devices</th>
<th>Timing of Usage</th>
<th>Environment of Usage</th>
<th>Purpose of Usage</th>
<th>Content of Media</th>
<th>Impact on Health</th>
<th>Impact on Learning</th>
<th>Conclusion/Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen time and sleep among school-aged children and adolescents: a systematic literature review (Hale and Guan 2014)</td>
<td>Yes</td>
<td>5-17 year olds</td>
<td>All digital devices (TV, computer, smart phones, tablets, gaming consoles)</td>
<td>Night time</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Screen time across different devices and on a consistent basis adversely associated with sleep outcomes but causal association not confirmed</td>
<td>Not considered</td>
<td>More studies necessary</td>
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<tr>
<td>Effects of screen time on health and wellbeing of children and adolescents: a systematic review of reviews (Stiglic and Viner 2019)</td>
<td>Yes</td>
<td>0-18 year olds</td>
<td>TV, Computers and Smartphones (but non TV data very sparse)</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Strong indication of negative effects of screen time on health.</td>
<td>Low quality/poor evidence that greater screen time was associated with poorer educational attainment. Moderate quality evidence for harmful effects of screen time on cognition among infants.</td>
<td>Strong evidence for correlation between screen time adiposity, unhealthy diet, depressive symptoms and quality of life. Weak evidence that small amounts of daily screen time may have some benefits.</td>
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<tr>
<td>Associations between screen use and child language skills: A systematic review and meta-analysis (Madigan et al. 2020)</td>
<td>Yes</td>
<td>Average age of participant s was 12 years</td>
<td>All Screen Based Devices primarily TV and Mobile Phones</td>
<td>Not discussed</td>
<td>Co-viewing with Parents considered</td>
<td>For Educational and Entertainment Purposes</td>
<td>Educational and Non Educational (both)</td>
<td>Impact on Language Skills</td>
<td>Greater Quantity of screen use associated with lower language skills but educational programs and co-viewing associated with stronger language skills</td>
<td>Limit exposure to screen time, select high quality programmes for viewing and co-view with parents when possible.</td>
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<tr>
<td>A meta-analysis of the effect of media devices on sleep outcomes (Carter et al. 2016)</td>
<td>Yes</td>
<td>6 - 19 year olds</td>
<td>All Screen Based Devices primarily TV and Mobile Phones</td>
<td>Discussion on night-time usage</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Bedtime media device usage associated with inadequate sleep quantity, poor sleep quality, and daytime sleepiness</td>
<td>Not considered</td>
<td>Age specific guidance for screen based media device usage and parent led initiatives to reduce access and use in collaboration with health providers and teachers.</td>
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<td>Cross-sectional study of use of electronic media by secondary school students in Bangkok,</td>
<td>Yes</td>
<td>Adolescents (secondary grade students)</td>
<td>All digital devices (TV, computer, smart phones,</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Use of devices not related to academic performance. As they age adolescents tend to spend more time engaged in longitudinal studies with precise time logs of device usage and description of type of content required to</td>
<td>Not considered</td>
<td>Use of devices not related to academic performance. As they age adolescents tend to spend more time engaged in longitudinal studies with precise time logs of device usage and description of type of content required to</td>
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<tr>
<td>Study</td>
<td>Participants</td>
<td>Devices</td>
<td>Findings</td>
<td>Conclusion</td>
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<tr>
<td>Thailand (Kiatrungrit and Hongsanguansri 2014)</td>
<td>7th Grade students</td>
<td>Tablets, gaming consoles</td>
<td>Boys more interested in competitive games, girls more in passive recreation and communication.</td>
<td>Determine the extent of effects in social and psychological development of adolescents.</td>
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<td>Mobile phone use is associated with changes in cognitive function in young adolescents (Abramson et al. 2009)</td>
<td>7th Grade students</td>
<td>Mobile</td>
<td>Not discussed</td>
<td>Not considered</td>
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<tr>
<td>Symptoms and cognitive functions in adolescents in relation to mobile phone use during night (Schoeni et al. 2015)</td>
<td>12-17 year olds</td>
<td>Mobile Phone</td>
<td>Night time</td>
<td>Not considered</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>The problematic use of Information and Communication Technologies (ICT) in adolescents by the cross sectional JOITIC study (Muñoz-Miralles et al. 2016)</td>
<td>12-20 years olds</td>
<td>All ICTs</td>
<td>Not discussed</td>
<td>Not considered</td>
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<tr>
<td>A latent class analysis on adolescents media use and associations with health-related quality of life (Foerster and Rski 2017)</td>
<td>Adolescents (7th - 9th Graders)</td>
<td>All digital devices (TV, computer, smart phones, tablets, gaming consoles)</td>
<td>Not discussed</td>
<td>Not considered</td>
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<tr>
<td>Behavioral correlates of television viewing in young adolescents in Turkey (Ozmert et al. 2011)</td>
<td>Adolescents (7th - 8th grade students)</td>
<td>TV</td>
<td>Not discussed</td>
<td>Not considered</td>
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<tr>
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<td>Findings</td>
<td>Causality</td>
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</tr>
</tbody>
</table>
| Does recreational computer use affect high school achievement (Bowers and Matthew 2013) | Yes 10th Grade students  
Computer: Not discussed  
Mathematics achievement was significant in higher grade students.  
Use of computers for fun and gaming were positive and significant on reading and mathematics achievement assessments in high school. | Causality is difficult to ascertain but effects of using computers for fun and games for 1-2 hours a day are +ve. |
| Internet use, videogame playing and cell phone use as predictors of children’s body mass index (BMI), body weight, academic performance, and social and overall self-esteem (Jackson et al. 2011) | Yes  
Average age of participants was 12 years.  
Computers and Mobile phones: Not discussed  
Use of IT did not predict BMI.  
Videogame play predicted positive visual-spatial skills but lower GPAs. Use of internet associated with better reading scores among females. More videogame time associated with low self esteem. | More research needed to investigate the causes and consequences of IT use and to incorporate individual differences in effects of IT use. |
| Night-time screen-based media device use and adolescents’ sleep and health-related quality of life (Mireku et al. 2019) | Yes  
11-12 year olds  
All digital devices (TV, computer, smart phones, tablets, gaming consoles); Night time (within one hour before sleep SBMD usage): Not discussed  
Lit and dark rooms: Not discussed  
Night time use associated with higher odds of insufficient sleep; Magnitude of association higher when night time usage occurred in darkness. | Screen-based media device (SBMD) usage should be curtailed within an hour before bedtime and particularly in darkness. |
| Physical fitness, physical activity, sedentary behavior and academic performance among adolescent boys in different weight statuses (Esmaeilzadeh and Kalantari 2013) | Yes  
15 - 17 year olds  
All sedentary behaviour through usage of all digital devices (TV, computer, smart phones, tablets, gaming consoles): Not discussed  
Positive relationship between sedentary behaviour and BMI.  
No relationship between weight classes and academic performance. | Longitudinal studies needed to determine the directionality. |
| The impact of media use on sleep patterns and sleep disorders among school aged children in China (Li et al. 2007) | Yes  
Elementary Children, Mean age = 9 years  
TV and Computer: Not discussed  
Device in bedroom of children: Not discussed  
TV viewing of more than 2 hours was a risk factor for sleep disorders. Computer use, however, had NO correlation with any sleep disorder. | Presence of media in child’s bedroom and media use had a negative impact on sleep patterns duration and sleep disorders. |
| Association between screen time and children’s performance on a development screening test (Madigan et al. 2019) | Yes  
Data collected at 2, 3 and 5 years of age for each participant  
TV, Computers and Smartphones (but non TV data very sparse): Not discussed  
Development Screening Test measured: communication, gross motor, fine-motor, problem solving and personal-social. Higher levels of screen time significantly associated | Evidence of directional association between screen time and poor performance on development screening |
<table>
<thead>
<tr>
<th>Study Title</th>
<th>Age Range</th>
<th>Devices Considered</th>
<th>Methodology</th>
<th>Findings</th>
<th>Policy Implications</th>
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<tr>
<td>A large-scale test of the Goldilocks Hypothesis: quantifying the relations between digital-screen use and the mental well-being of adolescents (Przybylski and Weinstein 2017)</td>
<td>15 year olds</td>
<td>All digital devices (TV, computer, smart phones, tablets, gaming consoles)</td>
<td>Compares weekday vs weekend usage</td>
<td>4 classes of usage identified: Watching films, TV programs, etc.; Playing games; Using computers for internet, email, etc.; Using smartphone for social networking, chatting, etc.</td>
<td>The categories of digital activity examined in this study are unlikely to present risk to mental well-being at moderate levels.</td>
</tr>
<tr>
<td>Association between adolescent well-being and digital tech use (Orben and Przybylski 2019a)</td>
<td>12 - 18 year olds</td>
<td>All digital devices (TV, computer, smart phones, tablets, gaming consoles)</td>
<td>Not discussed</td>
<td></td>
<td>Association between Digital Technology use and adolescent wellbeing is negative but small</td>
</tr>
<tr>
<td>Screens, teens and psychological wellbeing: evidence from three time use diary studies (Orben and Przybylski 2019b)</td>
<td>9 year olds</td>
<td>TV, Computers and Smartphones (but non TV data very sparse)</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Little substantive statistically significant and negative association between screen time and wellbeing.</td>
</tr>
<tr>
<td>Screen time in children and adolescents - is there evidence to guide parents and policy (Ashton and Beattie 2019)</td>
<td>NA</td>
<td>TV, Computers and Smartphones</td>
<td>Not discussed</td>
<td>Not discussed</td>
<td>Overall negative but lack of evidence; correlation but no causation.</td>
</tr>
<tr>
<td>Digital screen media and cognitive development (Anderson and Subrahmanya 2017)</td>
<td>Mainly infants and toddlers</td>
<td>TV, computers and touch screen devices</td>
<td>Not discussed</td>
<td>Co-viewing with parents considered</td>
<td>Impact on cognitive development is the main focus of the article. Educational television found to have positive impact on early cognitive development. Violent content found to influence antisocial and aggressive behaviour.</td>
</tr>
</tbody>
</table>