University of Hull

iPad Scotland Evaluation

Kevin **Burden**, Paul **Hopkins**, Dr Trevor **Male**, Dr Stewart **Martin**, Christine **Trala**

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UNIVERSITY OF Hull

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(Faculty of Education, The University of Hull)

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Abbreviations

1:1	One student to one computer or device
3G	3rd generation mobile telecommunication
app	iTunes software application
AUP	Acceptable Use Policy (Agreement)
CfE	Curriculum for Excellence
ICT	Information, Communication Technologies
iOS	Apple's mobile operating system (currently iOS 6)
MDM	Mobile Device Management
S.A.M.R	Substitution, Augmentation, Modification, Replacement
VLE	Virtual Learning Environment

Acknowledgements

This is the final report of the iPad Scotland Evaluation undertaken for schools and local authorities in Scotland by the Technology Enhanced Learning Group based in the Faculty of Education at the University of Hull.

Faculty of Education,
The University of Hull,
Cottingham Road,
HU6 7RX,
Hull,
East Yorkshire,
England.

Email: k.j.burden@hull.ac.uk

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Greenwood Academy, North Ayrshire Council

Kilsyth Primary School, North Lanarkshire Council

Kingswell Primary School, Aberdeen City Council

Sciennes Primary School, City of Edinburgh Council

St. Kentigern's Academy, West Lothian Council

1. Executive summary

Key words: mobility, portability, access, training, data transfer, transformation, personal ownership

This Report has been prepared by the Technology Enhanced Learning Research Group based in the Faculty of Education at the University of Hull. We report a case study of mobile technology adoption from eight individual educational locations in Scotland that differ significantly in terms of demographics, infrastructure, the approach of the Local Authority and readiness to implement the use of tablet technology for learning and teaching. The study took place between March and summer 2012 and the mobile technology used was the Apple iPad.[1]

The schools in the sample were selected via recommendations from their Local Authority. Whilst this sample includes a wide range of variation in key factors likely to influence the adoption and successful use of mobile technology, it does not necessarily represent all schools across Scotland. We therefore do not attempt to draw comparisons between schools or report on the long-term impact of this pilot initiative regarding individual educational attainment or cohort assessment outcomes. This report forms part of a developing longitudinal investigation that is seeking to achieve these larger objectives.

Three models of 'personalisation' of the technology were found in the schools:

1. Some deployed class sets of the technology where devices were retained in the school and issued to students for particular lessons or purposes;
2. Other schools allocated machines to individual students for use across lessons but they were not allowed to take the equipment home;
3. A third group of schools adopted the most personalised approach and gave students the device for the duration of the pilot for use in school and at home.

Sometimes schools used a hybrid of these three main approaches. A total of eight schools and around three hundred and sixty five iPads were involved in the pilot. The majority of teachers in the pilot were provided with a personal iPad before or at the start of the initiative.

Research data was drawn from:

- Initial (baseline) and exit surveys of parents and students;
- Interviews with the lead teachers and senior managers in each school;
- Interviews with advisers and senior leaders in each of the Local Authorities;
- Focus group meetings with students in each school, and;
- Lesson observations by the research team.

1 Most students had access to the 2nd generation iPad although a few used the 1st generation device which lacked a camera feature

In addition reflective journals that teachers were asked to write and the video diaries and logs kept by a representative sample of students were drawn upon. Analysis of the data was undertaken between July and October 2012.

Key findings

1. Use of tablet devices such as the iPad was found to facilitate the achievement of many of the core elements required within the Curriculum for Excellence framework and could be further developed in order to achieve these aspirations.

2. The adoption of a personalised device such as an iPad significantly transforms access to and use of technology inside the classroom with many attendant benefits:

   - Many teachers noted that ubiquitous access to the Internet and other knowledge tools associated with the iPad altered the dynamics of their classroom and enabled a wider range of learning activities to routinely occur than had been possible previously.
   - The device also encouraged many teachers to explore alternative activities and forms of assessment for learning.

3. Personal 'ownership' of the device is seen as the single most important factor for successful use of this technology:

   - This is seen as the critical element:
     - in increasing student levels of motivation, interest and engagement;
     - in promoting greater student autonomy and self-efficacy;
     - in encouraging students to take more responsibility for their own learning.
   - Evidence suggests that greater personal ownership of the iPad may also contribute to more interdisciplinary activity.

4. The individual possession of and early familiarisation with the iPad by teachers was seen as being responsible for the significant 'buy in' and low level of resistance from teachers:

   - The iPad engaged both teachers and students equally well.
   - Many members of school and Local Authority management teams commented that the deployment and effective use of iPad technology had been the most easily accepted, successful and problem-free initiative they had ever witnessed.

5. As a result of the pilot initiative schools are reconsidering their existing technology deployments with a view to more mobile provision:

   - Some schools have decided that because of their experiences with the iPad their existing ICT suites of computers will not be replaced in future.

- Many schools reported that teachers and students were using iPads every day and in most lessons.
- Little formal training or tuition to use the devices was required by teachers; they learned experientially through play and through collaboration with colleagues and students.

6. The device is bringing about significant changes in the way teachers approach their professional role as educators and is changing the way they see themselves and their pedagogy:

   - Teachers noted that iPads had promoted more collaboration between them and students.
   - Teachers now see many students coaching and teaching their peers without the intervention of the class teacher
   - Software and applications (e.g. screen recording apps) support these processes and resultant changes in pedagogy
   - The use of iPads has enabled many more students to express their creativity, to engage in peer assessment and in group critique.
   - Teachers have seen the emergence of a real learning community that extends beyond the academic to include a partnership between students and teachers who work closely together.
   - Students report that within a month of the pilot starting, they noticed from their perspective that the quality of teaching seemed to have improved.
   - Class teachers feel that the functionality of these devices better supports students of all abilities.
   - Teachers reported that iPads allowed them to develop and extend homework and provide better feedback to students about their learning.

7. Parents also appear to become more engaged with the school and their child's learning when the iPad travels home with the student:

   - The overwhelming majority of parents believe that students should be allowed to use mobile technologies in their school before they reach the secondary stage and reported that their children gained significant positive dispositions towards learning as a result of access to the iPad.
   - Over 80 per cent of parents considered the pilot project to have been valuable for their child despite its short duration and say it has significantly changed their child's enjoyment of and attitude towards school.
   - Parents say that greater motivation, interest and engagement of their child with learning have been the single largest benefits.
   - Over 90 per cent of students believe that the iPad has helped them to learn more and to learn more difficult concepts and ideas better.
   - 75 per cent felt that their children were now more willing to complete homework.
   - Many noticed that their children were now more willing to talk to them about their school work.

8. Education departments and associated services within Local Authorities were perceived to have been helpful towards the iPad initiative and to have worked hard to support its use although corporate systems sometimes found this challenging:

- Some concerns surrounded data security and eSafety but schools felt that corporate structures should recognise the need to place more trust in schools and students.
- Schools felt that the appropriate use of the Internet is primarily a behavioural and educational issue that was within their abilities to address.
- Schools saw many central or corporate eSafety protocols as unhelpful and counter productive and most felt they prevented them from making full use of iPads.
- The physical safety of the devices has proved unproblematic and schools reported that students displayed high levels of responsibility and care even when taking iPads home.
- The iPad itself is simple to operate and is robust and reliable although a number of bulk maintenance and upgrading issues remain to be resolved in schools.

9. Many teachers and students wish to have access to the iPad after the end of the trial and are convinced it has changed learning for the better.

2. Recommendations

For Government

1. If a wider roll-out of mobile computing devices within schools is desired, the sensitivities surrounding procurement will need to be addressed as soon as possible at governmental level.

2. Consideration will need to be given to how 1-1 devices can be resourced. If options to lease/purchase are to be included, national support and a consistent pricing strategy will be necessary.

3. The installation, maintenance and upgrading of applications ('apps') on numerous mobile computing devices requires a robust systemic approach both from the manufacturer(s) and schools and such a system needs to be in place before a wider roll-out of such devices is attempted.

4. Careful consideration should be paid to the minimal need for formal training in how to use the iPad since this has important implications in reducing impact on resourcing. The volume of training required by teachers and the simplicity of adoption should be important criteria when other mobile devices are being evaluated.

5. We recommend that a more extensive evaluation is undertaken to extend and consolidate the findings in this report and to explore how teachers, curriculum planners and software developers might leverage more educational advantage from mobile computing technology.

For Local Authorities / Corporate Services

1. Corporate services should address the issue of eSafety from a different perspective, which places more trust in schools and students and recognises the appropriate use of the Internet as a behavioural rather than technological issue.

2. Local authorities should begin preparation to support multiple user platforms in the future which may run counter to the current approach built around standardisation.

3. Data security will require consideration of how Cloud computing is to be used by schools (for example via the use of applications such as *GDrive*, *DropBox* or *iCloud*) as well as changes to the way information is managed and there is an opportunity here for local authorities to assist with these issues through offering appropriate advice.

4. Formal and regimented training in how to use the iPad and its features is unnecessary and would in our view prove counter-productive in encouraging its use in teaching and learning. We recommend that whilst local authorities might wish to support schools by offering formal training it should be provided only if requested, and other opportunities for professional development should be actively considered.

For Schools

1. Robust connectivity and school-wide access to Wi-Fi are essential and should ideally be in place before mobile computing devices are deployed.

2. The adoption of mobile computing devices incorporating Wi-Fi Internet connectivity, camera and video recording capability and storage is strongly recommended.

3. Teachers should have access to mobile computing devices on a personal basis, preferably before they are used in a school, to aid familiarity and improve successful adoption.

4. Professional development in the use of mobile computing devices appears to be a largely experiential, collaborative process and formal 'training' should only be offered if requested by the teacher.

5. The use of a 'full personal ownership' model for implementing mobile computing devices in school, where pupils are able to make use of their device at all times in school and are also able to take it home, is strongly recommended on educational grounds and for strengthening parental engagement.

6. The use of a full personal ownership model in schools will require traditional practice surrounding the school-work / home-work divide to be revisited to take account of the capabilities of this technology for supporting more seamless and integrated patterns of learning.

7. The use of tools such as *Configurator*© and *Volume Licensing* is helpful in the management of mobile computing devices and the use of software of this nature is recommended.

8. The use of Apple TV™ or mirroring software such as AirServer to allow pupils and teachers to share the materials on their iPads with a wider audience is recommended as a tool for collaborative working.

9. Acceptable Use Policies (AUPs) will need to be revisited to consider the inclusion of mobile devices especially if, as recommended in 5 above, the devices are to be taken off school premises

3. Introduction

The social context and landscape for learning is evolving rapidly and young people are increasingly dependent on personal technologies, such as their mobile "phone" (an increasingly inaccurate descriptor), to manage both their learning and their lives which they perceive to be seamless and constantly connected (Ling & Donner, 2009; Pachler, Bachmair, & Cook, 2009; Traxler, 2010). Personal handheld technologies, such as tablet devices, facilitate this concept of learning drawing little distinction between the traditional boundaries of the school and the wider World or previous notions of formal and informal learning (Pachler et al., 2009). Evidence indicates young people are less likely than adults to differentiate between these contexts and simply expect to be able to use their personal technologies seamlessly wherever, and whenever it is most appropriate (Hartnell-Young & Heym, 2007). Schools across the globe are beginning to grasp the challenges, implications and educative potential of these shifts in young people's life-Worlds and are actively considering how they can adapt their current practices to appropriate this emerging ecology of learning with personal technologies (Pachler, Cook, & Bachmair, 2010).

The current evaluation study is set against this backcloth and broader landscape and recognises the urgent need to better understand how young people are using technology, and in particular personal devices, to make sense of their own life-Worlds and learning. It comes at a significant point in time as the hegemony and dominance of the fixed personal computer (PC) are diminishing, making way for a variety of flexible, ubiquitous alternatives which have enormous implications for learning, both within formal and informal sites of learning. National, regional and local policy-makers and administrators across Scotland are aware of the opportunities and significant challenges they face in responding to this complex and constantly evolving landscape and this study represents an attempt to better understand the phenomenon of personal device ownership in order to make more informed and evidence-based judgments about future deployments and patterns of technology adoption in schools across Scotland.

3.1 Scope and purpose of the study

Background

Based on previous experience and expertise in researching the use of personal mobile devices in schools [2] The University of Hull was invited to design a research framework to be used in an independent evaluation of a pilot study to be run across local authorities in Scotland who were interested in exploring the use of mobile technologies in their schools. The research framework was discussed by representatives from a number of local authorities over a number of conference calls during which the aims and objectives of the study were clarified and some modifications were suggested for the research design itself. Those local authorities interested in participating in the study were asked to identify suitable schools who were then sent the modified research framework and accompanying research instruments. Like the local authorities, each school was invited to provide feedback on this documentation and some modifications were incorporated into the final research instruments.

Six local authorities and eight of their respective schools decided to participate in the study (see below for details). North Lanarkshire council identified three schools to participate (one secondary and two primary), and the other authorities identified one school each. Representatives from each local authority and each participating school were invited to attend a launch event in March 2012 where the research framework was explained in much greater detail. It was made clear to participants that the research undertaken by the University of Hull had not been commissioned by any third party and was an entirely independent evaluation undertaken to contribute to their existing mobile research evidence base.

Figure 1: Students using their iPads for learning

2 See for example http://handheldlearningproject.wikispaces.com/

Aims and objectives of the research

The main aim of the evaluation was to identify how the use of personal tablet devices in schools impact on teaching and learning, including the wider context of learning which occurs outside of the formal institution when students have access to a personal mobile device. The main research question guiding the evaluation study was:

> *How does the use of tablet devices (e.g. the iPad) impact on teaching and learning?*

In order to answer this question a number of objectives were identified based on key factors and issues emerging from the existing research-based literature on mobile learning (see Section 6). These were:

- Leadership and management of change issues.
- Parental engagement and informal learning beyond the school.
- Professional development issues for staff.
- Technical and logistical issues associated with the management of personal devices.

Examination of these issues form the boundary and scope of this study and they are captured in the following sub-questions which are used as the framework for the final report:

> *What does learning and teaching look like when students and teachers have access to a personal tablet device?*
>
> *How does personal ownership of a tablet device by students impact on parents and other carers?*
>
> *What are the leadership and management implications associated with the shift to a tablet device strategy for schools?*
>
> *What models of professional learning and development are effective in supporting the take up of tablet devices by teachers?*

The study was not designed to investigate technical issues associated with the specific use of iPad devices which featured in this evaluation, but where these issues impact on teaching and learning they are reported and some recommendations are drawn. These types of issue were identified within the leadership and management of change strand of the evaluation (see Section 8.3).

3.2 Limitations and disclaimers

The study was undertaken over a relatively short period of time during the Spring and Summer terms of 2012 and in some cases schools had only used the iPad for a few weeks when the study began. In other cases schools had started to deploy and use the iPad before the evaluation was commissioned and therefore there was no common starting point against which to create a standardised baseline for

the initiative. This is effectively a mixed methods, collective case study consisting of eight individual schools or cases. These differ considerably in terms of their student demographics, their infrastructures, the support and attitude of the respective local authorities, and their readiness to implement a highly personalised device strategy of this nature. The report does not attempt to draw causal comparisons between schools and there is no intention to measure impact in terms of attainment or results, which was seen as highly problematic and unsuitable in this pilot at this point in time.

Schools involved in the initiative were selected through recommendations from their local authorities, not the research team, and are not therefore necessarily representative of schools across Scotland. The novelty factor of a technology initiative of this nature should not be under-estimated, nor should the 'Hawthorne effect' (Mayo, 1949), whereby participants are unintentionally well-disposed towards the intervention simply because they know they are being observed or researched. A longitudinal study of this phenomenon is recommended to rectify both of these issues and readers should be aware of these limitations when considering the findings and conclusions which are presented.

4. Implementation

4.1 Context and background

Primary and secondary schools across Scotland were invited to participate in the pilot study by their local authorities and eight were eventually selected (see Figure 2). The pilot was scheduled to run from March until June 2012 when schools closed for the summer vacation.

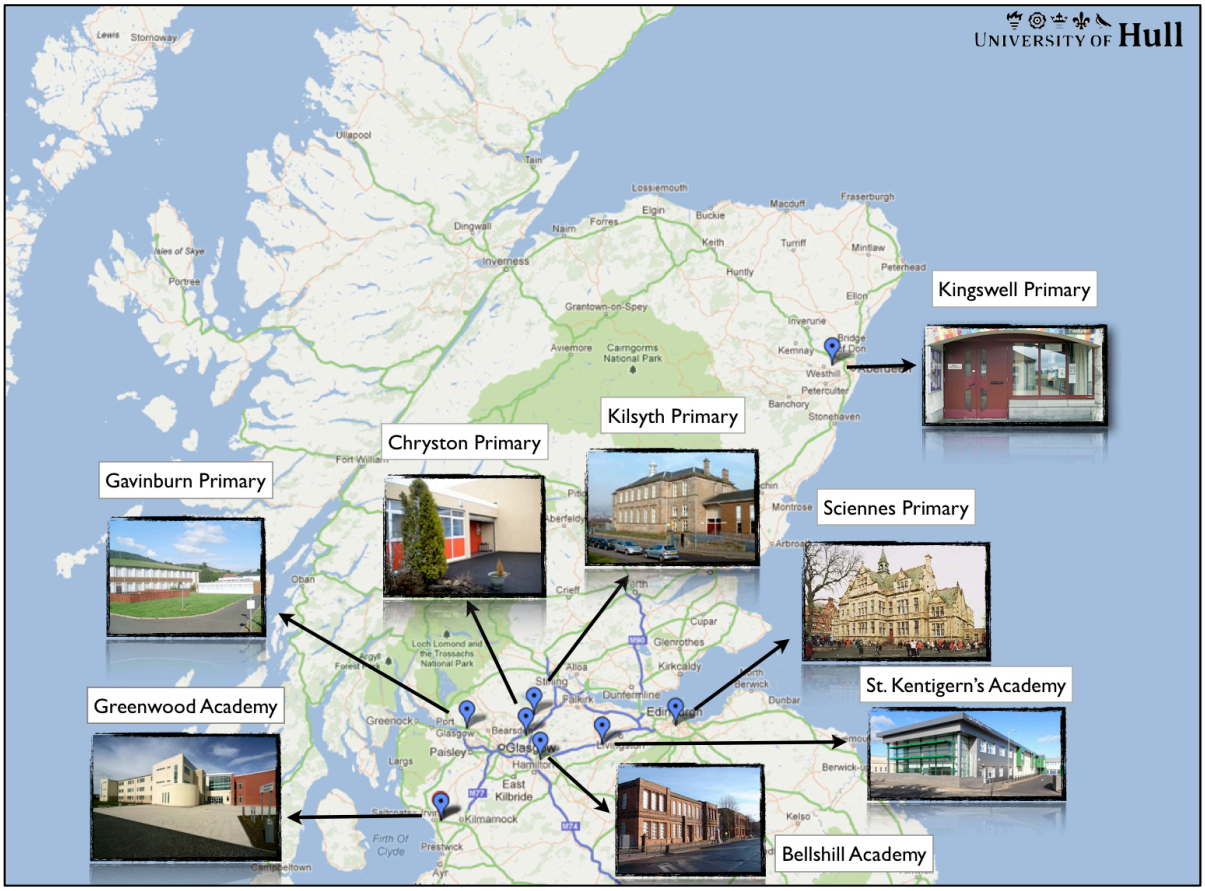

Figure 2 Schools participating in the pilot phase (March-July 2012)

All but one of the selected schools (Kingswell, Aberdeen) are located across the central region of Scotland, including three secondary and five primary schools spread across six local authorities (see Table 1 for the breakdown of participating schools and local authorities). The greatest concentration of schools was in North Lanarkshire which included a large secondary school (Bellshill Academy) and two primary schools (Kilsyth and Chryston Primaries). Approximately 365 students had access to an iPad device during the pilot study. The majority of these had access on an entirely personal basis, enabling them to use the iPad in school and at home. A smaller number had personal access to the device only in school, and one school deployed the devices as class sets which were handed out and collected in after each lesson. The youngest students involved in the pilot were in P3/4 (7 to 9 year olds) and the oldest were in S2 (13 and 14 year olds).

School	Local Authority	Year	Numbers	Version of iPad	Deployment pattern
Bellshill Academy	North Lanarkshire	S1	98 students with personal iPads	iPad 2 (2nd generation)	iPad as personal device (school and home) Additional class set of 30 devices
Kilsyth Primary		P7	24 students	iPad 1 (1st generation)	iPad as personal device (school and home)
Chryston Primary		P5	19 students	iPad 1 (1st generation)	iPad as personal device (school and home)
Gavinburn Primary	West Dunbartonshire	P5/6	22 students	iPad 2 (2nd generation)	iPad as personal device in school only
Sciennes Primary	City of Edinburgh Council	P5 and P6	P5 set: 32 iPads	iPad 2 (2nd generation)	iPad as personal device (school and home)
			P6 set: 31 iPads	iPad 2 (2nd generation)	iPad as personal device (school and home)
		P6 – shared set	33 shared as a set	iPad 2 (2nd generation)	Class set shared by two teachers
Kingswell Primary	Aberdeen City Council	P3/4	24 students	iPad 2 (2nd generation)	Use iPad in class but not always as personal device
Greenwood Academy	North Ayrshire	S2	Set 1: 27 students	iPad 2 (2nd generation)	iPad as personal device (school and home)
		S2	Set 2: 30 students	iPad 2 (2nd generation)	iPad as personal device (school and home)
St. Kentigern's Academy	West Lothian	S1 (top maths set)	28 students in top maths class	iPad 2 (2nd generation)	Only use iPads in maths – can take them home (can use in other classes but not common)
Approximate number of iPads in pilot		P3-S2	365 students		

Table 1: Schools, local authorities and students involved in the pilot study

In most cases schools were supported by their local authorities to purchase or borrow iPad devices for the duration of the pilot, although some schools purchased their own or used existing stock. Details of these arrangements are provided in Table 1 and in the vignettes from each school (see Section 7). The majority of the devices were 2nd generation iPads but some schools used 1st generation devices which lack the camera feature. Since this was identified as a potential pedagogical affordance, or benefit, its absence was considered to be an important factor limiting certain types of teaching and learning activity. The type of device used is therefore identified in Table 1.

Schools were left to make the decision about how the iPad device would be used and allocated to students although it was assumed they would seek to maximise personal ownership where possible since this was a primary focus of the study. In practice schools adopted a number of different models for deployment and ownership of the device and these often evolved and changed during the course of the study itself. The dominant model across most schools was personal ownership with students responsible for the device during the school day and outside of school.

4.2 Patterns of deployment and ownership

1. Class sets

Three broad patterns of use and ownership were identified during the evaluation. The most traditional model was class sets where the devices were maintained as a set and allocated to students for specific lessons or purposes. These deployments were almost identical to existing patterns of laptop use where teachers are able to book and use the technologies which are usually available in portable charging units as illustrated in Figure 3. This was the model adopted by Kingswell Primary school in Aberdeen.

Figure 3: Fixed iPad charging cabinet (Kingswell Primary, Aberdeen)

In these instances the tablet device was shared between different users at different times. This was considered to be the least personalised model of deployment in the evaluation. At the time of the pilot it was impossible to create separate profiles for each student on the device and this model of deployment therefore lacked the degree of personalisation which characterised the majority of devices used in the other schools. Since the pilot phase finished in July 2012 Apple have updated their operating system (iOS 6) enabling users to manage the devices through Apple Configurator in what is termed a 'layered model'. This mode of operation would allow teachers to deploy class sets of iPads which recognise the user and restore the work of each user from a backup. It was not possible

to evaluate the effectiveness of this approach during the pilot, although it is recommended this is investigated in any further research.

2. Personalised use inside school only

The second model featured a greater degree of personal ownership by students since they were allocated a personal iPad to use across lessons within school, although they were not allowed, at first, to take it home. This was the model adopted by Gavinburn Primary School, West Dunbartonshire.

3. Personalised use inside and outside of school

In the third and most personalised model, students were allocated a personal device for the duration of the pilot which they could use in school and at home. This model generally involved a close relationship with parents who were invited into the school at the launch event and were required to complete an Acceptable Use Policy (AUP) which was usually customised from the school's existing AUP (see Appendix B for an example from Bellshill Academy).

In many of the schools visited they also operated a hybrid scheme which included either model two or three and class sets of iPads which teachers could book when required. As reported earlier, these models were not rigid and many of the schools moved from the traditional to the more personalised deployments as they gained greater confidence and awareness of the device and its potential as a personal learning device. These details are covered in the individual vignettes for each school (see Section 7).

4.3 Support and advice for pilot schools

Technical support for the initiative was provided by XMA Ltd[3] who were responsible for most of the installation and infrastructure issues associated with the initial deployment of the iPad in school and subsequent support issues. XMA provided an online and face-to-face support service for schools during the study although this falls outside the scope of the evaluation. Additionally an independent consultancy organisation (Connected Flow Ltd[4]) led by Fraser Speirs and colleagues at Cedars School, worked alongside schools and teachers to support their pedagogical needs and requirements. They provided technical support and advice at the initial launch meeting (March 2012) and subsequently worked with individual teachers and schools on a personal basis when requested. Teachers from the pilot schools were invited to attend several 'recall' days organised by Connected Flow to share ideas and undertake workshop training, although attendance at these events was variable owing mainly to the pressures facing teachers during the busy summer term.

An online learning project management system (Basecamp[5]) was also made available to teachers during the study, providing each school with a private space to post questions, organise events and share ideas. It also included a communal space where members of the various support teams

3(http://www.xma.co.uk/)

4 http://connectedflow.com/

5 http://basecamp.com/

(including research staff from the University of Hull) were able to communicate with participants. The use of Basecamp during this study was patchy and some schools made little or no apparent use of this facility. A small number of schools, however, used it extensively and reported very positively in terms of value and potential to support community based learning. They were generally disappointed that the community did not expand significantly during the study but their own contributions and learning are still considered significant by the research team who have analysed these activities under the heading of professional development and learning (see Section 8.4).

5. Research design and methodology

A mixed methods research design was used in this study consisting of quantitative data collection instruments (online surveys) and qualitative approaches (interviews, focus groups and analysis of documents). The data was subsequently analysed to produce descriptive statistics and graphs from the survey instruments, and rich narrative accounts derived from the interview and documentary evidence.

An electronic online survey instrument [6] was used to collect baseline data from parents and students at the start of the initiative (March 2012) and subsequently at the end of the pilot phase (July 2012) in order to identify changes and shifts in attitudes and practices, where this was applicable. The baseline survey invited parents and students to describe their existing use of technology, including the volume of technologies available to their children in the home and at school. These questions enabled the research team to establish the frequency of technology use, both at home and at school, and to identify attitudes towards technology, and particularly mobile technologies. A slightly modified set of questions was included in the exit survey which enabled the researchers to identify patterns, trends and changes in attitudes towards the use of technology, which now included the iPad, both in school and at home.

The parental surveys were administered through the individual pilot schools, although Bellshill Academy did not participate as they had organised their own surveys shortly before this and allowed the University to use the data they had collected. A total of 138 parents or carers completed the baseline survey and 86 completed the exit survey. The statistics are shown in Figure 4, broken down by individual school.

6 Bristol Online Surveys (BOS): http://www.survey.bris.ac.uk/

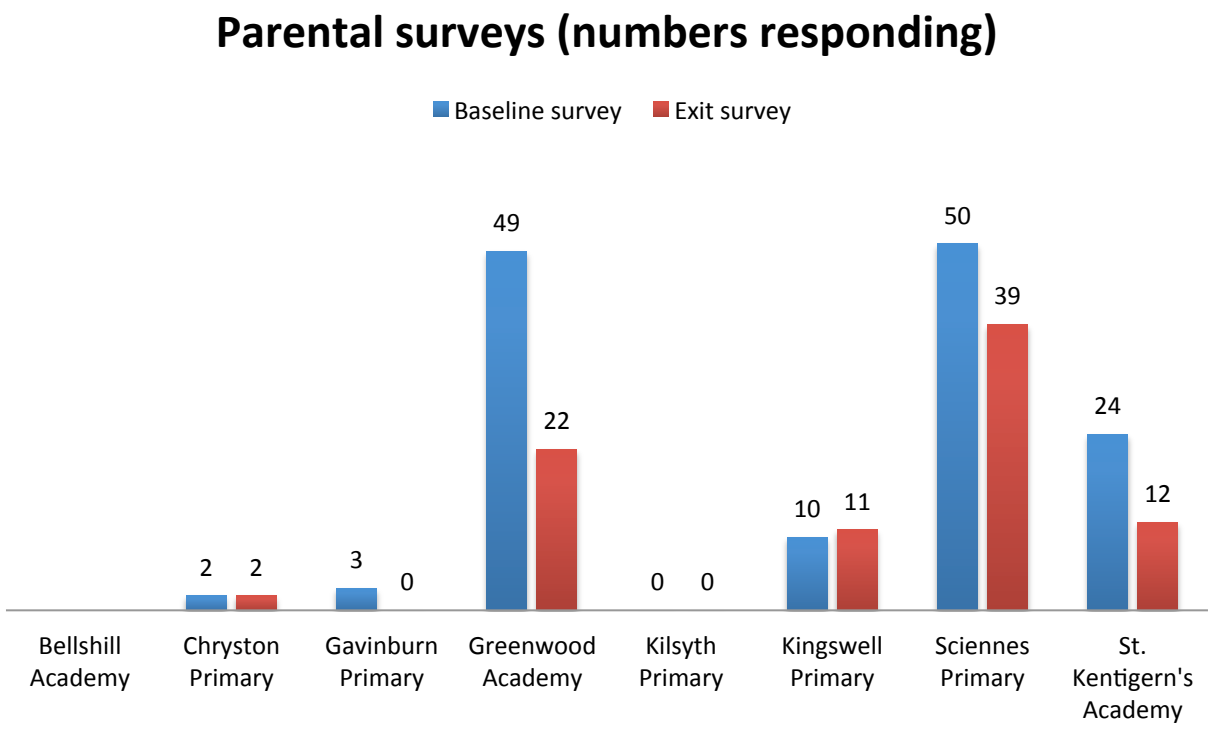

Figure 4 Parental baseline and exit surveys

The student surveys were administered directly through each school. 261 students completed the baseline survey and a similar figure (262) completed the exit survey. These results are shown in Figure 5 .

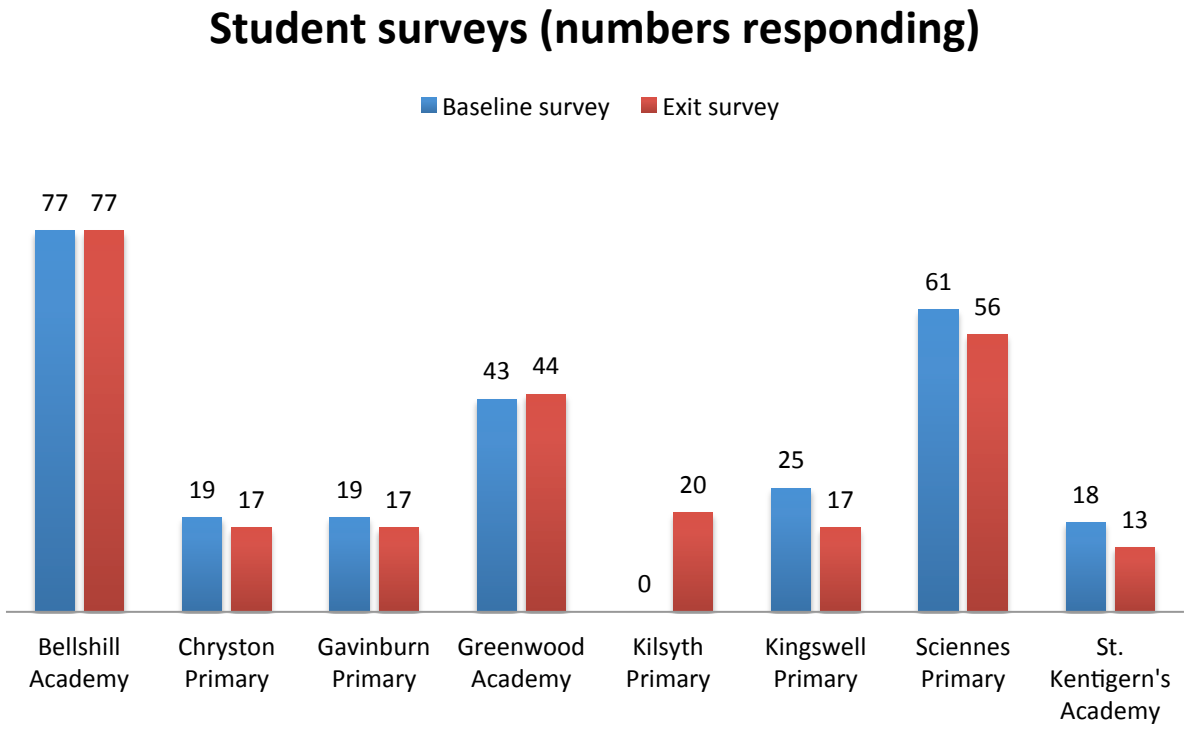

Figure 5: Student baseline and exit survey

Interviews were conducted with every lead teacher in each school and in many cases these included two persons since many schools paired teachers for the purpose of the pilot. In total 11 teachers and the majority of Headteachers or senior staff were interviewed during the course of the pilot. Additionally a number of advisory staff and senior personnel from each local authority were also interviewed separately as part of the leadership strand (see Section 8.3).

Research staff from the University of Hull visited each of the pilot schools at least once to observe lessons, talk with a focus group of students and interview key staff. Given the exploratory nature of the research during the study, observation proformas were not at this point. Additionally a significant amount of documentary data was collected from students and teachers. Teachers were asked to maintain reflective journals during the study and to identify a representative sample of pupils (six in each school) who were asked to keep their own video diaries and/or logs of their activities. A standard template was provided to assist teachers and students in this task. Teachers were given access to a Cloud based storage account where they were asked to post these various artefacts on a regular basis. Appropriate ethical permissions and informed consent forms including, where necessary, consent from parents underpinned all of the research instruments and data collection techniques.

The short duration of the study, which coincided with the busiest school term, made some of these data collection approaches problematic and it was not possible to ensure a complete return from each school. The baseline and exit surveys were completed by the majority of students involved in the study and by a significant proportion of parents (see Figures 4 and 5 above). Interviews with teachers and senior leaders were conducted in every school and in some cases more than one teacher was interviewed. As well as this pupil focus groups were also undertaken in each school. The collection of teacher and student artefacts was more problematic; only two schools collected and provided teacher and student logs on a systematic basis although other schools later sent some examples of this work.

The data available to the research team was still considerable, despite the limitations mentioned above, and analysis was undertaken over three months between July-September 2012. Some of this employed a deductive approach based on existing frameworks for the analysis of technology impacts in educational contexts. Two frameworks in particular were examined (the S.A.M.R model by Puentedura, 2012 and McCormick and Scrimshaw's model 2001) and these results are analysed in the final discussion part of the report (see Section 9). The data was also examined from an inductive perspective, which involves the identification of codes and categories which gradually emerge and form themes and claims. These themes are presented in each of the main sections of the report which then summarise the main findings and claims in the discussion section. This is the basis of claims and recommendations that appear in this report.

6. Literature review

Although there is an extensive body of research investigating the use and impact of technology in education, and an emerging corpus of work exploring the application of mobile and handheld devices in schools[7], surprisingly few studies have focused specifically on the phenomenon of tablet devices, such as the iPad. The author of one of the few studies to examine the specific impact of tablet devices in a school setting has noted this gap whilst also drawing attention to some of the shortcomings in those extant studies including their academic credibility, breadth, scope and focus (Heinrich, 2012).

This is not intended to be a comprehensive review of the existing literature in this field, but rather a more precise examination of studies and literature related specifically to the use of touch sensitive devices such as tablets and other mobile technologies in educational settings. There is a growing body of research and literature emerging in the field of m-learning and this brief review does not attempt to cover this evidence base which is addressed elsewhere,[8] although it is acknowledged to be an important area of study for those wishing to set this study within a broader framework of technology use in education.

Whilst there is no shortage of debate and discussion focused on the use and impact of tablet devices in education, and particularly the iPad, much of it is self-reported and anecdotal in nature, or alternatively it is small-scale and specific to particular sites or institutions (Heinrich, 2012). None of this is particularly surprising given the short amount of time which has elapsed since the launch of the iPad in 2010 but it has tended to fuel arguments from those critics who perceive this to be yet another example of schools being driven by the seductiveness of the device and the manufacturers' advertising prowess, rather than genuine pedagogical needs or evidence (Cuban, 2003).

There is as yet no definitive empirical study into the use of iPad devices which addresses all of the concerns mentioned above and indeed this current study falls some way short of this ideal, given its relatively short duration and lack of longitudinal insights. Nonetheless, taken together the small number of empirical studies which have investigated this field and phenomenon paint an emerging pattern of how schools and teachers are beginning to reconceptualise their practices, especially in cases of entirely personal ownership, whilst simultaneously highlighting the areas where there is a need for further research. This brief literature review therefore focuses primarily on those few studies to have examined tablet devices, and iPads in particular, in the context of school education which is the focus of this evaluation.

7 The study of mobile devices in education is often referred to as 'm-learning'. For the purposes of this study m-learning is defined as the 'process of learning mediated by a mobile device'(Kearney, et al, 2012)

8 see for example: http://www.londonmobilelearning.net/aigaion2/topics

Tablet and touch sensitive devices in education

Australian educators and researchers have pioneered some of the first deployments of touch sensitive devices in schools including an iPod Touch study in the state of Victoria (Murray & Sloan, 2008) and a more recent study based upon the use of the iPad2 in Queensland (Department of Education and Training, 2011). Despite limitations in each study they have each contributed to the knowledge base on mobile touch sensitive devices, identifying many of the main findings and themes which are starting to shape the current agenda around educational impact and potential of mobile devices such as tablets and phones.

The first of these studies, undertaken in 2008 for the Department of Education and Early Childhood Development in the state of Victoria, Australia investigated the use of the iPod Touch focusing on the '*impact on student learning, on teacher pedagogy, curriculum and assessment, and on external technical issues involved in implementing emerging technologies* (Murray & Sloan, 2008, p. 1). The study was located across three schools (all primaries) which were already committed to the use of technology to support student learning.

In each school teachers identified the creative opportunities available to students through the iPod Touch and other benefits associated with greater collaboration between learners and gains in literacy and numeracy, especially for ESL students. Increased student confidence and independence were identified as really noticeable features, as were evidence of peer coaching using the device and significant benefits for non-English speakers who developed podcasts in their own language to share and speak with each other. They also reported time to be a significant factor in developing new curriculum opportunities for students, along with the need for considerable technical expertise required to use the devices effectively. Despite these concerns teachers were strongly supportive of the technology and believe they offer genuine value for learning and for making learning tasks more authentic.

It should be noted that unlike most of the schools in the iPad Scotland initiative, the iPod Touch devices were not allocated to students on a personal basis, although some were allowed to take them home occasionally to show parents. Instead they were allocated to students by teachers when and where it was deemed they would add value. Given these were all primary schools this implies students probably had access to the device quite frequently but they do not appear to have been given responsibility for the device itself, reducing the opportunities for agency and independence identified in other cases and indeed in the current study.

A second example, also from Australia, was initiated in 2011 by the Department of Education and Training (DET) who undertook a trial and evaluation of iPad devices on behalf of the Queensland Government to identify its suitability as a learning tool in both schools and the enterprise sector. This involved two schools – a primary and secondary – set in different contexts (urban and rural) featuring approximately 50 iPad devices. In the primary school the iPads were assigned to individual students, spread across three year groups, who were able to take them home. In the secondary school the devices were used as a class set shared across three classes (approximately six iPads per class) but students were not allowed to take them home.

These patterns of ownership and deployment were judged to be significant variables associated with the effectiveness and impact of the project. Although some teachers, such as the music department, found the shared model preferable, most identified the personal ownership model as being more effective, not least because it matched the personal nature and design of the device itself which they did not find suitable for multiple logons or users:

> *'It is not possible to log onto the iPad as different users, therefore it is a device best suited to a 1-to-1 model. This is particularly the case if personal information, documents, email accounts, calendars and photos need to be stored on the device."* (Department of Education and Training, 2011, p. 17).

Use of the iPad was focused mainly in the areas of numeracy and literacy which were identified as weaknesses in each school, and teachers identified several learning gains in these areas including increased enthusiasm by students, better understanding of complicated ideas which could be broken down into their constituent parts, and greater engagement and motivation in learning through applications which were games-based in nature.

Teachers in both schools agreed it was important to gain personal familiarity with the iPad before using it with students, but they were equally surprised to discover how often students and teachers worked alongside each other as co-learners when using the iPad, a feature which was also evident in many schools in the current Scottish pilot:

> *'An unexpected benefit for Kedron State High School teachers arose when they stepped outside their comfort zone, acknowledging they were not expert in using the device and openly demonstrating that new technologies are an opportunity for all to learn. Students responded well to this and were keen to assist teachers with the technology, resulting in a shared approach to problem solving and the learning process'* (Department of Education and Training, 2011, p. 18).

The overall conclusion from parents, teachers and students was positive leading to recommendations and support for a wider roll-out of these devices, whilst recognising the difference between this as a personal device, and traditional laptops or PC which are shared. Teachers involved in the project defined the iPad as a cross-curricular device rather than something constrained to particular subject areas:

> '*The iPad was viewed unanimously by participating teachers as a cross curriculum device that is not constrained to a specific subject area. This is demonstrated by the range of apps available and mobility of the device'* (Department of Education and Training, 2011, p. 25).

More recently interest and adoption of mobile technologies such as the iPod Touch and iPad have spread to the UK where a growing number of schools have started to consider the benefits of large-scale adoption and personal ownership.[9] Longfield Academy in Kent is one such case, recently evaluated on behalf of NAACE- The ICT Association who have worked closely with the Academy since

9 see for example Essa Academy (http://www.apple.com/uk/education/profiles/essa/)

2009 to implement a personal device strategy (Heinrich, 2012). Although it is only situated in one school, this evaluation features an extensive deployment of over 700 iPad devices across the entire school, based around a leasing scheme. Students are responsible for the device, which they are able to take home and use in most lessons, although the author notes some resentment by older students who did not feel their teachers used the device as effectively or frequently as they might like.

In line with many of the previous studies, and indeed the broader research into m-learning, this evaluation noted the positive impact on student dispositions such as motivation, interest and willingness to work. Teachers have identified learning gains in student work and progress such as presentation which they associate with the use of the iPad. Teachers and students alike find the iPad to be an effective tool which is beginning to generate a number of impacts such as greater collaboration between students and assistance in teacher workload issues. It was clear, however, that some teachers and subject areas have embraced the technology and associated pedagogies more than others, with Mathematics, English and Science appearing to use it significantly more than other subject areas.

Summary

The iPad and other touch sensitive devices like it have only been available for a relatively short period of time and it may be premature and indeed problematic to attempt any definitive claims related to long-term impact on learning at this early stage. However those few studies which have examined the use of these technologies in educational contexts point towards a number of emerging themes and patterns which are likely to apply across a diversity of settings as these technologies are adopted more widely, and these reinforce some of the theoretical research findings which have emerged in this field recently.

Firstly, there is a largely unspoken assumption evident in most of these studies, that technologies like the iPad or the iPod Touch, which were not designed primarily as educational tools, will be transferable into educational contexts and this will be unproblematic. Evidence from the few empirical studies to investigate tablet devices including this one, generally support this assumption as schools, teachers and students apply their creativity and imagination to discover multiple uses and opportunities to appropriate the device into a school context. However, the transfer of these technologies from one context to another is not entirely unproblematic and most of the issues which were reported in the previous studies are related to the fact that these devices have been designed as personal, not shared or corporate technologies:

> *'With its single user logon and personalised choice of applications, the iPad is really designed as a device for the individual user, even if it can be passed around and used in more collaborative settings'* (Melhuish & Falloon, 2010, p. 11).

In a sense, therefore, devices like the iPod Touch and the iPad itself were not designed to support a corporate or networked technology solution which still underpins the technology paradigm evident in most local authorities and schools. Many of the early problems and issues identified by practitioners such as software purchasing (apps), licensing and workflow issues are associated with this mis-match, but in hindsight these may prove to be relatively minor teething issues which solutions such as Configurator and Volume Licensing (in the case of Apple products) have already addressed and

largely resolved. Less easily resolved and more significant are the issues around teaching and learning which underpin a personal, as opposed to a networked, vision of technology.

For example, even over the relatively short timescale of these initial studies it is apparent that teachers, students, and even parents, are beginning to question the traditional dynamics of classroom learning, such as the role and authority of the teacher when students have ubiquitous and instant access to boundless amounts of information, and indeed the relationships which exist between teachers and students as learners and constructors of knowledge:

> *'Another complication is the shift in paradigms for teachers, from the seemingly stable environment of the classroom or lecture hall, to more fluid environments in which the challenge is to create enough stability to allow learning to be guided'* (Sharples, 2007 cited in Melhuish and Falloon, 2010, p. 9).

These issues are fore grounded in studies where students have been granted extended personal access to the device across the school day and beyond. In these cases there is also the growing recognition that learning is no longer bounded by the physical constraints of the classroom or even the school, and the traditional notion of fixed lessons over a fixed time period (i.e. the school day) becomes more fluid when students have access to a learning device on a 24/7 basis.

What may prove to be problematic, therefore, on the basis of the studies reported, is the extent to which teachers and the structures within which they operate are able and are predisposed to accommodate these changes which shift responsibility and agency for learning from the teacher to the student and their personal learning networks. As Melhuis and Falloon acknowledge, *'realizing this potential is premised on the view of the individual as learner*,' and whilst the iPad '*presents some exciting opportunities*' in this respect (2010, p.11), it also raises challenges for teachers, including the need to find the appropriate balance between complete freedom and choice for learners and the need to provide a framework to guide learners.

The ***second*** theme arising from these studies and others like them relates to how teachers move rapidly away from technology focused issues and discussions when they adopt this kind of personal technology, and focus instead on a pedagogical agenda which centres around the most effective ways in which they can harness the technology to support or even transform the learning experiences of their students. These studies, and the m-learning research which pre-dates them point in many directions. They cite enhanced opportunities and resources to build greater creativity into the curriculum enabling students to demonstrate their skills and understanding in multiple fashions, thereby developing a more inclusive and engaging curriculum. They support the case for more cooperative and collaborative forms of learning whereby students are encouraged to work alongside side each other to construct and showcase their work and that of their peers. And they highlight ways in which aspirations for more personalised learning can be turned into reality such as the provision of greater choice about how, where and when students learn, and the facility to use the technology to customise learning to the specific user.

Initial findings from these studies indicate how the adoption of a personal device available to the learner throughout their school lives acts as a catalyst for deeper pedagogical thinking on the part of teachers as they grapple to comprehend some of the fundamental consequences and transformations

which this might support. The technology is not itself directly responsible for these shifts in thinking but the affordances it offers may be, and these are explored in the final point below.

Thirdly and arguably of greatest significance, these studies draw attention to the concept of pedagogical affordances associated with technologies which are highly mobile, personal and always connected. Although few of the studies raise the issue of affordances in an explicit sense many of them give examples where teachers are effectively demonstrating their ability to make informed decisions and choices about how best to combine existing content and pedagogical knowledge (CPK) with emerging technology knowledge (in this case about the iPad) which constitutes TPACK (Mishra & Koehler, 2009).

Melhuish and Falloon (2010) identify five specific affordances or 'benefits' associated with the use of iPads, although it should be noted this is a theoretical think-piece not an empirical piece of research. These are listed below along with a summary of their potential pedagogical benefits or impacts:

Affordance		**Pedagogical potential**
Portability		• Makes technology 'invisible' • Changes where and when learning occurs • Encourages learning in the 3rd Place
Affordable and ubiquitous access		• Makes for greater equity and inclusion • Places web access and other digital tools in the hands of more users than any other digital technology
Situated		• Enables more constructivist learning using authentic contexts • Enables 'just in time' rather than 'just in case' learning • Blurs boundaries between formal and informal learning
Connection and convergence		• Opportunities to 'create, share and connect with others in authentic learning situations' (2010, p. 9)
Individualised and personalised experiences		• Learning can be tailored to individual needs and preferences

Table 2: Pedagogical affordances of iPads (based on Melhuis and Falloon, 2010)

Assisting teachers to explore and better understand the complexities and subtleties of pedagogical affordances when applied to mobile technologies like the iPad is, therefore, emerging as a priority highlighted in many of the studies covered in this review. This study identifies a range of different frameworks and typologies to help educators conceptualise and think about their practice and pedagogy when mobile devices are available to learners (see Section 9: Discussion). One of these frameworks, developed collaboratively between academic staff at the University of Hull and the University of Technology, Sydney, has particular relevance in the context of affordances and this study (see Figure 6). It draws upon over thirty reported case studies and research findings, identifying three key elements which educators should consider when using mobile technologies, particularly when they are available to learners on a personal basis. These are:

- Personalisation.
- Collaboration.
- Authenticity.

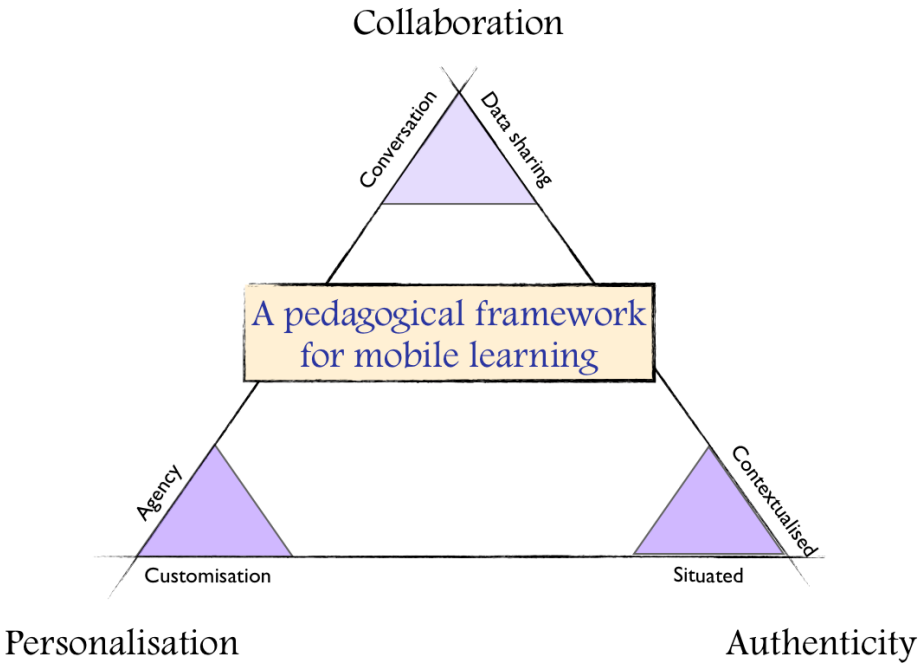

Figure 6: A framework for mobile learning adapted from Kearney, et al, 2012

Space precludes a detailed analysis of how the framework has been developed but it can be used by educators in a variety of different ways including as a planning tool to construct learning opportunities which maximise the pedagogical affordances of mobile devices and as an evaluation tool to measure the extent to which mobile devices have impacted upon pedagogical practices or an institution[10].

Conclusions

For various reasons associated with e-Safety, perceived moral panics and infrastructure difficulties, m-learning has remained on the margins of formal education and schooling, recognised as a defining and indispensable aspect of many young people's life-Worlds outside of school, but seen to be largely incompatible with the dominant cultures and practices inside school (Pachler et al., 2010; Traxler, 2010).

The dramatic emergence and popularity of tablet devices as personal technologies available to students inside school, challenge the previous conservatism and restraint of many schools and it may not be coincidental that the debate around Bring Your Own Device (BYOD) has come to prominence again as schools and local authorities assess how they will be able to finance and support a vision of personal ownership which is spreading rapidly.

10 see Appendix C for further details of the framework

Tablet devices like the iPad are not entirely mobile technologies in the sense that the mobile phone can be secreted about one's person and it should not be automatically assumed that all the affordances and benefits identified in the m-learning literatures will necessarily transfer immediately, or unhindered to a larger device intended for similar, but not identical purposes. However even in the short period since the emergence of tablet devices there has been a noticeable shift from using them to perform the same tasks previously undertaken though desktop computers or laptops, with teachers and students identifying myriad opportunities to exploit learning in different contexts, through collaboration, mobility, construction and learning in informal spaces. This would appear to be the emerging challenge facing teachers who are wishing to deploy tablet and touch sensitive devices like the iPad, as they seek a sound pedagogical rationale which justifies the purchase of these technologies along grounds which do not simply replicate or repeat what can already be achieved through existing fixed solutions:

> *'While there are many exemplars of prosaic uses of mobile devices for communication, few examples currently exist of how they might be used as cognitive tools (Jonassen & Reeves, 1996) to solve complex problems and to engage students in authentic and meaningful tasks'* (Herrington, Mantei, Herrington, Olney, & Ferry, 2008).

7. School vignettes

Eight schools across Scotland participated in this pilot of iPad tablet devices for learning and teaching. Each school was different and therefore it is important to consider the contextual factors which shaped the use and impact of these devices in each school before drawing more generalised conclusions about the pilot as a whole. This section of the report uses short vignettes based on the interviews with teachers and students and the observations undertaken to give the reader a sense of context about the specific issues emerging from each school.

7.1 Bellshill Academy, North Lanarkshire

Bellshill Academy is a non denominational 11-18 school, serving the communities of Mossend and Bellshill. The students come from a wide range of social and economic backgrounds however a high proportion of youngsters experience the challenges of long-term generational unemployment and social deprivation (e.g. a large number of students are entitled to free school meals). During the course of the pilot the school was inspected by HMI who reported positively about the impact of iPad technologies in the school.

The iPad pilot was located in S1 (11-12 year olds) where all students (98) were provided with an iPad as a personal device for use in school and at home. An additional class set of 30 iPads was also available for other teachers to book on demand. The equipment for the pilot was purchased by North Lanarkshire council and was managed by staff from the Learning Centre based in the Academy. Bellshill was the largest secondary school to take part in the pilot. The Academy identified a lead teacher to co-ordinate the initiative and formed a staff committee of ICT champions to share experiences across subject disciplines.

The Headteacher saw the iPad pilot as an ideal opportunity to lever curriculum change at a time when the school was undertaking a fundamental review of teaching and learning strategies. Effective use of technology as a tool for learning was identified as a key priority for the Academy and staff were encouraged to use the iPad to assist in modifying their pedagogical approaches in line with the Curriculum for Excellence initiative:

> *"So the iPad enables this facilitation of learning, so that in line with the new curriculum the teacher can be the facilitator, if you like; so the iPad is absolutely perfect to ensure that this more flexible and dynamic approach to learning is not only possible but practicable."*
>
> Headteacher, Bellshill Academy

Despite the short duration of the initiative the Headteacher and all of the staff involved are already convinced the adoption of a personal 1:1 device for students is highly advantageous and worth

continuing beyond the pilot phase. The benefits that have been identified during the pilot are many, and include:

- 'Just in time' rather than 'just in case' access to technology;
- Opportunities for more seamless interdisciplinary learning;
- Greater personalisation and individualisation of learning with attendant benefits in motivation, interest and behaviour.

Personal ownership of the device by students is perceived to be the key factor in the success of the iPad initiative at Bellshill Academy. Access to technology is immediate and ubiquitous through the iPad resulting in savings in teaching time whilst making learners more autonomous and responsible for their own learning:

> *"…within modern languages, it meant there was lots of things you could do, which you couldn't do before which were not practical, due to constraints with timetable in the computer rooms and all the rest of it."*
>
> Lead Teacher, Bellshill Academy

This has encouraged, *'teachers who, in the past, would not even have considered taking their class out of their room …'* to use technology in an authentic and appropriate manner just when it is appropriate.

Less obvious, but arguably as important, the ownership of a personal device like the iPad encourages learners to take more responsibility for their own learning and helps to break down some of the subject silo boundaries which traditionally exist between departments in a secondary school. Students take responsibility for storing and curating their own work using the iPad as a virtual backpack, rather than in books which are guarded by teachers. As they move between subjects and different locations within the school, the iPad remains with them enabling them to store and re-use work in different contexts. It makes the task of re-using existing content much easier for students and promises to breach some of the artificiality that traditionally exists between subject disciplines:

> *"Staff directly involved in the initiative consider it has fostered greater personalisation of learning by offering students a greater degree of choice and freedom in how they access information (e.g. through apps or the Internet), how they process information and how they present and offer it up for assessment.*"
>
> Headteacher, Bellshill Academy

Many parents who were surveyed both during the initiative and again at the end supported these views and benefits. The results showed that 100 per cent of parents expected the use of the iPad would help their children with learning. Over 75 per cent thought their children were more willing to do their homework with the iPad and a sizeable group (37.7 per cent) noticed their children were more willing to talk with them about their schoolwork since the introduction of the pilot.[11]

11 These figures were supplied from Bellshill Academy who conducted their own parental survey

Finally the issue of staff development and support is one that the Academy considers to have been crucial in the early success of the initiative. Staff who were teaching S1 students were all provided with their own iPad which they personalised like the students. This was a difficult decision for the school with so many teachers involved (32) but they are adamant it was essential and is largely responsible for the significant extent of 'buy in' from teachers and the low level of resistance, which had not been anticipated.

Bellshill Academy is determined to maintain maximum benefit and awaits the outcome of the pilot evaluation since there have been so many demonstrable gains associated with learning, behaviour and parental engagement. Despite some of the technical issues and problems which staff at the Academy faced and resolved the Headteacher has identified the approaches which were pioneered in the pilot as the way forward for the school and community of learners and is determined to pursue this ambition in the coming years.

7.2 Kilsyth Primary School, North Lanarkshire

Kilsyth is a small to medium sized primary school comprising of seven classes (177 students) serving the community in the south side of Kilsyth town in North Lanarkshire. The pilot was located in a single P7 class consisting of 24 students, mostly boys. The school had been identified by North Lanarkshire council as suitable to participate in the pilot and they provided the equipment which were all first generation iPad devices, lacking a camera feature.

The Headteacher reported how the invitation to participation matched her aspirations to use technology more pervasively across the school although she did not consider herself as a technology expert. At the time of the visit (May 2012) students had used the iPads for approximately five months and were allowed to take them home. The Headteacher was convinced by the early outcomes of the pilot that mobile devices of this nature were the way forward with technology and had already decided she was unlikely to replace the existing ICT room when funds were available since there had been a measurable decline in the usage of this space. By contrast the iPads were used every day, in most lessons, and students gained from taking them home where they could continue work started in class.

The Headteacher also noted how popular the device had been with parents who had reported using the device themselves. Teachers in the school had received no formal training to use the iPad and had not called upon the support offered during the pilot from Connected Flow, although they commented on how supportive their local authority advisor had been throughout the process.

The class teacher leading the pilot in P7 described herself as a confident user of technology and had previous experience using iOS devices which she considered important but not essential. She pointed out how the students, like the staff, had received no formal training at the start of the pilot although this had not caused any issues since the device was so intuitive and simple to learn. Indeed one of the most important and prevalent models of learning was self-directed whereby students taught each other and the class teacher, where appropriate. Her main aspiration was to gain greater and more

natural access to the Internet as a research tool and she considers the use of a personal iPad in this way has achieved this, compared to the previous approach which involved booking the ICT suite, even when it was not needed for the entire lesson or full class.

In terms of impact the class teacher considered the device was extremely versatile supporting both the less able, who needed to undertake less reading to achieve success, and the more able who were stretched further by the various creativity applications on the device. She has recognised how students are becoming more autonomous in their learning and more independent in their research, rather than relying upon her for knowledge inputs and answers. This is a deliberate action on the part of the teacher who has modified her pedagogical practices accordingly to encourage more independence and less teacher talk. Additionally the use of iPads appears to engage students who are more focused and on task:

> *"They're more aware, really, of what they're hoping to achieve, about what the learning intentions are when they're actually in the zone using these iPads, and they want to give you the best that they can, and you can see that they're actually… Their minds aren't wandering anywhere else – they're in there, they're totally engrossed."*
>
> Class Teacher, Kilsyth Primary

The device was used widely in almost every lesson with apps like 'Toontastic' (used to make a script for the Olympic torch when it visited nearby Cumbernauld), 'Puppet Pals', 'Pages', 'Keynote' and 'GarageBand' proving most popular with students and the teacher alike. In the case of 'GarageBand' the teacher noted how this single app had broadened access to music in the classroom which was previously inaccessible:

> *"GarageBand – it just gives them a way of connecting with different instruments, … which you wouldn't have access to at all, and it's broadening their mind on music, really. Before, they would be listening to music and drumming along on their table or whatever, but, now, they're actually composing music and enjoying it."*
>
> Class Teacher, Kilsyth Primary

Dropbox was used to transfer work from students' iPads to the teacher's laptop where each child had their own folder and password. Due to the limited functionality of the 1st generation iPad it was not possible to stream students' work onto the screen at the front of the classroom although this was an aspiration and it was noted by both the teacher and students how the use of the interactive whiteboard had diminished with the introduction of the iPads.

The school places considerable trust upon individual students to be responsible users and they are allowed to install their own apps and access sites, such as YouTube which are often filtered in other schools. The teacher adopts a 'hands off' approach to regulation and control although she observes what apps are downloaded and students are made aware she may check their Internet history, a technique used in many of the other pilot schools. Research and the Internet were identified as being amongst the most important uses of the device changing the dynamics and nature of classroom teaching and learning.

In contrast to some schools who reported games to be a distraction, Kilsyth allows students to use games such as 'MineCraft' where they can see an educational potential. During the evaluation visit the use of 'MineCraft' was very evident with students working to complete a variety of learning objects associated with project topics such as the Titanic. It was noticeable also how much overt collaboration and cooperation was involved in these activities as students coached and taught each other without the formal intervention of the class teacher.

7.3 Chryston Primary School, North Lanarkshire

Chryston is situated in the mid socio-economic range with a spread of parental incomes and occupations. Geographically it is in the mid-belt of Scotland with parents who were very supportive of the project. The class chosen (P5 – ages 8 to 9) is a small group of 19 students each with their own device and a teacher who is experienced with ICT but new to using iOS devices. The students have had the devices since early in the year (2012) and have been allowed to take them home from "day 1". The devices are 1st generation iPads and so do not have cameras or the ability to easily interconnect wirelessly with the teacher.

Students are using the iPads with huge enthusiasm and delight and are very keen to use the devices whenever possible. Parents are very supportive with several having bought, and others keen to buy, devices and send them with the children to school when the trial finished at the end of the current academic year, if it is not continued.

Simple but effective classroom management means that the teacher monitors the devices whilst giving the students freedom to use them in their work. This balance of independent and directed learning builds on the way the teacher prefers to teach and the students like to learn. The device is used mostly for research and creating materials. The teacher has worked hard on developing the students' research skills and sees this as a bonus to the work with the devices. As access to knowledge is very easy and comprehensive it is the higher order skills of analysis, provenance and relevance of knowledge that is deemed to be important for students to develop and the iPad is seen as a means of achieving this.

Students use the iPad with familiarity and ease and have personalised their devices in various ways making the backgrounds their own. They use apps such as 'Brushes', 'Keynote', 'Notes', 'Screen Chomp' and the Internet access and have been allowed to download their own apps and games onto the device. They use specialist apps such as a spelling test app, which allows them to record themselves saying the spelling words allowing them to put correct spellings. The teacher reports this has improved their spelling. The students use Maths apps to develop their mental arithmetic seeing this as a game rather than 'work' – the iPad seems to have turned lots of learning into games. This has not diminished over the first months of the use of the device.

One key example of change of practice has been the use of 'Screen Chomp'. This has allowed the teacher to upload a resource onto the device for the students to complete in their own time, possibly

at home, and record their thoughts or problems while they are completing the piece of work. This has meant that the teacher when marking and assessing this work can be much more informed, allowing her to target follow up work for the student. The use of feedback apps like this (see also 'Explain Everything') was observed in a number of schools across the pilot and their popularity with teachers, students and parents, suggests this is an important avenue for future exploration in line with Assessment for Learning and peer assessment identified within the Curriculum for Excellence framework (see section 9 for further details).

Both the teacher and the students are very keen to have access to devices after the end of this trial – there is no doubt in the minds of either that this has changed learning for the better.

7.4 Gavinburn Primary School, West Dunbartonshire

Gavinburn Primary school is situated in one of the more economically challenged Scottish boroughs but in the words of the Headteacher, it sits within a "*privileged pocket*" with very supportive parents who are excited about the iPad pilot. The class chosen for the pilot was a P5/6 group (ages 8 to 10) taught by a relatively new teacher who has worked at the school for four years. The device is the iPad 2 and students have had access to it in school since March 2012. Students have occasionally taken the device home but it is currently used mainly as a personal device within school. The device is kept safe when students are not using it in an iPad safe:

> *"The class are using the iPads with great enthusiasm and to great effect. The school already has a strong ethos and tradition of both creativity and collaboration and the iPad is being used with both these 'C's' in mind, providing greater opportunities for a third 'C' – Communication."*
>
> Headteacher, Gavinburn Primary

The Headteacher has been a keen advocate of mobile and creative technologies for some time and has also been promoting and developing the school as a cooperative learning environment in which the use of a tablet device has considerable value. The students have already been involved in some very creative work developing songs for the "Euro-Gavinburns", making music to celebrate the Olympics with the support of an external language specialist and creating inspiring artwork. The art apps are one of the students' favourite and they have made considerable use of 'iMovie' on the device which enables them to film and edit movies as adverts encouraging tourists to come to Scotland.

The teacher and Headteacher alike concur that the device has allowed students to create outstanding work. Although it has not made students more creative *per se* it has put into their hands a tool which enables them to express their creativity more productively and more effectively. These students are all natural story tellers and the iPad has given them a tool to express this in a variety of ways along with a teacher who is happy to let them choose the media in which to demonstrate their abilities, be this text, graphic or moving images.

The students have required little or no formal tuition in using the device and have learned through a combination of enthusiasm, peer assistance and teacher help when needed. They are willing to experiment and learn from their mistakes and the teacher creates a climate where this is encouraged. This has meant that a real learning community has developed with students and staff teaching each other and effectively blurring the boundaries of who is who.

Perhaps the most striking change to a 'normal' classroom is the way the teacher is using Apple TV and the sharing function of the iPad2 to allow students to "show and tell" the work that they are carrying out on their Pad. This can be done at the touch of a button and sound, text and images can be relayed via the plasma screen to the rest of the class allowing for demonstration, peer assessment, group critique and community input for development, creating a real community of practice in the classroom.

The Headteacher is determined that students should continue to have access to these kinds of devices as she is certain that this is improving the teaching and learning at her school – for her this journey has only just begun.

7.5 Greenwood Academy, North Ayrshire

Greenwood Academy is an integrated community secondary school located in North Ayrshire. There are 54 iPads distributed between two groups of second-year (S2) mixed ability English classes, although students are free to take the iPads to all of their other classes. The students have had the devices (iPad2s) since May and are able to use them both in school and at home.

Teachers, who received the devices in December (2011), were open-minded about the integration of iPads and were eager to see how the device could impact upon their English subject area and improve their integration of technology skills. Early observations by teachers indicate that the iPad's flexibility and ease of use have enabled students to explore ideas collaboratively and draft, revise and edit with ease, which has improved students' writing confidence. This sense of personal student empowerment is extended by teachers' willingness to learn the finer points of technology use from the students, and one teacher states that, *"anything I was stuck with the children could usually show me what to do."* The impact therefore seems to extend beyond the academic to include a developing sense of partnership between student and teacher. Teachers had explored a variety of apps to support their own teaching and administration including one ('Daily Notes') which replaced their traditional planner, demonstrating how ubiquitous technology can yield immediate benefits in terms of efficiency and administration:

"I actually quite like that because it allows me to go in and it's colour coded and it lets me see what I've got already planned in for that class and I can very quickly go back and you're not going through lots and lots of pages for lots of different classes, it's all within that one."

English Teacher, Greenwood Academy

The cooperative nature of classroom activity with the iPads is seen across both English classes. Students in one creative writing lesson which was observed by the researcher worked in groups to explore and describe scenes taken from the app 'Epic Citadel'. Individually, students chose and wrote a description of a scene. Cooperatively, students read their description to group members, whose job it was to locate the scene described. Students were eager to help each other find the location and give feedback on strengths and weaknesses of each description. The teacher was able to move from group to group and conference with individuals on their particular writing needs, hence personalising the learning experience by spending longer with individual students than whole-class teaching.

In another English class, the student groups were challenged to create a presentation on any aspect of grammar. They had twenty minutes to complete this task. Student groups quickly brainstormed a list of possible topics, discussed appropriate apps and divided the work between themselves. Students consulted both books and the teacher for accuracy. Individual work was sent to one iPad where it was compiled into the final presentation. Presentations were delivered via one student's iPad and the teacher's presentation devices. The high levels of concentration, creativity and agency through such active engagement were remarkable. Here too, the teacher set the activity's parameters, but allowed students to make critical decisions on content, applications, and final presentation. Again, the teacher was free to move from group to group providing support as needed. No student appeared to be off task or idle.

These examples are snapshots of the eagerness of staff, supported by the Headteacher, to use iPads in ways that encourage creative thinking, active learning, cooperation, partnership, and problem solving within the context of English teaching.

7.6 St. Kentigern's Academy, West Lothian

St Kentigern's is a state funded secondary school located in Blackburn West Lothian. There are 28 iPads used for one group of first year (S1) students in a top set Mathematics class shared between two teachers. Both teachers also received a personal iPad at the start of the initiative and like many of the teachers involved in the pilot, most of their own learning was undertaken experientially through play, often outside of school, rather than formal training events:

"I use mine all the time for personal stuff for surfing the net, for readings books, I've got the free book one."

Mathematics Teacher, St Kentigern's Academy

The students have had the devices (iPad2s) since April and are able to use them both in school and at home. However, there are difficulties associated with the subject based model adopted in this case since the same students do not stay together as a group in other subjects and therefore other teachers may, or may not allow them to use the iPad outside of Mathematics lessons. Additionally the lead teachers explained how there is less incentive to develop resources and materials for the iPad (e.g. eBooks using iBooks Author) when it is limited to a small group of teachers and is not perceived to be either a sustainable, or whole school approach.

Teachers were willing to explore the iPad and were especially eager to see how it could help in the creation of curriculum materials for Mathematics, bringing resources available on the network into the classroom. They were disappointed, however, to discover the iPad does not support Flash based materials since the Maths department has invested in many Flash based Mathematics resources. This was seen as a significant issue for these teachers at a time before many Flash based developers had converted their existing materials to operate in an iPad app friendly manner.

The major benefit identified by Mathematic teachers in this subject based pilot was immediate access to the Internet and to Internet based resources, rather than apps:

"We're doing real life examples in speed, distance, time and it's been beautiful, it's beautiful for that. I immediately got online I immediately get, 'Oh well tell me how fast can the fastest runner run, Oh we'll just Google it."

Mathematics Teacher, St. Kentigern's Academy

Having immediate access to the Internet through the iPad was seen by the teachers to change the dynamics of the classroom since students had instant access to information and answers, empowering them to make decisions for themselves:

" … browsing's great and just to answer a simple question like, "Who Pythagoras was?" "I don't know you tell me". And just stuff like that just to make it more realistic I think that has been fantastic, it's been great just to have it to do that. And for us that's a big step forward because we didn't have that before, we didn't have the chance of going to computers, you know the computers are always booked solid and we don't have access to computers in maths."

Mathematics Teacher, St. Kentigern's Academy

Students and teachers also reported significant changes in the way learning was structured using the iPad. This revolved around the ubiquitous access to technology which these students enjoyed, including the opportunity to continue their work beyond the classroom:

"They love taking them home they are so much more motivated to get through their work, maybe because at the end you say, 'Well if you're finished go and get your iPads then'"

Mathematics Teacher, St. Kentigern's Academy

Like many of the schools in the pilot, teachers at St Kentigern's also detected a significant level of behavioural improvement with students more focused on their work, and consequently less disruptive or off-task. Persistence and resilience are commented upon many times by these teachers, and students themselves, who recognise how the device is impacting on their learning dispositions in a positive manner:

> *"It's really nice…they've just been calm, interested in the lesson, listening to what's been said and before I would say, "Right let's have a go at this and let's see what you …", "I can't see it", "Well what bit can't you do?", "I can't do it at all". Whereas now they'll go and they'll go, and they'll have a go…"*
>
> Mathematics Teacher, St. Kentigern's Academy

This pioneering spirit is also evident in the students who often discovered ways to use the iPad that teachers had not considered. Not enough books? Not a problem. One student explained that a shortage of books for a homework assignment led to him taking a picture of the Mathematics problems with the camera tool on the iPad!

Students at St Kentigern's used the iPads to access Google maps, calculators and 'Notes' to create authentic time/distance word problems for a partner to solve. The students were focused and on task for the duration of the activity. In an interview with students prior to this lesson one student said, "*I think the iPads have sort of had a change in the behaviour of the class*." Another student shared, "*It's always dead quiet in our class isn't it?"* The active engagement that the iPad offered seems to engage both students and teachers.

7.7 Sciennes Primary School, City of Edinburgh Council

Sciennes is a large and popular primary school (640 students) on the edge of Edinburgh city centre, serving a cosmopolitan catchment and population with a significant range of nationalities and bi-lingual speakers (approximately 20 per cent). The school - a traditional late nineteenth century building - has embraced City of Edinburgh Council's current initiatives in developing a technology infrastructure supporting a vision of personalised learning through ubiquitous access to technology. The iPad pilot is one of many pilots undertaken at Sciennes, all driven by a clear pedagogical focus and purpose led through the Headteacher and her senior management team.

The school had already decided to explore the potential of technologies, including tablet devices, before it was nominated to join the iPad pilot, and purchased a set of iPad devices for use in P6 starting in September 2011. The positive results of this trial were shared with staff across the school and two teachers were nominated to lead the iPad pilot when it was announced in Spring 2012. Initially the plan had been to implement the pilot across P6 but this was altered to include a younger class (P5) enabling an evaluation across a wider age range. 62 iPads (2nd generation) were allocated to students on an entirely personal basis, enabling them to take the device home. In this case the devices were purchased both by the school and Edinburgh City Council which match funded the initiative.

The implementation of iPad devices on this scale was carefully managed and monitored by the Deputy Headteacher who was given overall responsibility for implementing the initiative. Parents were consulted on several occasions before the launch of the pilot and were invited into the school during and at the end to stay informed of progress. They were also given access to various virtual spaces (e.g. a wiki and a GoogleDoc) to communicate with the school and to share ideas between themselves, although these mechanisms were rarely used. All parents were required to sign and agree to the terms of an Acceptable Use Agreement, which was based on examples shared by Bellshill Academy and Cedar Schools (see Appendix B). Preparing parents before the pilot began and keeping them abreast of developments during the pilots itself, were identified as essential prerequisites by the school and it is evident that some parents needed to be persuaded that personal technology adoption would not impede the progress of their children in what they considered to already be a highly successful school. These measures appear to have been largely successful in this respect. Some parents remained concerned about a few aspects of the initiative but the careful management of parent expectations by teachers and the senior management team contributed to an overwhelmingly positive parental attitude.

As with many other schools in this pilot the initialisation of the device and its subsequent allocation to students was time consuming and resource intense, involving the senior team, the lead teachers, parents themselves and outside support and effort such as XMA Ltd. who provided technical advice and assistance. In the early stages of the pilot issues associated with the transfer of work to, and especially from the device, frustrated the lead teachers who invested considerable amounts of their own time in identifying a work-flow to enable them to share and assess work completed by students on the device. Most of this was achieved via e-mail in the early stages although the school has recently identified a number of proprietary solutions which appear to have made this much less cumbersome and time consuming. At the time of writing this report new arrangements for volume licensing and management of iOS devices have appeared in the UK and these promise to streamline many of the issues which teachers at Sciennes and other schools in the pilot experienced.

From a pedagogical perspective the success of the iPad pilot in Sciennes is widely acknowledged by senior management, teachers, students and their parents, and the school has rapidly established itself as a beacon of good practice in this emerging field of personalised digital learning[12]. The benefits associated with personalisation are particularly evident in the data collected from teachers, students and their parents who frequently referred to the greater element of choice and personal freedom available when the iPad is available for learning:

12 http://www.holyrood.com/2012/05/ipad-pilot-sciennes-primary-michael-russell-education-scotland/

> *"This task* [making a film with 'iMove' interviewing Bonnie Prince Charlie] *allowed for a lot of choice in how they presented their arguments and built upon a paper and pencil task where they outlined possible arguments. It made the task more memorable and fun. The children were able to make choices about the characters in their drama; how they would present the arguments e.g. on a news show, straight to camera; about how to introduce the piece and how to finish."*
>
> Class Teacher, Sciennes Primary

The immediate availability of different multimedia apps and media tools through the iPad, such as a camera and recorder, enable teachers to vary the range of tasks and activities they ask students to select and in Sciennes school this has resulted in far greater student choice in how, where and when they complete a piece of work. This element of personal agency and choice is seen as a major factor in explaining the increased levels of behaviour, attention, motivation, interest and engagement which teachers and parents have noticed over the course of the pilot:

> *"...sometimes in the classroom it's almost like there's a negative noise, so like there's no noise at all, it's like it's been sucked out of the room with the concentration they're thinking about what they're doing."*
>
> Class Teacher, Sciennes Primary

When students have direct access to a personal device and screen like this teachers become aware there is less need to focus every children on the interactive whiteboard to view a resource or object. This can alter the dynamics of the classroom, shifting the locus of control from the teacher to the students enabling greater individualisation:

> *"The children loved having their own copy of everything in front of them and under their control, rather than looking at the Promethean board. Several of them zoomed in on the text. They enjoyed playing with the view they had of it."*
>
> Class Teacher, Sciennes Primary

In addition to these benefits associated directly with personalised access to resources and learning materials, one of the teachers at Sciennes has pioneered the use of a wiki space which is used extensively as a virtual noticeboard for students and a collaborative place where they can work together or share resources, both in school and from home. This is only practical when students have direct access to the Internet in class which is possible when each student has their own personal learning device such as this. Using a wiki in this way has significant benefits for learners but it also saves time and resources for teachers who no longer need to duplicate worksheets or resources for each student:

> *"I'm enjoying never having to photocopy extra sheets for when children have lost theirs and not having to get everyone to write down details of each week's reading - everything is easily available (at school or at home) on the wikispace."*
>
> Class Teacher, Sciennes Primary

In a logistical sense the school is well placed to evaluate the different ownership models for iPads since they have deployed both class sets and personal devices. Teachers and students are unanimous in support of the latter model which they see as both pedagogically and logistical beneficial. The logistical benefits are considerable because they transfer many of the problems or issues which teachers previously handled, to the students themselves, encouraging them to be more independent and responsible for their own learning:

> *"One of the things that I realised this week was just how much easier and less stressful having one to one devices that the children have personal ownership of is, than having a set that stay in school. Some of the things that used to cause us problems such as charging (which used to be difficult to manage), storing personal work (the iPads were often borrowed and it was really difficult to manage getting back the same one to finish off work on), expectations of people who wanted to borrow could sometimes become quite disruptive ... and having to finish things in class time - have gone."*
>
> Class Teacher, Sciennes Primary

Teachers involved directly in the pilot have developed a wide range of strategies and expertise associated with their pedagogical practices when using the iPad, and these have tended to evolve informally rather than through any formalised training and input. Teachers see themselves as learners and co-learners working closely alongside their students with whom they share ideas and expertise:

> *"We now know more about what particular apps can and can't do because the children have time to play with them at home. Learning then becomes even more of a partnership because they are teaching each other and me."*
>
> Class Teacher, Log, Sciennes Primary

Pairing teachers together as Sciennes did was a significant decision in supporting how the device was understood from the perspective of what works and in what circumstances. Teachers regularly plan together when the iPad is used and there is a strong culture and ethos of sharing and collegiality pervading the school. These factors help to explain the early success of the initiative and why it has embedded itself so rapidly in the structures of the curriculum and school. The school plans to expand the initiative to other year groups where there is an appetite for the kind of student centred, problem-solving pedagogies which have been promoted and developed through the initial pilot phase.

7.8 Kingswell Primary School, Aberdeen City Council

Kingswell Primary is a dormitory school located on the outskirts of Aberdeen serving the oil community. The school and its community had recently developed a vision for personalised learning where every child from P1-P7 had access to a personal learning device, but this was temporarily stalled when the issue became headline news in the local media following exploratory discussions about a leasing scheme with parents. The school saw the current pilot as an opportunity to rekindle their original aspirations to move towards personalised learning through technology and have been involved since the launch in March 2012.

Due to infrastructure problems associated with the corporate network, the school was delayed from connecting the iPads to the wireless Internet and depended instead on parent volunteers taking batches of devices home to run the initial installation. Therefore students only started using the devices in early May 2012 and the initiative was still in the initial stages of deployment when the research team visited the school at this time. The lack of Internet access was identified as a major barrier to transferring work between devices and work-flow issues were identified as a difficulty although it was expected this would be resolved with access to the full Wi-Fi network. The senior teacher responsible for the initiative also indicated how many primary schools, like her own, lack dedicated technical support and therefore face more serious challenges in implementing a personal device strategy compared to their colleagues in secondary schools although other schools in the pilot contest this point.

Despite these initial frustrations there was considerable enthusiasm amongst teachers for the initiative, and initial reactions to the iPad device were extremely positive, particularly its simple interface which teachers and students alike found highly accessible and intuitive:

> *"Everything that we've done so far I've been really impressed with, the ease of the children being able to use it and just how satisfying and how motivating it is for them to see their work."*
>
> Class Teacher, Kingswell Primary

The pilot was focused around the work of two teachers undertaking a job share with one class consisting of 25 students in P3/4. One of the teachers was the school ICT coordinator and the other described herself as reasonably competent and confident, though not a technical expert. The iPads had not been allocated on a 1:1 personal basis at the start of the initiative although it was anticipated this would eventually happen enabling students to take them home. Instead the school has opted for

a more traditional deployment pattern whereby the devices are located as a class set, held in school, though available on a preferential basis to the P3/4 class identified for the pilot. In this sense the initial impression was similar to a class laptop deployment with student monitors assuming responsibility to collect and hand out devices at the start and end of lessons.

Both teachers involved in the pilot were very positive about their initial impressions of the iPad as a classroom technology, reporting how its use had inspired students to be more creative and reflective in their work, citing the use of a variety of apps such as 'iMove' and 'iBooks' to create a movie trailer and e-book linked to a novel the class were studying. Other applications such as 'Keynote', for presentations, 'BookCreator' and 'Puppet Pals' were also very popular with students although the lack of Wi-Fi connectivity limited some of the functionality of these apps and the device itself, which was frustrating. The ability to capture moving images on the device was considered particularly significant by the teachers who had already identified learning gains in this respect as students used it as a tool to capture examples of their own learning (e.g. a group-work exercise). During the research visit itself students were observed using the camera function to record mini-reflective episodes where they interviewed each other about their own work or used it to keep a video log of their experiences with the device. The teachers were actually surprised by the maturity of students undertaking this meta-cognitive task and considered it to be especially beneficial for reluctant writers who appeared more prepared to talk into the device than normal.

Like many of the schools in this pilot, the teachers also commented on the noticeable improvement in motivation and engagement and sensed students were more focused on their work when it involved the use of the iPad:

> *"That was one thing I was really impressed by – how focused they were on their work – recording little sounds to go into, taking photos of their friends."*
>
> Class Teacher, Kingswell Primary

Both teachers felt the initiative had already impacted on their pedagogical practices, though in different ways. One of the teachers was aware that the use of the device altered the classroom dynamics and her classroom management strategies. She sensed she was able to address the needs of students on a more personalised level, working more with groups and teaching rather less from the front of the class or from the interactive whiteboard. The other teacher also considered she had become more of the 'guide on the side rather than sage on the stage' but she noted how the device enabled her to give students more choice about how they undertook a piece of work which is in line with the drives and focus of the Curriculum for Excellence initiative.

Pupil behaviours were also changing as the device supports them in working more collaboratively on creative projects. It appears to give students more confidence to talk about and share their own work which teachers associate with the higher level of presentation:

> *"They have that little bit extra confidence because it is presented so well."*
>
> Class Teacher, Kingswell Primary

Other than the issues associated with the wireless network, printing was the only other serious concern mentioned. One of the teachers was concerned she could not print out student work directly

from their iPads and whilst the other teacher had similar reservations initially, she was beginning to re-conceptualise if printing was necessary when students were able to store their work electronically and make that available to her as a record of their achievements. This foregrounds a more significant issue which is digital curation and how teachers select and maintain examples of student work when it is digital in nature.

Other than this there were no other problems associated with the device or the pilot itself and teachers were looking forward to gaining full access to the Internet in order to explore the more collaborative opportunities for learning, such as the Apple TV, offered through the device.

8.Research findings

8.1 Teaching, learning and pedagogic understanding

Continuous access to ubiquitous technology

The introduction of the iPad as a personal device in seven out of the eight pilot schools in this study, dramatically transformed the access and use of technology experienced by students both in lessons and outside of school. The student exit survey showed that 99 per cent of students who responded (257) had access to their iPad on a personal basis and were able to take it with them to every lesson. 81 per cent of those who completed the survey (201) were also able to take the device home where they could continue using it for both academic and social purposes (see Figure 7 below).

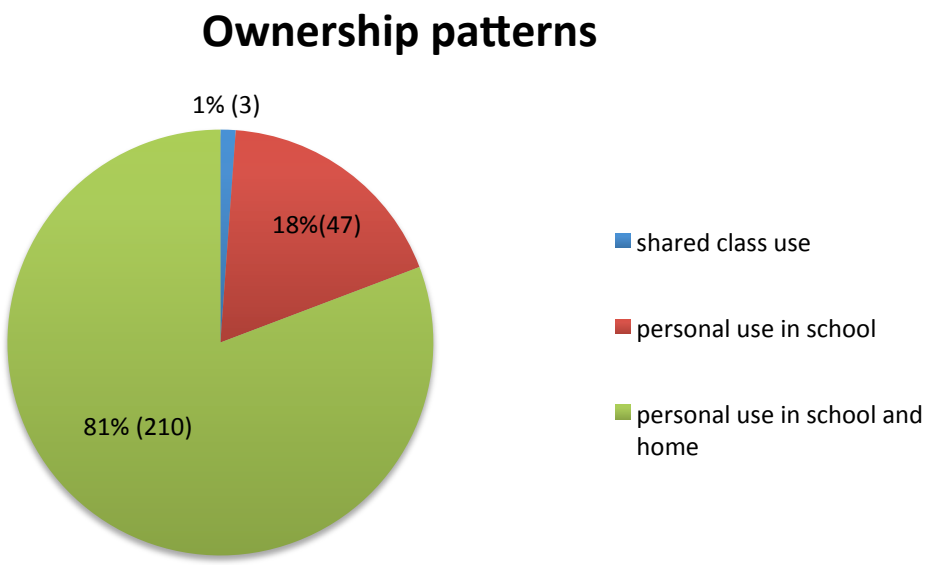

Figure 7: Ownership patterns of iPads

Potential access to technology in school therefore rose dramatically with the introduction of the iPad initiative but more significantly, so did daily or regular use of technology in classrooms, which is arguably a better indicator of how far technology has been embedded in the daily learning routines and experiences of students. This is shown in Figure 8 below:

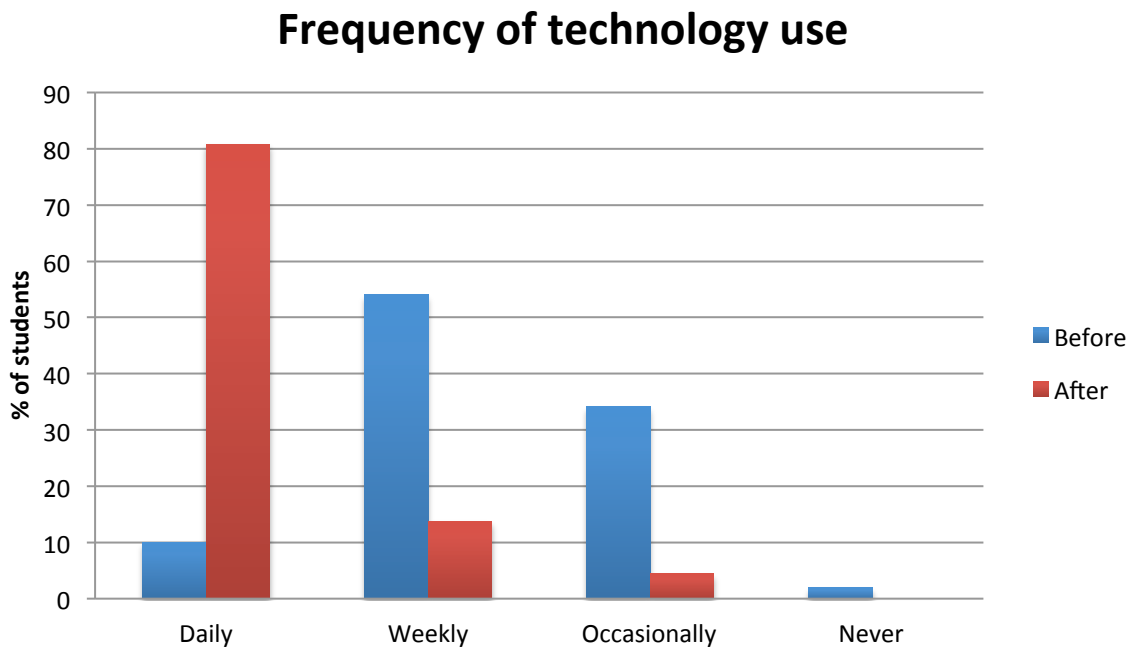

Figure 8: Frequency of use of technology in the classroom

Whilst all of the schools involved in the pilot initiative had good quantities and reasonable access to technology at the start of the initiative, students only reported using this technology occasionally before the initiative(see Figure 8), presumably because it was not located in the classroom where it could be used when it was required. Only 10 per cent of students reported using technology on a regular basis in their classroom before the iPads were introduced whereas 80 per cent reported using it afterwards. It is clear this shift is linked directly to the allocation of the iPad itself largely on a personal basis ensuring the device is on hand, in the classroom, whenever students need to access technology. This is a 'just in time' model of technology use rather than 'just in case' where technology is made available but in a remote location from the learning itself.

It was beyond the scope of this study to measure the precise amounts of time different technologies are used in each school but these figures suggest the investment in portable and personal devices is repaid, at least in terms of actual usage, compared to fixed technologies and suites of computers where technology can remain unused for significant portions of the school day. Surveys undertaken by the IT support staff in Bellshill Academy suggest there has been a significant shift in patterns of technology usage in classes where students have access to the iPad and they are now investigating the cost benefits of fixed technology deployments compared to mobile.

Leading on from this finding the research team also sought to identify how frequently, and for what purpose, technology was used on a daily basis, in lessons. The frequency results are shown in Figure 9.

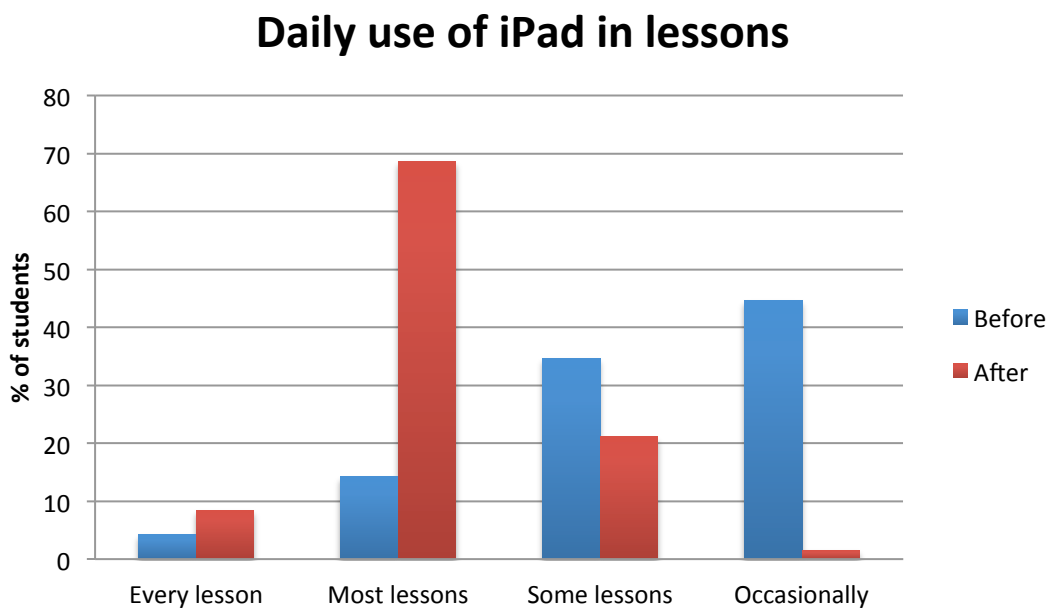

Figure 9: Daily pattern of iPads used in school

Although students do not yet appear to use technology in every lesson, even when they have access to a personal device like the iPad, they are used twice as much in every lesson as technology was used previously. Most students in the survey (almost 69 per cent) now use technology in most lessons compared to only 14 per cent before the initiative started. It is also noticeable in this graph how infrequently students used technology on a daily basis before the introduction of the iPad, with the largest single grouping (44.6 per cent) claiming to use it only occasionally. Taken together the data in this graph illustrates a significant increase in the amount of time students have direct access to technology in their lessons. This removes the need for classes to relocate to another venue when technology is required and this is considered to be closely associated with many of the learning benefits and efficiency savings identified by teachers in the rest of this report.

These results suggest students use the device as part of a wider ecology of learning resources, integrating the iPad with existing tools such as their jotter. What has changed may not be the actual amount of time students spend using the device (a statistic beyond the scope of this study) but the fact that technology is omnipresent, ready for students to use when and where they chose:

> *"I mean they don't use it for an hour at a time, they pick it up, put it down, they use it for their spelling, they put it away then go on to their reading work, then pick it up to do something else. But it is in consistent use during the day, not constantly but it is consistently used on and off during the day."*
>
> Lead Teacher, Bellshill Academy

This pattern of personal ownership has significant benefits and implications for how students use technology to support and enhance their learning and how teachers structure learning activities based on these new opportunities, a theme which is explored further in the Discussion section at the end of the report (see section 9).

Interest, motivation, engagement and disposition to learning

Looking across the various sources of data available from this study there is little doubt that the ownership of a personal device, such as the iPad, significantly increases levels of motivation and interest shown by students in their work at school leading to greater engagement and autonomy by students. The exit survey completed by students points towards significant positive student dispositions towards learning with the iPad, and these are supported by the overwhelming majority of parents and by teachers surveyed or interviewed at the end of the pilot phase, captured in this comment from one teacher at Bellshill Academy,

> *"I think that there has been a real improvement in motivation for many of my pupils, several of whom have support for learning needs. The 1-1 aspect has meant that the children have really personalised their iPads and made them work the way they want. They have become important tools for learning in my class with many children surprising me on a daily basis with the types of work they come up with."*

Comments like this from teachers and parents were common in the data set and they are corroborated by students themselves who were asked a series of questions related to their attitudes and dispositions towards learning following the introduction of the iPad (see Table 3 below). When asked if they learned more when using the iPad, almost 92 per cent of students agreed or agreed strongly, and almost 94 per cent claim to learn difficult ideas or concepts better with the iPad. These figures were collected after the focus groups and interviews had taken place and therefore it was not possible to explore with the students any of the explanations for these overwhelmingly positive results. This is clearly an important area for further investigation as it is necessary to understand the processes and affordances of the device itself and the various contexts within which it is used which contribute to these very remarkable shifts in attitudes associated with a portable personal device. It was beyond the scope of the study itself to capture or define these processes although the discussion section (section 9) does set out some tentative explanations based largely on the observations and perceptions of teachers who were interviewed.

Attitude or disposition to learning with the iPad	Agreed or agreed strongly
The use of the iPad in lessons makes learning more fun	99.6 per cent
I am more interested in learning when I can use the iPad in lessons	96.2 per cent
The use of the iPad helps me understand difficult ideas better	93.9 per cent
I prefer to use an iPad to a traditional computer or laptop	93.9 per cent
I learned more when I used an iPad in lessons	91.6 per cent
I worked more with other people when I had the iPad	88.8 per cent
I behaved better in lessons when I used the iPad	87 per cent

Table 3: Students' attitudes and dispositions towards learning with the iPad

Student uses of the iPad for learning

Students and teachers reported using the iPad for a large variety of different learning and teaching activities within school, which are captured in the graph below (see Figure 10).

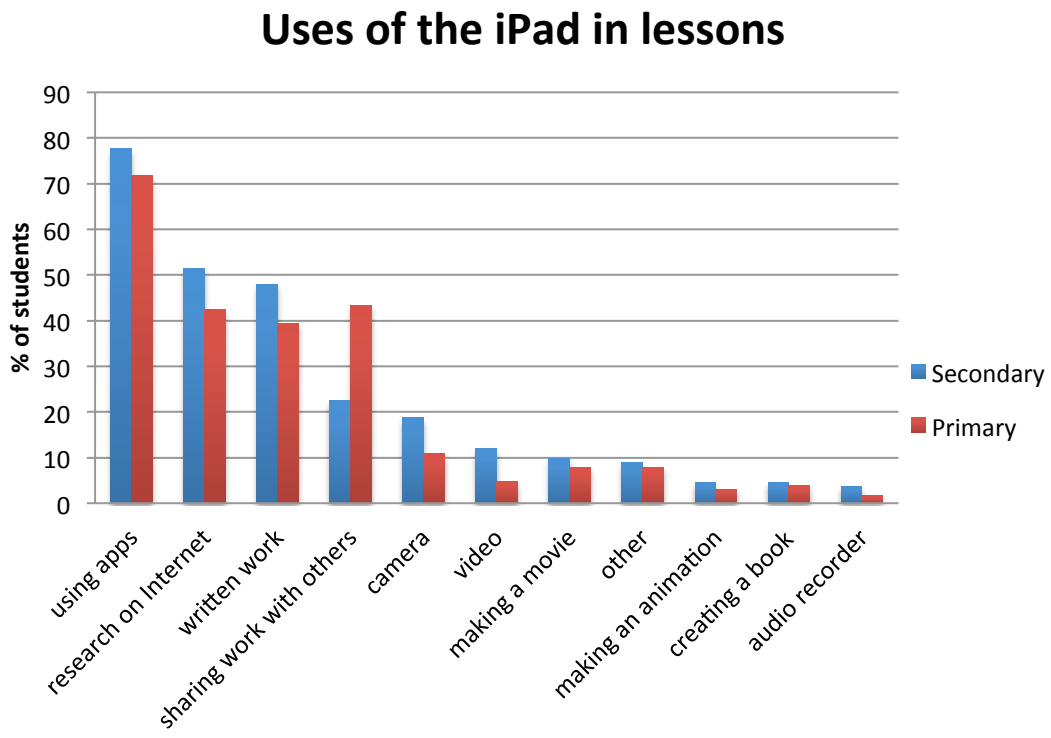

Figure 10: Daily use of iPads in lessons

Secondary school students appear to use their iPad slightly more frequently than primary, at least to undertake the activities captured in this survey, although the difference is not significant. The exception to this pattern is collaboration where primary students claim to use their iPad almost twice as often as secondary students. The collaborative use of the iPad in many of the primary schools visited was most noticeable and several teachers commented on how it had encouraged more collaboration between students, not less.

Use of apps in primary and secondary school pilots

The single largest use of the iPad reported by students in Figure 10 above was 'apps' a generic category which requires further explanation and investigation. During the online survey students were asked to provide examples of the different apps they used in school and this data informs this section of the report. For purposes of clarity and space in Figure 11 only apps identified by at least four students are included in this analysis since too many apps were cited occasionally to be captured in this graph.

In the primary pilot schools the three most popular applications - 'Page', 'Keynote' and 'iMovie' - were all purchased apps, produced by Apple.

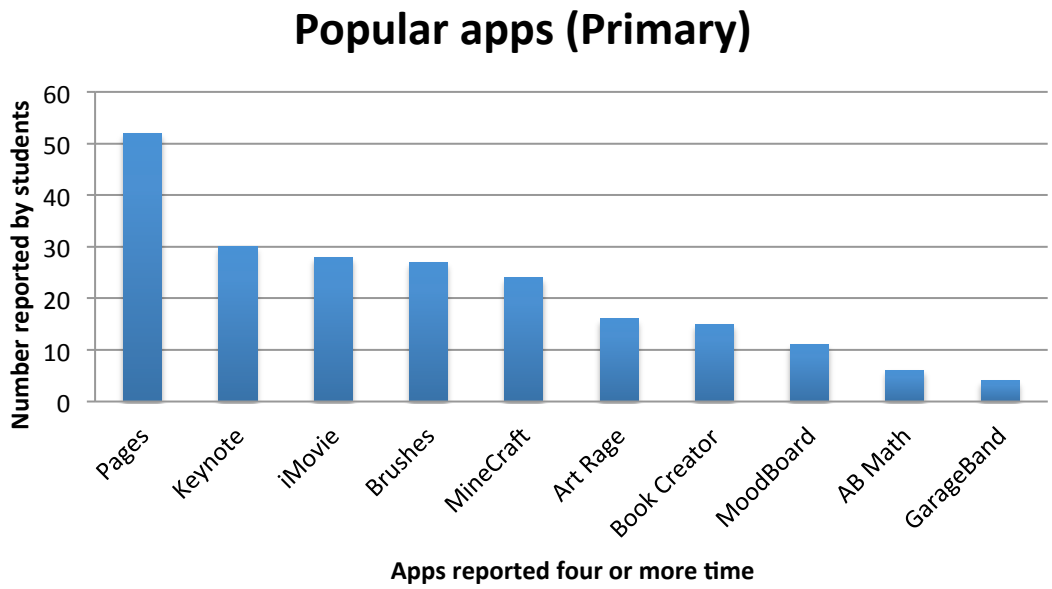

Figure 11: Popular 'apps' used by primary students

'Pages' was used extensively for writing and desk-top publishing tasks and 'Keynote' was very popular as a presentation tool. Apps like 'Brushes', 'Art Rage' and 'Book Creator' were also popular for creative activities in which students were often offered a choice of how they would create and present their work, dependent on teacher preferences and interests. The popularity of this particular tool-set probably reflects the preferences and interests of the teachers involved in the pilot phase. Other apps, which appear less frequently, tend to be personalised according to individual choices and often reflect the interests and preferences of the user, in this case the students, who were generally able to install their own apps using their own iTunes account. Many of these were games based apps, although the app MineCraft, which is a collaborative game, was cited often and therefore features in this graph.

In the three secondary school pilots students also reported using a wide variety of different apps and again only those referred to more than four times are shown in the graph below (see Figure 12). The pattern of apps usage in these secondary schools is noticeably different from the primary school pilots. Most obviously, secondary school students appear to use more productivity type apps, such as

'Open HD' and 'Notes' (Apple's basic note taker), which are designed for writing.

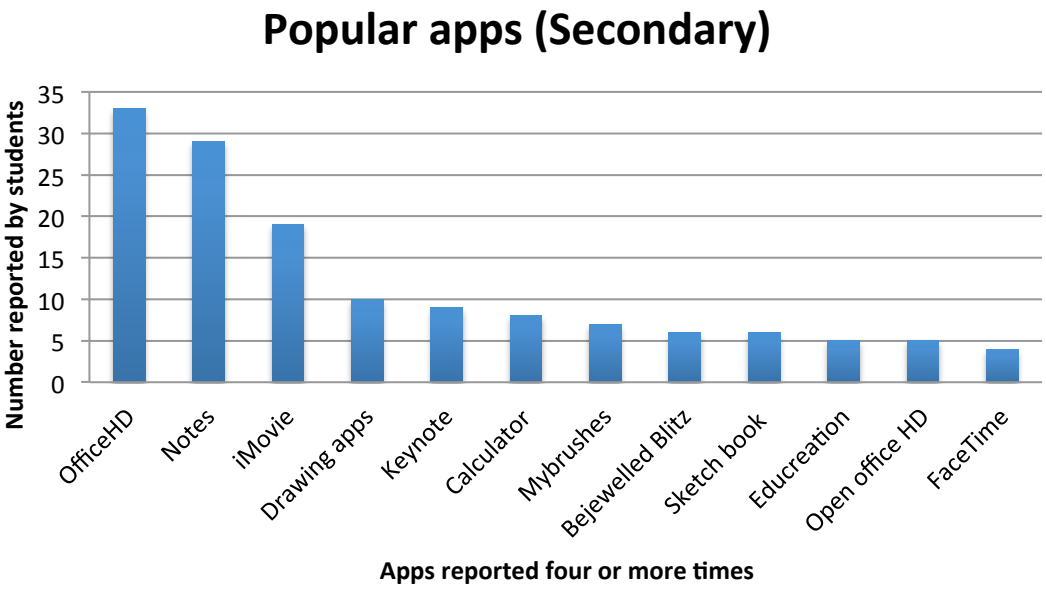

Figure 12: Popular 'apps' used by secondary students

As a general rule it is worth noting how the most popular and most frequently used apps, cited by students in both primary and secondary phases (and corroborated by teachers), were content free apps that could be used across all subject areas and topics. Specific content apps and tools were seen on devices during the observation phase but students did not report using these with any great frequency and this supports what a number of teachers described as a shift from content based applications or 'skill and drill' apps to open, content free apps which tend to encourage the user to be more creative and independent. The interview data from teachers indicates this is a common experience as they gain greater experience and familiarity with the device and become more discriminatory in the software applications they select:

> *"So at first I was thinking, 'Right, what will I do with the iPad?' And I was, sort of thinking, 'Right, what could I do for Maths? Or how could I do spelling differently?' And then it, kind of, evolves as you realise from hearing what other people do on blogs and things that it evolves into understanding it, it's a much more creative tool, it allows them to publish and to create movies and to show their demonstrations of understanding through different media. And then it, kind of, becomes a much more versatile tool."*
>
> Class Teacher, Sciennes Primary

Other reported uses of the iPad by students

Research was the next most popular use reported by students, which is not surprising when ubiquitous connectivity to the Internet provides students with direct access to vast amounts of information and expertise that would have previously been selected and channelled at the discretion of the teacher:

"I think the iPads have given pupils greater ownership over their learning. They are developing their research/IT skills and also learning to discriminate effectively."

Art Teacher, Bellshill Academy

This feature of personal networked devices challenges many of the assumptions and paradigms around which traditional models of teaching and learning are constructed, including the authority and expertise of the teacher, the role of the learner as an author and producer of knowledge, rather than simply a consumer, and the power relationships which exist between teacher and learner when the teacher is no longer the sole arbiter or conduit to knowledge and truth. These issues are address in the discussion section (see section 9) at the end of this report.

Some of the other more ***creative*** uses of the device reported by students in lessons, such as movie making, animation or using the camera feature, may appear less significant in Figure 10 but it should be noted that many of these activities would be almost impossible to undertake in the classroom previously as they required sophisticated, expensive and multiple equipment sets which most schools did not have available at a classroom basis. Making movies, for example, would normally involve three separate processes and sets of equipment as students film and capture the subject, edit and embellish the raw footage, before packaging and outputting the final product, usually to a separate format such as DVD. Using the iPad students are able to undertake all of these processes within a single device, overcoming many of the technical and logistical barriers that might otherwise make this a prohibitive undertaking in the classroom. Instead the focus of such activities is essentially pedagogical as students make movies and movie trailers to demonstrate their understanding of a process or to explain a difficult or abstract idea to their peers:

"In Art and Design, the iPads have given pupils a personal visual library to use in expressive and design projects. It has increased the speed of projects as pupils have answers at their fingers tips allowing them to develop and generate ideas/design much faster."

Art Teacher, Bellshill Academy

The creative uses of the device, and their simplicity of use, has already encouraged teachers to consider alternative activities and forms of assessment and it should be expected that these uses of the device will increase in popularity as teachers and learners become even more familiar with what is possible in this respect. Additionally the use of creative applications and features in this manner liberated many students who did not previously see themselves as 'artistic' or musical, such as the example below in which a student in P5 explains how the use of the app 'Art Rage' has increased his confidence in art:

"I don't feel confident enough to draw this kind of thing on paper but on 'Art Rage' I'm fine because you can put a picture in the background as a guide, and if you make a mistake you don't ruin the whole picture like you might on paper."

P5 Student, Gavinburn Primary

An example of his work, alongside the inspiration for the work is shown in Figure 13, below:

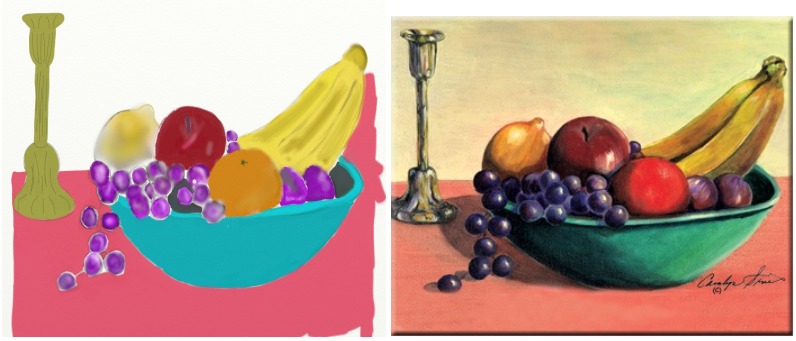

Figure 13: Copy of P5 student's art work using 'Art Rage', alongside original

Use across curriculum areas in secondary and primary

In the primary school pilots students tended to use their iPad in most of their lessons which were often taught by the same teacher. They report using it in most lessons when they have access to it on a personal basis. In the three secondary school pilots this was not the case and the iPad was used more commonly in certain subject areas than others, as shown in Figure 14 below:

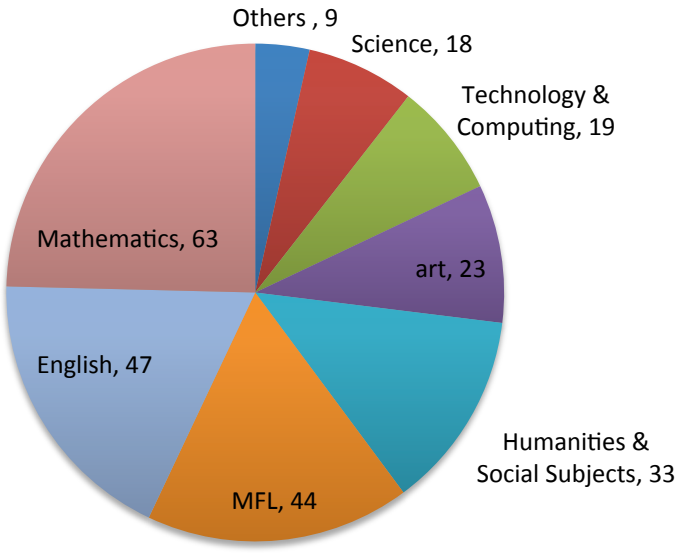

Figure 14: Use of the iPad in different secondary curriculum areas (reported by students)

Students reported using their iPad in many secondary subject areas as shown in Figure 14 but Mathematics (24 per cent), English (18 per cent) and Modern Foreign Languages (17 per cent) jointly account for almost 60 per cent of the reported use. These figures should be interpreted with some caution, however, since two of the three secondary pilots were based in subject departments; which were Mathematics (St Kentigern's Academy) and English (Greenwood Academy) which will account for the somewhat skewed distribution of subject areas. Only in Bellshill Academy (Secondary) were the iPads deployed across an entire year group (S1). Here it might it be expected they would be used

more evenly across all subject areas, although further research is required to ascertain this level of detail.

Use of the iPad and apps for teaching

As outlined in the previous section, it is evident that teachers' thinking and practice with the iPad, and its associated apps evolves and changes as they become more experienced and familiar in using it. In the initial stages of the pilot when the technology was still unfamiliar teachers describe using the device to replicate many of their existing classroom practices, such as its use as a presentation tool, tethered to the data projector and interactive whiteboard.
As a presentation tool tethered to the data projector and the screen the iPad is used to replicate existing practices with a laptop or PC, but these practices shifted significantly for those schools and teachers who experimented with the Apple TV, or mirroring software. [13] In these instances the teachers discovered how the classroom dynamics are altered when they are released from the need to teach from the front of the class, and when students are able to project the work on their own iPads to the whole class without the need for the teacher to intervene. These pedagogical shifts, are seen as potentially very significant and are explored in more detail in the Discussion section at the end of this report (see section 9).

Although the pilot phase was short and some teachers did not use the iPad as a teaching device for very long, it is also evident from the interviews how they detected changes and shifts in their teaching approaches, even over this short period. In the case of Bellshill Academy, for example, who conducted their own surveys, 100 per cent of the teachers questioned (12) found the iPad to be good or excellent as a teaching tool, and 11 of the 12 reported being far more comfortable in using technology in their teaching. The majority of these teachers (10) thought the iPad made the delivery of lessons easier. This finding was echoed by many of the teachers across the pilot schools who reported a variety of savings and benefits associated with the device.

In some cases these benefits were relatively simple but important efficiency changes, such as not having to photocopy multiple sheets or resources for each student, but some were more significant such as the reliability of the device ("*it always works*") which gave teachers more confidence to use it on a regular basis. The use of apps for teaching has also changed the ways in which some teachers prepare or resource lessons and there is a growing recognition that apps which are thoughtfully designed from a pedagogical perspective can make life easier for teachers:

> *"As a teacher, I have been surprised with how easy the iPad is to use in class. It has freed up preparation time as many of the apps can be used in day-to-day work."*
>
> Class Teacher Survey Bellshill Academy

There is, of course, a learning curve associated with the use of any technology but in this pilot teachers did not appear to find this too steep or insurmountable, and recognised the benefits of investing time to learn how to use the iPad as a pedagogical tool:

13 Mirroring software such as AirServer or Reflections allows the teacher and the students to 'mirror' their iPad device to a laptop or computer connected to the data projector.

"After the initial burst of preparation and getting to know the iPad and apps which we can use in class, the preparation and lesson delivery has become easier. At the beginning of the project there was a lot of work involved and it was quite a big workload. Worth the time and effort though when you see how the children have progressed."

Class Teacher Bellshill Academy

Bringing the Internet into the classroom changes how and when students access information and some teachers were aware this challenged their traditional position as 'knowledge givers'. It also facilitates new opportunities for learning, which is more student centred, or less teacher directed, if this is recognised by the teacher, as the following example illustrates:

"it is self learning focused where they can go and find out things for themselves and tell others about it. That's one good things about it as well that they share with each other which you would not have done if they had done a paper exercise or something. They would keep all that to themselves. If they are on their iPads and come across something they tell others and share it."

Class Teacher, Kilsyth Primary

Table 4 below, provides an insight into the typical range of apps used by a teacher (in this case from Sciennes Primary school) over the course of the pilot study.

App used over 10 week period	**Purpose and application**
'Book Creator'	To create an Easter Maths books with problems and challenges related to fractions and per centages (extension activity) – uploaded book to iBooks
'Brushes'	Used to make silhouettes based on ideas from 'Cooking with Apps' book (Fraser Speirs)
'iMovie' app	Make short film/interviews of Bonnie Prince Charlie (Jacobite Rising)
'Viewfinder'	To find images and attribution texts
Hot Apps 4 HOTs	Links activities to Bloom's taxonomy
'AB Math'	Practise tables
'Tom and Ben Talking News'	Creating news stories in film (used it to record a news interview with Bonnie Prince Charlie)
'Pages'	Report on an amusement park (reviewing current rides and asking for feedback) – very realistic not contrived
'MoodBoard' Lite	- made a board about places where the Olympics have occurred
'Music Sparkles' lite	Creating fanfares in groups
'iSpell That'	Homework task

eBooks Library to Go	Allows children to download eBooks from the City of Edinburgh library
'Popplet'	To mind map a piece of creative writing
Flashcardlet app	Spelling
'Puppet Pal'	Animations on Usain Bolt and his diet/lifestyle
'Inspiration' Lite	Children used it to plan a mini Olympic event for year 4 (younger class) – helped in making note taking more flexible (easy to add in new sub-nodes)
'StickyNotes'	To undertake research
World Clocks	Used to explore World time
Wikispaces (not an app but accessed through iPad)	Sharing document; homework tasks, + many other things
'iThoughts' HD	To keep weekly logs for University research

Table 4: apps used by one primary teacher during the pilot phase (Sciennes)

Out of school use

Six of the eight schools involved in the pilot allowed students to take the iPad out of school and home from the very beginning. This further extended the use of technology to support learning as many students, teachers and their parents reported increased levels of homework and learning using the iPad. Almost three quarters of the students (74 per cent) claimed to use their iPad on a daily basis out of school and at home, compared to 33 per cent who said they used technology on a daily basis previously. Students reported using the iPad at home for a wide variety of tasks with homework set by teachers being the most common activity. Almost 84 per cent of them said they were more likely to complete work at home when they were able to use their iPads, and a significant number (150/262) were more willing to show and share their school work with their parents when it was produced using their iPad. The impact on learning and parental engagement in this process is examined separately under section 8.2

Conclusions drawn are that:

- The availability in school of a personal tablet device like the iPad significantly increases the amount of time students can access technology to support their learning at the point it is required ('just in time learning').
- Even in schools where technology provision was deemed to be very good students previously reported using it only occasionally. The allocation of a personal device made a significant difference and students reported using technology in most lessons during the pilot.
- Data collected from students, parents and teachers all highlighted significant transformations in the motivation, interest, persistence and engagement of students following the introduction of the iPad initiative. It was evident that student dispositions towards learning had improved

dramatically during the pilot, a fact that was recognised also by teachers and parents (see section 8.2 below).

- The iPad is used for a wide variety of learning tasks across the curriculum, and apps are referred to as the most frequently used feature of the device. Further examination reveals that secondary students tend to use the productivity type apps (e.g. 'Office HD') more frequently than primary who tend to focus on Apple's own suite of creative apps more often.
- The iPad is used in all subjects across the primary curriculum but in the secondary pilot schools it was more often reported to be used in Mathematics, English and Modern Foreign Languages, although this is likely to reflect the departments where the pilot was located.
- Teachers are beginning to identify particular apps and features of the tablet device which extend their existing teaching approaches, including the adoption of more collaborative teaching strategies and a shift away from delivering content in a didactic manner. These shifts and reconceptualizations are examined further in the Discussion section of the report.

8.2 Parental engagement and use of the iPad at home

In the majority of the pilot schools students had access to the iPad as a personal device available on a 24/7 basis, enabling them to use it in various locations beyond school itself. The personal and ubiquitous use of the iPad in this study offers opportunities for students to continue and extend the work they begin in school, making study more seamless by providing a link with informal sites of learning such as the home. This section of the report focuses on the use and impact of the iPad outside of the classroom when students use it in their home settings. It explores parental attitudes to the iPad pilot in terms of how they witnessed the iPad being used when their children brought it home, and the impact of this use on their children's activities and attitudes towards school and learning.

The evidence for this section is drawn largely from the baseline and exit surveys, which parents completed at the beginning and end of the pilot phase. Both surveys were undertaken online although paper copies were made available, on request, by the respective schools. The survey included a range of different question types and also provided opportunities for respondents to provide extended, free text replies. All but Bellshill Academy participated in the parental surveys conducted in this way resulting in 139 response to the baseline survey, undertaken in April 2012, and 87 to the exit survey, undertaking in June 2012[14]. Under the circumstances and time pressures associated with the pilot evaluation the completion rate was considered reasonable though not comprehensive.

	Baseline Survey (April 2012)	**Exit Survey (June 2012)**
Male	45 (32 per cent)	25 (29 per cent)
Female	94 (68 per cent)	62 (71 per cent)
Total	139	87

Table 5: Gender breakdown - baseline and exit parental surveys

In each of the parental surveys the majority of respondents were female. They comprised mainly of parents from three schools as shown in Figure 15:

14 Bellshill Academy undertook their own survey as part of a local authority initiative and it was not deemed useful to ask parents to undertake a second survey at this point. North Lanarkshire Council have kindly made the findings from this survey available for the research team.

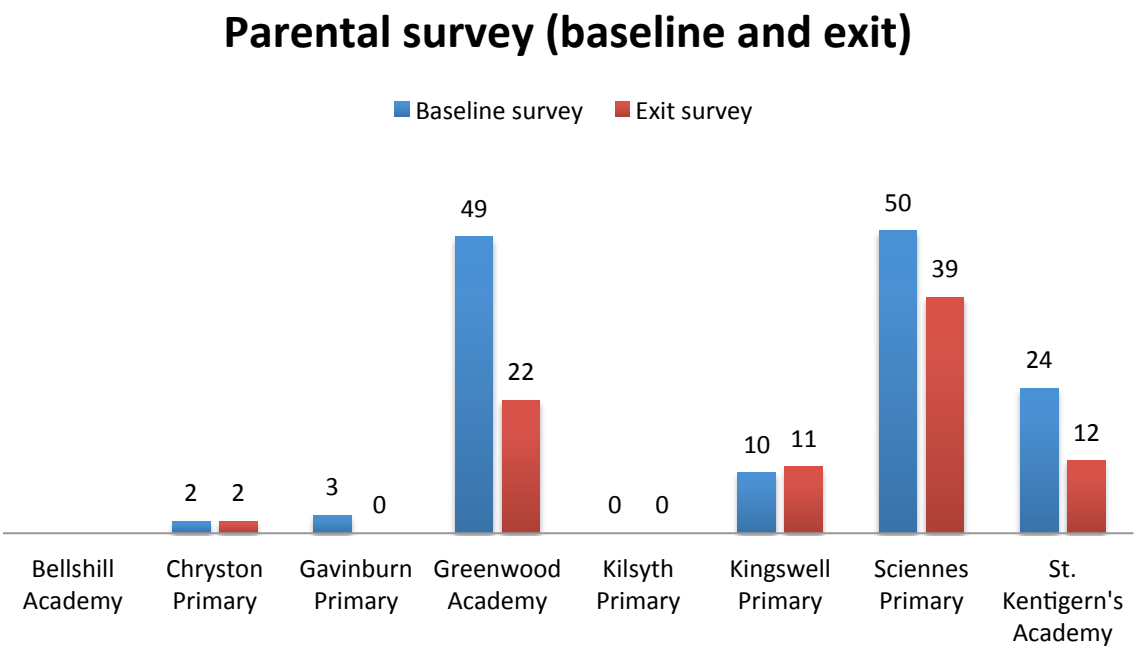

Figure 15: Parental surveys (baseline and exit)

The limitations of the data should be considered carefully when reading the findings and conclusions that follow.

Initial perceptions of parents towards technology before the initiative

The baseline survey revealed high levels of technology ownership in the home, and expertise and confidence in using technology itself by parents. Ownership of at least one mobile device was almost universal with many parents identifying multiple devices as shown in Figure 16. The significant feature highlighted in this chart is the high level of Internet access available in the home from a mobile device rather than the traditional laptop or personal computer, with only 13 per cent of devices identified as being non-Internet capable. 34 per cent of the Internet enabled devices were identified as iOS based devices (iPhone and iPod Touch) suggesting many parents were familiar with the operating platform of the iPad device brought home by their children.

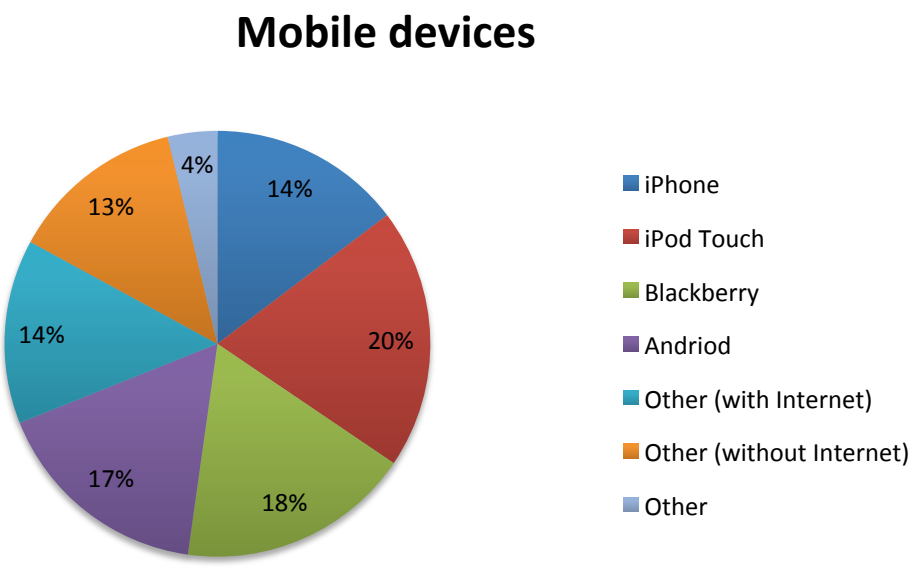

Figure 16: Mobile technology in the home

Very few parents saw themselves as weak users of technology with most (88 per cent) describing themselves as at least average and almost half (46 per cent) as confident or expert technology users. When asked if they felt confident in helping their children use the iPad for learning purposes almost 80 per cent responded positively.

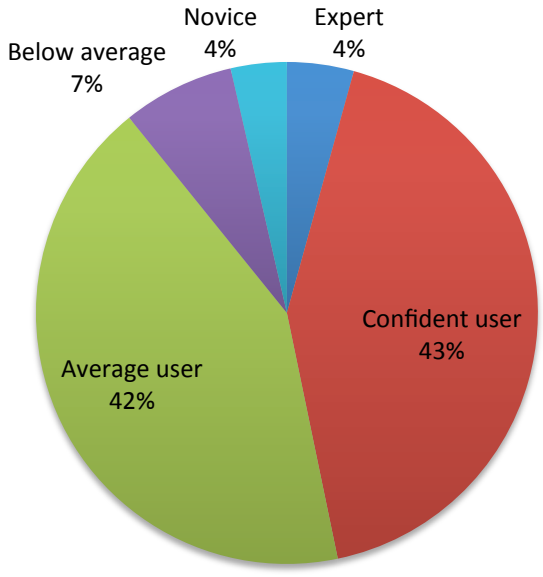

Figure 17: Parental confidence levels in using technology (baseline survey)

The iPad has been identified in previous studies and research (Heinrich, 2012; Melhuish & Falloon, 2010) as a highly personal and individualised technology and it was considered important to understand what restrictions and controls (if any) parents would apply when their children brought the device into the home. 78 per cent of parents had existing rules of some kind regarding the use of technology at home by their children, although only 18 per cent applied these strictly in a manner which might be seen to negate the value of a personal device such as the iPad. Generally parents in the study adopted a flexible and liberal position as regards the use of technology at home which the following extract illustrates:

> *"We don't let them play games during the week but [they] can use computers for homework and can check emails. Games are allowed weekends and holidays and time is limited."*
>
> Baseline Survey - Parent

Rather than adopting strict or rigid rules most parents judge each case on its merits (55 per cent), however 72 per cent take steps to limit the amount of time their children have access to the Internet at home. Their reasons for imposing a time limit vary but, somewhat surprisingly, concerns about online safety and privacy are relatively minor (9 per cent) compared to factors such as health and fitness (37 per cent) where parents consider technology to be an adverse attraction (see Figure 18 below). These findings contrast somewhat with the impression perpetuated in parts of the popular media which promote issues such as safety, privacy and video violence as reasons to curb young people's use of the Internet and associated technologies. It is also worth noting that parents surveyed at the beginning of the pilot phase did not consider technology use by their child at home to be detrimental to their academic work or chances of academic successes, although this changed for a small minority of parents mainly in the primary phase following the introduction of the device.

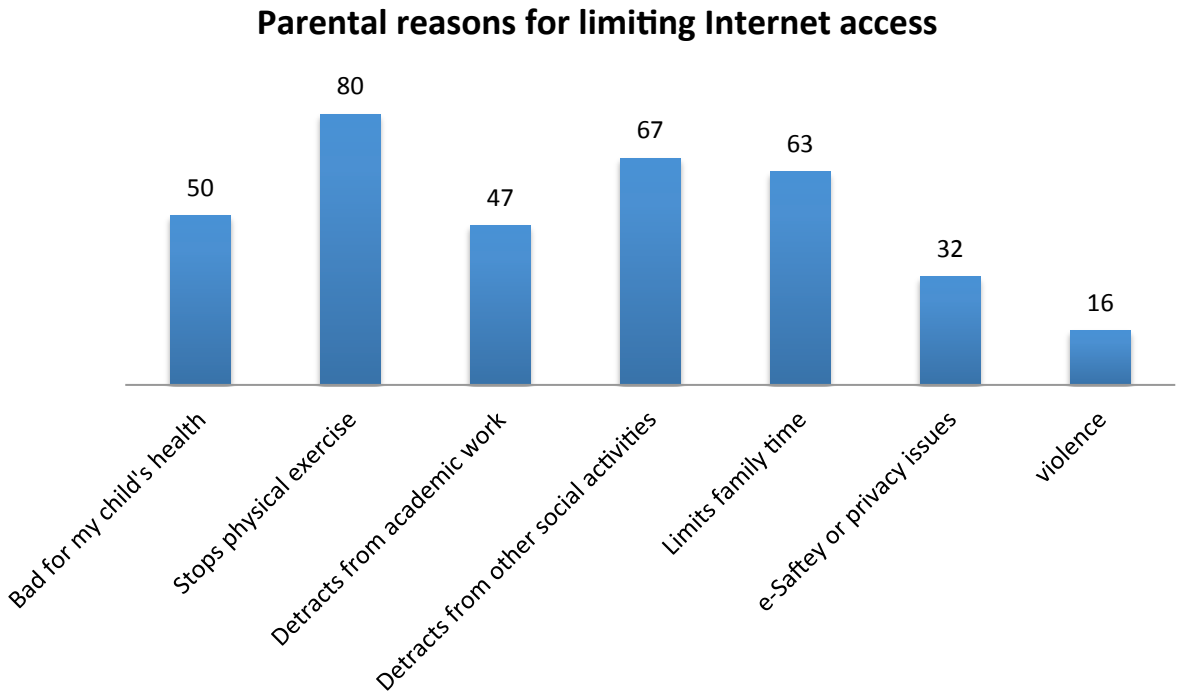

Figure 18 Reasons parents limit the amount of access to the Internet

Activities undertaken in the home with technology, before the pilot

When asked how their children used a mobile device at home (see Figure 19), the major reason given was for entertainment and leisure (59 per cent) rather than specific educational activities, although 21 per cent agreed that it was useful in preparing children to use technology. A relatively small number (10 per cent) identified learning or school related activities as explicit reasons for using a mobile device in the home which suggests these are not yet recognised as learning technologies by parents in the same manner a personal computer or laptop is perceived to be. This supports recent research in the use of mobile devices, which indicates that most students do not see their personal mobile device (e.g. their phone) primarily as a learning tool (Gupta & Koo, 2010; Kinash, Brand, & Mathew, 2012).

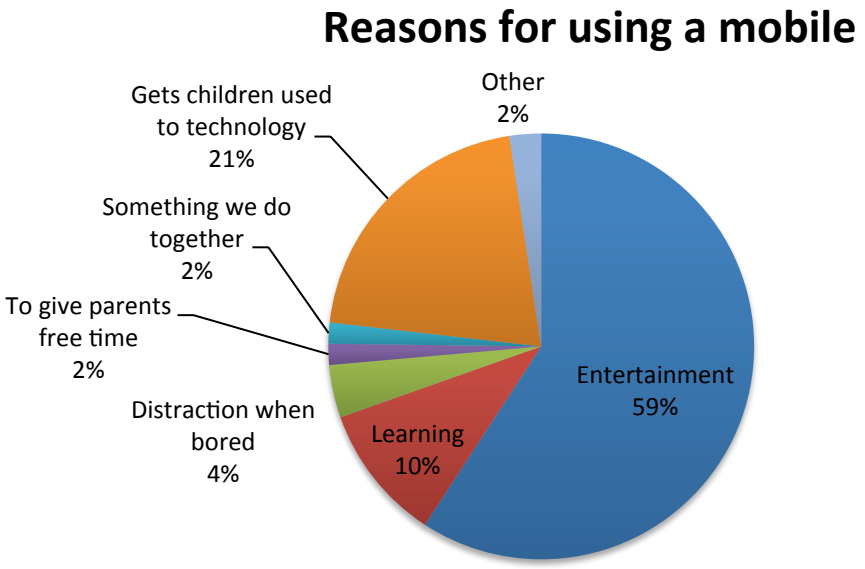

Figure 19:Purposes parents cite for allowing their children to use a mobile device in the home

Underpinning our reasons for surveying parents and carers at the beginning of the project was the assumption that the introduction of the iPad into the home might generate additional parental interest in their child's learning at school and, indeed their own learning. Evidence from similar projects in England has identified this as an unintended, though significant, outcome when students are provided with a personal device which they take home (e.g. http://handheldlearningproject.wikispaces.com). The baseline survey revealed that parents feel more capable of assisting their children in schoolwork using traditional media such as books, rather than technology, such as mobile devices. 77 per cent of parents claimed to help their children with homework using traditional media at least once per week with 14 per cent doing so on a regular or daily basis. This figure fell significantly to 44 per cent when technology was involved, with only four per cent assisting on a regular or daily basis. This discrepancy, which is significant, indicates parents are less confident or willing to support their children in school related work when it involves technology and invites the question whether the introduction of a personal device such as the iPad

into the home would compound this difficulty or help to alleviate it as parents become more familiar and confident in using it themselves and with their child.

Although parents appeared to be less willing to work with their children when it involved technology this does not appear to be related to either their levels of confidence in using the iPad or their general attitudes towards technology and learning. 91 per cent of parents believed they would be moderately confident or better in using the iPad to support their child's learning before the project had begun, and there was an almost universal agreement that technology was a positive factor in learning and preparing young people for the World of work.

The vast majority of parents (83 per cent) believed students should be allowed to use mobile technologies before they reach secondary school and a significant proportion (62 per cent) also considered students should be allowed to use a mobile device in school itself, with only six per cent indicating otherwise. A sizeable minority (21 per cent) were uncertain about this issue and this provided a useful benchmark against which to measure changing attitudes and beliefs as a result of the experiences brought about by the project itself.

In summary the baseline data collected for this study indicate:

- Parents are generally well disposed and resourced for the use of technology in the home, with widespread familiarity and use of mobile technologies, which are networked through to the Internet.
- Parents are confident about their own abilities to use technology in general although it appears they are more reluctant to use it to help their children with school work which also suggests they have not yet conceptualised mobile technologies as learning devices in the same way as more established technologies such as the desktop or laptop computer.
- Parents were interested and willing to undertake training in how to use the iPad as a tool to support their child's learning. Almost 85 per cent of respondents expressed an interest in attending training events of this nature with an overwhelming majority identifying school rather than commercial based workshops and training as their preference.

Impact of the pilot on parental perceptions and attitudes

In terms of parental attitudes and responses to the pilot project the headline findings are overwhelmingly positive and supportive as shown in Table 6 below, which reports parents' overall impressions of the pilot.

	Yes	No	Not sure
Do you think the iPad pilot has been valuable for your child?	83.9 per cent(73)	2.3 per cent(2)	13.8 per cent(12)

Table 6: Parents' perception of the iPad pilot for their children

Similarly, a significant majority of parents is very positive about the impact the pilot has had on their children's attitude to school and learning in general as shown in Table 7:

	Agree/agree strongly	Disagree/ disagree strongly	Not sure
Has the use of the iPad had a positive effect on your child's attitude to school and learning?	70.2 per cent(61)	17.2 per cent(15)	12.6 per cent(11)

Table 7: Parents' perceptions of the iPad pilot on their child's attitudes to learning

Almost 84 per cent of respondents considered the pilot project to have been valuable for their child, despite its short duration. Perhaps more significant in terms of learning and dispositions towards school, over 70 per cent of parents believe the use of a personal iPad device has significantly changed their child's attitude towards schools. A small number of parents (fewer than 15) had some concerns about the use of the device and a third group were ambivalent citing both advantages and drawbacks. These views are examined further in the following section.

Positive parental attitudes towards the pilot

Given the short duration of the pilot phase (roughly three months) and the limited access some students had to the iPad as a personal device, it is considered highly significant that over 70 per cent of the parents who responded believe the use of the iPad has changed their children's attitude towards school and learning in a positive direction. In some cases it was as simple as the recognition that their child had been chosen to be part of the pilot that inspired a change in their attitudes towards schools:

> *"My child feels very privileged to have been given a chance to have an iPad. It is apparent in the way he speaks to other family members about the device. He believes he is very lucky to attend a school where this has happened as he understands that it is unusual."*
>
> Secondary School Parent

A variety of other benefits were cited by parents who participated in the survey or attended one of the focus groups organised in several schools which included:

- Greater engagement and interest in learning.
- Improved attitudes and motivation to learning in general.
- Improved levels of confidence and responsibility.
- Gains in skills and knowledge associated with technology in general.
- Evidence of children spending extended time on tasks, especially homework, leading to increased quality in output.
- Making school work more enjoyable and fun.
- Enabling and encouraging children to be more creative.
- Making learning more relevant, authentic and technology based.
- Developing greater social and networking skills.
- Children are more willing to share and involve parents in their homework and use of the iPad.

- A more engaging and varied range of homework tasks set by teachers which encourage children to apply more effort.

Engagement, motivation and interest in learning

Greater motivation, interest and engagement were the largest benefits identified by those parents who believed they had witnessed a positive change in their children's behaviours and attitudes to learning. This was particularly evident in more positive attitudes to homework which many parents linked directly to the iPad device itself. These parents described how their children were more likely to complete homework tasks set by teachers when they previously saw this as a 'chore':

> *"He loves having it and even doing his homework on it and it doesn't seem as much of a chore to get him to work on it…."*
>
> Primary School Parent

Students were described as being more '*eager to complete homework using the iPad*' and more interested in homework and projects at school which were seen to overlap more seamlessly than before. In this case parental perceptions were supported by the findings from the student exit survey in which 84 per cent of students agreed they were more likely to complete work at home when they could use their iPad. Indeed many parents commented that their children needed less external prompting to complete homework and were more willing to involve or show their parents this work when it was undertaken on the iPad:

> *"Children all love technology these days and in my son's case, using an iPad to do some of his work at school and home has given him more of an interest in carrying out tasks and it has also made him more likely to show us his school work when he comes home."*
>
> Secondary School Parent

It was also evident that some parents believe this increased level of engagement and motivation brings about gains in performance and attainment, even in cases such as the one below, where the parent was openly sceptical of the technology at the start of the initiative:

> *"Motivated by the iPad and the presentation App she identified some 15- 18 facts. Without [the iPad] she would have stopped at 6. One point for the iPad!"*
>
> Primary School Parent

In many of these cases the traditional definition and understanding of the term 'homework' are changing and are being replaced by the notion of extension tasks, which are more authentic and engaging for students. They often elect to undertake these activities without the prompting of teachers which suggests the technology is playing a role in encouraging students to take more responsibility and agency for their own learning, a theme which is returned to in the Discussion section of the report.

Motivation and general interest in learning were prominent amongst the responses from parents who believe their child's attitudes to school and learning have improved significantly. The following examples are typical of these comments:

> *"School has become a lot more interesting. Even coming out of school late on some occasions…"*
>
> Primary School Parent

> *"She is more excited to go to school than before, greater initiative for group work and more learning and appreciation by teacher as well."*
>
> Primary School Parent

> *"Yes for example before my son would wish for weekends to be three or four days long and school the same. Now he says he wishes he was at school each day to do things with iPad!"*
>
> Primary School Parent

Motivation and engagement are widely reported across most technology initiatives in education and more longitudinal studies of this nature are necessary to establish if these perceived benefits of personal device ownership are sustained after the initial novelty effect has evaporated. However a significant proportion of parents (64 per cent) believe their children are more interested in learning at school when they use the iPad, and 86 per cent feel lessons are more fun and engaging for their children when the iPad is used as the following comment indicates:

> *" film (trailer) making has been lot of fun and a good way to involve the younger siblings."*
>
> Primary School Parent

Creative applications and family learning

Parents were also impressed by the creative possibilities which a personal device, like an iPad, offers for learning, including learning for the whole family as this parent explained:

> *"iMovies has been brilliant. For a lot of the weekend he filmed his little brother and his friend and made two trailers, which were really funny."*
>
> Primary School Parent

In many instances children used the iPad at home to capture and edit their own multimedia compositions, such as short movie trailers, biographical videos of family members (e.g. grandparents) or animations, and many parents indicated that these creative uses of technology had contributed significantly in changing their children's attitudes to school:

> *"It has certainly fired up her creativity and imagination in having film making and editing etc. Doing maths on the iPad seems to be more fun, though I'm not sure how much of this is novelty value. So far so good."*
>
> Primary School Parent

In some cases the creative opportunities available through the device are also linked to accessibility and writing issues and some parents saw these as key factors in encouraging their children to be more positive about school:

> *"My son finds handwriting very difficult, so being able to type on the iPad has been really beneficial - the iPads have been used in really creative and fun ways."*
>
> Primary School Parent

Additionally it was apparent that many parents believed the use of the iPad made learning and school more relevant and authentic for their children, whilst also enabling them to develop important technology related skills and competencies which they see as important. 92 per cent of parents believed the use of an iPad as a personal device had significantly improved their child's technology skills particularly when the school and their teacher provided opportunities for work to be completed and submitted in electronic format such as e-mail:

> *"She tends to be more focussed on homework and submitting it electronically to some teachers."*
>
> Primary School Parent

Finally some parents recognised how the ownership and use of a networked personal device like the iPad had encouraged their children to work more collaboratively and to be more social than previous, as the following comments indicate:

> *"She has interacted more with others as a result and experimented with many of the applications."*
>
> Primary School Parent

> *"She is more enthusiastic about homework, research etc and enjoys using the iPad to work with her friends both at school and via messaging / FaceTime at home."*
>
> Secondary School Parent

These parents perceived the networking capabilities of the device (e.g. FaceTime and messaging) in a positive light associated with social skills and learning, but for other parents these same affordances were deemed to be harmful or at least distracting from what they perceived to be 'academic work'. These views and opinions are explored in the following section.

Critical or ambivalent responses from parents

A minority of parents (17 per cent) disagreed with the previous comments, and although these views represent a minority of the parents who responded they are presented here to provide a fully balanced account from the perspective of parents. Another group (13 per cent) were more ambivalent in their opinions recognising the benefits of a personal device but still concerned at some of the issues

they perceived to be problems. In cases where parents did not detect a positive effect or were ambivalent they identified one of two reservations which are explained further below.

It distracts children from the basics (3Rs) by playing games or even the creative applications available through the device

A majority of the concerns and reservations about the iPad device related to the twin issues of game playing and associated distraction from learning, particularly what were considered to be the 'basics' (i.e. writing and mathematics). Most of these concerns came from parents with children in primary schools, rather than secondary. In many of these cases parents often described the iPad as a 'toy' or 'game player' which distracted their children from undertaking more traditional basic learning tasks such as reading and writing:

> *"I was more positive about the potential that can be used, but in practice it is mostly used for playing games. I can't see the benefit of doing spelling tests with automatic corrections, at a stage when even clear handwriting still needs to be developed."*
>
> Primary School Parent

Parents of younger children in the pilot were more likely to harbour these concerns arguing for tighter controls and less opportunity for children to download free games as they were able to do in some of the pilot schools:

> *"There are some things where use of the iPad at school has definitely been beneficial. e.g. when the kids had to prepare and present a talk, making iMovies and in one case story writing. However, the overwhelming attraction for my child, and from talking to other parents, has been the free games they have been able to download. My nine year old child in no way has the self discipline to restrict his screen time, and apart from the three projects mentioned, has only wanted to use the iPad at home to play the two games that he has downloaded."*
>
> Primary School Parent

In these cases there is an assumption that using technologies like the iPad is incompatible with traditional forms of cognition and thinking, and that the attractions of the technology will seduce students, hastening the demise of basic skills sets such as mental arithmetic and writing:

> *"Concern is that the ability to write, and do mental arithmetic will disappear altogether. Great that a movie can be made, edited etc. but cannot add up!"*
>
> Primary School Parent

Closely associated with concerns about game playing and distraction is the issue of socialisation which these parents believe has deteriorated as their children became more fixated playing games on the device rather than socialising with the family or participating in more traditional physical activities:

"I think at aged ten the iPad is a great toy and my child is very distracted by it. He certainly enjoys using it but has lost interest in basic reading, writing, playing physically with friends and communicating with us."

Primary School Parent

In cases such as this parents are fairly uniform in their outlook on game playing which is seen as a distraction not a learning opportunity. They feel somebody should take more responsibility to 'control' or lock the device to inhibit the level of personalisation which is the default setting:

"Children need to be prepared in a planned fashion for the developing technologies available not merely by playing endless games on computers and learning in a haphazard unpredictable and uncontrolled manner."

Primary School Parent

"I see advantages and disadvantages more clearly. The advantages of the iPad as a learning tool are quite obvious from the beginning. The disadvantages of the iPad for the children's creativity, social life and also activities in class become obvious only after a while."

Primary School Parent

This is, of course, an opinion or perspective rather than a truth and most parents did not report comments of this nature which might be described as a traditional or prescribed approach to technology and teaching in which access to, and use of, technology are highly controlled and regulated by the teacher. In response to these concerns at least one of the primary schools revised their policy on downloading games and put in place checks to prevent students downloading specific types of games, without permissions.

I do not see anything new in the use of the iPad

The second category of concern is not necessarily a criticism of the pilot or the iPad as such, but rather the manner in which it was conducted. In these cases - which are relatively rare - parents are not convinced they have seen anything novel or worthwhile in the use of the iPad by their child, particularly in the context of the school. The following example suggests parents were expecting more from the pilot project although what it is they were expecting is left unstated:

"I think they have huge potential that was not realised in this trial."

Primary School Parent

The following examples are more precise suggesting students are simply undertaking the same activities on the iPad they were performing previously:

'I have not seen anything particularly out of the ordinary. My child did PowerPoint before and now they do presentations using a different software. The only new thing is making their own film: it is a technical thing, easily learnt. No new knowledge is imparted on to the child. Done it once that is nothing new in doing it again. I don't

think the iPad is worth its value in education. In our case the Internet was not available on the iPad so it only served to write things on and create presentations or films."

Primary School Parent

"They seemed to use the devices mainly to make films and film trailers, which were fun and involved teamwork, imagination and creativity. However, the other tasks they had done (preparing presentations and creating documents) didn't appear to be that different from things that could be done on non-mobile devices (PCs or laptops)."

Primary School Parent

Whilst it is difficult to be precise with an anonymous survey of this nature this kind of comment is very specific and the observations of lessons made by researchers does not concur with this view. Whilst some practices and activities were undoubtedly replicating what had been done, in other ways before the iPad was available, other tasks move far beyond this indicating the device is capable of supporting alternative pedagogical patterns where this is carefully considered and conceptualised by the teacher. It is also important to stress that attitudes and beliefs are not fixed and can move over a period of time as the final example from a teacher in Kilsyth primary school illustrates:

Some of them, at the beginning, were saying, "I wish I could take that iPad away from them because that's all that they do now – they don't do anything else." But, lately, there's been nothing at all. The majority of parents were really pleased that they were getting them. So there's been no bad feedback from them, really.

Class Teacher, Kilsyth Primary

In summary the data from parents collected through the exit survey indicates they have altered their attitudes and perceptions about the value of mobile devices as learning tools. Where only 10 per cent of parents identified a mobile device as a learning device in the baseline survey the variety of positive and supportive comments reported above indicate that parents are now extremely supportive of the initiative and conceptualise the iPad as a learning device of some importance for their children.

Conclusions drawn from this are:

- Parents are extremely interested and willing to be more involved with their children and the work they undertake on a personal device than was previously the case.
- Traditional approaches to homework are changing as students take more responsibility and initiative in using their personal device to undertake learning outside of school which is not mandated by teachers.
- The majority of parents are extremely positive about the adoption of a personal device by their child and believe it has increased their levels of motivation and interest in school work.
- A minority of parents are concerned that their children use the iPad 'inappropriately' to play games which distract them from more academic work or physical activity. These views are predominantly from parents with children in primary school.

- Although only a small minority of parents (10 per cent) conceptualised mobile devices as tools for learning at the start of the pilot, the majority of parents are now aware that mobile devices have considerable potential to support their child's learning both inside and outside of school.

8.3 Leadership and management issues

The lead researcher in this aspect of the project visited six schools and three local authorities. Interviews were conducted with the Headteacher of four primary schools (Gavinburn, Chryston, Kingswell and Sciennes) and with project leaders in two secondary schools (Bellshill and St. Kentigern's Academies); the interview at Sciennes was also attended by the project leader. In addition interviews were conducted with education officers from three local authorities (West Lothian, North Lanarkshire and Edinburgh City Council). Interviews were recorded, with the transcripts (or notes) subsequently shared with the participants in order to confirm they were an accurate record of the meeting.

The key issues faced by the formal institutional leaders (Headteachers) and project leaders were:

- The leadership and management of change
- Relationships with the local authority and local community
- eSafety and student behaviour with devices
- Resourcing during and beyond the duration of the project

The leadership and management of change

Normally any change within education (whether desired or imposed) follows a distinctive pattern of behaviour by participants other than the person(s) responsible for initiating the change. Firstly, change tends to be embraced enthusiastically by innovators and early adopters who between them typically account for about 16 per cent of the population (Rogers, 1962). A further 34 per cent (the early majority) will follow quite quickly once persuaded that the advantages outweigh the disadvantages, with the remainder of the population adopting once a critical mass has been achieved within the social setting whereby the change is commonly seen as desirable (see Figure 20). Secondly, the pace of change is governed by the way in which the innovation impacts upon the structure of the organisation (or learning environment), the materials used by the participants, practice and the beliefs held by participants (Fullan, 1982). Conventional wisdom suggests the difficulties associated with implementation of change increase as previous structure, materials and practices are affected, with the greatest difficulty being faced when beliefs are challenged.

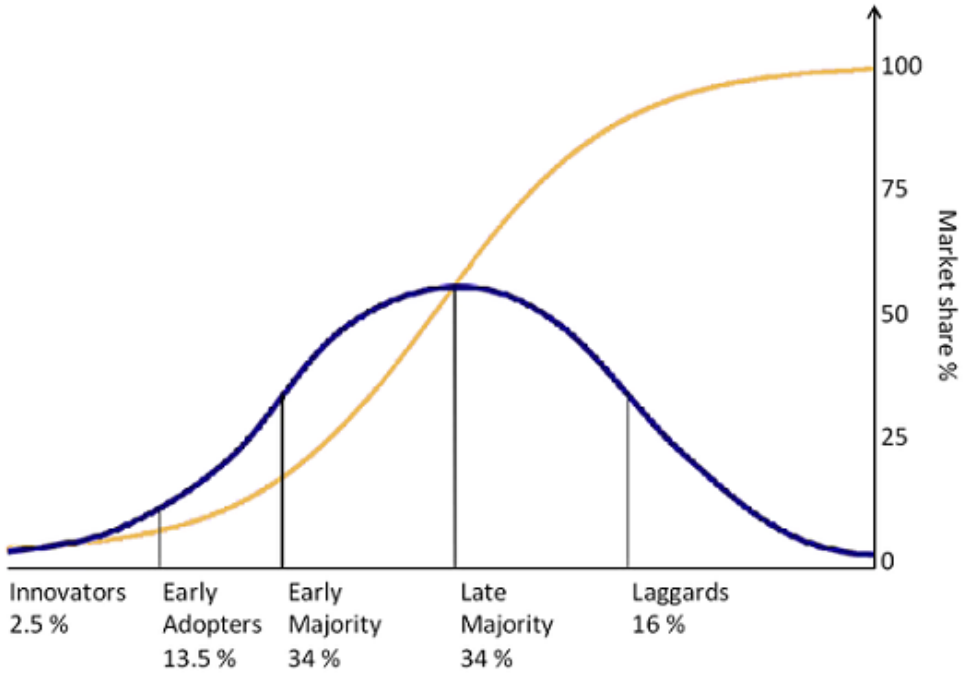

Figure 20: The diffusion of innovations with successive groups of users adopting the new technology. The second line shows when the innovation reaches saturation level (Adapted from Rogers, 1962)

Within the Scottish iPad pilot, however, neither issue normally associated with change initiatives produced any instance of resistance. Not surprisingly many of the leaders in the schools could be described as innovators or early adopters, with the consequence that the introduction of personal devices (Apple iPads) was greeted enthusiastically and with little of the passive resistance that is so often a feature of schools ("teachers are wonderful passive resistors" – Headteacher, Primary School). This finding remained consistent in the experience of the secondary schools where, in one instance, 28 of the 33 teachers of the S1 classes were provided with iPads. In a very short period of time (less than a month) students in this school were reporting the quality of teaching had improved from their perspective.

It was surprising, therefore, to see how quickly adult participants changed their belief even where they were not normally innovators or early adopters. Teachers, it seems from this evidence, were quickly attracted to the iPad and were equally quick to notice some of the direct benefits (no need to duplicate worksheets for example). This finding contradicts the normal pattern of change where beliefs are harder to change than organisational structures, materials or practices. Here it seems the reverse order is applied in that the device (iPad) quickly changed teacher beliefs and practices which now has them searching for materials and new ways of organising learning.

As a consequence Headteachers and project leaders indicated that this had been the least problematic implementation of an initiative they had experienced in their career.

The conclusions drawn are that:

There were features of the Apple iPad that made this project appealing, including:

- Apple's previous experience and expertise in education meant there was a large range of apps which practitioners considered trustworthy;
- The device was exceptional in regard to visual media, personalisation and ergonomic design, making it intuitively easy to use;
- There was brand recognition by parents and students who saw it as having street credibility.

These features (which may also be applicable to other personal devices) appeared to add considerably to the finding that adoption of this innovation was notably easier than any other educational initiative that participants had dealt with in the past. Caution still needs to be exercised, however, as most participants in this project could be considered as either innovators or early adopters. The feedback from one of the secondary schools, which had 28 teachers involved in the project is encouraging, however, and suggests implementation of this initiative more widely would not be as problematic as other initiatives have proved in the past.

Relationships with the local authority and community

There were mixed messages from the schools involved in this project in regard to the local authority. In Scotland there is still a large measure of control of school operation vested in the local authority, which was deemed by participants in this evaluation sometimes to limit the range of opportunities offered by these devices.

There was distinctiveness between education departments and the larger corporate structure of the local authority. Education departments (and associated services) were commonly considered to be supportive whilst corporate computer services were seen as less facilitative. There were two main areas where local authorities were generally considered not to be matching the expectation of the school based users: firstly corporate IT systems were not seen to be as responsive to local need as was required of a project such as this, and; secondly there were difficulties with filtering systems for the use of school computers to access the Internet. The second of these issues will be dealt with more fully in Section 3 of this report on eSafety (see below).

Some of these perceived connectivity problems seem to emanate from the use of Apple devices, although it has to be pointed out that the education departments within the local authorities were considered to have worked hard to support the use of such equipment including, in one case, running training programmes for schools in the use of Apple machines. At corporate level, however, systems tended to be PC based with use of Apple equipment seemingly perceived as more challenging to deal with. This has sometimes led to some perceived tardiness of response to requests for support and in the worst instances to a form of passive resistance with consequent evidence of frustration at school level. Participants in these interviews indicated they often had difficulty making or requesting changes to allow access to corporate and Internet services, with one suggesting that they had to be very assertive in order to get appropriate attention to their requests.

In fairness to corporate services this appears to be a universal issue perhaps best manifested through the debate surrounding the use of personal handheld devices in publicly funded systems. One major concern relates to security of data whilst a second concern, and perhaps more common in relation to vulnerable members of society such as children, is about the concept of eSafety (see next section). Corporate ICT services within the local authorities are clearly concerned on the first issue, as are many other organisations and governments worldwide (see for example the document posted on Basecamp from Australian Department of Defence, (2012)).

As one participant suggested, however, this is an issue that is not going to go away as the "iPad is equivalent of King Canute: you cannot stop it". The consequence and conclusion drawn here are that local authorities have to address this issue in much the same way as other major organisations and develop policies that not only protect, but also facilitate.

The conclusions appear to be that:

- Corporate services need to address the issue of eSafety from a different perspective, which expects (and places) trust in schools and students. Appropriate use of the Internet is a behavioural rather than technological issue;

- Local authorities have to be prepared for multiple user platforms in the future (especially with the increased ownership of personal devices) and avoid temptation to standardise.

e-Safety and student behaviour with devices

This leads straight to the concern over the notion of safety for which there were two elements: the safety of children from inappropriate material and engagement with the Internet and the concern for the physical safety of the devices (particularly when they are off-site).

Schools (generally supported by the education departments of local authorities) had implemented codes of practice for use of the devices, both in and (where applicable) out of school. In all instances parental agreement was sought for use of the devices, which were not distributed without their engagement. Schools generally required access to (and monitored) student emails, also requiring them not to delete their personal history of Internet use. Another key feature was that in all instances the device was owned by the school and/or local authority and this provided a further element of security which could not be guaranteed if students were to bring their own device.

In regard to eSafety (i.e. the protection of children from inappropriate material and engagement with the Internet) there was a considerable degree of concern within the schools that corporate systems have prevented full use of the devices through the establishment of firewalls designed to limit access to so-called 'safe' sites on the Internet. The consistent view of interview participants was that such an approach is counter-productive. This view is perhaps best summed up by the contribution of one Headteacher who employed the analogy of road safety:

"If we put restrictions on the device we are not building responsibility in the child. We think of it like road safety (and we would not say to children don't go there). The Internet is like a fantastic road system so we must encourage them to use it."

The principle of this view was reinforced by all participants and specifically by another primary Headteacher who, in talking about the need for a different pedagogical approach in a digital age pointed out that children need to be able to develop the skill to choose between potential sources of information, with the job of the school being:

"To teach them to be able to differentiate between what is real and what is fictional [in order] to make informed decisions."

The issue of eSafety was not considered by participants to be a technological problem, but a behavioural one. Inappropriate use of the Internet (say, for example, visiting sites displaying pornography) should be treated in the same way as if the student had brought that material into school in another medium. Schools had addressed their eSafety responsibilities via personal contracts with students (and parents) whilst reserving the right to view emails and personal browsing histories on individual devices. There had been almost total compliance and acceptance of these expectations by students with only one having to relinquish use of the device for inappropriate use of a social networking site (something that could have been achieved on any technology platform).

In regard to the physical safety of the devices (i.e. the extent to which students look after the equipment) there were only two instances across the pilot project where there was either physical damage or loss of a device. One device was run over by a commercial vehicle after a student (in a moment of youthful exuberance/playfulness) threw the bag of another student in the road. Amazingly, although there was damage to the screen, the iPad was still working after this incident. The only loss recorded was as a result of a house burglary. Schools generally reported that students had responded positively to advice/guidance about not displaying the equipment (either in school and, where admissible, between school and home) in such a way as to attract attention to the device for those who may exhibit envy or criminal tendencies (NB all students were advised not to put themselves into danger in order to protect a device). What was astounding was that there were no reports of equipment failure across the project.

The conclusions drawn are that:

- Schools, students and parents are aware of what constitutes inappropriate use of Internet sites and there is no evidence to suggest that their behaviour would be different if corporate firewalls were removed;

- Greater levels of eSafety could be guaranteed if the schools and local authorities were owners of the device;
- Students (and parents) valued and protected the device from physical damage and loss;
- The device used (Apple iPad) has an outstanding record of reliability and durability.

Resourcing during and beyond the duration of the project

There was a great deal of nervousness about how the education system could engage (or not) with the idea of use of personally owned devices, particularly in the wake of what happened in one local authority which investigated and sought to implement a lease/purchase scheme. In the whole project no student was allowed to bring their own device to school despite many already owning an iPad and many parents keen to buy. Given that the majority of schools in the project were looking to extend the use of 1-1 devices this is a fundamental issue that needs to be addressed at the highest, probably ministerial, level. Consequently interview participants were encouraged to discuss the concept of personal device ownership in comparison with other essential requirements for schooling (such as school uniform, PE kit and school meals). It was generally agreed there was no real conceptual difference between the ownership of a personal device and other equipment, with the conclusion that funding had to be addressed on the basis of social equity in the same way as other benefits were applied. One school, for example, had explored the establishment a potential lease/purchase scheme on the basis that there would be a need to provide for some families who could not afford the purchase. Previous experience on a range of social issues has demonstrated there to be multiple ways in which inequity can be addressed.

The key issue to recognise here is that all participants in these interviews could not envisage a situation where firstly the devices were taken back by the local authority (or funding agency) and, secondly, a future for schooling without the use of 1-1 handheld devices. Partly this was a long held belief, but evidence from the participants showed that they had not anticipated how successful this project was to become. In one secondary school, for example, planning had been for problems (e.g. inappropriate use, loss, theft) or how to get the devices used in the classroom with the consequence that targets were set too low and had been reached rather too easily. Within a month, however, these targets had been exceeded and there had not been social or technical problems. As a consequence they have not yet thought ahead of possibilities. The experience of this school was reflected across all participant responses.

Another, emergent issue, related to the way in which the devices could be managed, maintained and improved. In one primary school the acquisition of Configurator and Paratech (a charging unit) had not only aided the installation (and upgrade) of appropriate apps, but it had also assisted in the recharging of devices. Typically schools insisted the device was brought into school fully charged (where it had been allowed home overnight), with the consequence that re-charging on site was rare. Where this need occurred it tended to be addressed in schools by providing a substitute device (although it was commonly recognised that one of the benefits of the device was to retain the notion of a personal device). Conversely one school found its project leader in the invidious position of having to visit a local store in order to purchase multiple iTunes cards so basic apps could be loaded onto individual devices. One unfortunate outcome of this was that small amounts of credit were left on the iTunes card which students occasionally 'spent' and for which they then felt guilty leaving them to arrive at school with small amounts of money in an effort to recompense the school for their 'illegal' expenditure. This was clearly unsustainable and caused unnecessary additional administration. Consideration, therefore, needs to be given (particularly by the manufacturer) as to how best to maintain (and upgrade) multiple devices.

The conclusions drawn are that:

- Students (and parents) not only value and protect the devices, but also are able to use them responsibly;
- Consideration needs to be given on the macro scale as to how 1-1 devices can be resourced. Options to lease/purchase (if adopted) need to have national support and consistent pricing strategy;
- The installation, maintenance and upgrading of apps need an appropriate systemic response, both from manufacturer and institutions.

8.4 Professional development and learning

The adoption and effective utilisation of iPad devices across the eight schools participating in this pilot were marked by a singular lack of formalised or external training and were characterised instead by a mixture of informal, emergent, work-based learning which was highly vicarious and experiential in nature. This section explores how teachers involved in the pilot learned to use and teach with the iPad devices and the lessons these experiences have for the wider teaching community.

Research-based literature examining how teachers learn to assimilate technology into their daily practices points to several key factors which were evident in this study (Borko, 2004; Putnam & Borko, 2000). These include:

- The importance of situating the learning with technology in the context it will be used;
- The value of collaborative and social forms of learning to encourage teachers to share and reflect upon their use of technology;
- The need to understand and experience the mediating affordance of the technology at both a practical and theoretical level.

The findings from this study strongly support these aspects of professional development when teachers use tablet devices like the iPad, pointing to a naturalistic and distributed form of learning in which teachers support each other and their students in a relationship which is mutually beneficial. It reveals that formal training or instruction of the type traditionally associated with attendance at external courses or events was relatively insignificant in this case and this invites exploration as to how far the iPad device itself is a factor in explaining this phenomenon.

Initial familiarisation with the iPad device as a tool for learning

Other than the initial launch event, which was largely organisational and administrative in nature, teachers in the pilot event did not attend any formal training or courses external to their own institutions and generally learned how to use the iPad through self-directed and experiential forms of learning. One of the secondary schools in the study initially considered they should have provided more formal training themselves for specific applications on the device such as 'Pages' and 'Keynote', but none of the teachers who were interviewed were concerned about this and it may have been more perceived by the IT support unit in that particular school than the teachers themselves.

Based on interviews with teachers in the pilot schools the most common and effective method for gaining a basic familiarity with the device itself was through play, usually in the context of their own homes:

> *"Well, you sit at home and you play with it, and you use it in the classroom, and you ask the children also as well, "What have you found out from this? Oh, how did you do that?" – and they tell you. And you just pick up on things. But you do just play with it at home…That's not a bad thing to have to do…"*
>
> Class Teacher, Kilsyth Primary

The majority of teachers in the pilot were provided with a personal iPad before or at the start of the initiative and this appears to have been a particularly powerful incentive and form of learning as teachers experimented with the basic functionality of the device and particular apps in their own time, usually from home. They often described learning with their own children at home or even their parents where they felt safe and secure to experiment and explore both the device and the apps available. One Deputy Headteacher in a primary school explained how she had purchased an iPad for her elderly father and how his interest and enthusiasm for learning through the device was infectious, serving as an inspiration for her own learning:

> *"He is always on the look out for things that might be of use to me in school. He told me about the Google Art project a while ago and about an app for it very recently...I'm really enjoying sharing technology and interests with my dad!"*
>
> Deputy Headteacher, Sciennes Primary

Experiential teacher learning with the iPad

Stage 1: Learning from concrete experiences

This initial phase of learning was generally very concrete in nature and was firmly rooted in a practical and authentic context, rather than an external venue where IT training can be seen to be decontextualized and remote from real teaching. In this sense this first stage of learning can be seen to match Kolb's (1984) first stage of experiential learning whereby participants tackle a problem or issue at a concrete, rather than an abstract level, as shown in Figure 21 below:

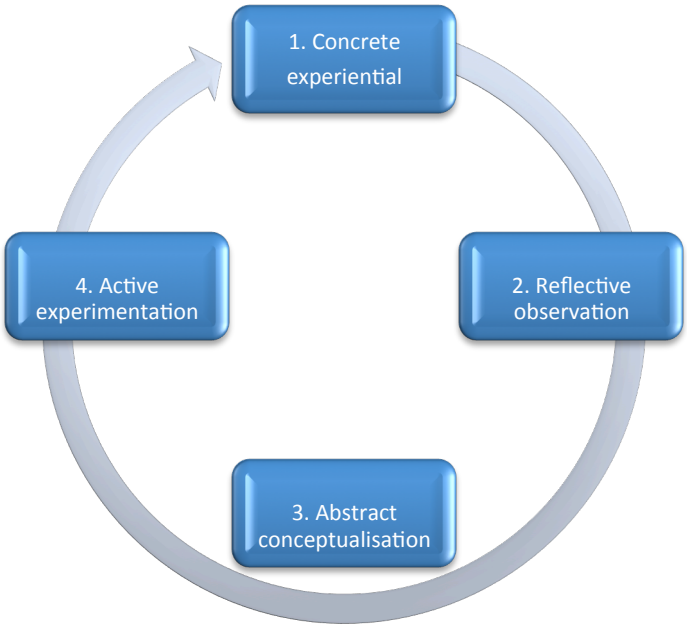

Figure 21: Experiential learning and iPad use (adapted from Kolb, 1984)

Stage 2: Reflecting and drawing conclusions on concrete experiences

In the second stage of Kolb's model (Reflective Observation) learners step back from their concrete experience of learning to reflect, think and draw conclusions centred on these 'concrete' experiences. This stage was evident in many of the pilot schools and also the 'recall' day which some teachers attended. It often manifested itself in informal conversations and discussions between teachers who would compare notes and apps, share their thoughts about what they had experienced and draw up plans to try out new strategies or actions based on these reflections. This tends not to be a formal or separate activity, or even something teachers consciously plan, but rather an emergent and somewhat unpredictable process when teachers happen to compare notes or share an app they have discovered.

In some schools, however, this was more structured since some of the teachers had been paired together for the duration of the pilot or formed an implementation committee as in the case of Bellshill Academy. Where teachers came from a culture of shared and joint planning the iPads were taken on board as another tool for collaborative learning:

> *"We share a lot of the planning of learning tasks and they are keen to be able to access the ones where we can use the iPads"*
>
> Class Teacher, Sciennes Primary

Whether by design or by accident this strategy was tremendously significant since it provided a point of reflection enabling participants to gain feedback and inspiration at an early stage in the implementation cycle. In several cases such as Sciennes and Gavinburn primary schools, this stage was also formalised to some degree as teachers maintained reflective journals and logs documenting their thinking and reflections. This was initiated by the University and the research requirements of the evaluation since it provided a valuable window on participants' evolving thinking and practices between formal visits or meetings. Whilst this was not common across all of the participating schools it was seen as a particularly powerful form of learning by those teachers who were able to sustain and persist with it, especially when they were trying to judge how far they had progressed. In both of these cases they also utilised the various features of the iPad itself to capture their reflections including the camera and audio recordings which enabled them to produce video logs of their reflections.

Stage 3: Applying a framework to clarify understanding

In Kolb's model of experiential learning the third stage (Abstract Conceptualisation) occurs when learners attempt to conceptualise a theory or a model to explain their experiences and reflections. This phase usually brings together the concrete learning by doing elements, along with reflection, and theoretical or conceptual inputs to enable learners to contextualise their own learning within a wider context. In the case of the iPad pilot this often did not occur immediately after stage 2 and sometimes it did not take an overt or obvious form. Rather it started to emerge as a series of 'theories in action' (Schon, 1995) whereby teachers start to describe their experiences and thinking to other colleagues, including those outside of the pilot group itself. This phase or stage of professional learning was predicted at the outset of the pilot when participants were given access and support to several theoretical models associated with technology implementation, such as the S.A.M.R model

(Puenteduera, 2012) and a model developed by staff from the University of Hull and the University of Technology, Sydney (Kearney, Schuck, Burden, & Aubusson, 2012). At the time of the launch event these models were not high priorities for participants but it is evident some of the teachers did reflect upon them later into the initiative enabling them to locate their own thinking and experiences in using the iPad within a broader framework, as the following extract indicates:

> *"Yeah, that's been an interesting one, actually. It* [the S.A.M.R model] *has made me think about how we've done things in the past and a lot of it, I guess, was substitution. And I think it would be easy to just think of it as substitution – you know what I mean? I think that's maybe what some people think of it as well. So it's an interesting model, I think – it really makes me think about where we're heading to. I think we are kind of in the middle. I would like to think we're heading towards the middle rather than just substituting. I think we are limited, again, with the technology just now – without the wireless, I think we're quite limited. I think we're now ready – we're confident to move on to the modification stage, but I think we're a wee bit held back."*
>
> Class Teacher, Kingswell Primary

Stage 4: Planning for the next step

Finally, in stage four of Kolb's model, the conclusions which participants have reached from their reflections and considerations of wider models, enable them to plan for change and the start of the next iteration in the experiential cycle of learning begins. In this pilot stage four became increasingly evident as participants and their line managers started to draw conclusions and plans for the next stage of the initiative which often involved extending the pilot to a new cohort of learners and teachers. In all of the pilot schools which were visited there was tangible evidence for stage four since every school had developed a plan of action to take the initiative forward, out of its pilot phase and into something more embedded and sustainable.

Kolb's model of experiential learning is not conventionally associated with professional development activities undertaken by teachers, or with initiatives where technology is a central feature of the change process. There are numerous models and ways of conceptualising professional development but experiential learning appears to capture much of the learning and development which teachers in this pilot experienced. It was not formalised in the style of traditional technology courses, nor was it situated outside of the school. Rather participants learned to use and become familiar with the technology through a 'playful process' (Crook, 2008) which was emergent, rather than predetermined and was frequently undertaken in pairs or small learning sets involving coaching and mentoring.

Virtual networks for teacher learning

Participants in three of the schools (Bellshill, Gavinburn and Sciennes) also made extensive use of the support mechanisms and expertise available via Basecamp, an online virtual learning network which was created for the pilot. Those teachers who overcame initial teething issues associated with any virtual environment found Basecamp and the communities of users extremely beneficial and were very positive in their praise:

"…I am thrilled that now Basecamp is open we have begun to have access to help and advice from our partner colleagues too. Xxxxx has been posting really helpful information. We have managed to get up and running extremely quickly and we recognise that part of the pilot is trial and error in exploring different solutions for work-flow."

Deputy Headteacher, Sciennes Primary

Where teachers failed to establish contact with the community within the first two or three weeks of the initiative they seldom joined it often citing pressures of time or complexity as their reasons for not participating as this extract indicates:

"I have been on Basecamp … I can see that there's some emails that are coming through where we can't do this and we can't do that and there's some suggestions, but you look at some of the answers that are there and you think, "Hmm, it sounds a bit too much for me. I need to see someone else about this."

Class Teacher, Kilsyth Primary

Communities of Practice and iPad learning

Regardless of whether it is facilitated as a virtual online group or a face-to-face event within or between teachers in schools, the pilot phase has constituted a form of situated learning which is community orientated and in this sense it bears strong similarities to the features of a Community of Practice (Lave, 1991; Wenger, 1998). A Community of Practice is distinguished by its domain, its community, and the practices it supports and in this pilot these were all fairly well defined and distinguishable. Wenger considers learning in a Community of Practice to be a process of participation as less experienced members, or novices, become active participants in the community, learning the various practices and conventions and gradually moving from the periphery, where they are deemed to be apprentices, towards the centre where they are eventually welcomed as experts. He describes this as a process of 'legitimate peripheral participation' and there are many parallels in this model with how teachers learned to use the iPad device for teaching and learning. Several teachers described themselves as novices and recognised how they had been supported in their own learning by the actions and support or a more knowledgeable other (Vygotsky, 1978) suggesting that 'scaffolded' learning was also important in how they learned to become experts;

> *"I don't know. I kind of watch X, who is way down the line compared to me. And there's some great things she's doing, I think yeah actually I could see myself getting there. I feel very much I'm still learning how to use it at the moment."*
>
> Primary Teacher, Sciennes Primary

Teachers and students as co-learners

Finally there is a need to acknowledge how much of this informal process of learning was collaborative between teachers and students who were often described as 'equals' in respect to their learning experiences. Many of the teachers in the study were prepared to admit to their limited skill sets, at least at the beginning of the pilot, and often acknowledged the support and role played by students. Even amongst some of the very youngest students in the pilot teachers were willing to invite ideas and often described how they had learned about new apps or features of the device from their students:

> *"And what I tended to do as well was to look up apps that were suitable for the children and then tell them about them. And they actually did the same – they would go home and say, "I found this app – can we try this one out?" So they really were quite enthused by everything."*
>
> Class Teacher, Kilsyth Primary

This collaborative approach to learning is partially dependent on the attitude and disposition of the teacher who must be able to acknowledge their role as a learner in this relationship rather than a teacher:

"I used a YouTube video to show them some of the basics of editing in iMovie but several groups were soon teaching me and the rest of the class how to do things like, increase the volume, add in an image."

Class Teacher, Sciennes Primary

"Learners experimenting at home has fantastic benefits in the classroom. We now know more about what particular apps can and can't do because the children have time to play with them at home. Learning then becomes even more of a partnership because they are teaching each other and me."

Class Teacher, Sciennes Primary

In some cases this collaborative approach to learning between teachers and students was recognised at a more formal level suggesting it is worth further consideration as a form of professional development. In Bellshill Academy, for example, the art teacher was observed concluding her lesson with the 'app of the week' activity in which students were asked to demonstrate and critique an app they had researched for homework. Bellshill was also noticeable, although not alone, in organising regular student forums where representatives from the pilot classes across S1 were brought together to share their experiences, providing teachers with valuable intelligence, from the perspective of students, of what had worked and not worked relating to the iPad.

The conclusions drawn are that:

- High levels of formal, lockstep training where participants learn at the same pace, are unnecessary and may actually prove counter-productive in encouraging teachers to use the iPad in teaching and learning.
- Teachers need access to the device on a personal basis, preferably before the initiative is rolled out into school, to 'play' with and become familiar with the device.
- Teachers will often learn how to use the iPad effectively in their teaching and learning through a self-directed experiential process which bears strong resemblance to Kolb's cycle of experiential learning.
- Teachers gain support, inspiration and confidence by working with another colleague or small learning set where they feel secure to test out ideas and share both successes and setbacks.
- The Community of Practice model is a useful lens through which to understand how teachers learn through participation, although the online variety may not be suitable for all learners.
- There are mutual benefits and gains when teachers and students learn together collaboratively and this democratic model of learning may be transferable to other contexts outside of the iPad pilot.

9. Discussion: Teaching, learning and frameworks for personal devices

Perhaps the key question to ask from this pilot is, '*to what extent has the use of the iPads impacted on the teaching and learning in the schools?*' with the corollary being *'and has this changed the teachers' concept of pedagogic practice'*? In this section we explore these important questions using a selection of popular conceptual frameworks identified in the general literature on technology adoptions. In the second part of this Discussion section we examine the findings in relation to the Curriculum for Excellence, highlighting obvious alignments and areas for future developments.

9.1 Existing frameworks

Two frameworks or models have been selected in this study to assess the impact of the initiative on teaching and learning. These are McCormack's and Scrimshaw's 'Conditions for ICT' (2001) and Puentedura's 'Substitution; Augmentation; Modification and Redfinition model, commonly referred to as the S.A.M.R. model (2012)[15]. For the purposes of this report these two models have been amalgamated to identify two key areas in which the use of iPads in the pilot schools has **Enhanced** or **Transformed** teaching and learning.

McCormick and Scrimshaw's model considers three ways of looking at technology use:

- As an efficiency gain.
- To extend the existing learning.
- As a transformational device.

Puenterdura's model considers the use of technology as a tool for:

- Enhancement.
- Transformation.

A combined version of these separate frameworks is presented in Table 8 below, illustrating the areas of overlap and difference.

15 See http://www.youtube.com/watch?v=lYXNGcjbNlc

	McCormick and Scimshaw (MS), (2001)	Puentedura - SAMR model (2011)
ENHANCEMENT		**Substitution**(technology acts a direct tool substitute with no functional change or improvement)
	Technology used to do things more **efficiently** (productivity)	**Augmentation**(technology acts as a direct tool substitute with functional improvement)
TRANSFORMATION	Technology used to **extend** the reach of teaching and learning/the task *(e.g. using the Internet to work with experts or other children abroad)*	**Modification** (technology allows for significant task redesign)
	Technology used as **transformational** device *(e.g. allowing you to do things that were (to all intents) impossible or impractical before the technology*	**Redifinition** (technology allows for creation of new tasks previously inconceivable

Table 8: Combining McCormick and Scrimshaw's model and Puentedura's (SAMR) model.

The following section provides a small but representative sample of data taken from the interviews with teachers and with students exemplifying some key aspects of the impact of the iPad in schools. Many more examples could have been given but have been omitted due to limitations in space.

A. **Enhancement**

Enhancement incorporates efficiency (MS) and covers both *Substitution* and *Augmentation* (SAMR). This level could be more simply described as doing what we already do but doing it better, faster, and more comprehensively. At this level the iPad is used to replace a conventional resource (e.g. a laptop or desktop computer) but the other factors in the classroom remain largely the same. This does not mean there are not important educational or other gains achieved at this level – one only needs to

consider the automatic functions of a digital register to see this - but it does not transform the underlying pedagogical patterns or characteristics of classrooms and learning.

In the following examples, selected from a variety of different school contexts, teachers and students explain how the use of the iPad has enhanced their learning, augmenting and helping them to be more efficient. Even in cases which might appear to be a straight substitution of technologies, there are often discernible 'functional improvements' leading to the conclusion that the 'substitution' level may not be applicable in the case of tablet computers like the iPad:

> *"The children are using maths apps to do, essentially, arithmetic problems. They see this as a game and so tackle it with great enthusiasm. If I asked them what 2 x 25 was they might struggle but in the game they do this with ease."*
>
> Class Teacher, Chryston Primary

> *"The overall look of the work the children produce has been fantastic. Some have been really innovative in how they have used the iPad both in school and at home. Children who would struggle to get much down on paper have had great results when using the iPad."*
>
> Class Teacher Survey, Bellshill Academy

> *"I had the children doing one of the spelling games one week and the kids loved it because each time it asked them to spell a word, it gave them a different way to do it. They were either to type it in, or they were to swish the letters up, or they were to… whatever it was, and they loved it. And I felt that was good because each time they were seeing that word formed correctly in front of them, it wouldn't let them get it wrong. They had to get it right."*
>
> Class Teacher, Sciennes Primary

It is too early to determine if these impacts are only temporary or "Hawthorne" effects, however even a short term gain in a key skill such as the acquisition of number bonds or developing writing is important. Additionally there is also the gain in the organisational aspects of the classroom where the teacher is able to spend more time working with the students who need help and less time on functions which can be automated by the software such as the marking or routine arithmetic problems. In mathematical aspects the software and the devices are able to take away the lower level skills and leave the teacher to operate the higher-level skills such as dealing with misconceptions and problem solving.

A noticeable enhancement level impact of the iPad, reported in several schools and interviews, is the ways in which it replaces the need for existing resources such as printed materials in reference books and/or photocopying worksheets. Teachers and pupils alike have seen the 'efficiency' benefits of using the iPad in this way such as the secondary teacher who has "gained an hour at the beginning of each day by not being in the photocopying room" [not to mention the saving in cost and paper], and the pupils who have access to materials for their homework and so are able to develop higher order skills in research and information processing. However it is personal ownership and the simplicity of use, especially touch gestures operations, that make the tablet and the applications a key driver for change and improvement over previous computer technologies even using similar software

"I've worked with children on music and GarageBand for about four years now and we've used the MacBooks and they've all been around the one MacBook and trying to do it. They've produced brilliant work but it's been a long drawn-out process and it's quite exhausting and you need to go and try and help them with it, and without actually stamping on their creativity you need to sit and try and help them organise themselves; it's quite difficult. They'd done their songs in here in a day and a half, not even a day and a half – that's with all the input. And what they'd produced was just phenomenal. And they'd been using the jamming sessions in GarageBand so they were all engaged; they were all involved in it rather than being crowded round this one laptop."

Class Teacher, Gavinburn Primary

Research is a key skill for all students, helping them to develop the ability to access and process information, but resourcing this in classrooms can be difficult and expensive. Many of the schools in the pilot were engaged in project based learning[16] or topic based learning where a core component involved research into the topic. For example one of the primary schools was investigating, as part of a topic based on the jubilee, aspects of the six decades of Queen Elizabeth's reign. The teacher remarked on how the devices enabled her to set research tasks for the students using a number of sites she had identified knowing that all the students would have access to all the resources without the need for extensive photocopying. This 'unfettered' access to the Internet is not without issues and challenges and teachers are having to adapt their teaching approaches in order to ensure students have skills in filtering and checking information and not taking information at face value. For many this is seen as an important learning outcome in itself, developing a key set of digital literacy skills including critical reflection and evaluation and even as a tool for promoting reflective dialogue in the classroom:

"What I am trying to get through to the children is you can't always believe what you read on the Internet. Somebody came to me with a random fact the other day, and it was wrong. I cannot remember what it was. 'No that is not right, what makes you say that?'. 'Well that is what it says on this.' I said, 'remember I said you can't always believe everything you read', so I am trying to teach them to maybe take a few sources if they are looking for something don't just take the first web page you find. Look at a few different pages and then use your judgement for which one you think is correct, and are there more than two or three that say the same thing?"

Class Teacher, Primary School

The iPad gives access to a wide range of resources on-line and whilst, as noted above, this opens up the discussion on critical evaluation, students find this a significant enhancement to how they previously learned:

"You can research information much faster and much more easily; you can zoom in on it so it's clearer; you can copy and paste pictures to it, just really fast; and you can get on to the web easier, and stuff like that."

Student, Greenwood Academy

16 This is sometimes referred to by other terms such as Challenge based-learning (see http://www.apple.com/education/challenge-based-learning/).

Homework is another area where teachers, students and indeed parents, reported benefits associated with the use of iPad which fall into the 'enhancement' category. Teachers and parents were both convinced students were more likely to complete homework and to a higher standard when using the iPad :

> *"As I said, the homework, it is a lot of children who I maybe struggled to get written homework from before, are doing their homework now. And I am receiving pieces of homework from children that are well thought out, they are well presented, there is a little bit of extra effort into it, as well, from the more able children."*
>
> Class Teacher, Chryston Primary

In a number of cases teachers were conscious of the fact they had used the iPad as a substitute for an existing technology (e.g. the PC in a computer room) and had not necessarily transformed their pedagogical practices, although they all had aspirations to do so. Even so there were evident benefits associated with even this relatively low level of transition including greater motivation, interest and engagement, which in the example below is associated with the authentic and realistic nature of the task set by the teacher:

> *"Aye, like we've substituted getting everyone along at a PC...it's more about like when we're learning about speed, distance, time it's the dullest thing in the world doing examples out of a book. You know Johnny was walking to school, it's so dull, but when you say to them, "Do you think that Usain Bolt would be faster than a greyhound?" or something you know like then they want to know. And so it is enriching it but it's still using them [the iPad] as ... we're still going online, we are substituting them for a computer."*
>
> Class Teacher, St Kentigern's Academy

Personal ownership of the device and the fact that students have ubiquitous access to a computer also enhance the learning experience for many students, even if this does not transform their learning approachas such:

> "*It's like kind of your iPad so you can – it's yours, so you can do what you want to do, obviously what the teachers says but you can do it in your own kind of way and pick what you want, like what app you want to do it in instead of them just like "You write on a piece of paper". You can pick what app you want to do it in."*
>
> Student, St. Kentigern's Academy

Where the personal ownership model was not adopted, or where devices were dispersed across classes the reverse pattern was evident. In these cases students were prevented from determining when, and when not they would use the iPad and this appears to impact negatively on their attitudes and work.

> *"It was better when we were all in the one class because all the teachers, everyone in the class, had an iPad so they were teaching using the iPad. But now that you've spit*

up it's about two people in the class have an iPad and the rest don't, so they don't really use it as much to teach. So it's completely different."

Student, Secondary School

Summary

Even at the level Puentenduera would define as 'enhancement' rather than transformation, the impact of the iPad is considerable and it is clear the device makes the classroom a more efficient pedagogic place. This has had significant impact on the attitudes of the students to learning allowing them to develop in some key skills areas as autonomous learners and self-managers of their own learning. Also the way the device acts as a modifier of classroom behaviour cannot be underestimated:

"I think they did about forty minutes of actual writing time and every child was engaged in the activity. I got round so many of them; you'd never get round the whole lot in one lesson. You kind of have to bounce about, but I got round to so many of them yesterday because I didn't have any behaviour management stuff going on."

Class Teacher, Sciennes Primary

B. Transformation

The second level of change in this adapted framework is considered to be discernibly different from Enhancement and can be described as broadly transformational in nature, consisting of two separate levels:

- *extending* (MS) or *modification* (SAMR) in which the device is used to extend or modify the task undertaken by the student or the teacher
- *transformation* (MS) and *redifinition* (SAMR) enabling the learner or the teacher to do things which were previously impossible or even inconceivable without the technology

Extension and Modification

In this section these sub-categories are treated as one and the discussion is centred on degrees of transformation as examples from the study are used to illustrate how these emerging technologies are set to challenge existing paradigms or World-views of teaching and learning.

'Brushes', an application used extensively by teachers in both the primary and secondary pilot schools, exemplifies many of these transformational opportunities, enabling learners to extend and modify their normal practices, and in some cases to undertake activities which would previously have been inconceivable at the school level. At the simplest level the ability to revert to a previous version (the 'undo' feature) when an error was made gives all students the opportunity to experiment, play and take risks which are essential for creative learning. More importantly the software enables students to capture an image of a person using the camera feature which can then be converted instantly into the outline of a face and can be used as a template to develop their art ability. The

results were seen to bring about marked improvements in both the students' attitudes to, enthusiasm for and results in, their artwork.

> *"You already know about the art competition that they entered during the jubilee … and that took the children quite a few weeks during their art lessons, working through it, and learning how to use the 'Brushes', and we had some stunning results with it."*
>
> Class Teacher, Chryston Primary

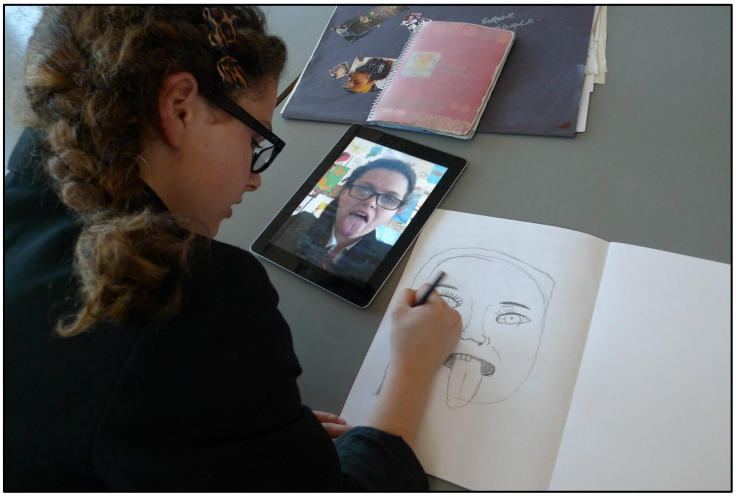

Figure 22: Student using 'Brushes' in art (Bellshill Academy)

The opportunity to use the iPad in creative subject areas like Art was recognised by some teachers as a significant factor in enabling them to undertake learning activities which would previously be difficult, if not impossible, in the context of a classroom:

> *"I found 'Photo Booth' and 'iMovie' extremely useful as it gave pupils a chance to try stop motion and cutout animation which logistically would have been much more difficult without…*[the iPads]*"* Art teacher, Bellshill Academy

Similar benefits were described by teachers who identified how personal ownership of a device provided to all students through the school transformed opportunities and equity issues associated with learning in the home where access to resources and tools could not previously be guaranteed:

> *"We are doing an art task for homework, and it was to draw a picture of the Queen on her Coronation day. Now I have been able to upload some pictures of the Queen onto DropBox for them, and they have been able to use them at home. It is not something I could have done before, it would have been paper, paper, paper, send home pictures, but they have got that access there at the touch of a button, and they can take that onto the art app and play about with it."*
>
> Class Teacher, Chryston Primary

> *"The parents can see their kids' work at any time because it's there on the iPad and I quite like that. And I think there's a few of the parents getting into that now and quite liking that."*

Class Teacher, Sciennes Primary

The device also provides opportunities to scaffold and customise the learning of students across a range of abilities using built in tools such as dictionaries, thesauri and text to speech apps, meaning that students who might previously struggle to access text are able to use the device to aid and support learning in other ways - something that would otherwise need considerable teacher time or that of a teaching assistant.

> *"Now I have a group of little young boys who are in the worse reading group, and usually they fly out the door as soon as the bell rang, and they sat and they sat and they sat and I was like 'Are you going out for behaviour treats?' 'Can we just stay in and finish this?' Now that is not something I would ever have expected, they would have been away but because they are getting to work on the iPads and it is taking away the strains of actually physically writing things, and it has taken that away from them and they are able to put in what they know without actually having the physical act of writing, which I think for some children is quite a lot."*
>
> Class Teacher, Chryston Primary

In a number of the classrooms the device was seen as a developer, encouraging student engagement in focused talk and conversation, or what Alexander (2008) would term constructive dialogue:

> *"So one of my boys might go over and he wants to show what he's done to his pal; he's not wanting to go and talk about the football or what he's doing at the weekend, he wants to go over and show the piece of work to his friend or ask how he's done it or ask "How you do that again?" And I kind of feel like there's a lot of discussion generated between the pupils but it's all about what they've been asked to do, it's all on task; it's all with a purpose rather than it just being that they're bored and they want to have a natter whilst trying to do their work."*
>
> Class Teacher, Gavinburn Primary

Transformation and Redifinition

The previous examples illustrated how the iPad has been used in some cases to extend or modify the learning task, environment or context, enabling students to learn differently and more effectively, not just more efficiently. Beyond extension lies a new level – allowing student to do things that would not previously have been possible or even conceivable in the school setting. Here the technology becomes transformational (MS) refining (SAMR) rather than simply modifying the experiences of the student or the pedagogical repertoire of the teacher.

The most prevalent example of this level, evident across both primary and secondary phases, was the use of native features and software (e.g the camera tool and an app like 'iMovie') to generate and construct multimedia artefacts such as a short video trailer or an animation as evidence of learning, a task which was virtually inconceivable as a standard classroom activity for all students previous to this technology:

"Children were making videos to showcase Scotland they were able to use stills, music and moving images to create their own "come to Scotland" video adding captions, voiceovers and credits. The quality of the finished products filled the children, and their teachers, with delight. They were able to create something that would not have been possible before. The mobility, power and flexibility of the table device contained in a single unit and with the power to share and collaborate with others put the power of a movie studio into the hands of 11 year olds."

Class Teacher, Gavinburn Primary

There are a number of factors at play in this scenario and others like it from across the pilots. Firstly it is the simplicity of the tool itself, which requires minimal formal instruction from the teachers and enables students to construct a high quality multimedia resource in a fraction of the time taken to produce an equivalent artefact previously and using a single device rather than a combination of devices (camera, editor, producer):

"My pupils and I am sure it is the same for any other pupils in any school, they just pick these things up and run with them."

Class Teacher, Chryston Primary

Secondly, it is the ability to focus on the core skills of any given task involving multimedia, ensuring students are not unnecessarily distracted or detained undertaking 'secondary' tasks, such as adding captions or special effects. The low cognitive entry level of the software in many of these apps (e.g. 'iMovie') ensures all the students are able to complete their allotted task and the 'special effects' are not left just to those students possessing higher level graphics skills. However the sophistication of the device also allowed for "auto differentiation" giving those with the higher graphics skills more options. All the students were able to produce items, which had "value and relevance" for them and for their peer group - some of the key factors in the production of creative work of this nature:

"Although I have said that there is some improvement in attainment I do believe that for some children there is a huge improvement. These children now have fantastic IT skills and many have shown a real creative streak during the past few months. They are brimming with confidence and have learned that they can experience success in their learning. The way they have worked together and encouraged each other has been a real pleasure to see. I would not have seen this if we had not been part of this project."

Class Teacher, Bellshill Academy

Transforming the dynamics of the classroom

There are signs across some of the pilot schools to suggest how the availability of a personal Internet enabled device, controlled mainly by the student not the teacher, is changing the traditional dynamics and pedagogical patterns of the classroom, in ways which are considered to be transformational. Some of the more innovative applications which are being used in the pilot schools enable the teacher to customise the feedback and advice they provide to students, enabling them to move towards a more personalised learning environment which is more student centred than was previously possible. A good example is the application '*Screen Chomp'*, and others like it such as '*Explain Everything'*, which were designed to enable users to produce short screen recordings on

their device overlaid with a personal commentary. A number of innovative teachers in the pilot schools have appropriated this tool as a mechanism for providing highly individualised and personalised feedback on student work which they can listen to and see, thus increasing their involvement of the feedback process as explained in the following example:

> *"... before I would have maybe sent a worksheet home and they would just complete it and send it back to me. But if I put the worksheet on 'Screen Chomp', then they can do the worksheet on 'Screen Chomp' but record themselves while they do it, and explain what they are doing to me, so I can see where their understanding is, and I can see any points that they are not understanding. And I can also, when I am marking it when I am talking to the children after, I will be able to give them more direct and targeted feedback because I will know exactly where they have gone wrong with things. I think that has been a big change in being able to do that."*
>
> Class Teacher, Chryston Primary

In this case the teacher is encouraging students to use the application on their own iPads to complete the work, which is then 'marked' using the same process. This detailed level of feedback would not have been possible previously without multiple and expensive equipment sets, or through the teaching sitting and talking to each student. In recording the feedback, and involving the students themselves, the technology provides an extra dimension, which is transformational.

It was not just the use of movies but also the production of music where the ease of use of the device combined with the creativity of the children produced work of transformational value:

> *"I think GarageBand is good for making songs on and you can loops on the song for making different tunes. I couldn't have done it with out the iPad because I can't play these instruments in real life."*
>
> Student Log, Gavinburn Primary

Figure 23: Gavinburn Student's Log – image from GarageBand

Similar transformations in practice were beginning to be evident in classrooms where teachers had experimented with the AppleTV, or similar software, enabling students to present their work without moving to the front of the class, and teachers to circulate around the class, working with groups of students whilst also presenting. These approaches enable the teacher to move from centre stage where technologies such as the interactive whiteboard have often restricted their freedom to move around and interact with students:

> *"… it kind of takes me, I think, from being there at that whiteboard – I find that I am round the room much more than maybe I would have been before…but I do think now, when I'm teaching, it's like, "Okay. Everyone do this on their iPad" and it will be… It isn't just me standing at the front saying do this – it is wandering around. But they can also… Because the iPads are so portable, they can just take them all down with them – we can do stuff… We do a lot of stuff focused – we sit down, they sit on the carpet beside me, so we can do stuff there."*
>
> Class Teacher, Kingswell Primary

This change in the nature of learning in the classroom has, in the opinion of this teacher, also brought about a transformation in the relationships between the teacher and the class and encouraged the children to become more engaged in critical appraisal of each other's work.

The personal aspect of the device as a vehicle for transformation must not be underestimated and most of the schools in the trial emphasised the importance of the students having their "own device". In many of the schools students were allowed to personalise the device by installing their own screen savers or desktop pictures as well as installing free apps from the apps store. This sense of ownership undoubtedly contributed to the lack of problems with damage or theft even in schools where there had been initial concerns over such things, but the device in order to be efficient must belong to the individual child as one teacher commented:

> *"It doesn't work if it's shared because all the good things that happen, happen because it's yours and you're taking it home and you're using it and then you're adapting and you're taking the different things. And you're getting so used to using it that you can use them across the different apps and you can have that bit of personal choice."*
>
> Class Teacher, Bellshill Academy

The core redefinition that is taking place is the relationship between the teacher, the learner and the learning. The device is, in many of the classrooms, reshaping the nature of learning that is taking place by giving the student more control of the learning and redefining the role of the teacher:

> *"I don't feel like the learning has to come from me. You do feel like more of a manager of the learning rather than being the learning tool."*
>
> Class Teacher, Gavinburn Primary

This notion of 'ownership of their own learning' is a recurring motif in the data set repeated by many teachers who have detected a significant shift in terms of student responsibility for learning. It is probably still too early to estimate how far these effects are related to the novelty value of having a

personal device and further longitudinal studies will be better placed to track this feature. Nonetheless, for some teachers in the pilot, such as the one below, this has been a transformational experience which, they claim, transcends the novelty factor:

> *"...it's very hard to gauge impact on attainment in such a short time but I think the novelty factor wore off some time ago and the kind of interaction the children are having with each other and the teacher is different in a positive way. They have ownership of the learning and can customize their experience within a shared environment; so the class can be working together, in groups and individually all at the same time with no barriers or boundaries to where the learning can be taken."*
>
> Class Teacher, Bellshill Academy

Due to restrictions in space this report has only quoted a small proportion of the examples from the work observed and reported on in the pilot schools visited. There is no doubt that the teachers, and more importantly the students, were excited, motivated and inspired by the iPad and the possibilities for learning it offered. It is not possible in the short time that the survey was running to show causal links between achievement in attainment scores and the use of the device but it is possible to show the positive impact on the teaching and learning in the classrooms and some of the core elements of this.

In summary, therefore, the following conclusions are made with regard to this pilot phase and issues for further consideration.

Summary

A combination of a range of things was allowing transformational learning to take place in the classroom:

- A device which is intuitive to use and which combines a range of functions in a single package.
- A portable, always connected device which allows the pupils access to all the resources that they need wherever they need these.
- A redefinition of the relationship between learner and teacher where more responsibility for learning moves to the learner and the teacher becomes a co-facilitator in learning.
- The options for choice by the learners – so they can be more directive in their own learning.

A summary of some examples of practice

The table below gives a summary of some of the ways in which the devices have been used in both teaching and learning during the course of the pilot study. This is only a sample.

	McCormick & Scimshaw [2001]	Using iPads for teaching	Using iPads for learning	S.A.M.R model [Puentduera, 2011]
Enhancement			• Using a simple app (e.g. Fractions) to do fractions • Using the word processor / notes to develop writing skills • Reading text from iBooks or eBooks • Completing worksheets on the device	**Substitution** (technology acts a direct tool substitute with no functional change or improvement)
	Technology used to do things more **efficiently** (productivity)	• Sending materials to the pupils to use in class via drop box or another cloud medium • Using the big screen to demo apps and functions to the children • Encouraging the use of the device for "everyday" tasks e.g. calculator, dictionary	• Being able to do research using resources stored on the device by the teacher. • Using art packages on the device that allow for correction and overlap of images and art functions • Using music apps for composition • Using "everyday" apps such as the calculator and dictionary • Using the cameras to take a picture of the exercise book so they have it with them	**Augmentation** (technology acts as a direct tool substitute with functional improvement)
Transformation	Technology used to **extend** the reach of teaching and learning/the task *(e.g. using the Internet to work with experts or other children abroad)*	• Changing the nature of homework moving from directed to developed tasks • Engaging parents in out of school learning opportunities • Giving children freedom to chose the "how" of task completion	• Sending work to the teacher through the device for marking easier and quicker • Being able to personalise your learning device with the apps you want and like • Using game apps as part of learning • Overlaying music and photos to make multimedia presentations • Developing critical thinking skills through research skills	**Modification** (technology allows for significant task redesign)
	Technology used as **transformational** device	• Using the Apple TV to enable collaborative presentations through the device • Developing independent learning	• Having greater freedom to select the way you approach a task; how you produce it • Making videos or animations in and on the device itself (all self contained) • Being able to access the Internet, take a picture and share it with other instantly, anywhere • Using apps to plan and manage independent learning tasks	**Replacement** (technology allows for creation of new tasks previously inconceivable

Table 9: A summary of examples of practice for teaching and learning.

9. 2 Curriculum for Excellence and personal devices

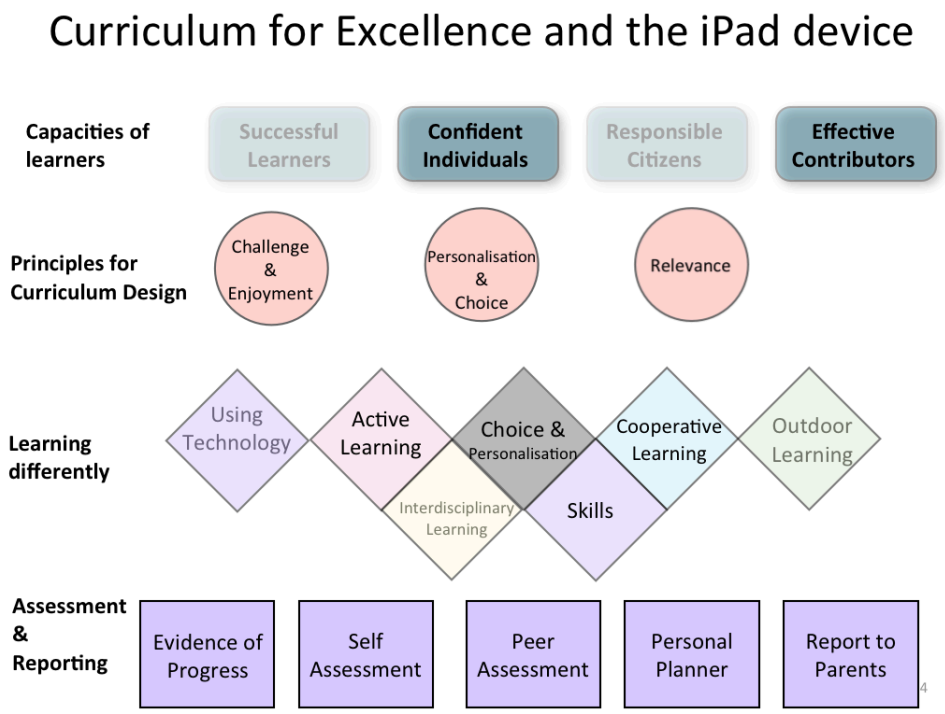

Figure 24: Key elements of Curriculum for Excellence and mobile devices

It was evident, even from this relatively short pilot study how teachers, students and their parents were using the iPad device in ways which matched many of the core elements of Curriculum for Excellence, or in ways which could be easily modified to do so. This final section of the report illustrates some of these examples, highlighting a number of directions and possibilities for future developments in this respect.

The Curriculum for Excellence framework aims to transform the learning experiences of young people in Scotland by providing a more flexible and enriched curriculum offering which addresses the totality of experiences, both within and beyond the formal boundaries of schooling[17]. It identifies four broad Capacities for every student to achieve during their time in school, along with Principles for Curriculum Design, ideas to encourage 'different kinds of learning', and various strategies for encouraging teachers, students and their parents to use assessment and reporting as dynamic tools to underpin progress and achievement. These various elements are shown in Figure 24 above which is used in this report to highlight how the effective utilisation of a device like the iPad can enable learners to achieve many of these aspirations.

17 http://www.educationscotland.gov.uk/thecurriculum/whatiscurriculumforexcellence/index.asp

Four capacities for learning:

Curriculum for Excellence identifies four capacities for learning which all students should develop during their time in formal education in order to be lifelong learners:

- To be successful learners
- To be confident individuals
- To be responsible citizens
- To be effective contributors

There is evidence presented in this report to show how all four of these capacities have been addressed and strengthened by students use of a personal device during the pilot phase, but two of them in particular - *confident individuals* and *effective contributors* - stand out from the data which was collected in this study.
There is a palpable sense, expressed throughout the report and data which was collected for the study, in which teachers, students and their parents acknowledge the difference which ownership of a personal device has made in terms of confidence, self-assurance and associated attitudes and behaviours including independence and agency. In all of the schools visited teachers highlighted the growth in confidence they had witnessed when students used the iPad as a device to present original work to their peers, or to undertake a complex problem or task with which they would previously hesitate and require help.

Parents also referred positively to this in the exit surveys. Most importantly, it was evident to the students themselves who frequently reported in focus groups how the iPad encouraged them to share their work more often because it enabled them to produce work which they were more proud to share with others:

> *"The iPad is a great piece of technology for basically everything. It has made me a lot more confident with showing my work on the Apple TV."*
>
> Student, Chryston Primary

The other capacity for learning which was abundantly evident is the role which personal devices of this nature play in enabling students to be effective contributors. Students used the iPad to contribute in many different forms but the example which stands out most prominently is the creative use of the device to contribute to the growing volume of user generated content available for others to access and enjoy. In both primary and secondary schools students utilised these personal technologies to construct, often in a social context, a wide variety of digital resources such as short movie trailers to teacher younger children or animations and presentations to demonstrate their understanding. These resources are available for others to watch, share and in some cases, re-use, and these forms of learning are underpinned by a philosophy which emphasises the role of the student as a contributor and producer of knowledge, rather than simply a consumer.

Principles for designing the curriculum

The findings from this report have repeatedly emphasised how the personal ownership of a device like the iPad impacts on learners in terms of enhanced motivation and enjoyment; increased levels of personalisation and choice, and greater relevance and authenticity in the tasks and contexts students are set to undertake. These findings map closely with at least three of the principles for curriculum design described in the Curriculum for Excellence, highlighting an important area for further investigation and development.

Students, teachers and parents unanimously identified enjoyment and motivation as the most compelling benefits of the iPad pilot, but they also refer to 'challenge', for example when the teacher sets students to explain how they solved a complex problem in algebra using a screen recording app like *'Screen Chomp'*. The emphasis in examples like this is process orientated and students are required to use their device to show how they reached a solution, not just finding the correct answer. Using multimedia resources and apps to construct a movie trailer, an animation or a screen-cast is no less demanding a challenge than traditional pen and paper approaches and many participants in this study would contend it is actually more, not less, challenging.

Personalisation and choice is a thread which weaves its way across this entire report, emphasising how access to an Internet capable device equipped with powerful construction tools, enabler learners and teachers to have a far greater degree of agency and choice in how, when and where they undertake learning.

By its nature learning inside school is a practice field and will always be some way removed from the World and context in which young people live and eventually work. Technology offers a means by which this gap between school-based learning and learning in the real world can be bridged, or at least narrowed. The report has illustrated how teachers used the iPad to set more realistic tasks and activities in less contrived contexts and situations. In several cases teachers used the device to tap into external expertise or authorities who were able to support students in their learning, making the process more realistic and also more motivating. Authenticity has been highlighted as one of the most significant affordances of m-learning (Kearney et al., 2012) and this study has started to pinpoint how personal ownership of a mobile device can help to make school more realistic, bridging the gap between formal and informal sites of learning.

Learning differently

In aspiring to transform the learning experiences of young people across Scotland, Curriculum for Excellence encourages schools and teachers to explore different learning approaches to enable students to develop skills, knowledge and understanding in more depth and has prioritised the use of technology in order to develop Successful Learners. Technology played a central but not deterministic role in this pilot study since schools and teachers were primarily guided and focused by pedagogical aspirations. These pedagogical foci cover all of the areas identified in Curriculum for Learning as 'learning differently' including:

- Active learning.
- Cooperative learning.
- Interdisciplinary learning.
- Outdoor learning.
- Personalisation and choice.
- Higher order skills and competencies.

Each of these approaches to learning was evident in varying degrees during the pilot phase and each is associated closely with the use of a personal mobile device.

Active learning

Active learning was a fundamental tenet for most schools and teachers who participated in the pilot since they perceived personal ownership to be a powerful lever for shifting much of the responsibility for learning from teachers to students. Learners used the Internet access and tools available on the iPad to undertake a host of activities and tasks which teachers would previously undertake or be required to 'deliver'. This includes the necessity to read from one text book, to focus on one interactive whiteboard screen and to have resources already available and photocopied. These restrictions are less prevalent when every student has their own screen and is granted the autonomy and agency to make decisions for themselves.

Cooperative learning

Despite some concerns about students becoming more isolated and nomadic in their learning when they are all given access to an individual mobile device, the findings from this study indicate this is unfounded and students actually work more collaboratively and socially together, with the iPad acting as a mediating tool for conversation, discussion and sharing of resources. Many of the activities and tasks which teachers devise for students are more collaborative in nature and many of the apps and tools on the iPad, such as a games app like 'MineCraft', encourage social interaction and cooperation. The duration of the study was too short to equate these changes with any quantifiable learning gains but teachers and parents were convinced these had been some of the most important changes they had witnessed, enabling classrooms and the wider environment to become more collaborative and community focused.

Interdisciplinary learning

There was a limited amount of evidence in the data to suggest interdisciplinary learning is set to expand and grow when teachers and students recognise the benefits and opportunities of a personal device like the iPad which carries their learning across and between traditional subject barriers. In Bellshill Academy for example, the lead teacher who was a modern foreign language expert, reported how students and teachers were beginning to draw upon the work undertaken in one subject area to inform activities and learning set in another. He associated this change with the iPad which acted as a single portfolio of student work enabling them to draw upon resources quickly without the need to carry around separate volumes for each subject area which inhibited interdisciplinarity:

> *"And I think, also, from a certain point of view, it's also interesting to see how… I suppose it's that curiosity thing; how what they're learning in a different subject, or an app they're using in a different subject can then be transferred across the board, or into different things and freeing up… I think Curriculum for Excellence at this moment in time within Scotland is all about freeing up as much as possible. Giving pupils more choice, more options, more ability to move on. And I think part of it was to see, from my point of view, whether or not this or the iPads would actually do that. Would they open up opportunities? And I think it's, as you saw today, within the classroom, it does…"*
>
> Lead Teacher, Bellshill Academy

Such practices may be more common in the primary phase where subject specialisms are less likely to serve as a barrier to integrated learning but even here it is apparent that students are more likely to see learning in an holistic fashion if they are given more responsibility and choice for how and what they learn.

Outdoor learning

Outdoor learning is not actually a new form of learning but it is a context for learning which schools do not always find easily accessible. Technologies like the iPad, and even more so the iPod Touch and other mobile devices, are set to expand the opportunities for learning beyond the school gate and these opportunities are closely aligned with the drive to make learning more relevant, realistic and authentic. In this study most students were able to take their devices home and many did use it for learning purposes, mainly in the home, as described in previous sections. Use of the device for learning in the Third Place (where school is the first place and home is the second) was less well captured and it appears teachers have only begun to conceptualise how they could maximise opportunities for learning in this space when students have access to a personalised device like the iPad. Unlike a mobile phone, however, the iPad has no connectivity to the Internet when it is beyond the boundaries of the school or home Wi-Fi, unless it is fitted with a Simcard which none of the devices in this pilot featured. This may limit some of the opportunities for dynamic real-time data capture or GPS tracking which many out of school apps depend upon, but it does not render the device unusable in outdoor contexts and some students described how they use it for reading or watching movies whilst travelling to school, or to capture pictures and sounds whilst out on a field visit. The full potential of this aspect of learning outdoor with a mobile device such as the iPad is yet to be understood but this report identifies it as an important and urgent recommendation for further inquiry and development.

Higher order skills and competencies

Curriculum for Excellence emphasises the development of key skills for learning and for life, with a particular focus on higher order skills such as thinking skills, meta-cognition, problem-solving, creativity, critical thinking, developing arguments and decision making. Space precludes a detailed examination of all of these skills and their individual components but it is important to note how many and how frequently they were referenced by teachers, students and parents during the pilot, which suggest personal ownership of a mobile device can support and enhance the use of these skills both within and beyond school. Again, this will be a fruitful area for further inquiry and development as teachers and students become more familiar with the potential of the device.

Assessment and Reporting

Effective feedback for learners is widely acknowledged as being amongst the most significant mechanisms in the learning cycle (Hattie, 2008). Curriculum for Excellence recognises this along with reporting to parents as key elements in a holistic approach to learning which attempt to balance the normative assessment demands of society with more student friendly approaches such as criterion-referenced and ipsative assessment methods. There were indications and evidence collected in this pilot which signpost a number of directions for further exploration around the use of a personal device like the iPad as both a record of progress and a tool for more personalised feedback and assessment.

Several teachers in both the primary and secondary pilot schools, for example, explored ways in which the iPad could be used as an assessment tool by both the teacher and the student to provide a greater amount of detail, personalised to the individual student, around their performance, in ways which could not otherwise be achieved. One example, which has been cited previously, is the use of screen recording apps (e.g. 'Screen Chomp' and 'Explain Everything') which enable the teacher to use the camera and audio capability of the iPad to give multimodal feedback related to a specific piece of work which the student can watch and revisit again at his or her leisure. These teachers believe this kind of formative feedback is more meaningful for students than traditional written annotations, and it is particularly effective when students and their peers are encouraged to use the app and the iPad themselves to critique their own work.

Similar results and effects can be achieved when students use their iPad as a portable voting device (see for example the app 'Socrative') enabling the teacher to gauge the level of understanding across a class instantaneously, before moving on to focus on areas of misunderstanding or weakness. Students themselves discovered how they could use the various notation tools in the iPad, including the camera and audio recording, to keep records of their own progress which were integrated with their work rather than separate from it, as may be the case in a traditional record of achievement.

Additionally it was evident from the parental data reported previously that students are more willing to share their school work at home when they use the device, and this suggests it could form a more naturalistic way of reporting to and informing parents about their children's progress at school, without the need for additional, and time consuming paperwork.

There are signs, therefore, which suggest the use of a personal device like the iPad, which accompanies students across their various sites of learning (including the home and other Third Places), can play a significant role as an assessment device and as a record of progress. Apps already exist which turn the iPad into a school planner (see for example 'iStudiez Pro') and it is highly likely these will expand to include many of the aspects of assessment and recording as set out in the Curriculum for Excellence framework. If the initial results and explorations undertaken by teachers and students in this pilot study can be replicated and expanded there is a genuine opportunity to harness technology for effective and personalised assessment and reporting.

Summary for this section

The availability of a personal mobile device like the iPad enables learners to take greater control and responsibility for their own learning and presents teachers and curriculum planners with rich opportunities to re-design learning experiences to take account of these multiple learning affordances. As a framework guiding educators in Scotland, Curriculum for Excellence offers considerable scope and freedom to design learning opportunities for students which are naturally aligned with the affordances of mobile devices including greater personalisation, choice, creativity, collaboration and learning that are situated in realistic activities and authentic contexts. This section has identified how many of these elements which constitute Curriculum for Excellence at the highest level are currently being achieved and developed by teachers through the creative application of a personal device with the various apps which are currently available. It is recommended that a more extensive mapping exercise of this nature is undertaken to verify and extend the findings in this study and to explore how teachers, curriculum planners and app developers might jointly advance this agenda.

10. Conclusions

Each section of the report has drawn its own conclusions and these concluding remarks should be considered alongside the Executive Summary and Recommendations. In this section we return to our original research questions for a short commentary on each of these. For further details on each of these please return to the main sections in the report.

What does learning and teaching look like when students and teachers have access to a personal tablet device?

Whilst we cannot, in this short study, offer any casual links to academic improvement we are confident that we can demonstrate that the iPads have had a profound impact on the teaching and learning in the classrooms where the devices have been deployed.

Teaching and Learning with the iPad change the nature of the relationship in the classroom: learning becomes more student centred and student friendly releasing the creativity of the student. The myriad apps that are available allow students to work independently, in groups and as part of the whole class, developing a range of knowledge and skills.

The use of the device blurs the boundaries between formal and informal learning making creative processes more possible.

An important factor was the possibility for the redefinition of homework and how this could be developed into work which allowed both the creativity and independent work of the student to be developed as both the technical resources and knowledge content could be made available for the child.

How does personal ownership of a tablet device by students impact on parents and carers?

Whilst there was a range of opinions expressed by parents, the significant majority found that the device was a strong motivator for the child in the completion of set work, in the development of homework and perhaps most significantly in the encouragement of self-motivated learning and use of the device. Parents found that the device helped to bridge the home school divide and found the device had a positive impact on the child's attitude to learning and the quality of that learning. A minority were concerned about the need to restrict usage of the device, especially for younger students.

What are the leadership and management implications associated with the shift to a personal device strategy for schools?

The management of information flow is a key area. In the early stages of this trial issues around device management, data security and workflow were significant. The introduction of tools such as **Configurator©** and Volume Licensing will aid in managing the devices and if the devices become the 'property' of the students then issues such as charging and updating also become less arduous for the school. Data security is an issue and there will need to be developments in the use of the Cloud (with applications such as GDrive, DropBox and iCloud) as well as a change in the way the school thinks about information management.

Fast, ubiquitous wireless also becomes essential for the effective use of devices as a transformational instrument. Worries about the security of the devices have proved to be mostly groundless; devices have been well looked after with very few damaged or stolen. Students seem to have responded positively to the trust given to them.

Management of the applications that are used on the devices, and access to inappropriate materials via the Internet will be a concern for many schools and monitoring of usage is an important part of the school's safeguarding responsibility.

What models of professional learning and development are effective in supporting the roll-out of personal devices?

Whilst there has been some more formalised training on the use of the device we would argue that the key approach has been to give the device to both the teachers and to the students and to allow them to learn through exploration and in collaborative dialogue. The portability, immediacy and ease of use of the device mean that there is a great desire to experiment and to share and we have seen both teachers and students wanting to show each other, and that includes teacher-teacher, student-student, teacher-student and student-teacher, what they are discovering is possible with the device.

On-line sharing portals and forum made available for the duration of this pilot have also been of some use, though more limited in sharing practice. The video conferences with teachers were less effective due mainly to technical issues.

11. Appendices:

A. Schools and classes participating in the pilot study

School	Local Authority	Year	Numbers	Version of iPad	Deployment pattern
Bellshill Academy	North Lanarkshire	S1	98 students with personal iPads	iPad 2 (2nd generation)	iPad as personal device (school and home) Additional class set of 30 devices
Kilsyth Primary		P7	24 students	iPad 1 (1st generation)	iPad as personal device (school and home)
Chryston Primary		P5	19 students	iPad 1 (1st generation)	iPad as personal device (school and home)
Gavinburn Primary	West Dunbartonshire	P5/6	22 students	iPad 2 (2nd generation)	iPad as personal device in school only
Sciennes Primary	City of Edinburgh Council	P5 and P6	P5 set: 32 iPads	iPad 2 (2nd generation)	iPad as personal device (school and home)
			P6 set: 31 iPads	iPad 2 (2nd generation)	iPad as personal device (school and home)
		P6 – shared set	33 shared as a set	iPad 2 (2nd generation)	Class set shared by two teachers
Kingswell Primary	Aberdeen City Council	P3/4	24 students	iPad 2 (2nd generation)	Use iPad in class but not always as personal device
Greenwood Academy	North Ayrshire	S2	Set 1: 27 students	iPad 2 (2nd generation)	iPad as personal device (school and home)
		S2	Set 2: 30 students	iPad 2 (2nd generation)	iPad as personal device (school and home)
St. Kentigern's Academy	West Lothian	S1 (top maths set)	28 students in top maths class	iPad 2 (2nd generation)	Only use iPads in maths – can take them home (can use in other classes but not common)
Approximate number of iPads in pilot		P3-S2	365 students		

B. Acceptable User Policy (AUP) for mobile devices (courtesy of Bellshill Academy)

North Lanarkshire Council

iPad Project
Acceptable Use Agreement

Pupil Name	**A N Other**	Class	**1D2**
iCloud Username	**Bellshillipad2072**	iCloud Password	**Senate56**
iPad Serial Number	**North Lanarkshire asset tag no**	Ipad Code	**Passlock code**

Information on how to use the iPad can be found on the Bellshill Academy website

http://www.bellshill.n-lanark.sch.uk

1. I will take care of my iPad and protect it from damage.
2. I will not switch off the "Find My iPad" feature so that my iPad can be recovered if lost or stolen.
3. I will only access my iPad and the school network when given permission by a teacher.
4. I will only access the school network and Internet using my own username and password. I will not access files belonging to others.
5. I will only send emails to people I know or who are approved previously by my teacher. I will not forward chain letters.
6. I will only use my official iCloud account to send or receive emails concerning my school work.
7. I understand that the school can and will check my files, emails, blog posts and the Internet sites that I visit to ensure that I use my iPad and the Internet safely & properly. I will show my teacher or my parent/guardian the contents of my iPad on request.
8. I will not delete my search history in my Internet browser.
9. I will only download material from the Internet relevant to my school work.
10. I will tell a teacher at once if I see web pages or emails that are offensive.
11. I will only copy and use material as allowed by copyright legislation. I will ask my teacher if I am not sure of the legal position.
12. I will not use my iPad to share copyrighted files.
13. When using the Internet, writing blog posts and sending emails I will protect myself and others by not giving out personal information.
14. I will not arrange to meet any on-line contact. I will tell my guidance teacher about any invitations I receive to meet on-line contacts.
15. I will ensure that any emails or blog posts are polite, sensible and responsible.
16. I will not add any credit card details to my iCloud or iTunes account.
17. I will bring my iPad to school every day fully charged.
18. I will not change my password/screen lock without informing my teacher.
19. I will only record sound and pictures in class with permission.

I understand and agree to all of the above rules, to protect my iPad from damage or theft and to return my iPad when requested.

Pupil's Name: . . . . . Pupil's Signature:. . . . . .

Parent's Signature: . . . . . Date . . . . . .

C. Frameworks for evaluating mobile learning

Various frameworks have been developed to explain and analyse the phenomenon of mobile learning. The framework shown below and in Figure 6 (see section 6) is based upon research undertaken by staff at the University of Hull and at the University of Technology, Sydney (Kearney et al., 2012). It identified three broad affordances associated with the use of mobile devices in education, including personalisation, collaboration and authenticity. Each of these is sub-divided into two operational constructs shown in the diagram below (see Figure 25). Each of these operational constructs can be used to assess or measure the extent to which mobile devices are affording opportunities for greater personalisation, collaboration or authenticity in learning. This framework and tool-set is the subject of on-going research and development associated with this pilot and work in other settings.

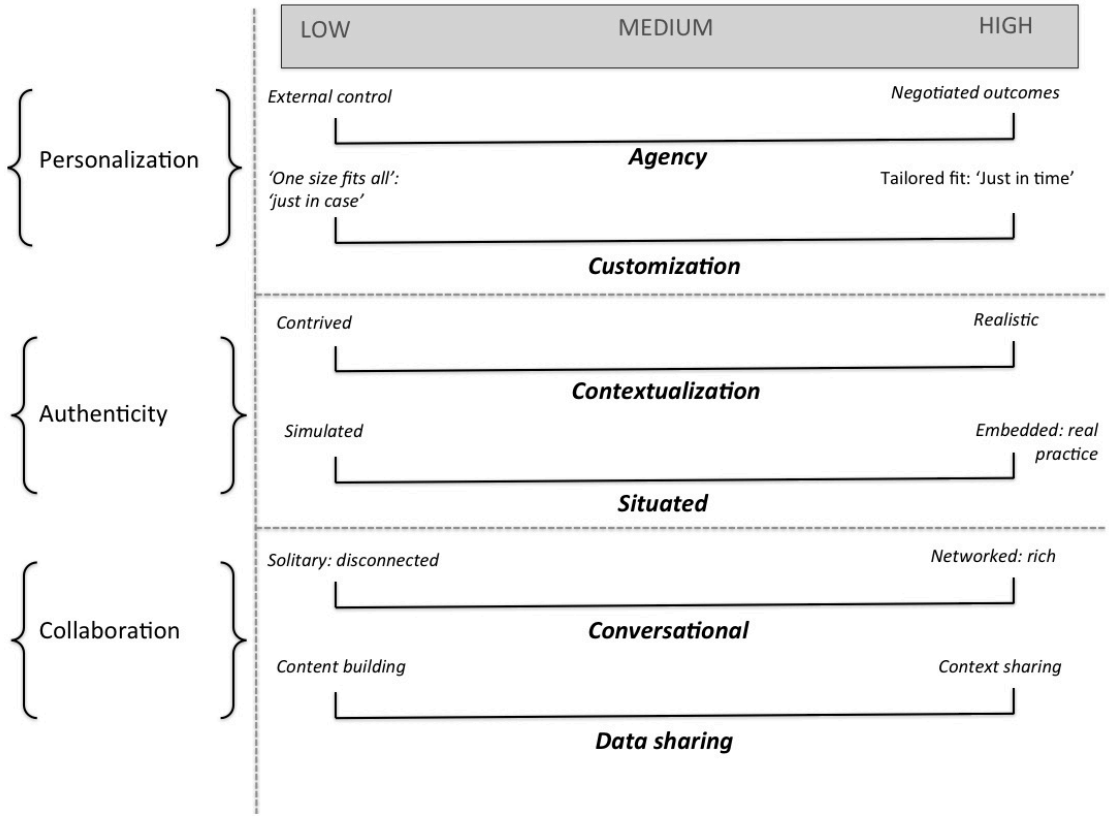

Figure 25: A framework for analysing the use of mobile devices in schools (adapted from Kearney, et al, 2012)

References:

Alexander, R. (2008). *Towards Dialogic Teaching: Rethinking Classroom Talk* (4th ed.). Dialogos.

Australian Government Department of Defence. (2012). *iOS Hardening Configuration Guide: For iPod Touch, iPhone and iPad running iOS 5.1 or higher*. Canberra: Defence Signals Directorate.

Borko, H. (2004). Professional development and teacher learning: Mapping the terrain. *Educational Researcher*, *33*(8), 3–15.

Crook, C. (2008). What are web 2.0 technologies, and why do they matter? In N. Selwyn (Ed.), *Education 2.0? Designing the Web for teaching and learning: a commentary by the Technology Enhanced learning phase of the Teaching and Learning research programme* (pp. 6–9). Institute for Education, London

Cuban, L. (2003). *Oversold and Underused: Computers in the Classroom*. Harvard University Press.

Department of Education and Training. (2011). *iPad Trial: Is the iPad suitable as a learning tool in schools?* Queensland Government, Australia.

Fullan, M. (1982). *The Meaning of Educational Change*. New York: teachers College Press.

Gupta, B., & Koo, Y. (2010). Applications of mobile learning in higher education: An empirical study. *International Journal of Information and Communication Technology Education*, *6*(3), 75–87.

Hartnell-Young, E., & Heym, N. (2007). Challenging Practice:Researching mobile phone use for learning in secondary schools. Presented at the Learning and Research Institute Seminar, Nottingham University.

Hattie, J. (2008). *Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement* (1st ed.). Routledge.

Heinrich, P. (2012). *The iPad as a Tool for Education: A Study of the Introduction of iPads at Longfield Academy, Kent*. Nottingham: NAACE: The ICT Association.

Herrington, J., Mantei, J., Herrington, A., Olney, I., & Ferry, B. (2008). New Technologies, New Pedagogies: Mobile Technologies and New Ways of Teaching and Learning (pp. 419–427). Presented at the 25th Annual ASCILITE Conference, Singapore.

Kearney, M., Schuck, S., Burden, K., & Aubusson, P. (2012). Viewing mobile learning from a pedagogical perspective. *Research in Learning and Technology*, *20*, 1–17.

Kinash, S., Brand, J., & Mathew, T. (2012). AJET 28 Challenging mobile learning discourse through research: Student perceptions of Blackboard Mobile Learn and iPads. *Australian Journal of Educational Technology*, *28*(4), 639–655.

Kolb, D. A. (1984). *Experiential learning: experience as the source of learning development*. Englewood Cliffs: Prentice-Hall.

Lave, J. (1991). *Situated Learning: Legitimate Peripheral Participation*. Learning in doing: social, cognitive, and computational perspectives. Cambridge: Cambridge University Press.

Ling, R., & Donner, J. (2009). *Mobile Phones and Mobile Communication*. Polity Press.

Mayo, E. (1949). *Hawthorne and the Western Electric Company. The Social Problems of an Industrial Civilisation*. Routledge.

McCormick, R., & Scrimshaw, P. (2001). Information and Communications Technology, Knowledge and Pedagogy. *Education, Communication and Information*, *1*(1), 37–57.

Melhuish, K., & Falloon, G. (2010). Looking to the future: M-learning with the iPad. Computers in New Zealand. *Schools: Learning, Leading, Technology,*, *22*(3).

Mishra, P., & Koehler, M. J. (2009). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Contemporary Issues in Technology and Teacher Education*, *91*(6), 60–70.

Murray, C., & Sloan, J. (2008). *iPod Touch Research Report*. Victoria: Department of Education and Early Childhood Development.

Pachler, N., Bachmair, B., & Cook, J. (2009). *Mobile Learning: Structures, Agency, Practices:* (1st ed.). Springer.

Pachler, N., Cook, J., & Bachmair, B. (2010). Appropriation of Mobile Cultural Resources for Learning. *International Journal of Mobile and Blended Learning*, *2*(1).

Putnam, R. T., & Borko, H. (2000). What Do New Views of Knowledge and Thinking Have to Say About Research on Teacher Learning? *Educational Researcher*, *29*(1), 4–15.

Rogers, E. (1962). Diffusion of Innovations. Glencoe: Free Press

Schon, D. A. (1995). *The Reflective Practitioner: How Professionals Think in Action*. Ashgate Publishing.

Traxler, J. (2010). Will Student Devices Deliver Innovation, Inclusion, and Transformation? *Journal of the Research Center for Educational Technology*, *6*(1), 3–15.

Vygotsky, L. (1978). *Mind in Society:The development of higher psychological processes*. Cambridge, Mass: Harvard University Press.

Wenger, E. (1998). *Communities of Practice: Learning, Meaning, and Identity*. Learning in doing : social, cognitive, and computational perspectives. Cambridge: Cambridge University Press.