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Chapter 4.2: Tablet devices in education – beyond face-value

Keith Turvey and Norbert Pachler

Introduction

If learners are to benefit educationally from the potential offered by tablet devices we must understand the nature of the legitimate concerns that are reported. In this chapter we therefore critically examine arguments and evidence relating to the use of tablet devices and smartphones in education. We do this by engaging with common concerns and issues: distraction from learning and potential negative impact on attainment, technology addiction, and online safety. We present evidence which we believe suggests that these genuine concerns associated with tablet devices and mobile digital technologies such as smartphones need to be engaged with beyond their face-value.

We take the view that tablet devices and smartphones bring new opportunities as well as raising imperatives for learners and teachers in formal educational contexts and beyond (Turvey and Pachler, 2016). The ubiquity and penetration of a global network of mobile technologies in so many aspects of our lives is intensifying. This prompts a call for action to all educators (parents, teachers, and the wider community) to play an active role in supporting future generations to develop constructive and critical orientations towards mobile technologies, the media they bear, the functions they perform and the possibilities they bring forth in the present and future. What is not helpful, we suggest, are the reductionist 'black or white' dystopian versus utopian views, which have tended to characterize debates about new and emerging technologies in the media over the decades.

Hype, crying wolf and genuine concerns

The guidance computer used in the Apollo moon landing on July 20, 1969, had a processor speed of 0.043 megahertz and a memory of 64 kilobytes (Saran, 2009). In theory, the gain in

speed and storage capacity of an iPad Pro, at the time of writing, is in multiples of thousands and millions respectively. Such facts about digital technologies pique consumers' interest for the latest gadget as technology companies know only too well. Why would you not want to put such face-value computing power in the hands of learners? Of course, when it comes to computing capacity it is all relative. Data-hungry multimedia combined with the kinds of multitasking we require of digital devices has a tendency to put gains in computing power into perspective.

Digital technologies are often promoted superficially on their immediate face-value, as opposed to being thought through critically as to how they might merge with, extend or inhibit current pedagogical and cultural practices. Similarly, on the other side of the debate, the proscription of digital technologies, such as tablet devices, is often done through appeals to face-value concerns. Consider for a moment the grave concerns expressed by some about the future of language as texting became commonplace with the use of mobile phones. This was accompanied by fears that the younger generation in particular, would use *textspeak* inappropriately in essays and examinations, leading to a decline in the quality of spoken or written English. However, Crystal (2008) highlighted the mythology surrounding these concerns, arguing that 'texting has added a new dimension to language use' and that there is no evidence of a widespread detrimental impact on standard English.

We do not dismiss face-value concerns or claims about the potential impact of digital devices in formal education contexts. But these do need to be examined more deeply, drawing on research evidence to shed light on the place of mobile technologies such as tablet devices and smartphones. However, while it is an issue that rightly concerns parents and children as much as teachers, it is probably true to say that often parents, children and, to some extent, teachers have little say about important decisions regarding the rationale, purchase and setup of digital technologies in schools. Selwyn (2016) has questioned what

appears to be a tradition of seeing educational technology as an inherently *good thing*, which has led to top-down government and school policy initiatives. Yet children, parents and teachers are key players in terms of the ways in which the devices will be used. User agency and context are also important factors when considering 'personal' devices as tablets which have implications beyond the formal education context. Available research and monitoring and evaluation evidence has often been ambivalent (see Weston and Bain, 2010, for example).

Many of the various stakeholders' concerns regarding the introduction of iPads or Android tablets in schools relate to areas in which there are already useful bodies of research knowledge. In any case, although we would argue that research can only help us to gain a deeper understanding of the issues, questions about what does or doesn't work when deploying educational technologies are problematic. Effective use of any educational technology is contingent upon understanding the multiple complexities of the context in which it is deployed and, most importantly, *how* it is used and for what purposes (Cox *et al.,* 2003). Tablet devices are no exception in this respect despite the hype often associated with them (Clark and Luckin, 2013).

Research can inform our understanding as educators so that we can make better intuitive decisions in response to the pedagogical complexities of specific educational contexts. But parents and children can also benefit from deeper consideration of the place they choose to grant mobile technologies in their lives, shedding light on the genuine face-value concerns they have about the increasingly anthropomorphic relationship we, as humans, develop with digital technologies. It is impossible to cover comprehensively the whole field relating to tablet and other mobile devices in the classroom but we offer an introduction to those issues we believe give the general public most cause for concern. These are: concerns about the potential to distract from learning and technology addiction,

neurological concerns about the long-term effects of technologies on the brain, and educational perspectives about online safety.

Beyond research face-values

At face-value, a meta-analysis carried out for the Education Endowment Fund, consisting of 14 different studies in the use of digital technologies, found that the introduction of digital technologies *on average* can offer 'moderate learning gains' of approximately 4 months progress (Higgins *et al.*, 2016). Hattie (2012) using similar methods estimates similar potential effects for the introduction of digital technologies. However, beyond face-value, the actual effect sizes of the different studies in Higgins *et al.*'s 2016 analysis vary significantly, ranging from the negative effect size of -0.03 to a positive effect size of 1.05. In other words, the face-value is misleading and such meta-analyses merely tell us that technology can have both a positive or negative impact on attainment and learning. Another recent meta-review (Haßler *et al.*, 2016) that looked specifically at research on the use of tablet devices in schools found more positive results in terms of learning outcomes. Out of 23 studies, Haßler and colleagues found 16 reported positive learning outcomes, 5 reported no difference and 2 reported negative learning outcomes. However, they also make the important point that much of the research included in their review did not go beyond face-value, stating that 'a large proportion of identified research offers limited or no details of the activities that learners engaged in' (Haßler *et al.*, 2016: 151).

It is not unreasonable to put the variability in impact of these various studies down to *how* the technology is actually appropriated by teachers and children and for what purposes in what contexts. These are far more complex questions to answer. The use of econometrics in educational research often tells us very little in terms of direct cause and effect between pedagogical practices, digital technologies and learning gains or loses. Wiliam (2014: 4)

points out that when conducting Randomised Control Trials[1] (RCTs) it 'turns out to be quite difficult to get people to implement the programs as designed', which raises further concerns about such face-value analyses of the impact of tablets and other mobile devices, on learning. Unfortunately, much of the large scale quantitative research into the impact of digital technologies on learning continues to take a face-value approach, often comparing the banning of digital devices with the blunt and undefined instrument of not banning digital technologies (see Beland and Murphy, 2015, for example). What is particularly interesting in Beland and Murphy's study, beyond the correlation between a blanket ban on mobile phones and higher attainment, is that the impact varied according to student characteristics, having no positive or negative impact on higher attaining children. This suggests that student dispositions towards, as well as teachers' pedagogical decisions about digital technologies are vitally important.

Concerns about distractions from learning

An important factor here in terms of pedagogical design and student dispositions is clearly the issue of distraction and what constitutes distraction from learning. When family sit down at a table to eat and share conversation over food, the issue of distraction can be more straightforward. The purpose of the activity is to eat and share conversation as a group. Such family rituals might indeed involve sharing photographs through a mobile device but the use of a mobile phone or tablet device by a member of the group can be more easily perceived as a distraction from the shared purpose of the group. Distraction in a learning context involving the use of tablet devices or smartphones is much more complex to determine, as has been noted from various case studies of teachers in the field (see for example, Pimmer and Pachler, 2014; and Turvey, 2014). In particular, it is important to ask what it is that children are being

[1] Randomised Controlled Trials (RCTs) form the basis of most meta-reviews where the results from a number of RCTs are synthesised to gain a meta-view of a field of research often over a number of years. A significant issue is that meta reviews or analyses can end up amplifying the significance of poorly conducted RCTs. To try to guard against this, selection criteria are used to decide which RCTs will be included.

distracted from. We believe it is more productive to focus on distraction from the conceptual knowledge and understanding that is being taught and therefore to draw on research from the field of instructional design and cognitive psychology.

In the 1980s and 1990s cognitive psychologist Alan Baddeley (1986), among others (Sweller, 1988, for example), provided evidence to support their theories about the ways in which memory functions in relation to stimuli and distraction during the process of learning or solving problems. Working memory in these studies is defined theoretically as a 'store' where small amounts of information are retained for a short period of time, such as the duration of solving a problem. A familiar scenario is holding in one's mind the cost of several items being ordered in a café. Long term memory involves the retention of much larger amounts of information 'stored' for much longer periods of time and retrieved as and when required. Returning to our café scenario, this would be the procedural knowledge one retrieves to calculate the costs held in working memory. Because working memory appears to be limited, the relevance of material presented and the way in which material is presented to learners is assumed to be vital for effective learning to take place (Kirschner and Kester, 2016). The theory, usually termed *cognitive load theory,* can be summed up as follows: the more extraneous material learners are required to process and/or the more effort they have to go to in making the material relevant or accessible for processing, the more distracted from the learning and the more impeded learning is likely to become as working memory becomes overloaded.

At face-value this would appear to offer a strong argument for banning the use of mobile devices such as iPads in schools, due to the potential to overload students with sensory stimuli that may not be germane to their understanding. However, Baddeley's research into *how* stimuli are processed by working memory and become established as longer term memories (see for example, Baddeley in Tulving and Craik, 2000) highlights the

importance of relevant semantic connections between different media and modalities (auditory, visual, textual) for understanding to develop and become established as long term memory, as 'deeper semantic processing leads to the best retention' (Baddeley, 2000: 82). In other words, the explicit and effective combination of relevant text, image and auditory stimuli can be highly conducive to learning and understanding. Tablet devices bring with them the opportunity to exploit media and modality in learning but, as Kirschner and Kester argue, it turns out that more evidence is needed to inform our decisions about what media and instructional designs 'should be used in what situations with what groups to achieve what goals under what circumstances' (2016: 538). Mayer (2008) unravels some of these fine-grained complexities and identifies principles for the design of multimedia instruction, based upon what is known about the limited capacity of working memory and also the way the brain appears to process visual and auditory information via separate channels.

However, most importantly here we believe, is Mayer's suggestion that learning with multimedia is also contingent upon learners' 'active processing — the idea that deep learning depends on the learner's cognitive processing during learning (e.g., selecting, organizing, and integrating)' (2008: 761). This emphasises the importance of metacognition or the importance of learners learning how to learn in a multimedia rich world. The more we understand about contingencies for, or barriers to learning and understanding with digital technologies, the more, we would argue, it becomes necessary to educate learners about how to optimise their opportunities to learn and to be critical about what they learn.

It is worth adding a note of caution here. There has been a tendency to popularise over-simplistic models and theories relating to learning and memory. In interpreting models from cognitive psychology, the complexities of the sensory register and the executive functions are sometimes underplayed. Executive functions such as learner motivation and emotions affect memory and retention, and are difficult to account for under laboratory

conditions, far removed from the complexities and dense variability of the classroom. Over-simplistic interpretations of metaphorical models of memory have led some policy makers to over-emphasise a reliance on impoverished approaches to learning and teaching based upon rote learning and repetition of facts with very little concern for deeper levels of understanding or issues about helping children to learn how to learn.

Despite these caveats, it is not unreasonable to assume, based on the evidence available, that the use of media-rich mobile technologies such as tablet devices, without careful attention to *how* they are used and without any attempt to teach children how to optimise their opportunities to learn with digital technologies and self-regulate their use, could impede or distract from learning as much as it could support it. Mills highlights the vital role of self-regulation in mitigating against 'negative consequences experienced from Internet use' (2016: 5). Media, it seems, as McLuhan forewarned as long ago as 1964, can be used to beguile, distract and exploit. The potential of digital technologies such as tablet devices to distract from, or hamper learning is not an argument for the banning of mobile phones and tablet devices in schools unless, as a society, we are content to leave future generations' critical media literacy and metacognitive capacity to chance. If anything it creates new imperatives to support learners in optimising their capabilities to use such digital technologies more critically and effectively. Indeed, in a recent meta-review on the potential effects of Internet use on adolescents' cognitive development, Mills suggests that cognitive changes that 'are likely taking place' might better be seen as an adaptive process that is necessary for 'emerging adults' ability to successfully navigate our highly–connected world' (2016: 10). This is more than merely a cognitive issue, it is also a socio-cultural issue as we consider later in this chapter.

Concerns about neurological impact

From a neuroscience perspective, the issue of learning in relation to mobile devices has led to some hypothetical and as yet only partly-evidenced speculation relating to potential long-term effects on what is often termed the cognitive architecture of the brain. Some have popularised neuroscience perspectives (see for example, Greenfield, 2014), speculating as to whether, due to digital technologies, as a species our brains are becoming 'rewired'.[2] Others have approached the issue of distraction from the perspective of cognitive engagement (Howard-Jones *et al.*, 2015). Paul Howard-Jones and colleagues explored how the design of an app gamifying learning. Specifically, applying elements of game design to non-game contexts via varying the certainty of the rewards learners received, which is linked to the production and uptake of dopamine in the brain[3]. The theory being tested was the intensity of emotional response – as indicated by levels of dopamine – and its capacity or otherwise to support the encoding of memories during a gamified process of learning. Howard-Jones *et al.*'s (2015) study provides evidence that engaging with multimedia through tablets or other digital technologies in a gamified learning context stimulates short-term responses in the brain. It suggests the extent of such changes (such as, levels of dopamine) can to some degree be designed into activities with digital devices. However, it is important to emphasise that these are short-term changes, the like of which we also experience moment to moment in response to every-day stimuli and activities such as: consuming food and drink, meeting friends, sleeping, experiencing disappointment or pleasure and so on. In relation to whether our engagement with tablet devices and digital stimuli can be linked to any long term changes in the cognitive or physiological architecture of the brain, there is currently no conclusive evidence to support any such assertions. Kim and Han offer some insight in their review of

[2] The speculative evidence for 'rewiring' claims about the brain are often linked to Magnetic Resonance Imagining (MRI) studies that show gray matter differences in the brain as a correlation with occupational and environmental stimuli. See for example Maguire, Woollett and Spiers' comparative MRI study of London taxi and bus drivers.

[3] Dopamine is a chemical that functions, among other things, as a neurotransmitter for the reward system in the brain.

the neurobiological features of problematic Internet and video game use. They point to the fact that a range of conditions such as ADHD, major depression, and social phobia often 'coexist with problematic Internet and video game use… [but] it is an open question whether such brain changes are the result of problematic Internet and video game use, pre-existing or coexisting psychiatric disorders, or other causes altogether' (2015: 75).

While a technology effect should not be ruled out, it is unlikely that a single technological cause could be isolated. It seems more likely that technology addiction is symptomatic of deeper and more complex neurological, biological, emotional and behavioural factors. This view of digital technologies as symptom rather than cause of addictive behaviour is further supported by population studies that have consistently found the issue of pathological Internet use to be prevalent in only a minority of the populations studied (Durkee *et al.,* 2012; Strittmatter *et al.,* 2015). News media reports tend to lay blame for addictive behaviours towards digital technologies squarely with the technologies themselves in a simplistic linear cause and effect explanation of the phenomenon. Reports often utilise the problematic *digital natives* meme to characterise children and young people as 'lost' to their digital technologies. But such simplified and superficial commentary also ignores the socio-cultural complexity and scope of this issue. Taking only a medical view of Internet or digital technology addiction, inadvertently places the remedy beyond our own actions and beyond the socio-cultural structures we choose to co-construct as communities and societies that could also play a more constructive role. At worst a purely medical perspective renders us increasingly powerless to address the issue. As Turkle notes:

> To combat addiction, you have to discard the addicting substance. But we are not going to "get rid" of the Internet. We will not go "cold turkey" or forbid cell phones to our children …. We have to find a way to live with seductive technology and make it work to our purposes.

(Turkle, 2011: 294)

Faced with such important concerns, there is an imperative, we would argue, for education to play a significant role in helping future generations orientate towards the purposeful, critical and creative use of digital technologies. On the one hand, the seductive qualities of digital technologies such as tablet devices create genuine tensions but, on the other, new opportunities for personalisation, collaboration and authenticity (Burden and Kearney, 2016) offer significant potential for purposeful and creative use in education. For example, the playing of video games is often portrayed by the media in a negative light in relation to genuine issues of technology addiction but the evidence suggests this issue is far more complex with potential to develop children's computer literacy and logical problem solving skills (Greitemeyer and Mügge, 2014). See Chapter 3.1 for a more detailed discussion of the problems associated with computer games.

Online safety: restriction versus trust

Smartphones and tablet devices bring multiple, personalised gateways to the Internet and the world beyond the classroom. The idea of 'control' in this scenario is far more complex than with other educational technologies such as Interactive Whiteboards (IWBs). Tablets and mobile phones challenge established forms of pedagogy because they put the window on the world in the hands of the child in such a way that requires a reconfiguration of pedagogy based on trust and participation for protection.

Since the inception of the Internet in schools, the approach has prioritised protection over participation, minimising the risk of exposure to inappropriate content or harm through restriction (the filtering or banning of certain technologies, for example); rather than prioritising the education of children about the risks and opportunities of the Internet to help them to develop the skills and dispositions to protect themselves, greater emphasis has been placed on restricting access (Male and Burden, 2013). The very real risks, such as

cyberbullying, commercial exploitation of young people, exposure to pornography and the potential for sexual grooming are well documented in the media. However, the Byron Review in 2008 highlighted the problem with prioritising protection through restriction over protection through participation:

> Children and young people need to be empowered to keep themselves safe – this isn't just about a top down approach. Children will be children – pushing boundaries and taking risks.
>
> (Byron, 2008: 2)

Livingstone et al's European collaboration (Livingstone, Haddon, Görzig, and Ólafsson, 2011) exploring the online lives of children and young people identified further evidence of the necessity for a more active and progressive stance towards online protection based on developing critical media literacy through participation. Content, or the World Wide Web, like the infrastructure – the Internet – is not static and nor are the risks that children and young people face or are yet to face. Livingstone and colleagues (2011) highlighted the ongoing emergence of new risks that often parents and teachers are unaware of and, therefore, draw attention to the need to listen to children and young people in order to understand the emergent risks that they may often be first to encounter.

It is beyond human possibility to police the Internet or the world wide web yet under the recent Investigatory Powers Bill (United Kingdom Parliament, 2016) new measures in England have been brought in which pursue an agenda of blanket surveillance of children and young people's online activities. It is now statutory (DfE, 2015a) for schools to have filters and monitoring systems in place to restrict children's access to inappropriate material and keep log files in order to identify individual users' search histories. Brought in to address most recent concerns about the radicalisation of children and young people, such measures, we would argue, could serve to merely heighten the probability of exposure to risk, driving

some children and young people towards more covert practices with mobile technologies. It is unlikely that the introduction of tablets or any digital technology into a school context where digital surveillance is of the utmost priority can lead to the openness and trust between young people and their elders that is required to tackle the difficult and emergent issues of online safety. As the UN Special Rapporteur remarks, these measures merely limit 'right to freedom of expression' and put 'children in greater danger by inhibiting discussion about online risks' (UNHCR, 2014: 18).

Conclusion

The way that a technology is actually appropriated by teachers and learners and for what purposes in what contexts, plus student dispositions towards, as well as teachers' pedagogical decisions about digital technologies are vitally important when it comes to the extent to which any technology does or does not support learning. Based on the evidence available, the use of media-rich technologies such as tablet devices, without appropriate attention to *how* they are used could impede or distract from learning as much as they could support it.

The negative potential of technology to provoke addiction is not well evidenced and it is unlikely that a single technological cause could be isolated. It seems more likely that technology addiction is a symptom of deeper and more complex neurological, biological, emotional and behavioural factors. Education must play a significant role in helping future generations orientate towards the effective use of digital technologies.

The issue of online safety gets to the heart of the purposes of education and the place of mobile technologies within any vision for their use. What is the likely output of a risk averse education system in which digital technologies serve an agenda of restriction and surveillance while paradoxically exposing the next generation to the commercially driven incentives of technology companies? It would appear now more than ever, what is needed is an approach

to digital technologies in education that goes beyond restriction and face-value approaches to online protection. Such approaches would put children and young people's rights at the centre of the use of digital technologies; that is, their right to open, accurate and critical debate of the difficult issues of our time that will no doubt shape their futures. This can only be built upon trust which gives children and young people active agency over digital technologies in order to develop the kinds of creative and critical media literacy needed. Anything less than this may merely 'exacerbate rather than diminish children's vulnerability to risks' (UNHCR, 2014: 12).

What the research says Key Findings Summary

- Teachers, parents and children should understand that tablet devices can have a positive, negative or indeed no effect on learning or attainment;
- The actual effect on learning and attainment cannot be linked wholly to the use of tablet devices and will be dependent on how they are used (as was also reported in Chapter 1.6), in what contexts and for what purposes;
- Increasing attainment is not the only purpose for incorporating tablet devices into education; they have an important place in children and young people's developing media literacy.
- The opportunity that tablets afford to combine visual with textual information or narrated audio with animation can contribute to learning and conceptual understanding.
- There is currently no evidence to suggest the use of tablet devices per se can cause addictive behaviours, but teachers and parents should play an active role in helping children to develop the self-control to moderate and critically mediate their use of tablet devices and mobile technologies;

- An overemphasis on a culture of surveillance may be counterproductive and expose children and young people to increased risk and vulnerability when adopting tablets or mobile technologies;
- There is no room for complacency in adopting mobile technologies such as tablet devices into formal education contexts; there should be regular opportunities for children, teachers and parents to discuss and critically review the ways the technology is being used and consider how they could use it more effectively;

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