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Julie Meates

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PROBLEMATIC DIGITAL TECHNOLOGY USE OF CHILDREN AND ADOLESCENTS: PSYCHOLOGICAL IMPACT

JULIE MEATES
University of Canterbury

Abstract

Since the evolution of the internet in 1969 and the inception of the personal computer in the early 1970s, a significant body of research has emerged that highlights the impacts of digital technology on education, health and human development. This paper reviews research in this area and examines the physical, mental, and social health effects on children and adolescents (10- to 19-year-olds), as well as the impacts of digital technology on educational achievements. The aim of this literature review, to examine the psychological impact of digital technology, was prompted in part by the widespread use of digital technologies in schools including Bring Your Own Device (BYOD) policies. BYOD asks students to bring personal laptop or iPad/tablet computers to school. Outcomes of this study may be surprising in the quantity of research available that provides red flag alerts. This fact alone will be of interest to school leaders as policy makers. There is a need for trustworthy information on which to base reviews and revisions of school policy to reduce the risks from the use of digital technology.

Introduction

The use of digital technologies in an educational setting has increased rapidly. As a result, schools are facing a paradigm shift with 21st-century developments in learning (Kaye, 2012; Wylie & Bonne, 2016). Computer technology has grown exponentially, with the evolution of the internet from its conception in 1969, and the inception of the personal computer in the early 1970s (Flisher, 2010). The number of internet users worldwide increased by 1167 percent between 2000 and 2019 (Miniwatts, 2020). Digital technology now plays an increasingly integral part in schools with many positive benefits and its use can have a positive effect as a platform for social systems, optimising the mobilisation of resources such as current information, news, and educational videos; it also has a range of negative impacts, however.

In recognition that there is already a significant amount of literature available extolling the benefits of the use of digital technologies in education, the aim of the literature review reported on here was to examine the potential negative impact of digital technology, including the use of Bring Your Own Device (BYOD) policies in schools. BYOD allows students to bring iPhones, iPads, and personal computers to school. Outcomes of this study will be of interest to school, health and political leaders as policy makers. There is a need for trustworthy information on which to base reviews and revisions of school policy to reduce the risks of using digital technology (Merga, 2016).

The design of this research report included a systematic review of scholarly articles from several online bibliographic databases and books in the disciplines of health, education, human development, psychology, environment, communication, law and leadership. Extant research has been reviewed as part of this project, including primary studies, secondary data analysis, meta-analysis, and systematic reviews on the health and educational impact of digital technologies.

Findings

It will be no surprise to any reader that the evolution of technologies has been exponential in the last 30 years, since in the 1980s, many had no access to a computer in homes or schools. Evidence from this review suggests New Zealand children can be classified as extreme users of digital technologies with accompanying associated psychological impacts.

Corresponding author
Julie Meates jag39@uclive.ac.nz
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Global and US statistics

Hardell and Carlberg (2015) note that globally, from the mid–1990s, the use of mobile phones increased rapidly. The International Telecommunication Union reported there were an estimated "6.9 billion mobile phone subscriptions" by the end of 2014 (Hardell & Carlberg, 2015, p. 3794). According to the American Academy of Pediatrics (2013), a third of all young people had a high frequency of texting, sending over 100 messages per capita daily.

The total numbers of internet users globally, as shown in Table 1, has increased to over 4.6 billion in 2019. This equates to a 1167 percent increase within a 19-year period from 2000 to 2019 (Miniwatts, 2020). Furthermore, when analysing the data regarding the exponential growth and indiscriminate use of virtual digital technological communities, the risks need to be navigated with openness, not deception, especially regarding our young. Not only are there more internet users, but the extent of their use has also grown with each generation; the highest usage (91%) is among 16–24-year-olds (Vink et al., 2016). According to McNaughton and Gluckman (2018), an average child between eight and ten years of age in the United States spends almost eight hours a day on various forms of digital media technology, with older teenagers spending in excess of 11 hours per day. And yet, according to the American Academy of Pediatric Policy and to Rowan (2017), as shown in Figure 1, technology exposure needs to be limited to one to two hours of total technology per day for ages two to 18 years, with no exposure for children younger than two years. There are implications for the young and developing mind. In fact, a policy recommendation made by the American Academy of Pediatrics (2013) highlights the need to discourage any type of screen media for children younger than 18 months and place limitations for all age groups on usage to ensure healthy mental and physical health.

Technology Use Guidelines for Children and Youth

Developmental Age	How Much?	Non-Violent TV	Handheld Devices	Non-violent Video Games	Violent Video Games	Online Violent Video Games and/or Pornography
0-2 years	None	Never	Never	Never	Never	Never
3-5 years	1 hour/day	Yes	Never	Never	Never	Never
6-12 years	2 hours/days	Yes	Never	Never	Never	Never
13-18 years	2 hours/day	Yes	Yes	Limit to 30 Minutes/Day	Never	Never

Rowan, C., Doan, A., Cash, H. (2014). Technology use guidelines for children and youth. Zone in Programs.
Retrieved from http://www.huffingtonpost.com/cris-rowan/10-reasons-why-handheld-devices-should-be-banned_b_4899218.html

Figure 1: ***Technology use guidelines for children and youth.*** Rowan, C. (2017).

Ten reasons why handheld devices should be banned for children under the age of 12. Retrieved from *Huffington Post*. https://www.huffpost.com/entry/10-reasons-why-handheld-devices-should-be-banned_b_4899218 Reprinted with permission.

New Zealand statistics

According to Research New Zealand (2015), there is increasing digital connectedness with ownership or access to laptops or notebooks for personal use (66% in 2013 with an increase to 72% in 2015; McNaughton & Gluckman, 2018). According to research by Nielsen, New Zealand data in 2016 showed that approximately 81 percent of 10-year-olds owned mobile digital devices. Statistics show an increase to 88 percent for internet access across the week for this age group (National Business Review, 2014). There was an exponential growth in smartphone ownership, which reached 91 percent for 18-year-olds in 2014 (Research New Zealand, 2015).

In New Zealand, "2.8 million people accessed social media sites in a month in 2013" (National Business Review, 2014). In 2015, a study conducted by Nielsen showed that 91 percent access social media by mobile digital technology (First, 2015). Furthermore, "the use of Facebook was estimated to be more than two million per day" (McNaughton & Gluckman, 2018, p. 2). In December 2017, there were over three million Facebook users in New Zealand (Miniwatts, 2020). With such an unbridled increase in such a short period, these are significant national and international statistics. It is essential that we critically examine and use the available empirical international data and research to develop policies that ensure the protection of our children and young people.

Table 1: World Population and Internet Usage Statistics for 2016 to 2019

WORLD INTERNET USAGE AND POPULATION STATISTICS
2019 Year-End Estimates

World Regions	Population (2020 Est.)	Population % of World	Internet Users 31 Dec 2019	Penetration Rate (% Pop.)	Growth 2000-2020	Internet World %
Africa	1,340,598,447	17.2 %	526,374,930	39.3 %	11,559 %	11.5 %
Asia	4,294,516,659	55.1 %	2,300,469,859	53.6 %	1,913 %	50.3 %
Europe	834,995,197	10.7 %	727,814,272	87.2 %	592 %	15.9 %
Latin America / Caribbean	658,345,826	8.5 %	453,702,292	68.9 %	2,411 %	10.0 %
Middle East	260,991,690	3.9 %	180,498,292	69.2 %	5,395 %	3.9 %
North America	368,869,647	4.7 %	348,908,868	94.6 %	222 %	7.6 %
Oceania / Australia	42,690,838	0.5 %	28,775,373	67.4 %	277 %	0.6 %
WORLD TOTAL	7,796,615,710	100.0 %	4,574,150,134	58.7 %	1,167 %	100.0 %

NOTES: (1) Internet Usage and World Population Statistics estimates are for Dec 31, 2019, as of March 3, 2020. (2) CLICK on each world region name for detailed regional usage information. (3) Demographic (Population) numbers are based on data from the United Nations Population Division. (4) Internet usage information comes from data published by Nielsen Online, by the International Telecommunications Union, by GfK, by local ICT Regulators and other reliable sources. (5) For definitions, navigation help and disclaimers, please refer to the Website Surfing Guide. (6) The information from this website may be cited, giving the due credit and placing a link back to www.internetworldstats.com. Copyright © 2020, Miniwatts Marketing Group. All rights reserved worldwide.

From "Internet World Stats: Usage and Population Statistics," by Miniwatts Marketing Group (2020). http://www.internetworldstats.com/ Copyright 2001–2020 by Miniwatts Marketing Group. Reprinted with permission.

According to OECD and PISA data from 2012, New Zealand had one of the highest percentages of students who started using computers at age nine years or younger (90%), while 50 percent first used a computer at six years or younger (OECD, 2015). Usage by youngsters in New Zealand and other OECD countries is shown in Figure 2. It can be seen that 51 percent of New Zealand students are classed as high internet users, spending two to six hours online during weekdays.

International and national research is compelling**.** While New Zealand, as well as the OECD (2018b), can recognise that moderate screen time is not necessarily bad and can also be beneficial, teachers and policy-makers should also recognise that the rollout of BYOD and access to mobile phones in schools does not restrict students to moderate use and instead can be seen to contribute to excessive use. For example, if a child uses their mobile phone for an average of six hours a day exclusive of school activity, combined with an additional three hours at school on a laptop, it is clear that the use of these devices acts as an addition to an already high usage.

Impact on wellbeing and mental health

Digital technology and cell phones are an integral part of school life and culture. Schools use technology, including BYOD as a platform for learning, so digital technology is now firmly established in educational programmes and is not without benefits. However, there is significant parental concern. Educational leaders, along with school Boards of Trustees, share responsibility to provide safe and positive learning environments for the children in their care.

Many studies have explored the potential for actual risks (Kuss & Griffiths, 2012; Kuss & Lopez-Fernandez, 2016). Despite the benefits for economies and societies that accrue from the internet (OECD, 2015), there is also an alarming potential for psychological distress. It is important to recognise that use of mobile phones can also be associated with harmful or disturbing behaviours, changing it from an instrument that supports social exchange to an object with risks (Billieux et al., 2007).

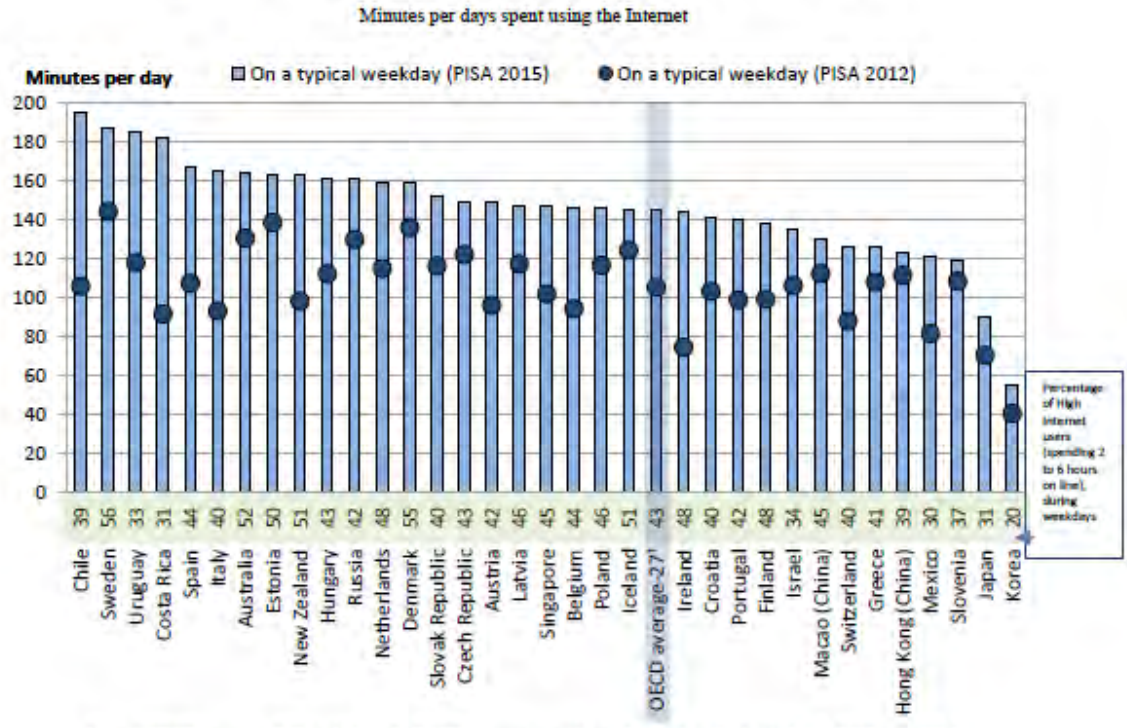

Figure 2: Changes between 2012 and 2015 for school students in time spent online outside school: OECD countries.

From New technologies and 21st century children: Recent trends and outcomes. OECD working paper, No. 179, 2018.

Several components influence psychological wellbeing and have a negative impact on mental health. Screen-time and bright screen light can delay melatonin secretion, a sleep-promoting hormone (Higuchi et al., 2005) and disrupt circadian rhythms (Kuss et al., 2019; Phillips et al., 2019), leading to sleep deprivation, stress and risk factors for depression (Glozier et al., 2010; Ma, 2019). Extensive scientific research, even from mobile phone manufacturers, warns of the impact of intensive cell phone use that can cause disruption to sleep patterns (Twenge et al., 2017). These harmful habits are implicated in increased waking tiredness (Punamäki et al., 2007) and insomnia (Bin et al, 2012; Mei et al., 2018).

Furthermore, there is evidence of companies targeting young people in emotionally vulnerable states. Disturbing evidence given by Zuboff to The International Grand Committee on Big Data, Privacy, and Democracy describes how Facebook gathers psychological insights from its users. In 2017, Facebook offered advertisers targeted advertisements to 6.4 million adolescents and young people in Australia and New Zealand, "based on detailed knowledge of when young people feel 'stressed,' 'defeated,' 'overwhelmed,' 'anxious,' 'nervous,' 'stupid,' 'silly,' 'useless,' and a 'failure'" (Zuboff, 2019, p. 13). In the same way as businesses are able to target advertising to customers based on their previous purchases of groceries or books, this method promoted by Facebook to businesses is aimed at affecting behaviour of high school and tertiary students and those young Australians and New Zealanders already in the workforce, based on negative psychological indicators.

International research endorses the correlation between usage of digital technology and anxiety, depression and suicide. New Zealand has one of the highest statistics of depression in the world and is in the top 25 percent in all statistics. World Health Organization (WHO) research shows that New Zealand is ranked in the top four highest rates in the world for high screen positive rates (Bromet et al., 2011). Cross-national epidemiological data of depressive episodes within the WHO's World Mental Health Survey Initiative interviewed "12,790 [in New Zealand], giving a total of 89,037 people in eighteen countries" (Bromet et al., 2011, p. 3). "The Screen-positive rate was … ≥ 60% in France, New Zealand, the USA, Brazil and Ukraine … the highest rates (> 18%) were in four high income countries (France, the Netherlands, New Zealand, the USA)" (p. 5). Respondents in the United States appear to suffer from depression at an earlier age than people in other high-income countries (22.7 years). The research states that the next earliest

age of onset was New Zealand, where "the median was 24.2" (Bromet et al., 2011, p. 7). The significance of the participant sample size—more than 12, 000 in New Zealand and nearly 90,000 across 18 countries—adds validity to the need to protect vulnerable youth. Perhaps we do not need to be reminded that New Zealand has the highest adolescent (10–19 years old) suicide rate among 29 OECD countries (Roh et al., 2018). The youth suicide rate in New Zealand is more than twice the OECD average rate" (OECD, 2018a, p.17).

Data from two nationally representative USA surveys (Monitoring the Future [MtF] survey and Youth Risk Behaviours Survey [YRBS]) conducted since 1991, with a sample size of 506,820 adolescents in Grades 8–12, as well as national statistics on death by suicide for adolescents aged 13–18 years, showed increases in adolescent mental health problems since 2010 (Centers for Disease Control and Prevention, 2016). Suicide became "the second leading cause of death among those aged 10–34" years of age (Hedegaard et al., 2018, p. 6). Using data from the MtF and YRBS studies, Twenge et al. (2018) reported that between the period of 2009/2010 and 2015, 33% more adolescents exhibited high levels of depressive symptoms, 12 percent more reported at least one suicide related outcome, and 31 percent more died by suicide. Twenge et al. (2018) examined possible causes for these increases, examining the data on the adolescents' other activities: there was correlation between screen activities and high depressive symptoms or a suicide related outcome. Results showed an elevated risk where "adolescents using electronic devices 3 or more hours a day were 34% more likely to have at least one suicide related outcome than those using devices 2 or fewer hours a day … compared to 29% of those using electronic devices 1 hour a day." The correlation was higher for girls than for boys. It is noteworthy that where those adolescents "used electronic devices 5 or more hours a day, 48% had at least one suicide related outcome" (Twenge et al., 2018, p. 9). Furthermore, the significance of the timing and data increase in smart phones is significant and relevant to increases in mental health problems. According to Twenge et al. (2018), approximately half of Americans used smartphones in 2012. Ownership of smartphones by teens and young adults increased to 92 percent by 2015; half of the public owned a tablet computer **(**Smith, 2017). In conclusion, "smartphones were used by majority of teens the year the depressive symptoms began to increase and by nearly all teens when depressive symptoms increased" (Twenge et al., 2018, p. 14). These statistics are alarming.

Data from childhood bipolar disorder diagnosis for youth increased approximately 40-fold from 1994 to 2003 (Moreno et al., 2007). According to Dunckley (2012), who refers to *electronic screen syndrome*, between 1980 and 2007 the diagnosis of ADHD increased by nearly 800 percent. High engagement with mobile phones and the internet was also associated with depression (Kardaras, 2016). A study by Roser et al. (2016) of more than 1000 adolescents in Switzerland has added weight to the many studies showing negative health effects associated with behavioural problems and decreased psychological wellbeing linked to problematic mobile phone use in adolescents. An earlier study in Taiwan showed that adolescents with problematic mobile use "were more likely to be aggressive, be victims of aggression and have low self-esteem (Yang et al., 2010, cited in Roser et al., 2016, p. 308). A potential to exacerbate poor mental health was shown in a study of 972 high school students in Thailand (Hanprathet et al., 2015). In an earlier Swiss study, Bélanger et al. (2011) found that "negative outcomes for aspects of mental health were found for heavy internet use (>2 hours)". To reinforce the point, heavy use was defined by this Swiss study in 2011 as greater than two hours per day.

Impact on a sense of belonging: Loneliness at school

Problematic smartphone use or addiction is a significant health and educational issue of importance in many countries (Soni et al., 2017). Emerging research across the UK and USA shows that excessive smartphone use and gaming can cause psychological issues such as loneliness, hostility (Griffiths et al., 2018), a sense of entitlement, isolation, distraction, narcissism (Buffardi & Campbell, 2008; Carpenter, 2012; Twenge & Campbell, 2009). Kardaras, a leading Harvard psychologist, makes the point that despite being so digitally connected to people, we are experiencing unprecedented loneliness and depression—forming "one of the loneliest societies" (Kardaras, 2016, p. 83) in human history. A meta-analysis of international research by Ryan et al. (2014) showed expectations of instant gratification and "highly materialistic" users valuing products consumed in public (Roberts et al., 2015, p. 14). The occurrence of these behaviours in school age children would be alarming since it is a crucial stage of

life where future adult attitudes and behaviours are beginning to be formed. Further research is endorsing such implications.

One association that can be identified in the PISA data from OECD (2015) (see Figure 2) is that students who spend more than six hours online per weekday in addition to any time in school are at risk of reporting that they feel lonely at school. Moreover, 17 percent were rated as *extreme internet users* and reported feeling lonely at school, compared with 13 percent that were *high internet users*, 12 percent that were *moderate internet users* and 14 percent that were *low internet users*. Likewise, extreme internet users performed worse across all subjects in the OECD PISA study, even after accounting for differences in socioeconomic backgrounds (OECD, 2017; OECD, 2018). According to OECD reports regarding the mental health and wellbeing of children and young people, an average 15-year-old student in 2015 from the PISA study had spent an average of 29 hours per week on the internet. This is an increase from the 21 hours spent by an average 15-year-old in 2012 (OECD, 2017; OECD, 2018). In 2015, approximately 540,000 students completed the PISA assessment, equating to about 29 million 15-year-olds in 72 countries (OECD, 2015). Of significance is that "students who are well-integrated at school are less likely to spend more than six hours per day online (Figure 2; OECD, 2015, p. 45). New Zealand figures for internet usage are some of the highest in the world, alongside China and Hong Kong, as shown in Figure 1. The percentage of students who agreed or strongly agreed with the statement "I feel lonely at school" (OECD, 2015) was at an estimated 10–25 percent, as shown in Figure 3.

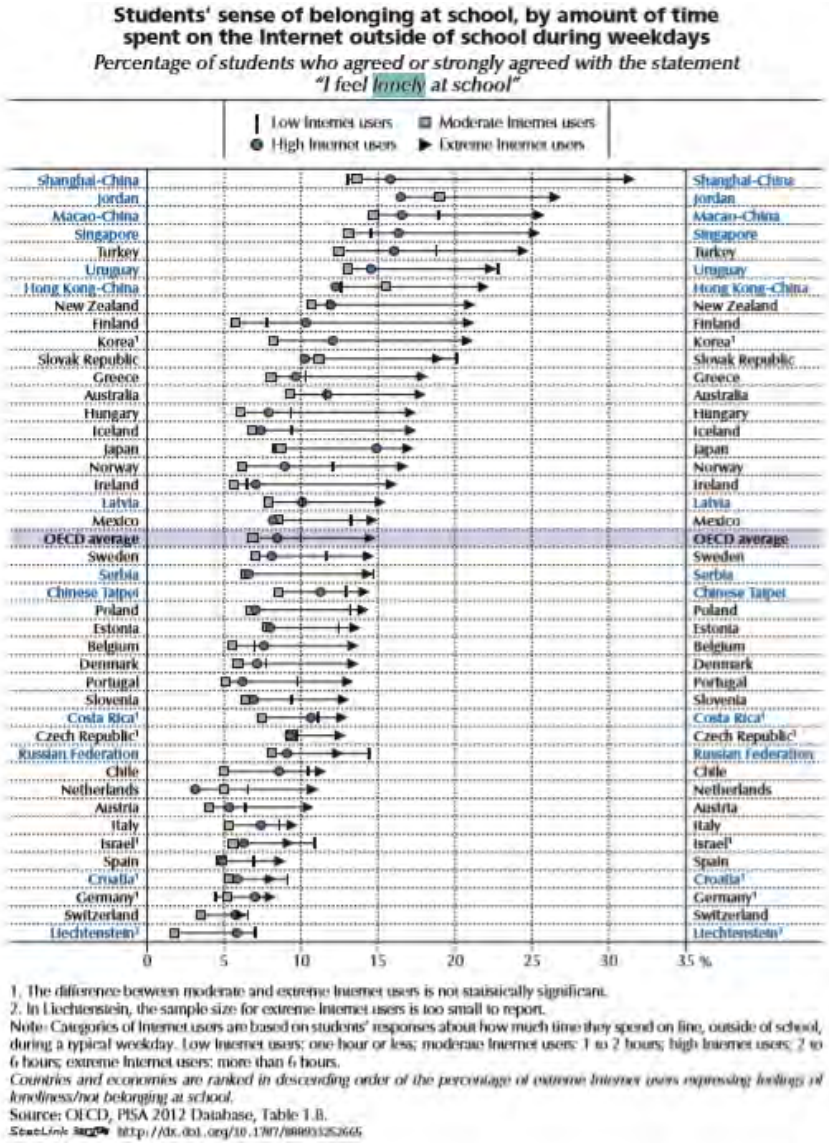

Figure 3: Students, computers and learning: Making the connection.
PISA, OECD Publishing. OECD (2015), https://doi.org/10.1787/9789264239555-en, p. 45

Exposure to pornography and mental health issues

A further risk to mental health is online pornography (Peter &Valkenburg, 2016) which is easily and accidentally accessible as well as being anonymous and able to cause considerable mental health issues. The statistics are incredible. "There were about 244,661,900 pornographic websites in the US during 2005–2006. Twenty-five percent (68 billion) of the total daily search engine requests were pornographic requests" (Torres, 2011), and an estimate of the internet pornography revenue at the time was $2.84 billion (Family Safe Media, 2009). It is difficult to estimate the size of the pornography industry now, but in 2014, CNBC reported that the adult entertainment business was a "$14 billion-a-year industry" (Tarrant, 2016). These figures bracket the inception of the individual use of BYOD in New Zealand (Kaye, 2012)—more challenging to monitor than the supervised access to computers.

Not only is there an immense amount of pornographic material available, but the ages of children when first exposed to such material is very young. According to GuardChild (2020, para 1), statistics from The Pew Institute, University of New Hampshire and the National Crime Prevention Center, as well as respected resources, show that "90% of children ages 8–16 have seen online pornography … The largest group of Internet porn consumers is children ages (sic) 12–17". Given the addictive potential of pornography, the young ages of children being exposed should be a cause for alarm. GuardChild (2020, para 2) highlights more comprehensive internet statistics, stating that 70 percent of children aged eight to 16 have accidentally accessed sites while doing homework. The FBI has reported a 2000 percent increase in child pornographic material on the internet since 1996, with approximately 116,000 child pornography requests made daily.

According to British Board of Film Classification (2020) children as young as seven view pornography, with mobile phones being the preferred method to access pornographic sites, although some boys preferred to use laptops or tablets. My own primary research from a randomised sample of University of Canterbury students suggests that first exposure to pornographic images in New Zealand was between five and 12 years of age. Since approximately 25 to 30 percent of the internet is pornographic material (Castleman, 2016; Torres, 2011), it is vital that age restrictions as well as classroom monitoring is put in place.

Many young people are digitally savvy and navigate safety mechanisms easily, as well as inadvertently accessing material. Furthermore, there are trends in youth reports of sexual solicitations, harassment and unwanted exposure to pornography on the internet, partly due to improving digital technology, faster internet and the aggressive marketing strategies of pornography sites (Mitchell et al., 2007). Wright (2014) examined a meta-analysis of sexual socialisation of children from pornography, concluding that exposure is almost inevitable and that steps should be taken to minimise its harmful effects on children. One recommendation would be for schools to return to computer suites that are closely monitored, although access at school to pornography is just one method used by youngsters. In a UK study, Nash et al. (2015) suggest a range of interventions that would reduce children's access to pornography and lessen the harm if they circumvent those interventions.

Children's use of technology and ramifications for education

Kardaras (2016) argues that we may have been fed the wrong narrative and technological innovation relies, paradoxically, on a lack of exposure to technology during a child's formative years and that age-inappropriate screen technology—like those from iPads and iPhones—and screen addiction might be hijacking our kids, comparing it to digital heroin (p. XVI) or electronic cocaine (p. 4). Using an analogy of his car, he stated he would not allow his eight-year-old twins to drive, nor would it help them be a more skilful driver. As we know, age-appropriate safety restrictions imposed, legal policies, and teachings learnt for the safety and wellbeing of our young are important. The same should apply for digital technology. The generation of computer scientists who developed the most popular digital devices of our own time were not immersed in such technologies as children themselves. On the contrary, the skills they used for developing personal computers were primarily non-digital. Steve Jobs developed hand-eye coordination from building and did not use a computer until he was 12-years-old, while Bill Gates was a boy scout who did not use a computer until he was 13 (Kardaras, 2016). The skills that Jobs and Gates used to develop convenient, user-friendly devices were gained in an analogue environment

which encouraged children (or at least boys) to learn with their hands. Gates himself imposed restrictions on computer use within his home. Nor would Gates allow his children to use cell phones until they were 13 and puts a cap on screen usage. Gates is not alone. Many technologically experienced parents who work for Google, Microsoft, and Apple insist on "no-tech classrooms precisely because they understand tech – and its dangers" (Kardaras, 2016, p. 31). Arguably then, the figures who understand digital technology best are aware that frequent use could impair the development of young learners and are unwilling to risk the development of their own children (Alter, 2017).

International research has shown mixed results regarding benefits from the increased use of digital technology in education. A meta-analysis by Karich et al. (2014) concluded that the components of learner control within educational technology had mainly negligible effects on the measures used for student outcomes. Others have found positive effects on student academic outcomes when certain conditions were in place that helped to increase study time and practice. With these conditions, including "increased time on higher-order tasks (such as editing and synthesising in writing); increased teacher–student interactions, either face-to-face or online; supportive home–school relationships; and enhanced aspects of guidance and feedback" (McNaughton & Gluckman, 2018, p. 6), positive effects on academic outcomes have been found. In a meta-analysis of strategies for teaching students to think critically, Abrami et al. (2015) found that exposure of students to authentic or situated problems and examples, and mentoring had positive effects on critical thinking skills. Only with such conditions with computer-based scaffolding of complex problems, tasks and goals (that help increase and integrate higher order skills) can positive academic outcomes occur (Belland et al., 2017). Recent comparisons across countries show that without certain conditions in place, heavy investment in digital technology has had little or no impact on 15-year-olds' achievements in reading, science, and maths (Karich, 2014; OECD, 2015). Further studies support such findings: there were no statistical advantages with using the iPad in an educational setting (Janssen, 2012). More research is needed; the negative effects may be due to screen time replacing parent–child interactions, such as playing, reading, singing, talking, outdoor and other positive life experiences. More research is also needed on where the balance is in classroom curriculum, between digital technology use and other approaches.

Academic results in the OECD (2015) publication suggested that "limited use of computers at school may be better than not using computers at all" (p. 16). However, of significance is the finding that "using them more intensively than the current OECD average tends to be associated with significantly poorer student performance" (OECD, 2015, p. 16). A later study reported that "mean performance in New Zealand has been steadily declining in reading (2000–18), mathematics (2003–18) and science (2006–18) from initially high levels of performance" (OECD, 2018b, p. 3). A study by (Park et al. (2011) of middle school and high school students in South Korea found that those identified as having internet addiction had lower comprehension scores than those in the nonaddicted group, although it was unclear which was the cause or the effect.

New Zealand research (Parsons & Adhikar, 2016), using data from secondary students, highlights a double-edged sword (Qi, 2019). While digital skills are found to improve, there are signs of issues with writing, lack of concentration, distractibility and 'technostress'. Other academic related ramifications include challenges for teachers monitoring students during classes to prevent them from going off task along with mobile phone problem use or addiction issues (Foerster et al., 2015).

Computer screens are not the only screens that have raised concerns: in a US study on children whose television exposure as toddlers was known, attention difficulties at age seven were linked with higher exposure (Christakis et al., 2004). In New Zealand, using data from the Dunedin Study, Hancox et al., (2005) showed that low levels of educational achievement in early adulthood were linked with increased television viewing times in childhood and adolescence. Television exposure has also been linked to sleep disturbances in children (Paavonen et al., 2006).

Conclusion

Practitioners, governments, schools, universities, ministries and educational and health leaders need to be aware of the risks when promoting digital technology in and through the New Zealand curriculum. We need to be cognisant of how to navigate the advantages and the dangers of digital technology with aroha, manaakitanga, wisdom, and balance. There is already a large body of evidence on problematic

mobile phone use and other digital technology overuse, dependence and addiction. Such psychological and cognitive issues all pose important, ubiquitous educational challenges. International research examined in this review highlights the harmful effects that can result from heavy usage. Heifetz et al. (2009) stated that leadership "involves orchestrating the inevitable conflict, chaos, and confusion of change so that disturbance is productive, rather than destructive (p. 5). But first we must know what should never change … timeless principles (p. 4) [and values]; discerning and conserving what is precious and essential" (p. 4). It is time now for New Zealand educational leaders and parents to heed the warnings and work together to place overall limits on hours of digital technology use across school and home environments.

Educational leaders have a responsibility to provide safe, positive, balanced and stimulating learning environments while also understanding and dealing with the influences and implications of the digital world that exists outside the educational realm. When pursuing policies of compulsory usage of personal devices in classrooms, such as through BYOD, school policy makers need to listen to the advice of eminent psychologists, such as Kardaras (2016) when he questioned how screen addiction is hijacking our children; or Dunckley, a child and youth psychiatrist, on electronic screen syndrome (Dunckley, 2012); and the perspective of Twenge and colleagues (Twenge et al., 2018) on the impact of the smart phone and other digital technologies. The impact of digital technology for education, health and child development has both benefits and risks.

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