

TABLETS **SCHOOLS**

An Updated Literature Review on the Use of Tablets in Education

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An Updated Literature Review on the Use of Tablets in Education

1. Introduction

Since the publication of the first Tablets for Schools literature review,¹ which argued that there was still a significant gap in the literature on the impact of one-to-one Tablets in education, the interest in this area has continued to grow among academic researchers. An increasing number of publications have debated the effects these devices have on teachers and pupils in educational contexts ranging from nurseries to universities. This report will update the findings from the previous publication and discuss the findings from recent studies, as well as the limitations of the research to date. It will also discuss what, if anything, distinguishes Tablets from other technologies that have previously been introduced in schools, such as computers, laptops and netbooks.

2. Research on mobile learning

The question of what distinguishes Tablets from devices previously used in schools can partly be answered by looking at what distinguishes mobile technology from other technologies. A UNESCO report (Shuler, Winters et al. 2013) defines mobile learning as learning using mobile technologies such as mobile phones, smartphones, e-readers and Tablets, and argues that these devices offer ‘unparalleled access to communication and information’. The report further argues that the increased affordability and functionality of mobile technology compared to technologies previously used in schools means they can support learning in new ways. Ubiquitous access to technology is recognised by UNESCO as facilitating more personalised learning, benefiting especially children with learning difficulties. Increased affordability of the devices and the option to reduce printing were associated with potential cost savings.

2.1 ‘Anytime, anywhere learning’

In addition to affordability and functionality, an important element in the popularity of mobile devices is their portable nature. This means that the technology can be used outside the classroom, potentially facilitating what has been termed ‘anytime, anywhere learning’ or seamless learning (Sha, Looi et al. 2011; Wong 2012; van 't Hooft 2013). It has been argued that access to a personal device and the portable nature of mobile technology allow learners to build links between school and everyday life, bridge formal and informal learning contexts, and transcend the limitations of their immediate environment (Seipold and Pachler 2011; Wong 2012; Shuler, Winters et al. 2013).

2.2 Independent learning

Mobile technology is believed to facilitate access to personalised learning content (Sha, Looi et al. 2011; Shuler, Winters et al. 2013). Along with the ability to learn outside traditional classroom settings, this is argued to support independent learning and the development of metacognitive skills or ‘learning to learn’ skills in young learners (Sha, Looi et al. 2011; Kearney, Schuck et al. 2012; Wong 2012). Wong argues that access to mobile technology allows students to design their own learning contexts in terms of when, where and how they feel they learn best, and learning thereby becomes increasingly self-directed.

¹ Clarke, B., Zimmermann, S. and Svanaes, S., 2013: *One-to-one Tablets in Secondary Schools: An Evaluation Study. Stage 2: January – April 2013.*

Kearney, Schuck et al. (2012) reviewed over 30 case studies of mobile technology use in education and found personalisation to be one of three main benefits, alongside collaboration and authenticity. Although the authors do not highlight one-to-one access, it appears that this is important to achieve the degree of independence described by this pedagogical framework. Personalisation is, according to Kearney, Schuck et al. (2012), a result both of being able to adapt learning content and activities to suit the individual learner's needs, and of the sense of agency and independence the student feels from being able to customise his or her own learning. Authenticity in this context means that the learning can be contextualised in ways that make the lessons relevant to the student, and it is therefore linked with this personalised approach to learning.

2.3 Communication

Thanks to the ease of accessing emails and messaging applications using mobile devices, researchers have noted improved communication between teachers and students as well as increased opportunities for feedback and continual assessment (Shuler, Winters et al. 2013). According to Snell and Snell-Siddle (2013), enhanced mobile communication and feedback can lead to greater student motivation and greater understanding of the learning process. West (2013) similarly argues that ongoing digital assessment can give students opportunities to reflect on their learning progress and therefore support greater student autonomy.

2.4 Collaboration

Collaboration is highlighted by Kearney, Schuck et al. (2012) as the third main benefit of mobile learning in addition to personalisation and authenticity. Collaboration is defined as the ability to engage in discussions about learning which are supported by technology, as well as the ability to transfer and collaborate on content. This degree of collaboration is facilitated by a personalised approach to learning where all students have access to mobile technology.

According to van 't Hooft (2013), mobile devices support collaborative learning thanks to their high mobility (i.e. they are small enough to be carried in one hand) and their small form factor (in other words, they are unobtrusive and do not interfere with face-to-face interaction). Van 't Hooft further points to the accessibility of mobile devices (ease of use and ability to turn on instantly), the ability to create, access and display information in multiple modalities (text, video, audio, graphics) and the ability to communicate and share information; these are cited as other facilities of mobile technology that support collaboration between students and between students and teachers.

2.5 Introducing mobile technology

One of the arguments for adopting mobile learning is that young people have access to and use mobile technology seamlessly in their individual lives, and that they will increasingly expect to have access to instant communication and personalised content in school (West 2013). Others, however, have warned against introducing mobile technology 'just' because students will expect it (Kinash, Brand et al. 2012). It has also been argued that students' perceptions of using mobile technology will differ greatly and that teachers must incorporate mobile technology alongside other methods of teaching in order to reach all students (Snell and Snell-Siddle 2013). Van 't Hooft (2013) argues that pressures on educational institutions to allow the same kind of access to technology will continue to

increase, and sees it as logical that teachers and students take advantage of mobile devices. He also argues, however, that integrating mobile technology requires making changes to education in order for mobile learning to be 'meaningful, effective and safe' (van 't Hooft 2013).

3 Research on Tablets

An increasing number of studies are currently being published looking at the use of Tablets from a variety of angles, from multinational trials to in-depth research with individual pupils. An overall limitation of the research to date continues to be small sample sizes and limited timeframes. Many studies focus on the use of Tablets in a single class or with smaller numbers of students. This is probably due to the fieldwork being carried out at a time when whole-school adoption was still fairly uncommon, while class sets were already frequent. Many of these studies employ a qualitative method, which has the benefit of capturing respondents' perceptions of the benefits the technology offers them. It does not, however, offer robust evidence of positive or negative impacts on pupils' learning. There appears to be little agreement of how to best measure the educational impact of one-to-one Tablets.

3.1 What distinguishes Tablets from other devices?

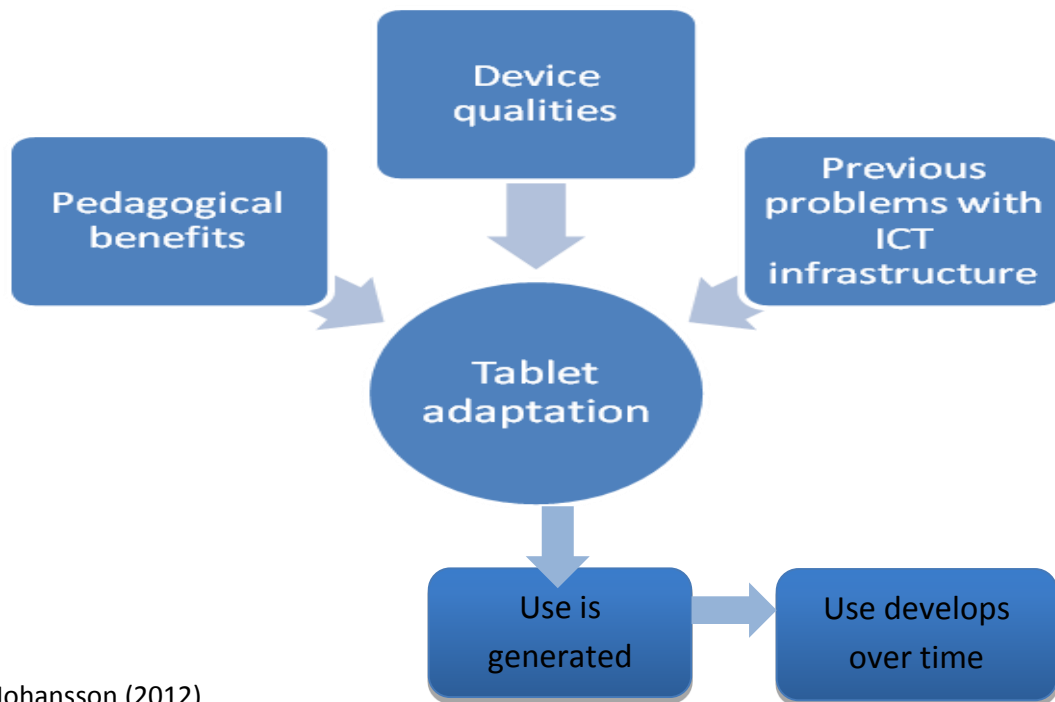
As discussed above, increased affordability and functionality have been highlighted as partly explaining the popularity of mobile devices in education. Looking at Tablets specifically, these can be argued to have greater functionality compared to, for example, smartphones and e-readers. Larger screens, an increasing variety of interactive apps, greater processing power, greater battery power and the availability of audio and video recording software can be argued to make Tablets more functional than other mobile devices, and as the prices of Tablets continue to come down² these functions are becoming available to schools at ever-lower cost.

3.2 What drives Tablet adoption in schools?

Johansson (2012) monitored the way Swedish primary school teachers adapted to using Tablets in their teaching and their perception of Tablets compared to previous technology. She argues that one of the main reasons Tablets are as popular as they are in schools is because of the lack of impact computers have previously had in education. The teachers she interviewed associated school computers with long boot-up times, during which pupils would lose focus, as well as frequent software problems. She therefore argues that 'the escape from the computers that do not work in itself becomes a driving force and motivation for learning a new system' (Johansson 2012, my translation), given that the new system is easily accessed and integrated into learning, which Tablets were felt to be. Johansson summarises the motivation for using Tablets as follows:

² <http://www.techradar.com/news/mobile-computing/tablets/rejoice-tablets-are-getting-cheaper-and-the-implications-are-huge-1209849>

Figure 1: Tablet adaptation among primary school teachers



According to Johansson, in addition to previous negative experiences with technology the inherent qualities of the Tablet as well as the pedagogical benefits teachers observed led them to adapt their teaching to facilitate the devices. From this a culture of use is generated and develops over time. Johansson stresses that the initial problems observed in her research, such as connectivity issues and inability to print, must be solved in order for the perceptions of Tablets to remain positive as the initial excitement among teachers and pupils wears off.

Churchill, Fox et al. (2012) argue that the extent to which Tablets will be used in education depends largely on teachers' perceptions of the affordances of this technology. They further argue that one of the limitations of research on the impact of Tablets is that it often looks at the affordances or qualities of Tablets separately from teachers' theories of how they can be used in teaching. While previous research has assessed students' perceptions of using Tablets for learning, and found that students often report feeling more motivated and encouraged to learn, Churchill, Fox et al. argue that this is not sufficient evidence of Tablets' impact on learning. It is therefore argued that studying the qualities of the technology and how these qualities are mediated by teachers' own attitudes towards technology and how it can be used is a better way of predicting the impacts Tablets can have on learning.

3.3 Research on Tablets in education

Much of the research on Tablets replicates the findings from studies on mobile technology in general discussed above. It has been argued, however, that ‘the iPad’s contributions to educational literacy and learning are still unknown because of the absence of thorough empirical studies’ (Dhir, Gahwaji et al. 2013). Dhir, Gahwaji et al. further claim that more research is needed to design appropriate guidelines for new curricula and pedagogy to support and assess the use of Tablets in schools.

Dhir, Gahwaji et al. (2013) carried out a literature review on the subject of the iPad’s role in education and found a number of frequently perceived benefits, which included ease of use, suitability for ‘anytime and anywhere learning’, use for both classroom demonstrations and small-group teaching activities, a wide range of educational apps, the ability to support interactive and collaborative learning, and increased communication between pupils and teachers. Another benefit was the use of Tablets for e-reading, which included the ability to support pupils with literacy difficulties, including pupils for whom English was a second language. In addition, it was found that the Tablets could potentially reduce teachers’ workload by enabling the digital collection and marking of assignments and providing easy content production and delivery to pupils. Tablets have also been linked with greater autonomy and motivation to learn (Churchill, Fox et al. 2012; Pellerin 2012; van ‘t Hooft 2013).

A survey of over 6,000 primary and secondary school students in Quebec, Canada highlighted both benefits and limitations of the use of Tablets in the province (Karsenti and Fievez 2013). Karsenti and Fievez argued that while the iPad programme had not yet reached its full potential, because it was not yet sufficiently integrated into teaching and learning, a number of benefits to students were visible. These included constant access to information and communication, increased collaboration among both students and students and teachers, increased motivation, improved quality of students’ and teachers’ presentations, more creativity, a greater variety of resources and types of learning material, development of both teachers’ and students’ IT skills, and a more personalised learning experience where students were able to work at their own pace. Practical benefits included a reduction in the use of paper and the ease of organising notes and other learning materials.

Some pupils found it difficult to write longer texts on the Tablet, which teachers found prevented them from developing writing skills. A further drawback was limited use of digital textbooks, as schools had limited access to these and found some versions of textbooks difficult to use. Several teachers found planning for the Tablet challenging, and felt that they had not been sufficiently informed about the technology before it was introduced. Teachers requested more training, which included technical advice, lists of useful applications, pedagogical discussions, and time to get used to the device.

3.4 Technology as a source of distraction

The possibility for technology to be a source of distraction has been noted in research on technology in schools, notably in the survey of teachers and students using one-to-one Tablets in Quebec (Karsenti and Fievez 2013). According to the teachers surveyed, having a personal device constantly available made the temptation to chat to friends or play games too much to resist for some students, which teachers felt was affecting the academic performance of these students. Research in

both primary schools (Henderson and Yeow 2012) and universities (Kinash, Brand et al. 2012; McCoy 2013) has also highlighted the use of technology for non-educational purposes during lessons. In Norway, the Department of Education is currently liaising with researchers and teachers about how best to manage technology and distractions in school.³ Options include giving teachers the option to shut off internet access during lessons. Teachers in the Canadian survey requested the establishing of appropriate use policies and accountability strategies in order to deal with inappropriate use in the classroom (Karsenti and Fievez 2013). Classroom management software was suggested to enable restriction of access to websites and applications following inappropriate use.

3.5 Developing literacy

As mentioned in Dhir, Gahwaji et al.'s (2013) review, there appears to be evidence of Tablets having a positive impact on language and literacy skills. Another research project found that the multimodal aspects of Tablets could support literacy learning in nursery, in early years primary levels and in special education (Flewitt 2012). A scoping review has also suggested that smart handheld devices such as Tablets can be beneficial for learning Asian languages, because the touch-screen allows pupils to draw symbols (Nooriafshar 2012). In Alberta, Canada iPods and iPads were used to support primary school children's acquisition of French as a second language (Pellerin 2012). Pellerin found that teachers were able to offer more individualised and guided practices, as well as more pupil-centred approaches.

3.6 Tablets as personal devices

Researchers have argued that personal ownership is crucial in order to reach the full potential of Tablet use. Burden, Hopkins et al. (2012) assessed eight primary schools in Scotland where iPads were used by pupils. In some of these schools the Tablets were kept in school and issued in classes for particular purposes, while in others they were given personally to pupils for use at school and at home. The study identified that personal ownership of a device was the 'single most important factor for successful use of Tablet technology' (Burden, Hopkins et al. 2012). This was seen as critical for increasing pupil motivation, promoting greater pupil autonomy and self-efficacy, and encouraging pupils to take responsibility for their own learning. A case study of two American primary schools similarly showed that students not being able to take the devices home and use them as personal devices prevented teachers from fully utilising their potential (Grant and Barbour 2013). Research in two primary schools in Chicago and Fairfax County showed that having personal access to Tablets at home made a significant impact on children's ability to access learning material outside school, especially for children who previously had to share devices at home.⁴ A survey with 169 Finnish teachers in schools using Tablets showed that the low device-to-student ratio was the main hindrance to carrying out the potential benefits the Tablets offered (Rikala, Vesisenaho et al. 2013).

Another research project provided Samsung Galaxy Tablets to pupils in a primary school class in Oregon, USA for a year (Bjerede and Bondi 2012). The devices were intended to be personal and pupils were free to take them home. The researchers argue that a key benefit was that the Tablets allowed pupils to take responsibility for their own learning and they state that centrally managing

³ <http://www.aftenposten.no/nyheter/iriks/PC-bruk-i-timene-Facebook-spill-blogger-chat-nettaviser-og-litt-fag-7432441.html#.UtUHbdJdWSo> *The Use of Computers in Lessons: Facebook, games, blogs, chatting, online news and a little bit of learning*. Published 13.01.14.

⁴ <http://www.tomorrow.org/publications/MobileDevicesTransformTeaching.html>

the devices would have prevented pupils from having this freedom. Increased collaboration between teachers and pupils was observed and teachers were said to rely less on formal instructions and instead let pupils find their own material. Teachers explained that pupils were better at organising their learning and reached a deeper understanding. The authors argue that learning is a highly personal experience, and that as long as the devices are personal, technology can function as an enabler of the distinctive qualities of each pupil:

This project demonstrates that technology-rich environments, with personal devices for all students tailored to their preferences, and the freedom for every child to discover and develop and own her learning is a powerfully effective model for the future of education.

(Bjerede and Bondi 2012)

4 The use of Tablets in primary schools

Research on Tablet use ranges from nurseries to universities, and it should be highlighted that the educational focus and context of Tablet use of course varies depending on the stage of education, which again affects research methodologies. Research on Tablet use in primary schools often focuses more on teachers' use of the devices as they inevitably will hold more control of the technology. A research project assessing the impact of smartphones and Tablets in preschool and primary classrooms (Parnell and Bartlett 2012) specifically focused on teachers' ability to document, analyse and communicate children's learning, rather than the children themselves engaging with the technology. Other research projects, however, are focusing on preschool children's use of Tablets. Researchers from Oslo University College and the Centre for ICT have carried out research workshops in nurseries in Oslo and found that the young children's confidence using the devices and the collaboration that occurred between staff and children created new situations for learning.⁵ In the UK the University of Manchester is currently planning to evaluate the use of Tablets in 24 primary schools where Tablets will be used to improve metacognitive (learning to learn) skills.⁶ Pupils will record their learning through photographs, audio recordings and written documents and will be encouraged to review and reflect on these. The teaching method has been developed by a London primary school which will be providing training for the remaining participating schools. The project will measure literacy, numeracy and attitudes to learning before and after the Tablets trial. Results will be published in 2016.⁷

In a study assessing the experiences in a New Zealand primary school where iPads were deployed to pupils aged 5–12 (Henderson and Yeow 2012), the devices were shared and not used as personal devices. Henderson and Yeow still observed positive impacts on learning and argue that this was partially due to the size of the screen. Being roughly the same size as a book, the device was thought to encourage pupils to engage with it the same way they would with a physical storybook. The authors further argue that the mobile devices encouraged collaboration as their size stimulated face-to-face interaction. Interactivity and instant feedback were also mentioned as a benefit which facilitated independent learning. Being able to carry the device across different locations was shown to allow pupils to access information and communication on the go. Henderson and Yeow further argue that the motivation that came from being able to access enjoyable learning content independently encouraged pupils to take control of their own learning.

⁵ <https://iktsenteret.no/aktuelt/nettbrett-i-barnehaugen#.Ui7kotKTiSp> Publication due.

⁶ <http://www.bbc.co.uk/news/education-24761270>

⁷ <http://educationendowmentfoundation.org.uk/projects/reflected-meta-cognition-rosendale-primary-school>

The Tablets were mainly used for research and browsing online, as well as for reading e-books (Henderson and Yeow 2012). The majority of younger pupils in the school did not use the internet browser as this was felt to be too complicated for them and instead used basic maths and spelling apps. The teachers in the school were on the whole very positive about the devices, arguing that their intuitive nature made them easy for children to use and that, because the children were able to carry them around, a more flexible learning environment was created. Teachers did acknowledge that distraction was an issue, but felt that this was inevitable when children have access to technology and, inevitably, a matter of classroom management skills. The researchers stress, however, that the school was still in the early phases of developing its use of Tablets when the fieldwork was carried out and that issues such as collaboration, mobility and independence had still not reached their full potential.

5 The use of Tablets in secondary schools

Findings from the Tablets trial carried out by Acer and European Schoolnet⁸ were published in 2013 (Balanskat 2013). 236 devices were provided to teachers in 63 schools in eight European countries. In addition 116 pupils across four classes were provided with Tablets; one in the UK and three in Spain. The research had two main objectives; to assess how Tablets affected teachers' practices and to assess how they affected pupils and teachers in a one-to-one environment. The survey found that teachers were generally positive towards the use of IT. During the trial they used the Tablets across a variety of subjects, mainly for browsing the internet for learning material. The devices were used most for lesson planning and delivery and less for assessment and communication. Use varied among teachers but increased over time. Most teachers used them in conjunction with other devices, and only 50% used them in more than half of their lessons.

Chou, Block et al. (2012) examined the challenges and opportunities one-to-one Tablet learning offered teachers and pupils in a US secondary school by observing lessons and interviewing pupils and teachers. Although the sample size of this study was relatively limited, it identified a number of benefits of using Tablets. Teachers reported seeing increased student engagement and felt that because the Tablets needed little preparation before they could be used in lessons this left more time for teaching and learning. Teachers also believed pupils' information literacy had improved and they were using the Tablets to teach digital citizenship. It was found to be easier to offer pupil-centred activities and teachers found themselves able to teach using more updated information and content. Challenges included the potential for distraction during lessons and a need for more suitable apps. It was also argued that both pupils and teachers needed more time and training to familiarise themselves with the technology and its uses.

6 The use of Tablets in universities

Researchers from the University of Northern Colorado measured twelve students' perceptions of using a Tablet (Alyahya and Gall 2012). The study relied solely on students' own feedback of the benefits they had experienced as well as observations in lectures. Students described the main benefits of a Tablet as having 'everything in one device', which was felt to make it easier to organise their learning. Students also appreciated having access to educational material, presentation and

⁸ <http://1to1.eun.org/web/acer/tablet-pilot>

note-taking software and, importantly, being able to communicate on the go, making them ‘more connected’ (Alyahya and Gall 2012).

Chen (2013) assessed the use of Tablets in informal language learning among university students and employed a mix of monitoring the students’ use of the Tablet and interviewing participants about their perceptions. Although the study found that students held very positive perceptions of the use of Tablets for language learning, the limited sample size and length of data collection means it has limited relevance in terms of proving any effect on learning. Moreover, the study did not include any assessment of students’ improvement but relied solely on participants’ feedback.

In a similar study, 209 university students at Indiana University, USA who used iPads in their classes (often sharing devices) participated in a survey exploring their perceptions of Tablet use (Rossing, Miller et al. 2012). The study highlighted the individual differences between students in using the devices. While some found the devices very helpful, others found them to be a distraction or difficult to take notes on. The study also emphasised the important role of the class instructor in carefully orchestrating and managing in-class activities. The researchers argue that teachers and lecturers must provide direction and carefully curate reliable digital resources.

7 The use of Tablets for children with special educational needs

Tablets are becoming increasingly popular among special needs educators (Pellerin 2012; Terrer-Perez 2013). For these technologies to have widespread impact on children with special educational needs (SEN), researchers have argued that the use of mobile technology must be included as a core skill in special needs education training (Dionne 2013; Terrer-Perez 2013). Dionne further argues that a framework for the use of mobile technology in special needs education must be developed to guide teachers.

The use of Tablets and the benefits observed vary across a spectrum of special needs, from helping children with visual impairments learn to read and write (Hayhoe 2012), to improving social skills, organisation and interpersonal communication in children on the autistic spectrum (Sultana and Hayhoe 2013). Research has also explored the potential impact of Tablets in literacy learning (Hutchison, Bechorner et al. 2012). The main benefit of digital reading is argued to be the ability to support different reading comprehension and engage pupils with reading difficulties. Audio support, word-by-word visual tracking and animation offer options for pupils struggling with written text. Hutchison, Bechorner et al. also point to the increasing number of literacy apps available to pupils with learning difficulties. The research found that offering pupils alternative ways of engaging with texts through a Tablet made them more engaged and motivated them to go further in their efforts to read.

A small qualitative case study examined the impact Tablet usage brought to one fifth-grade student with Attention Deficit Hyperactivity Disorder (ADHD) (McClanahan, Williams et al. 2012). Using an iPad in this student’s learning was found to help focus his attention and appeared to support the student in becoming more ‘metacognitive’⁹ in his reading. Comparisons of pre- and post-

⁹ Metacognition refers to higher-order thinking, which involves active control over the cognitive processes engaged in learning. Metacognition involves activities such as planning how to approach a given learning task, monitoring comprehension, and evaluating progress towards the completion of a task.
<http://gse.buffalo.edu/fas/shuell/cep564/metacog.htm>

assessments found that the student had gained one year's growth in reading within a six-week time period. Other benefits included improved confidence through the experience of being in control of his learning.

A group of Spanish researchers and software developers with a background in SEN software development have created a platform from which to design educational exercises for children with special educational needs (Fernandez-Lopez, Rodriguez-Fortiz et al. 2013). The platform was designed to run on iPod Touch, iPhones and iPads, and was tested with 39 pupils with a variety of special educational needs. The researchers highlighted the following aspects as important when designing content and activities for children with special educational needs:

- The ability to personalise and customise content
- The need to capture the pupil's attention
- The need for structure and an agenda to support the pupil's ability to organise his or her work
- The importance of sound, especially spoken language for children with hearing impairments as well as reading difficulties
- Promotion of proactive interactions to encourage communication
- Encourage the association of ideas and building relationships between concepts
- Easy and intuitive interface (important for both pupils and teachers)

The researchers assessed the pupils before and after a six-month period during which mobile devices were used in learning. The devices were not personal or one-to-one (with a ratio of two students per device). Questionnaires were designed to measure a set of skills before and after the trial as well as the frequency of use, the suitability of each activity and pupil motivation when working. Following the trial the researchers found an increase in pupils' language, maths and social skills as well as environmental awareness and autonomy.

A separate two-year study organised by the University of Hawaii, but yet to report results, has equipped 40 special needs teachers with iPad Minis and learning apps consistent with the national curriculum (Schmidt and Ho 2012). Teachers have to date been trained in how to use the devices in their teaching and began using the Tablets in 2013. Tablets will be introduced to pupils during 2014. The project will assess the teachers' use of the device and their perception of the impact on students four times over the two-year duration of the project. The trial aims to use these findings to design a framework for teacher training and the use of mobile devices in special needs education.

8 Teachers' perceptions of technology

One of the main concerns around introducing technology into schools has been teachers' levels of knowledge and confidence. A survey of nearly 2,500 American teachers found that they were generally very positive about technology but that there were concerns about mobile devices, the internet and social media (Purcell, Heaps et al. 2013). 92% of teachers agreed that the internet has had a major impact on their ability to access material for their teaching and 69% said it had had a major impact on their ability to share ideas with other teachers. However, 75% of teachers felt that the increase in access to technology had added new demands to their profession and increased the range of skills they must acquire.

The survey further showed that mobile technology is becoming increasingly popular in the classroom and 43% of teachers said they or their pupils use Tablets in school. The survey also revealed differences in confidence in using technology. Older teachers were more likely to say that their pupils knew more about technology than them, while younger teachers were more likely to share ideas and discuss their use of technology with other teachers. This was despite teachers overall being ahead of national benchmarks for adult technology use: 39% of teachers own a Tablet, versus 24% of adults overall.

8.1 The role of the teacher

Johansson (2012) argues that the use of mobile technology in learning is gradually changing the role of the teacher. Her main example of this is the acquisition of knowledge. While this was previously more of a direct transfer between teacher and pupil, the teacher is now increasingly supporting pupils in acquiring independent critical research skills which are considered to be crucial skills for the 21st century. Johansson suggests that teachers are now taking on the role of 'filter' for search engine results and the availability of apps, guiding pupils towards reliable content rather than prescribing it. She further suggests that teachers are increasingly freed up from their dependence on published learning material and able to create their own content.

Bjerede and Bondi (2012) similarly argue that giving pupils personal mobile devices for learning necessitates changes to the curriculum, specifically the inclusion of digital citizenship. They further argue that educators must ask themselves questions such as how to prevent pupils from engaging in cyberbullying, looking at indecent content, becoming distracted in lessons and damaging the devices. They stress, however, that bullying, indecent content, distractions and damage to school property are not new challenges in schools but that these are now delivered in new ways through technology.

8.2 Professional training and teacher confidence

The need for sufficient teacher training has been highlighted in the research on Tablets in education (Chou, Block et al. 2012; Johansson 2012; Balanskat 2013; Karsenti and Fievez 2013). Training includes not only technical guidance but also pedagogical discussions, recommendations and sharing of apps and teaching activities and, importantly, enough time to become familiar with the technology.

Johansson (2012) stresses that teachers have been taught how to use certain programs and facilities but have not been trained in how to handle students' use of mobile educational devices. There is an important difference, she argues, in how to use specific applications and how to incorporate technology as a pedagogical tool, and schools looking to implement technology must address this. Johansson further describes how the flexibility and physical shape of the Tablet in her research not only made pupils more mobile and able to collaborate but also improved collaboration between teachers. She argues that the motivation to use technology in teaching that she observed was partly due to the devices easily being brought out, used, shared and talked about, for example in the staffroom. Johansson observed teachers showing each other apps and offering help for those who experienced difficulties.

Giving teachers a Tablet to use and become familiar with at an early stage has been shown to reduce resistance to the initiative and promote motivation (Burden, Hopkins et al. 2012). In a trial in Scottish primary schools Tablets were found to be bringing about significant changes in the ways teachers approached their professional roles as educators. Teachers were observed promoting more collaboration between themselves and pupils as well as between individual pupils, enabling greater creativity and peer critique and supporting pupils of all abilities to a greater degree. Teachers reported having more time to develop and extend homework and give pupils better feedback on their learning.

The researchers assessing the Acer and European Schoolnet trial (Balanskat 2013) similarly observed that the implementation of Tablets led to more professional development opportunities but also necessitated training in areas such as the use of social networking sites and the pedagogical use of Tablets. Van 't Hooft (2013) argues that effective integration of mobile learning technologies requires ongoing professional development in technical and pedagogical areas. He also highlights the need for administrative leadership and commitment to support the vision. Van 't Hooft states that the use of mobile learning devices requires teachers to rethink the boundaries of learning and teaching and to consider what knowledge and skills are important in a digital world. Pedagogy is also seen as having to accommodate the dissolving boundaries between the classroom and the outside world. Van 't Hooft further argues that mobile devices require administrators to consider acceptable use policies, in terms of privacy, safety and intellectual property. The need for technical support within a school will also need to be redefined, according to van 't Hooft. Rather than providing hardware and software support, van 't Hooft predicts that technical teams will increasingly be tasked with creating, maintaining and monitoring networks and digital spaces that support learning.

The familiarity and confidence teachers have using technology varies considerably. A case study from a Chinese private school showed that the Tablet project initially had very low uptake with teachers, because of their lack of familiarity with the technology (Curtin and Tarnow 2013). Once the Tablets were implemented, many teachers reported feeling insecure. Curtin and Tarnow argue that the Tablets were encouraging collaboration and independence among pupils but that the trial was limited by a lack of educational content, and by pupils not being able to take the devices home.

9 Digital learning material

The rapid increase in the use of digital technology in education has led to a need for suitable, interactive learning content. The Joan Ganz Cooney Center, part of the Sesame Workshop, published a report assessing the availability of educational apps in the app store (Shuler 2013). The review showed that early learning applications for toddlers and preschool children were most prominent, comprising 58% of the educational apps targeted at children. This category has also experienced the most prominent growth, rising 23% since 2009. General learning is the most popular subject (47%) followed by Maths (13%). The researchers stress that there is currently a lack of research and evidence of the impact of educational apps and that academia and the industry must collaborate to create standards to make it easier for parents to discern beneficial content for their children.

Ostler and Topp (2013) reviewed the impact of the use of a specific app with university Maths students. In their study two classes made use of the application ShowMe Interactive Whiteboard for

digital note-taking during lessons. The notes could include audio, video and animations in addition to normal text and were used for practice and revision. The authors found that students found the app easy to use and helpful for revision. Students using the app described revising as 'being taught by a teaching version of themselves' (Ostler and Topp 2013).

10 The importance of pedagogical vision

There is a consensus in the research available that the introduction of technology in general and Tablets specifically must be supported by a pedagogical vision in order to reach its potential impacts on learning (Chou, Block et al. 2012; Churchill, Fox et al. 2012; Henderson and Yeow 2012; Johansson 2012; Cochrane, Narayan et al. 2013; Rikala, Vesisenaho et al. 2013; van 't Hooft 2013). It is also argued that more research is needed to establish how technology and pedagogical leadership impact each other and pupils' performance in school (Chou, Block et al. 2012; Johansson 2012). According to Rikala, Vesisenaho et al. (2013), the will to change pedagogy and to move away from teacher-led teaching was the main motivator to introducing Tablets in Finnish schools. The authors further argue that a continuous focus on pedagogy and professional development is crucial in order to harness the potential of educational technology.

Norris and Hossain (2012) argue that one of the main reasons many one-to-one laptop initiatives failed was because the technology was used for supplementary purposes and was not made essential. The authors argue that mobile learning initiatives must learn from this and that only in programmes where the technology is fully integrated into teaching and learning will the technology reach its full potential. Commenting on a trial of e-readers and iPads, Sloan (2013) argues that while transferring texts to e-texts requires little effort on the part of teachers and school administration, it will have limited impacts on students' learning. Integrating Tablets across teaching and learning is argued to require greater effort but would facilitate greater changes to teaching and learning.

Cochrane, Narayan et. al (2013) argue that the lack of evidence of the impact of technology on learning in academic research is partly due to researchers ignoring the importance of a pedagogical vision during the introduction process. Their assessment of six schools using Tablets therefore had as its starting point that the devices would have to be implemented as a catalyst for change within the school. After monitoring six schools, the authors argue that not only the device but also, importantly, the iOS platform and the available software facilitated collaboration and content creation, enabling opportunities for pedagogical change, the most important of these being a move away from teacher-directed learning.

11 Conclusion

This review has argued that there is still a need for more research on Tablet use in education that is based on larger sample sizes and, preferably, research on whole-school adoption, which to date is rare. There is also a need for more longitudinal research monitoring the development of educational Tablet use over time. In terms of methodology, a greater variety is needed in order to approach the question of what impact Tablets can have on teaching and learning from alternative angles. Research to date has mostly avoided the issue of impact on attainment, which will need to be tackled in order to convince local authorities and governments of the benefits of using one-to-one

Tablets. This is partly due to the limited timeframes of the research to date, which would not provide enough time for attainment figures to change. Research must also tackle the question of whether the introduction of technology and the changes some schools are making to their pedagogy alter how educational attainment is measured.

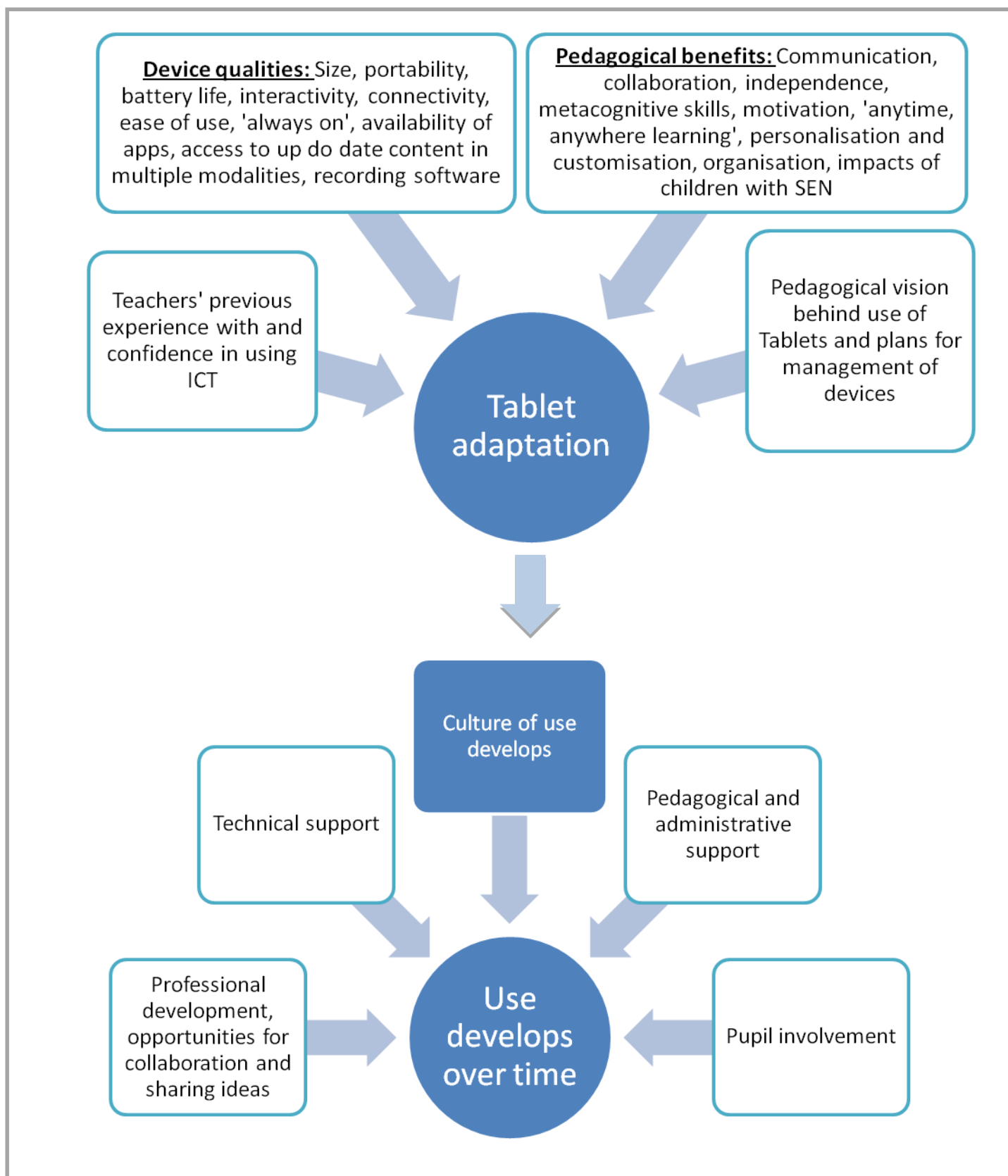
Despite the limitations of the research to date, some overlapping themes have begun to emerge and from this a picture of the factors that are important when introducing one-to-one Tablets can be established. It may at this point be useful to utilise Johansson's (2012) model of teachers' adaptation of Tablets to include findings from the research to date on Tablets in education.

The model below (Figure 2) summarises the qualities of the device and pedagogical benefits identified in the research reviewed. According to Johansson, teachers' negative experiences with previous technology functioned as a driving force for learning a new system, provided that this system was easy to access and use. Precisely the ease of use and increased functionality of Tablets compared to previous technologies, including other mobile technologies, means that these devices are able to support teaching and learning in a variety of ways. The cost of Tablets compared to other devices such as laptops has made equipping all students with a personal device achievable, and one-to-one access has been argued to be a crucial factor in increasing student motivation and independence (Bjerede and Bondi 2012; Burden, Hopkins et al. 2012). One-to-one Tablet use has also been argued to allow students to personalise their own learning experience, supporting the development of learner autonomy and metacognitive skills. The portable nature of Tablets and the ability to be connected at all times is argued to facilitate seamless learning. Pedagogical benefits identified across academic research include increased or improved communication and collaboration, increased independence, engagement and motivation among pupils, and the ability to customise learning and benefits for children with special educational needs. Device and software qualities that appear to support pedagogical benefits are size and weight, which facilitate portability, instant access to information and communication, access to apps and recording facilities, battery life, and ease of use.

In addition to the pedagogical benefits and challenges highlighted in the literature, teachers' and pupils' previous experience with using technology, as well as the existence of a pedagogical and administrative plan for the use of Tablets, are factors that will influence Tablet adoption in a school. From this a culture of use is created, which will develop over time, influenced by factors such as technical, administrative and pedagogical support, opportunities for professional development, and the involvement of pupils themselves.

The model below can be used to monitor schools' adoption of one-to-one Tablets and identify which factors are supportive of or detrimental to the use of the devices. Monitoring exactly how the use of one-to-one Tablets develops will be crucial, as this is currently missing from the literature. Comparisons of different software and hardware used in schools will also be beneficial to schools looking to implement one-to-one technology. Lastly, research needs to critically discuss how best to objectively measure impact on learning and what criteria need to be included in such an assessment.

Figure 2: The development of Tablet use



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