

What the research says

iPads in the Classroom

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A large, abstract graphic composed of overlapping, semi-transparent geometric shapes in shades of blue and grey, creating a sense of depth and movement. The shapes are arranged in a way that suggests a path or a sequence of events.

2013

EXECUTIVE SUMMARY

In the three years since the iPad was first introduced, there has been a rapid uptake of iPads and other 'Post-PC' tablet devices in schools both in the UK and globally. Enormous investment is being made, but do we have the evidence to support this show of faith?

The adoption and integration of tablet devices into school systems is not without its controversies, and the purpose of this report is to explore if we know enough to demonstrate if, how and when iPads support learning. Our aim is to identify key ideas from the literature on the effective use of iPads and other 'Post-PC' tablet devices, to discuss the implications of tablet technologies for school leaders, network managers, teachers, learners and their parents, and to set this within the wider global context. The term 'Post-PC' tablet is used to encompass the plethora of new-look mobile tablet devices.

This report is based upon a review of the literature, including newspaper reports and blog posts as well as academic and corporate research papers. The report is divided into five sections:

1. An Introduction;
2. What the research says about Teaching and Learning with iPads;
3. What the research says about Implications for Decisions Makers;
4. What the research says about Implications for Different User Groups;
5. A review of the Research Context.

Before proceeding, it is important to state that this report has an unapologetic emphasis on iPads in schools: 1) because that is where most of the current research on 'Post-PC' tablet devices is to be found; and 2) in the knowledge that there are nevertheless common lessons to be learned that are applicable to other tablet devices and their use in education.

When it comes to **Teaching and Learning** students are generally reported to be positive about the iPads, seeing them as essential for 21st century education. Within this report there are examples of iPads being used to support learners beyond simple drill and practice games, to **support collaborative learning**, to provide **personalised learning** experiences, iPads to **augment and enhance** deep learning, as **ubiquitous, distributed and connected** learning tools. We also discuss the ways in which iPads can contribute to **Digitally-Enhanced Monitoring and Assessment**.

- iPads can support **seamless learning**, allowing learners to easily switch learning contexts – from formal to informal or personal to social – and to take control of their own learning. For example, to supplement what they are learning in class in real-time through additional web-based inquiry, or by making digital notes.
- The finger-driven iPad interface can **motivate and engage students**, keeping them interested in content for longer, and allowing groups to interact with the device at the same time and with the same object. This **enhances and stimulates simultaneous opportunities for face-to-face social interaction** in ways that desktop, laptop and even netbook computing with their mouse-driven screen, 'individual' peripherals, fixed location, weight and overall design do not.
- Research suggests that the adoption and use of iPads in and beyond the classroom allows students to augment and **enhance their learning in ways that were previously not possible** or not so easy to do.
- Teachers, students and parents report that the multiple communication features, routine availability and easy accessibility of iPads in the classroom and in students'

homes **make communication between teachers and students, and school and home easier** and more routine.

- A key potential benefit of iPad-like devices involves their **working in combination with other technologies**. In combination with efficient network connectivity and cloud storage they offer ever-increasing capacity for the collection and collation of data about learning activity wherever learners are. The analysis and representation of this data about learning is vital to **formative evaluation, assessment, self-assessment and reflection**.

For **decision makers**, such as school leaders, there is pressure to enhance learning and iPads offer potential to help. Many schools have adopted the iPad or similar 'Post-PC' tablet devices, whilst many others are looking to do so in the near future. We can learn from their experiences. Our research revealed **multiple drivers and implementation models** for iPads in schools and classrooms. The majority of **1:1 implementation** models were **driven by government bodies and school leaders**. **Small-scale approaches**, such as class sets, and shared group iPads, **tended to originate from other groups**: industry pilots, researcher-supported studies, individual teachers or digital champions and individual schools. **Primary schools were more likely to go for shared devices** and class sets, whereas **secondary schools tended to aim for 1:1 devices**. **Early adopters tended to fund devices** whereas more **recent adopters are more likely to seek funding** through parental contributions or to arrange leasing options for students.

Our review suggests that **schools wishing to use tablets should have a clear rationale** for adopting this technology. **Successful implementation of tablet technologies in schools requires careful, long-term planning before, during and after the event**. Such planning involves consideration of existing technical networks, ownership models, the technology lifecycle, broad stakeholder preparation and on-going engagement (parents, teachers, learners, technical managers, etc.) as well as plans for capturing progress and evaluation.

In the current UK climate, funding in schools is very tight and many feel that the high cost of rolling out 1:1 tablet initiatives requires strong justification. The **potential impact of initial and follow-on costs** on what is an already limited funding stream is a particularly controversial issue for some, especially in those instances where parents are being asked to 'take up the slack'. **A variety of ownership models** were identified. It is important to recognise that the range and variety of ownership models do, however, have **implications for organising students' learning, continuity of access to students' work and learning data, as well as to management, maintenance and security of the devices**.

Beyond decision makers there are significant implications for other user groups. **The technical support implications are significant**. The apparent ease of transition that many of the UK schools that have successfully implemented an iPad initiative exhibited was masked due to the fact that they had recently moved to **new, well-equipped school buildings**. Beyond the provision of the network, the **integration process** can be made worse if new devices like tablets are not provided by the school or college and belong to learners, are of different makes and types and use different operating systems. The **consistency** of the iPad operating system and interface and the availability of apps, as well as issues of **security, backup, restore and lifecycle support** was identified as an important benefit of iPads over other devices. However, other device manufacturers have upped their game and can now compete in this important area. In this respect, **the rapid pace of development in the area of tablet computing is a key issue for schools** as they plan for future technology needs and one that **requires a process of continuous evaluation**.

For **teachers**, there is evidence that iPads **enhanced the learning experience and transformed teaching practice**. Mobility, portability and general ease of use as well as rapid one-touch access to tools (compared with time consuming logins and resource-booking requirements for networked

computers) **enabled a wider range of learning activities to routinely occur** in the classroom. The availability of a wide range of apps and connectivity to cloud computing as well as the immediacy of communication (via email, facetime, etc.) with students afforded by the omnipresent iPads enabled teachers to **explore alternative activities** (3D, interactive, multimodal, virtual tours, etc.) **and forms of assessment**. In addition, teachers felt that the devices enabled them, as teachers, to **promote independent learning, to differentiate learning more easily** for different student needs and to easily **share resources** both with students and with each other. There are however some implications for **training** and development and we identify that **there are recognisable phases** in teacher familiarisation with these devices and their integration into classroom activity. The identification of these phases can inform CPD.

The evidence from **parents** is positive in the main. They identify benefits such as: **increased engagement and interest in learning, gains in knowledge and technology skills, more time spent on homework and more opportunity to make learning relevant and authentic**. Parents state that **home-school communication is improved** with the introduction of 1:1 tablet devices and that not having heavy school bags to carry around is a major benefit. Parents do also express some **anxiety about breakage, theft, loss or misuse** of the devices by children, and **express concern about costs** and inconsistencies in what parents are expected to contribute.

For **learners** iPads are easy to use and attractive. The research on iPad use and adoption **overwhelmingly reports that tablet devices have a positive impact on students' engagement with learning**. Findings report increased motivation, enthusiasm, interest, engagement, independence and self-regulation, creativity and improved productivity.

No technology has an impact on learning in its own right; rather, its impact depends upon how it is used. iPads are no exception to this and in this report we identify ways in which iPads can be used to support teaching and learning. There is evidence that they can help teachers, learners and parents in multiple ways to be more effective. To leverage these learning benefits, the iPad should play the supporting role to the learning activity. The question that should be asked is not 'Can iPads support learning?', but rather "how can iPads be used to support collaborative learning, or exploratory learning", or whatever. The iPad is one of a range of tools that can help learning, and when used wisely it can be effective. For schools, teachers and parents thinking of investing in iPads, there is much to be learnt from those who have already taken this path, and an increasing array of devices and ownership options to choose from. As with all technology, this is not a 'one-off' decision and the on-going costs, and the need for on-going evaluation and monitoring should not be underestimated.

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A recent Horizon report on emerging technology in education (NMC, 2012) suggests that tablet computing is one of *the* hot trends for technology adoption in schools in 2013, alongside mobile devices and apps. There is evidence of increased adoption of Tablet PCs, iPads and other 'Post-PC' tablets in schools around the world (e.g. NMC, 2012; Quillan, 2011; Henderson & Yeow, 2012; Saenz, 2011) and, more recently, in the UK (e.g. BESA, 2012; NAACE, 2012). However, the adoption and integration of tablet devices into school systems has not been without its controversies – be they pedagogic, technical, social or economic.

A recent article in Time (Tech), for example, suggests that iPads might be “good for learning, but we don’t have the evidence” (Subramanian, 2012). Similarly, Larry Cuban, a professor emeritus of education at Stanford University, has urged caution, suggesting that, “There is very little evidence that kids learn more, faster or better by using these machines ... iPads are marvelous tools to engage kids, but then the novelty wears off and you get into hard-core issues of teaching and learning” (Hu, 2011).

In contrast to such views, however, school leaders involved in an iPad study at Roslyn Heights school in New York argue that “the iPad is not just a cool new toy but rather a powerful and versatile tool with a multitude of applications, including thousands with educational uses” (Hu, 2011).

Past research has shown that schools and classrooms are complex systems requiring a considered approach to technology integration and its potential impact on technical, social and economic infrastructures. For school leaders, technicians, parents, policymakers and taxpayers, the latter issues are just as important as pedagogical effectiveness when it comes to new technology adoption in schools. So far as the new range of app-enabled tablet technologies are concerned, the potential impact of initial and follow-on costs on what for many schools is an already limited funding stream is a particularly controversial issue for some, especially in those instances where parents are being asked to ‘take up the slack’ (This is Bristol, 2011; Daily Mail, 2011, 2012). For this and other reasons, the added value of these devices and the identification of effective adoption models are currently an important question for many. Thus, whilst it is evident that there is increasing interest in the use of ‘Post-PC’ tablet devices by schools, there are nevertheless concerns about schools ‘jumping on the iPad bandwagon’ (Kobie, 2011) without fully comprehending the nature of this potentially dramatic technology shift in the classroom. With such issues and concerns in mind, our aim is to identify key ideas from the literature on the effective use of iPads and other ‘Post-PC’ tablet devices for learning; specifically the aims of this review are:

- to provide a summary review of the literature on the use of iPads and other ‘Post-PC’ tablet devices in the classroom;
- to identify and discuss the implications of tablet technologies for school leaders, network managers, teachers, learners and their parents;
- to provide a context for current demand for iPad and other ‘Post-PC’ tablet devices in the classroom;

IPADS AND OTHER 'POST-PC' TABLETS IN THE CLASSROOM

When the New Media Consortium described tablet computing as a hot trend for 2013 (NMC, 2012) they are referring to the recent so-called 'Post-PC' tablets such as the iPad or Google Android device. Not to the earlier generation of stylus-driven Tablet PCs and handheld devices (Slates, PDAs, PIMs) which first started to appear commercially in the early to late 1990s. The design and use of this new generation of tablets are characterised by their adoption of:

- a mobile OS;
- capacitive high-resolution touch-screens; with
- multi-touch finger-driven interfaces;
- backed up by a well-provisioned apps marketplace; and
- a much broader range of connectivity options including wireless broadband, 3G, 4G, etc.

In contrast to early Tablet PCs, which failed to gain ground in the face of lighter, more efficient laptops and netbooks, the new generation of tablet devices have profited from fast moving developments in the related area of mobile phone technology. They are rapidly gaining ground as consumer tools of choice for general media consumption and informal learning. Increasingly, they are being adopted as potentially useful tools for teaching and learning.

EARLY TABLET COMPUTING IN SCHOOLS

The idea that portable, handheld and mobile devices are useful tools that enhance teaching and learning is certainly not new and, indeed, it is worthwhile referring back to earlier studies in UK schools to identify transferable lessons from work already carried out. PDA-GPS projects like Savannah (Facer, 2004) or Mudlarking in Deptford (Sprake, 2005), for example, combined web-based resources with mobile devices to encourage independent and collaborative learning amongst groups of pupils in and out of the classroom. Such studies continue to provide some basic context for understanding how to integrate tablet technologies into classrooms to promote learner inquiry, collaboration and communication skills. The Homework project demonstrated the effective use of tablet technology to link home and school in support of young learners' maths education and illustrated the contextualised personal learning power that well designed software can bring to bear when running on these devices (Luckin, 2010).

Other PDA-type studies include the eEscape (Kimbell et al., 2003-4) project that looked at students' use of PDAs to generate coursework eportfolios for design technology and other subjects like geography, as well as their use as a support for assessment, learner creativity and teamwork. This type of study provides useful insights into the utility of portable tools in facilitating student mobility and collaboration in practical workshop settings and the use of portable handheld tablet devices to capture work in progress in text, annotation, image and audio or video.

A major Tablet PC initiative in the mid-2000s was Microsoft's 'Tablet PCs in Schools' programme (Twining et al., 2005). The Microsoft Tablet PC didn't really take off in the UK and was gradually superseded by laptops and netbooks. Like the studies mentioned earlier, however, the 'Tablet PCs in Schools' report also offers a very relevant starting point for considering the potential implications for

the adoption and use of 'Post-PC' tablets like the iPad or Google Android or other similar devices. It provides detailed guidelines on evaluating tablet technologies whilst reporting on emergent practices and processes in the effective adoption and use of mobile tablet devices as a support for teaching and learning, as well as their integration into school systems more generally.

'POST-PC' TABLET DEVICES OTHER THAN THE IPAD

Since the introduction of the iPad in January 2010, other new-look 'Post-PC' tablet devices have rapidly gained ground, building on the popularity and functionality of mobile devices such as Smartphones. Although a year or so behind Apple in bringing their mobile tablet devices to market, Apple's key competitors now include producers of Google Android OS devices such as Samsung with its Galaxy range as well as a wide range of other players, like Sony with its Tablet S, Asus's Nexus and Eee Pad, Blackberry's Playbook and, latterly, Microsoft with its Windows 7 and 8 devices. More recently a raft of new, miniaturised tablet devices, including the new iPad mini, have also begun to appear. And, alongside these, a range of tablet-laptop hybrids by makers such as Toshiba, Sony, Dell, Asus and Lenovo although, with a price tag even higher than Apple's iPad, it seems unlikely that the latter currently represent serious competitors to the 'Post-PC' tablet market.

In addition to the above-mentioned app-enabled tablet devices, a broad selection of e-readers such as the Sony e-reader, Amazon's Kindle and others like the Kobo, Nook, etc. is also available together with an emerging range of hybrid e-reader/tablet-like touch devices providing facilities not only for full-colour textbook reading but also, increasingly, as with Amazon's Kindle Fire for example, offering access to the web, email, social networks, multimedia and apps.

It is clear that there is an increasingly wide range of 'Post-PC' tablet devices available, each with their individual benefits and limitations. Successful adoption, use and integration of such tools into schools thus requires that relevant stakeholders take sufficient time not only to understand the key features of available devices but, more importantly, to identify whether and how the various devices might 'best fit' the needs of their schools and the wider 'school community'. A key aim of this review of the literature is to aid stakeholders in that process.

PART 2: WHAT THE RESEARCH SAYS ABOUT TEACHING AND LEARNING WITH IPADS

In the three year period since January 2010, when the iPad was first introduced, there has been a rapid uptake of iPads and other 'Post-PC' tablet devices in education and, increasingly and more recently, in schools (NMC, 2012). As of January 2012, Apple reported some 1.5 million iPad devices being sold into educational institutions, including more than a thousand reflecting 1:1 deployments (Apple, 2012). A year later, in January 2013, the general consensus is that whilst the iPad is still the preferred leader for school-based tablet PCs, its competitors are rapidly catching up. Samsung, for example, had recently begun to roll out pilot projects for its Galaxy Tab 10.1 device both in its native South Korea and, more recently with partner schools in Memphis, USA (Samsung, 2012). Others, like LearnPad (LearnPad, 2013) or Frog4OS (FrogTrade, 2012), meanwhile, are quietly developing education-focused tablet-based content management systems akin to learning platforms in the hope of catching the current wave of enthusiasm for tablet devices, particularly in the UK.

IPADS IN THE CLASSROOM – TEACHING AND LEARNING

Whilst many parents are concerned about the high cost of tablet devices and sometimes find it hard to see the value in them as a support for students' learning, teachers and students are generally reported to be positive about the devices, seeing them as an essential 'toolbox' for the 21st century classroom (Clarke, 2012).

LEARNERS: KNOWING WHAT THEY KNOW AND NEED

As part of their 1:1 iPad initiative, Longfield Academy in Kent surveyed teachers, students and parents towards the end of the first year of the whole school roll out. Students reported use of their iPads in almost all subject areas, with key uses being: researching topics online, brainstorming (mind mapping) and presentations. They further indicated that they wanted to use their iPads more often to replace pen, paper and books; to take notes, design games, make music, do online research and homework; and to access the school VLE. Things students felt their iPad supported which couldn't be done (as easily before) were described by students as: easy Internet access, use of iBooks, access to translation tools, easy access to educational games and apps to support learning, routine access to tools that support reflection, e.g. digital mind mapping and annotation of texts. (Heinrich, 2012).

Being able to understand what a learner knows and understands is key to teaching and learning. Learners need to be completing tasks that are appropriately challenging, without being so difficult that learners are bound to fail. It is therefore vital to ask if there is a risk that iPads might risk 'dumbing down' by making learners perceive ease of use as a key factor in their engagement with learning. There may be reasonable grounds for probing the extent to which some iPad drill and skill games are too simple and not adapted for education. However, there are also examples in which iPads play a role in learning activities that enhance, augment and support deeper learning (science,

maths), authentic learning (foreign languages), and virtual visits (astronomy, history). There are some difficulties to negotiate, such as the fact that the device is not designed for productivity, and has no keyboard other than the touch screen. However, if these difficulties are overcome there are clear opportunities for greater collaboration, connectivity, and distributed support networks.

BIG DATA: DIGITALLY-ENHANCED MONITORING AND ASSESSMENT

A key potential benefit that iPad-like devices offer is the possibility to use them in combination with the ever increasing capacity for the collection and collation of data about learning activity that is afforded by efficient network connectivity and cloud storage. The analysis and representation of this data about learning which is vital to further developing technology enhanced teaching and learning.

A small, portable device that is personal to a learner and through which they conduct learning activities is not only a window for learning, but also a window through which invaluable data about the learner and their interactions can be captured, stored and analysed. However, whilst some recent studies on adoption and use of iPads made reference to monitoring students' learning, giving feedback and improved ease of sharing assessment and grades, as yet these were few in number, although in one reported example an English teacher at Lodi Unified School District in California is said to be using the app Edmodo to alert students about assignments and keep track of their homework submissions whilst students use it to turn in work, share notes and check their grades (NMC, 2012). In another UK example, the Essa Academy in Bolton (BBC, 2013) is making use of tablet-based testing in some subject areas, like Maths and Science, which give immediate feedback to students that can also be shared in real-time with the teacher.

Overall, however, it seems that the rollout of tablet devices like the iPad may still be too new for impact in the area of assessment and feedback to have been fully investigated. We know that can collect, collate and share data, conduct basic analysis in real-time to enable monitoring and feedback on students' learning as it happens to support formative assessment and self-assessment.

Schools are starting to monitor student learning with these devices is in their use as a digital portfolio, with students making use of the tool in combination with cloud computing to store a record of their ongoing work, as is the case at Roslyn High School on Long Island (Hu, 2012) and, indeed, UK schools like the Essa Academy in Bolton (BBC, 2013) and Longfield Academy in Kent where the cloud/dropbox model is also in evidence. Whilst storage capacity of the iPad device may be limited, access to cloud based storage is clearly being used by schools to alleviate this constraint. At the same time, this necessitates adequate access via wireless or networks, with attendant concerns regarding security of data, network stability and reliability (Henrich, 2012). In the Longfield iPad evaluation, teachers did indicate that having a personal tablet device did help them with data management in areas like pupil registration (Heinrich, 2012). Similarly, in a US study on the use of iPads by school principals, participants indicated that the mobility and multimedia tools of the iPad helped them monitor and assess teachers in classrooms and to manage everyday administrative tasks more effectively (Winsolow et al., 2012).

Whilst teacher interaction with such portfolios for assessment purposes was not explicitly discussed in the reviewed research, lessons may be drawn from earlier research studies on the use of digital portfolios and assessment using earlier generations of tablet PC (PDAs) such as the QCA eScape project in the UK (QCA, 2003-4).

The visualisation of analysed data on the iPad offers important support for assessment, feedback and personal reflection and the potential for the widespread use of tools that can capture the progress of a learning episode, individual or joint is particularly powerful. The recent development of more school-friendly tablet-based learning platforms for Android OS by companies like Samsung (Samsung, 2012), LearnPad (LearnPad, 2013) and FrogTrade (FrogTrade, 2012) may go some way to facilitating the transfer of data between mobile tablets, school networks and the 'cloud'. The Samsung Smart School Solution, for example, incorporates a Student Information System that allows teachers to track student data, including grades and attendance (Burke, 2012).

The combination of the apps-based environment of the tablet device, whether iPad or Android, with web-based systems and cloud computing also offers a potentially unique opportunity for transferring learners' digital data between systems, e.g. when using game-based learning or interactive learning apps that provide teachers and learners with instant feedback on their learning progress, e.g. the Socrative app, described as an 'instant assesment' e-clicker device, which allows teachers to create (and share) tests, quizzes and games-based learning or instant voting, and to collate feedback from students instantly and anonymously (SmarterLearning, 2013).

PERSONALISED

All learners are different and require teaching and learning interactions that acknowledge these differences and provide suitable support. A technology, such as an iPad, that is owned by an individual learner and populated with material and applications that are particularly suitable for their needs could be a powerful, portable, personal learning partner.

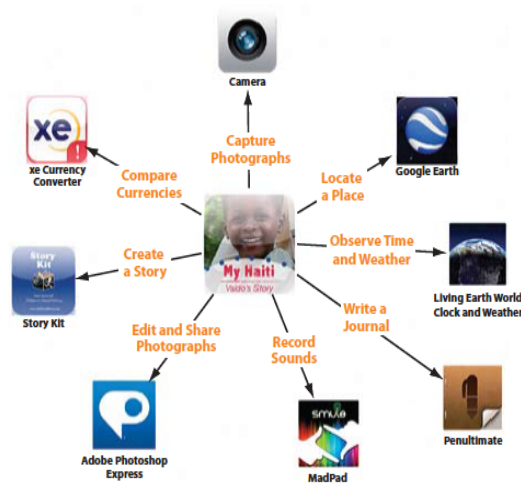
For many students, having not only *personalised access* to this state-of-the-art technology but also *individual ownership* of the device, is highly motivational. Indeed, Burden et al. (2012) found that personalised access and individual ownership is a crucial element in successful adoption and effective use of the iPads in their study.

Henderson & Yeow (2012) reporting on an iPad study in a New Zealand primary school point, for example, to the idea that such devices can support seamless learning, allowing learners to easily switch learning contexts – from formal to informal or personal to social – and to take control of their own learning, e.g. to supplement what they are learning in class in real-time even as their teacher speaks, through additional web-based inquiry or by making digital notes, practices also identified by students as a benefit of one-to-one iPad ownership in a UK study evaluating a whole-school rollout of iPad devices at Longfield Academy in Kent (Clarke, 2012).

In 'shared iPad' project in a Norwegian primary school, students were able to 'own' the iPad on a rostered basis, taking turns to take the device home (Gasparini, 2012). Students were free to add apps, allowing a degree of personalisation. Researchers later collected the ipads, interested to see what kind of apps students had independently selected. They discovered one student (pseudonym Josh) had organised his apps into thematic groups. Additionally, he had installed some free apps that supported text-to-speech. Through observation and discussion with the class teacher, they identified Josh as having reading difficulties. Thus, Josh was able to use the apps feature of the iPad to identify and obtain useful assistive technology to support his additional needs, an act that would have been far less likely to occur with a desktop computer where such specialist software is typically expensive to buy and installed by school technicians. Josh's experience illustrates the ease with which iPads

and similar tablet devices can, where personalisation is permitted, be customised to suit individual needs.

Personalisation can, however, take many forms – whether that is through ownership of the device, the design of individualised learning activities and personalised assessments, or something as basic as available choice of software and peripheral tools as a support for teaching and learning. In a class project on Haiti, a US educator supported young learners in engaging with recent immigrants to their class with shared use of 3 class iPads. Working in groups, learners were able to self-select appropriate apps and tools to support their learning in an approach that not only allowed the learners’ voices to be captured but also facilitated a student-centric construction of knowledge (Bearson et al. 2012).



Learner-selected apps : myHaiti

In this sense, even when shared amongst a group of learners, tablets like the iPad can still support a high degree of personalisation in student learning.

COLLABORATIVE

We know that human knowledge arises from social interaction. Social interactions can take the form of traditional teacher and learner interactions, peer-centred interactions, or participation in activities with large groups or communities. Research evidence suggests that ‘Post-PC’ tablet devices like the iPad can contribute to better quality collaborative, co-operative or cross-contextual learning experiences for students.

The portability of devices like the iPad may also help to develop the coherence of the learner’s experience, which can in turn reinforce prior learning and create deeper understandings?

A study of iPad use in a New Zealand primary school classroom, for example, reported that the portability of the iPad, its multi-touch, rotatable screen, range of apps and general ease of use provided learners with “much better opportunities for collaboration than were possible in the past” (Henderson & Yeow, 2012). The finger-driven interface motivates and engages students, keeping them interested in content for longer periods of time, and allows students to interact with the device at the same time and with the same object, enhancing and stimulating simultaneous opportunities for face-to-face social interaction in ways that desktop, laptop and even netbook computing with their mouse-driven screen, ‘individual’ peripherals, fixed location, weight and overall design do not. The class teacher summed up the collaborative nature of the iPad as a learning tool:

You have to a) bring a group to the computer and b) have to kind of sit around it, whereas if you want to show somebody work on the iPad you can flip it over and the screen would flip... Once you've finished with it you can pass it to the class in seconds, whereas a desktop computer you have to shuffle everybody to the computer.

On the other hand, teachers observing use of the device by groups of students did report that the multi-touch facility of the iPad tablet, although a technical reality, did not work very well in practice as the device size was too small for more than one student to manipulate the touch-screen at one time. Where it was more successful was in terms of its portability and the ability of students to generate information and easily pass the device to a peer for sharing. Another useful collaborative aspect was the ability to use the networked nature of the iPad to collaborate or compete using shared apps (Henderson & Yeow, 2012).

AUGMENTED AND ENHANCED

The research suggests that the adoption and use of iPads in and beyond the classroom allows students to augment and enhance their learning in ways that were previously not possible or not so easy to do (Heinrich, 2012; DEECD, 2011).

At the Auburn School in Maryland, USA, for example students were able to mix and match from a wide range of apps to enhance their learning about T.S. Eliot's 'The Wasteland' – all from a single device, including video interviews with authors and scholars, podcasts, dedicated 'easy-notes' apps on the text and to use the in-built tools of the iPad to make their own annotations, e.g. highlighting text or recording audio reflections or notes (NMC, 2012).

UBIQUITOUS, DISTRIBUTED AND CONNECTED

In many studies, teachers, students and parents reported that the multiple communication features, routine availability and easy accessibility of iPads in the classroom and in students' homes made communication between teachers and students and school and home easier and more routine (Heinrich, 2012; Burden et al., 2012; Clarke, 2012).

Another way in which the iPad can be particularly effective is the way in which it can easily put people in touch with each other when they are in distant physical locations, through wi-fi or phone network connections and using software applications such as Facetime or Skype. In one Texas school which had implemented a 1:1 iPad program, teachers communicated with parents using Facetime, whilst the potential for this feature of the iPad to be used to "provide a venue for guest speakers, interviews and peer discussions" was also recognised (Pilgrim et al., 2012). Similarly in a UK study of tablets in schools, a key finding was that teachers, pupils and parents agreed that communication had improved through tablet use, enabling pupils to use their iPads to collaborate on homework activities using Facetime (Clarke, 2012). Whilst other technologies also allow for video-conferencing features, the portability, speed and ease of use of the iPad and the proprietary nature of Facetime allows for additional reliability and security, whilst the device itself, with its ability to support add-on apps also allows for flexibility in this area. In this respect, whilst the iPad is not unique in its offering, these early examples do appear to suggest that it offers a high quality platform for shared learning.

We know that the circumstances of learning make a great difference to the efficacy of learning. The people, places, and things with which learners interact are crucial elements in their developing understanding of knowledge and skills. The mobility of the iPad can offer great opportunities for learners and their teachers to build meanings and experiences across different locations.

PART 3: WHAT THE RESEARCH SAYS ABOUT IMPLICATIONS FOR DECISION MAKERS

What this review of the research has revealed is that in the three years since the iPad was introduced, many schools have adopted the iPad or similar 'Post-PC' tablet devices, whilst many others are looking to do so in the near future. Non-iPad devices reported in the research are as varied as Android tablets, e-Readers, Kindles, iPod Touches, all the way through to the recent phenomenon referred to rather comically as 'phablets' (smartphones with screens between 5 and 7 inches). Whilst sales of the iPad have grown very fast, with predicted sales of more than 60 million units for 2012 and further predictions that the combined sales of iPad and Android tablets will soon outstrip PC sales, information on the adoption and use of these devices in schools remains small. Further, whilst, as indicated above, evidence about learning in schools with iPads is gradually beginning to emerge, what there is remains variable in quality. What is clear is that little is certain when it comes to the future of tablet computing in schools. It is against just such a context that Heinrich (2012) suggests that *the* key lesson from the research is that schools need to have a 'clear vision and strategy' for implementing any 'Post-PC' tablet scheme – and that means knowing what you want, why you want it, how to get it and how to implement it when you do.

INITIAL DRIVERS

The research revealed multiple drivers and implementation models for iPads in schools and classrooms:

- Government (South Korea, USA, Australia)
- Region, district or local authority (Canada, USA, Scotland)
- Industry (Apple, Samsung, Microsoft and others)
- Research (BESA, NAACE, NERP, Family Youth and Kids, University of Hull and others)
- School leadership
- Technology team, manager or department
- Individual teacher or digital champion (often trainee teachers or teachers studying for higher degrees)

IMPLEMENTATION MODELS AND FUNDING

The majority of 1:1 implementation models, particularly those aimed at whole school provision were driven by government bodies and school leaders (often assisted by technology teams, managers or departments). Small-scale approaches (class sets, shared group iPads) tended to originate with industry pilots, researcher-supported studies, individual teachers or digital champions and individual schools. Primary schools were more likely to go for shared devices and class sets, whereas secondary schools tended to aim for 1:1 devices where possible, and class or subject sets where funding was tight. Early adopters tended to fund devices whereas more recent adopters are more likely to seek parental contributions or to arrange leasing options for students.

Some examples from the research (Global Context):

- **South Korea:** A government-led, centrally-funded US\$2 billion 1:1 tablet provision scheme for every school child. Linked to a wider digital curriculum policy focusing on tablet-based e-learning between home and school, e-textbook provision and cloud computing. First introduced in 2007 and set to be completed by 2015. Initially piloted in 50 schools, and using Samsung Galaxy 10.1 Android tablets. Related development of tablet-based learning platform and tablet-enabled school management system software. Tablets and software now being rolled out to other countries. Home project meanwhile being cut back due to concerns over student over-reliance on digital devices. E-textbooks will no longer replace textbooks but both will co-exist side by side. Young learners (1st and 2nd grade) may not use them at all. (Saenz, 2011)
- **United States:** Variable implementation and funding models. Many schools influenced by general government focus on digital curriculum and e-textbooks in particular. McAllen County, Texas – district-wide and district-funded 1:1 tablet provision scheme for all school age children for a total of some 25,000 iPads. Staggered roll out. (Sherman, 2012).
- **Canada:** government-funded, school-led 1:1 iPad provision – Calgary Science School – pilot school. Roll out to one year group of 100 Grade 7 students. Parents asked to contribute to insurance costs – CAD\$60 per annum and CAD\$100 excess. (Petronch, 2012)
- **Australia:** government-funded 1:1 iPad provision – Ringwood North Primary, Melbourne. Apple-related pilot. 136 Year 4 and 5 students. (DEECD, 2011)
- **Norway:** research-funded iPad provision. 6 iPads in one 4th grade class (age 8-9). Researcher-led study. 1 iPad for teacher, 1 for each group of 5 students. Loaned for one school year. Wireless had to be specially installed for the project. Students allowed to take iPads home on rotational basis. (Gasparini, 2011).
- **New Zealand:** school-funded provision of iPads, shared class sets 5/6 iPads per class, managed collaboratively by school leaders, ICT manager and class teachers. (Henderson & Yeow, 2012).

Some examples from the research (UK Context):

- **Honywood Community School, Essex:** Apple pilot school. School-funded, cost £500,000. 1:1 iPad 2 provision to all 1200 students. Parents asked to donate £50 towards insurance. Academy status (Clarke, 2012).
- **Longfield Academy, Kent:** Apple pilot school. Leasing scheme with Apple. 1:1 provision, 726 units as of March 2012 (76% of pupils), additional 100 students had iPads not supplied by school. Implementation led by senior management through an iLearning Group led by the principal. Parental contribution of around £16 per month over 3 year leasing period requested (Clarke, 2012).
- **Wallace High School, Belfast:** Apple pilot school. Leasing scheme with Apple. 530 1:1 iPad provision for pupils in years 8-11 for use in class and homework. Parental contribution of £170 per year requested. Implementation led by staff working group, led by vice-principal (an Apple Distinguished Educator) blah (Clarke, 2012).
- **Essa Academy, Bolton:** 1:1 provision of iPads, 840 students, school-funded. (BBC, 2013)

- **Clevedon School, Bristol:** 1:1 iPad provision. Lease or purchase scheme. Parental contribution of approximately £16 per month required. School-led with extensive parental consultation and additional information evenings for incoming Year 6 students. Online portal – iClevedon to support tablet initiative. (This is Bristol, 2011)

What is evident from these UK models is that the Apple leasing option at a cost of around £16 per month over 3 years appears to be the most commonly accepted model for more recent adopters.

THE RATIONALE FOR TABLET ADOPTION

A review of the literature suggests that schools wishing to use tablets should have a clear rationale for adopting this technology. The Redoubt Primary School in Auckland, for example, identified the wide range of available apps as one of the most compelling reasons for adopting iPads as a support for teaching and learning (Henderson & Yeow, 2012). Accessibility, ease of use, increased productivity and the potential for collaborative, co-operative, personalised and seamless learning were also cited as good reasons by many early adopters (Henderson & Yeow, 2012; Clarke, 2012; NMC, 2012, Burden et al, 2012). Others point to the iPad as an easily accessible tool for accessing learning content in the form of e-textbooks, web-based materials, and content not generally available in print textbooks or readily accessible on a 1:1 basis other than in school computer labs, e.g. 3D environments, virtual learning environments and interactive materials (Saenz, 2011; Hu, 2012; Quillan, 2011, Heinrich, 2012; BBC, 2013). School leaders and teachers, meanwhile, point to the ease of access, portability and real-time monitoring and assessment of student learning and progress and teacher CPD (BBC, 2013; Winslow et al, 2011). Whatever the rationale, this suggests that any adoption of such tools for schools, requires a particular focus on teaching and learning, school management systems, and added value for learners and parents, especially where parental contribution to leasing agreements is requested. Additionally, as with any new technology, these devices require significant strategic planning to ensure adequate and appropriate integration with existing systems and negotiation of the general lifecycle of the technology. Whilst one teacher at Longfield, for example, has claimed that “iPads have revolutionised learning” at the school, the school management team responsible for implementing the roll out were also quick to establish that “effective project management has been critical to the success of this development” (Heinrich, 2012).

ROLL OUT MODELS AND STRATEGIES FOR IMPLEMENTATION

A majority of existing 1:1 roll outs in UK schools from the early adopters (Cedar, Honywood, Longfield, Wallace High School) to more recent adopters (Clevedon, Essa and Rossett) have shown that successful implementation of tablet technologies in schools requires careful, long-term planning before, during and after the event (Heinrich, 2012; BBC, 2013; This is Bristol, 2012; Burden et al, 2012). Such planning involves consideration of existing technical networks, ownership models, technology lifecycle, broad stakeholder preparation and ongoing engagement (parents, teachers, learners, technical managers, etc.) as well as plans for stepping progress and evaluation. The team at Longfield, for example, suggest a nine-lesson model (Heinrich, 2012).

1. Develop a clear vision and strategy.
2. Define your learning culture.
3. Define and create your user experience and support model.
4. Work with a traffic light and reporting system.
5. Evaluate your existing position.
6. Know how many staff/students already own an iOS device.
7. Involve all stakeholders – don't let a perception grow that it is a 'done deal'.
8. Get devices into the hands of teachers and learners as soon as possible.
9. Record and share your experiences.

Burden et al. (2012) also signal the importance of engaging parents and seeking their views and feedback at all stages: before, during and after the project. Key parental concerns in the Longfield study (Heinrich, 2012), for example, focused on value for money, high costs of leasing, especially in multi-child families and fears over security and safety of devices. Following a survey of parental perceptions, Longfield decided that more work was needed to make the added value of the tablet initiative visible to parents, e.g. by providing more feedback on how they were being used in school.

FUNDING

In the current UK climate, funding in schools is very tight and many feel that the high cost of rolling out 1:1 tablet initiatives requires strong justification. With no centralised program and schools rolling out a range of different models, some parents have expressed concern over the disparity in funding models, with some schools providing the devices free or for very little cost, whilst others require long-term, heavy leasing payments (This is Bristol, 2011; Mail Online, 2012). Others (teachers, parents, school managers) have expressed concerns around supplementary costs, e.g. of downloading apps, upgrades to existing technology, e.g. wireless networks and access to, storage on and backup costs for cloud computing as well as insurance, training and general maintenance costs (Henderson & Yeow, 2012; Gasparini, 2011; Heinrich, 2012, Burden et al., 2012). Some schools adopting 1:1 roll out models, however, claim to be able to make cost savings in relation to 'paperless' learning with less photocopying and textbook costs (BBC, 2013). Others argue that costs are justified as part of the general ongoing technology lifecycle of the school (Heinrich, 2012). Once again, however, a key issue here is the level of parental contribution required, for what purpose (purchase, lease, insurance) and the ability of parents to meet those requests and, if not, how schools deal with students whose parents are unable to fund a 1:1 tablet initiative. Ways in which schools do recognise and meet these concerns include provision of school-owned devices on a 'lending' basis to individual students where this is deemed necessary, and subsidised funding in whole or in part for multi-child families and those on low incomes (Heinrich, 2012), e.g. students who get free school meals (This is Bristol, 2011).

OWNERSHIP MODELS

A variety of ownership models was identified in the literature on iPad use in schools. These 'ownership models' include the concept not only of 'provision', i.e. whether provision leaves ownership and control in the hands of the school or the student, but also to 'physical' and 'economic' ownership, i.e. who the device ultimately belongs. The following 'provision' types were identified in the research (Henderson & Yeow, 2012; Heinrich, 2012; Burden et al., 2012).

- **1:1 tablet devices** – provided for use by individual students
 - some only for use in school;
 - some for use at home and school;
 - some whole-school roll outs;
 - some partial/staggered roll outs (1:1 but by class, year, subject);
 - **funding models for 1:1 provision;**
 - free but school-owned;
 - 3-year lease, school-owned for duration of lease, then student-owned;
 - outright purchase – student-owned;
 - BYOD – student-owned;
- **Shared tablet devices** – provided for use by multiple students
 - some only for use in school;
 - some for use at home and school (on rotational basis);
 - generally partial/staggered roll outs rather than whole school;
 - sometimes class sets or year group provision, more often primary than secondary schools;
 - sometimes subject sets, more often secondary than primary schools;
 - **funding models for shared tablet provision;**
 - almost universally school-funded and school-owned;

The range and variety of ownership models do, however, have implications for organising students' learning, continuity of access to students' work and learning data, as well as to management, maintenance and security of the devices. Many schools, for example, placed restrictions on the kinds of apps that could be installed and who could install these (Henderson & Yeow, 2012; Heinrich, 2012), placing additional constraints on flexible use of the devices by learners, especially in the home setting and an additional burden on technical support in terms of managing multiple devices within the school system. Most schools deployed an acceptable use policy (AUP) to deal with such issues. See, for example the AUP for use of mobile devices at Bellshill Academy in Scotland (Burden et al., 2012, p 113).

PART 4: WHAT THE RESEARCH SAYS ABOUT IMPLICATIONS FOR DIFFERENT USER GROUPS

The iPad studies in the UK were not implemented without issue or concern. As indicated in section 3, such issues and concerns require close consideration by school leaders. In addition, there are further implications for network managers if tablet devices are to be successfully integrated into classrooms. Teachers, learners and parents all have their role to play too if iPads are to fulfil their potential to support teaching and learning. We now, consider the implications for network managers, teachers, parents and learners.

IPADS AND NETWORK MANAGERS

The level of resourcing for technical support in schools is often low and the prospect of multiple devices moving in and out of a school or college and then re-connecting to a network can be challenging. In many of the recent UK iPad pilots, embedding tablet PCs into classrooms required installing new, or upgrading existing, wireless networks to cope with demand. Perceived ease of transition was masked in some studies due to the fact that many of the UK schools who have successfully implemented an iPad initiative had recently moved to new, well-equipped school buildings, e.g. Essa Academy in Bolton (BBC, 2013), Longfield Academy in Kent (Heinrich, 2012) and Honeywood Community School in Essex (Clarke, 2012). In an equivalent Norwegian study, the participating school in a researcher-led project had no wireless system present at the start of the project and one had to be installed (Gasparini, 2011).

THE DEVICE LIFECYCLE

Important technical (and financial) implications of iPad adoption and use in schools were identified as relating to the device lifecycle and the need for regular equipment upgrades, installation of apps, ongoing maintenance and upgrading of technical support networks, insurance costs for protection against loss, theft or damage and maintaining accurate records and logs for 1:1 devices for a whole school population. In addition, resource costs in terms of monitoring and controlling the use of the devices and maintaining an acceptable use policy were also identified as potentially high cost issues, both economically and in terms of time and people resources. This was true also for the provision for on-going evaluations of relevance and performance to ascertain whether tablet devices continue to be a 'best fit' for the school whether for teaching and learning, home-school communication, or general administration and data management (Henderson & Yeow, 2012; Burden et al., 2012, Heinrich, 2012).

MINOR TECHNICAL ISSUES

Other, more general technical issues were identified around compatibility of existing school systems, like school VLEs with Apple software such as the Safari browser (Heinrich, 2012) or the inability of the iPad to utilise Flash, a platform upon which many existing school-based e-learning tools (e.g. the very popular myMaths) are based (Heinrich, 2012). Schools were, however, able to meet these 'minor technical issues' e.g. by using an alternative app such as the Puffin Web browser (Heinrich, 2012).

BENEFITS OF IPADS OVER BYOD AND ALTERNATIVE 'POST-PC' TABLETS

The integration process can be made worse if new devices like tablets are not provided by the school or college and belong to learners, are of different makes and types and use different operating systems. The Longfield Academy iPad study, for example, suggested that a 1:1 solution, fully managed by the school, using a single OS minimised technical problems and areas like teaching, learning and administration also benefited because all students were able to use the same tools and apps, in contrast to 'Bring Your Own Device' (BYOD) models where students and staff might be using a variety of different devices, from Smartphone to iPads, bringing with them a 'raft of technical and management issues and associated resource costs' (Heinrich, 2012). The Longfield project team (Heinrich, 2012) also argued that iPads in particular offered significant benefits over similar 'Post-PC' tablet devices insofar as it offered a 'consistency of operating system and interface and the availability of apps' as well as on 'issues of security, backup, restore and lifecycle support' which only Apple was currently providing. Whilst this may have been true as of summer 2012, when the Longfield report was published, as indicated earlier in this report, Samsung and other tablet device and OS makers are rapidly pushing similar education-focused packages that could soon compete with Apple in this area (Samsung, 2012; LearnPad, 2013).

In this respect, the rapid pace of development in the area of tablet computing is a key issue for schools as they plan for future technology needs and one that requires a 'robust and systematic approach' (Burden et al., 2012) and a process of continuous evaluation.

ONGOING EVALUATION

The key UK studies (Burden et al., 2012; Clarke, 2012; BESA, 2012; Heinrich, 2012) on iPads in the classroom suggested three important phases in evaluating the integration of tablet devices into their schools:

- *Pre-implementation phase* - strategic planning, familiarisation with device and use/user context(s) through initial teacher/stakeholder workshops; evaluating existing technology infrastructures and device ownership data; preparing/engaging with relevant stakeholders - parents, students, teachers, school managers, and the wider community, e.g. local authorities, support charities, technology advisers and researchers; devising implementation plan.
- *Initial roll out* - evaluating use of iPad and apps for teaching and learning, including homework and informal learning; use in home-school or distance contexts; ongoing evaluation of impact on perceptions – across stakeholder groups; monitoring and supporting issues – technical, pedagogic, social, economic; ongoing resourcing and support for teaching, learning and CPD, e.g. through specially set-up project teams, regular discussions at staff briefings, classroom observations of teachers and learners, teacher use of online iPad research networks, etc..
- *End of phase review* - full phase review, usually at end of year, to monitor progress and review issues arising; and to seek stakeholder views, e.g. using surveys, interviews, student focus groups.

IPADS AND TEACHERS

Teachers have been quick to take up iPad type applications and there are many examples of their use to be found in practitioner blogs (Swanson, 2013; Page Burdick, 2013; Andrews, 2013), discussion forums and informal practitioner networks (Gliksman, 2013). This presents a challenge as well as an opportunity: authors rarely discuss *how* the applications they have used were integrated into practice *effectively* and it can be hard for teachers to know which of the many options available would be best for them and their learners. The benefit of many of the recently emerging studies on iPad pilots in the UK (Burden et al., 2012; Clarke, 2012; Heinrich, 2012) and other schools worldwide (NMC, 2012; DEECD, 2011) is that some of these issues are finally beginning to be addressed in a more systematic, practical way. In this section of this report, we deal with general issues in relation to teachers and iPads, including teacher perceptions of the device, teacher CPD and potential changes to the teacher's professional role in the classroom.

TEACHER PERCEPTIONS ON IPAD USE

In the 'iPads in Scotland' study, Burden et al. (2012) found that teachers felt that using iPads to support teaching and learning in the classroom enhanced the learning experience and transformed their teaching practice.

Teachers were particularly enthused at the way in which iPads transformed access to and use of technology in the classroom. The mobility, portability and general ease of use as well as rapid one-touch access to tools (compared with time consuming logins and resource-booking requirements for networked computers) enabled 'a wider range of learning activities to routinely occur in the classroom. The availability of a wide range of apps and connectivity to cloud computing as well as the immediacy of communication (via email, facetime, etc.) with students afforded by the omnipresent iPads enabled teachers to explore alternative activities (3D, interactive, multimodal, virtual tours, etc.) and forms of assessment (Burden et al. 2012).

In addition, teachers felt that the use of iPads in the classroom caused them to rethink their professional role and facilitated greater collaboration between themselves and students as co-learners in partnership with each other, and with students learning independently of the teacher as well as increasing peer-to-peer learning and mentoring (Burden et al., 2012).

Other studies produced similar findings. At Longfield Academy in Kent, for example, teachers also identified the benefit of 'not having to worry about finding a computer' and spoke of how personal ownership of iPads enabled them to use the tool not only to support teaching and learning but also for administration and data purposes such as taking registration, planning lessons, facilitating target setting and enabling students to see immediately the results of their learning. They also felt that the devices enabled them, as teachers, to promote independent learning, to differentiate learning more easily for different student needs and to easily share resources both with students and with each other. At the same time, they did identify lack of time to develop relevant resources, e.g. teacher-authored iBooks and lack of budget for paid-for apps as an issue whilst, at the same time, expressing a desire for more 'subject-specific' apps. Activities which were not yet widespread in the school but which were seen as useful developments for the future were use of performance videos for assessment and peer review (for both students and teachers), self-review and peer assessment in

general, peer teaching, the creation and use of revision materials, use of voting systems and game-based learning (Heinrich, 2012).

TEACHER CPD

Whilst some (Heinrich, 2012; Henderson & Yeow, 2012) identify teacher training as a necessary support for effective integration of tablet devices in classrooms (covering technical, pedagogic, social and economic aspects of the device), Burden et al., (2012) suggest that requirements for 'formal' training of teachers should be minimal, with teachers learning instead through experiential learning, virtual practitioner networks and communities of practice. They did, however, feel that some form of initial familiarisation with the device was important in getting teachers started. In some schools, e.g. Longfield Academy in Kent (Heinrich, 2012) and Calgary Science School in Canada (NMC, 2012) a dedicated school improvement programme encouraging staff to share experiences and report on findings was included in initial implementation and on-going evaluation plans. These ranged from a simple sharing of experiences for 5-10 minutes at regular staff briefings (Andrews, 2012) to more formal reporting of case studies (Petronech, 2012; DEECD, 2011).

What the research does indicate throughout is that there are recognisable phases in teacher familiarisation with these devices and their integration into classroom activity, with examples identified as:

- initial familiarisation with the tablet device – it's features, functionality and resources (including storage and in-device tools such as camera, audio, video and communication functions as well as it's potential for teaching and learning);
- locating and understanding apps and the apps marketplace, including understanding and negotiating issues around the use of free apps (e.g. inappropriate advertising);
- identifying, installing and using appropriate and *relevant* apps that support teaching and learning in general and curricular (subject) content more specifically;
- identifying apps that support personalised and/or collaborative learning, including those that can cater to learners with additional needs (e.g. autism, dyslexia, etc.);
- identifying ways that tablet devices can be used beyond basic teaching and learning, e.g. for distributed learning, monitoring and assessment, pastoral care, data management, facilitating student voice (e.g. voting, surveys, noticeboards), virtual exchanges or tours, and engaging with the wider learning community (other schools, external experts, etc.);
- creating, uploading and sharing teaching resources (for students and peers).

This recognisable phases for the general roll out of iPads in schools is also reflected in the process implementation, as detailed elsewhere in this report.

IPADS AND PARENTS

As with many of the studies emerging from UK iPad early adopting schools, in those schools researched by Burden et al. (2012) as part of the 'iPad in Scotland' programme, made use of baseline and exit surveys to gain data on parental attitudes towards the iPad Pilot. They found that most parents felt confident in helping their children use the iPad to support learning in the home. One important finding, echoed also in the South Korean tablet initiative (Saenz, 2011), was a concern in some parents (not held at the baseline survey stage) of young primary school learners that their children's increased use of technology at home and school might actually be detrimental to their academic work more generally. Overall, however, 83% of parents felt that the iPad pilot had been valuable and indicated, amongst other things, that it led to increased engagement and interest in learning, gains in knowledge and technology skills, more time spent on homework and offering more opportunity to make learning relevant and authentic (Burden et al., 2012).

In the FK&Y 'Tablets for Schools' study, Clarke (2012) found that parents felt that home-school communication had been improved with the introduction of 1:1 tablet devices. Some parents indicated greater engagement with their children's learning with their child feeling 'proud' to share work with their parents, a finding also upheld in the Norwegian iPad study (Gasparini, 2011). Parents of pupils at one school in the FK&Y study – Alex Hunter in Braintree, Essex were found to be positive about the idea of tablets and felt that the ability to 'have everything in one place and not having to carry round heavy school bags' was a major benefit (Clarke, 2012). This finding echoes thinking in other projects, such as the e-textbook/tablet initiative in South Korea (Saenz, 2011). Concerns raised by parents in the FK&Y related to fears about breakage, theft, loss or misuse of the devices by children, however, by the end of the first year, these had dissipated somewhat (Clarke, 2012).

At Longfield Academy in Kent, a parental survey was conducted at the end of the first year of the iPad initiative. Despite receiving only a small number of responses, some key concerns of parents were nevertheless highlighted. Perhaps unsurprisingly in the current climate of austerity, a key concern for parents was costs, with nearly half of responding parents feeling that the scheme did not represent good value for money. Parents were concerned at the length of the leasing period (3 years) and the long-term costs of ongoing payments (£16 per month), particularly for families with more than one student at the school. They were concerned also about the lifecycle of the machine and possible further expense in future upgrades. One particularly disgruntled parent indicated that they 'felt bullied into participating in the lease scheme' (Heinrich, 2012).

The available studies suggest that key questions that arise for parents relate to the benefits and implications of iPad use, how they will be used to support teaching and learning generally and homework, exams and revision as well as more practical concerns relating to use, misuse, security, lifecycle, training and support and, above all, costs to parents. In this respect, emerging studies show that early, ongoing engagement with parents that includes opportunities to discuss and negotiate approaches to implementation, as well as to learn more about the benefits of the tool have a high impact on acceptance and overall success of these iPad initiatives.

IPADS AND LEARNERS

The research on iPad use and adoption overwhelmingly reports that tablet devices like these have a positive impact on students' engagement with learning. Whilst there are some minor concerns raised about potential overuse or distracting influence (Saenz, 2011), misuse (Clarke, 2012) and a lack of confidence or skills in some students (BBC, 2013; Henderson & Yeow, 2012) these findings are far outweighed by those which report on increased motivation, enthusiasm, interest, engagement, independence and self-regulation, creativity and improved productivity (NMC, 2012; Burden et al., 2012). Many report, more specifically, on students' ability to control their own learning in ways not possible before (Gasparini, 2011; Heinrich, 2012; NMC, 2012) whilst others report students' own view that 1:1 ownership of tablet devices provides them with easy access to resources and apps that can help them collate and organise notes and support materials which, in turn, improves their productivity (Heinrich, 2012).

Such positive findings are, however, contrasted with reports from early adopters that point to learner difficulties in using the iPad's touchscreen interface for extensive text-based input (Henderson & Yeow, 2012), and in using app-based tools to capture and collate information. As a key benefit of the iPad is its portability, the idea of 'attaching' peripherals such as a wireless keyboard to address these issues is anathema to some (Henderson & Yeow, 2012). More recent research, however, does not appear to see these issues as problematic, pushing the idea that the iPad is just 'one tool amongst many' and that it should not be expected to do everything (Clarke, 2012; BBC, 2013).

In terms of learner confidence with tablet devices like the iPad, a majority of recent studies suggest that most students find them easy to use (e.g. Heinrich, 2012). Others suggest that some students, and particularly younger learners, may require initial support not only in dealing with the features and functionality of the device – including how to find, download and use apps (Gasparini, 2011) as well as how to create and access accounts and storage in 'the cloud' (Allen, 2011), e.g. using dropbox (Heinrich, 2012) - but also in terms of how, when and where tablet devices can be used to support learning (BBC, 2013; Henderson & Yeow, 2012).

PART 5: THE RESEARCH CONTEXT

As context for the rising demand for iPads and iPad-like devices in schools, in the section that follows, we provide a summary review of key trends and developments in the adoption and use of 'Post-PC' tablet devices firstly in the global context, followed by a brief overview of the current situation in the UK.

SCHOOL-BASED IPAD STUDIES: GLOBAL CONTEXT

There has been considerable take up of iPads in K-12 education in the US since the introduction of the device by Apple in 2010. Forbes lists in October 2012 report 70 out of the top 100 rollouts of iPads by enterprise are in K-12 education (Lai, 2012). A reported 1.5 million iPad devices having been sold to the education market by Apple as early as January 2012. Some school districts, such as McAllen County in Texas, have pushed for a district-wide rollout of iPad devices, despite the high initial investment cost (Sherman, 2012). Others have taken a more cautious approach, with small-scale pilots in individual schools focusing on the use of apps and tablets to support various activities around teaching and learning as well as communication and administration.

The recent Horizon report on emerging technologies in K-12 education (NMC, 2012) provides useful examples of how iPads are being used in such schools:

- for interactive learning (*Pleasant City Elementary School, Florida*) real-time communication and feedback between teachers, students and parents;
- use of apps to support students with special needs, e.g. autism (*Belle View Elementary School, Virginia*);
- social and communication needs (*Auburn School, Maryland*) and
- for homework, assessment and grading (*Lodi Unified School District, California*),

At Snoqualmie Valley School District in Washington iPads are used to identify student and teacher training needs and to facilitate teacher networking (*Meeks, 2011*) whilst students at Roslyn High School on Long Island use them for digital portfolios and interactive learning (*Hu, 2012*).

Elsewhere, and as early as 2007, the South Korean Ministry of Education announced its intention to push for a US\$2 billion government-funded mandatory digital curriculum in all of the country's schools by 2015. The plan had a strong focus on digital textbooks, cloud computing and tablet PCs (Saenz, 2011). The hope was that learners would not only benefit from lighter schoolbags but that they would also develop enhanced information skills and practices, and obtain access to new learning media not previously available in print textbooks, e.g. multimedia, web-based support systems, 3D interactivity and distributed content storage 'in the cloud'. Five years on the program, initially piloted in 50 schools, has met with some successes and some unanticipated and less welcome outcomes. The provision of government-funded Samsung Galaxy tablets to learners has delivered on the desire to make e-textbook content readily available. The digital textbook program has, however, also led to:

- concerns about possible damage to student health (Internet addiction, depression, vision problems);
- a perception that these 'digital devices are too pervasive', and
- that a 'young generation of tablet-carrying, smartphone-obsessed students might benefit from less exposure to gadgets, not more' (Harlan, 2012).

Alongside these developments, however, the South Korean tablet manufacturer Samsung has been able to develop and trial an education specific 'learning hub' - the Samsung Smart School Solution – for its tablet devices (Chosun Ilbo, 2012). Pilots are being run initially in South Korean schools and, more recently with Geeter Middle School in Memphis, USA (Samsung, 2012) and Loreto Secondary School in Kilkenny, Ireland (Burke, 2012). Samsung's Smart School Solution is a fully integrated one-to-one learning platform that enables teachers to create an interactive learning environment using devices such as the Galaxy Note 10.1 tablet, a 65-inch interactive e-board and an AllShare Cast Dongle to allow for wireless streaming of content. The solution comprises three integrated systems:

- an IMS (Interactive Management Solution) that allows teachers to control interactive lessons, including the ability to lock down student screens,
- an LMS (Learning Management System) providing course materials such as e-books, apps, timetables, school notices, forums and
- an SIS (Student Information System) to track student attendance, grades, etc.

In Canada, the Alberta government hosted an event for educators in October 2011 to explore the use of iPads in schools and to discuss the opportunities, challenges and emerging lessons learned from implementation of iPads as a support for teaching and learning in local classrooms (Alberta, 2011).

In Australia, the Victorian government has been running an iPads trial in conjunction with Apple. The 'iPads for Learning' initiative saw 700 iPads distributed on a 1:1 basis to students at nine schools and one hospital school. The trial is supported by a web-based project site offering a wide range of resources, including first-hand accounts from iPad educators, including school-based case studies, app reviews, reports and other guidelines documenting a wide range of uses and ways of integrating iPads in the classroom (DEECD, 2011).

In New Zealand, one early adopting iPad school, the Redoubt North Primary School in Auckland (Henderson & Yeow, 2012) had previously used netbooks and turned to iPads due to the range of apps available. This iPad case study is a particularly strong example of one school's considered implementation strategy for the use of iPads being shared by small groups as part of a larger class set.

An early iPad-adopting rural elementary school in Norway provides a similar (and usefully contrasting) case study on the initial implementation of iPads in the classroom with groups of children (Gasparini, 2011). Whereas in the New Zealand study, management of the roll out was essentially a top-down affair, in Norway, the opposite was the case, at least initially, with much freedom regarding choice of apps and use of the devices being given to students. Taken together these two studies provide a useful overview on the use of iPads 1) only at school and 2) between home and school, with a focus on management of devices, selection of apps and the impact of device 'ownership models' on learners.

Before concluding this section, it is worth returning briefly to the Samsung/Apple situation outlined earlier as Samsung's foray into tablet-based learning platform/school management system software could mean that its Galaxy tablet range could become a serious iPad competitor in the near future.

Samsung's education-focused pilot is in stark contrast to the iPad pilot programmes run by Apple which have tended to focus more on real-world contextualisation of educational apps, i.e. as a sub-category of a wider app family rather than a 'closed' educational system reminiscent of the desktop/laptop PC generation. Each system has its own benefits and limitations. The Samsung offering will be familiar to schools' existing practices for managing learning and other school-related tasks. The Apple offering, meanwhile, offers a more 'open' system capable of linking learners to the wider knowledge community via systems like iTunesU. Apple, however, has the advantage of a head start in the educational research stakes with initial research data beginning to emerge from its early pilot studies around the world, many of which feature in this report. Samsung and, indeed, other Android-style tablet device players have yet to prove the robustness, stability and overall utility of their systems, with little research having been published to date. It is clear, however, that there is an emerging battle for tablet-based education, which has yet to be fought in the 'Post-PC' tablet arena. Whilst iPads continue to be regarded as 'leading edge' costs are high on the agenda and, insofar as schools generally have tight budgets and limited resources, it remains to be seen who will win the battle.

Judging by recent reports in newspapers and early research reports by the British Educational Suppliers Association (BESA, 2012) and the National Association of Advisors for Computers in Education (NAACE, 2012) the situation regarding iPad adoption is currently trending just as 'hotly' in UK education as elsewhere.

SCHOOL-BASED IPAD STUDIES: UK

In a speech to the Schools Network Annual Conference in December 2011, the UK Secretary of State for Education, Michael Gove, suggested that "As we move to a world where we expect every child will have a tablet, the nature and range and type of content that can be delivered will be all the greater."

In contrast to this somewhat optimistic statement regarding tablet ownership, in a recent survey by the British Educational Suppliers Association and the National Education Research Panel, 82% of schools saw funding as a barrier to the uptake of tablets in schools (BESA, 2012). In the same survey, and despite recent government policy giving schools freedom and autonomy to choose ICT tools and resources appropriate to their needs, 61% of primary and 39% of secondary schools felt it was important to wait for the government to support adoption of these devices.

The survey, carried out in May 2012, also carried the message that a majority of schools (72%) want more evidence that tablets are suitable for the classroom before they will support adoption of the devices. Despite this note of caution, a high number of respondents: 66% of primary schools and 70% of secondary schools admitted to an awareness of apps being used in the classroom.

Key concerns raised by respondents were: funding (82%), security and management of devices (85%), value and risk of damage (73%), and issues relating to the installation of and funding for apps (71%).

Against this general background, three key research reports provide emerging findings on the implementation of iPads in early adopting schools throughout the UK.

In Scotland, the *'iPad in Scotland'* study was carried out by the University of Hull in association with a variety of Scottish schools (primary, secondary, state and independent) and their local authorities (Burden et al., 2012).

In England and Northern Ireland, the *'Tablets for Schools'* study was carried out by Family Kids and Youth and reported on iPad adoption in three pilot schools: Honeywood Community School in Essex, Longfield Academy in Kent and Wallace High School in Belfast (Clarke, 2012).

A more detailed report on the Longfield Academy iPad project was also produced by NAACE and 9ine Consulting (Heinrich, 2012).

In addition to these higher profile case studies, UK television and newspapers are increasingly reporting on whole-school roll outs of iPads to students on a 1:1 basis, including schemes at Clevedon Community School in Bristol (This is Bristol, 2011), Rossett School in Harrogate (Mail Online, 2012) and the Essa Academy in Bolton (BBC, 2013).

Each of these studies has been referred to in more detail in the main body of the report. In summary, however, key lessons from these global and UK-focused studies turn attention on: the rationale for tablet adoption, roll out models and strategies for implementation, funding, ownership models, strategic planning, technical requirements, teaching and learning, device lifecycle, skills training and teacher CPD, security, risk and project evaluation.

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