Access Denied? Twenty-first Century Technology in Schools

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The term 'twenty-first century technology' refers primarily to multi-functional equipment or devices with Internet connectivity capable of using Web 2.0 tools or applications. At the time of writing most desktop computers, personal digital and handheld devices are now not only capable for accessing the Internet, but also have the capability to allow for user generated content and social networking. In its original form (Web 1.0) the Internet was used by a small elite in a 'delivery and receipt structure' as it only permitted a one-way flow of information and service to the end user. Web 2.0 is personified, however, as a 'read and write', democratic and highly participatory publishing model. It is not just access to greater volumes of content which is radically changing the Internet, however, but rather the fact that users can access a greater volume of people and potential communities (Crook, 2008). Web 2.0 has moved away from the mainly text-based architecture of the first generation Web and has begun the process of fostering social interaction and knowledge representation based on multi-modal representations including images (e.g.Flickr), video (e.g. YouTube), audio (e.g. Podcasts) and combinations of these various media. This is turn has transformed the kind of social interaction possible over the Internet making it feasible to undertake discourse and dialogue without having to rely solely on text based mediation. Twenty-first century technologies have thus superseded Web 1.0 which, like most printed material, had remained epistemologically traditional and maintained by a relatively small group of privileged authors (Dede, 2008; Nagy and Bigum, 2007). Web 2.0 technologies, however, represent a fundamental change for education, shifting from passive acquisition of someone else's ideas to active learning experiences that empower people to inquire, critique, create, collaborate, problem solve and create understanding (Dede & Barb, 2009).

Twenty-first century technologies are also about the portability of mobile digital devices which now have the potential to allow any-time access for users either through Wi-Fi or mobile broadband providers and for those devices to become personal. (Traxler, 2010) lists mobile devices as including smart-phones, game consoles, digital cameras, media players, netbooks, in-car *sat-nav* and handheld computers. Almost everyone owns one, uses one and, as he points out, often has more than one. Such devices he suggests are both pervasive and ubiquitous, conspicuous and unobtrusive, noteworthy and taken-for-granted. Their roles are new and completely different from older, static, and less personal information technologies such as desktop computers, he argues, going on to say (author emphasis):

> Interacting with a desktop computer takes place in a bubble, and in dedicated times and places where the user has his or her back to the rest of the world for a substantial and probably premeditated episode. Interacting with mobile technologies is different and is woven into all the times and places of students' lives. Desktop technologies and landline phones are about *buildings*; mobile devices are about *people*. (Traxler, 2010: 5)

The implications for education caused by the development of twenty-first century technologies are enormous and the anticipated change probably ranks alongside the introduction of the printing press in terms of historical importance. This article considers those implications and draws on research we have recently conducted in schools and other educational settings in England and Scotland. We conclude that the need to allow use of personal digital devices in schools (and other sectors of public education) seems inexorable the further we go into the new millennium. This simple premise is fraught with many difficulties and challenges, however, which suggest that for many students the current situation is 'Access Denied', a situation we find difficult to understand given the potential benefits of such devices.

The Research Base

In order to explore these issues we draw upon a body of empirical research we have accumulated from different projects we have been engaged in during 2012-13. Firstly we were members of a research team commissioned to undertake the evaluation of the pilot project in Scottish schools where students were allowed personal use of iPads including, in many instances, the right to take them home. In total 11 teachers and the majority of Headteachers or senior staff within the pilot schools 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 (Burden, Hopkins, Male, Martin, & Trala, 2012). We have since been engaged in a similar evaluation in a major city in Scotland where three schools are undertaking a pilot project involving the use of personal digital devices (again with the right to take them home). In this instance these were either android or windows devices (Male & Burden, forthcoming). Both projects also employed interviews with headteachers and project leaders within the schools as well as on-line baseline and exit surveys of students, teachers and parents from which quantitative data were accumulated. Quantitative data derived from the two evaluations are supplemented by a third survey conducted with a large comprehensive school in London. In total 1017 students, ranging from final two years of primary school age through to sixth form students, completed an on-line survey prior to the introduction of personal digital devices. Interim and exit surveys were

also carried out in both Scottish projects, but we are not drawing on the data from those surveys in this paper.

The findings from these two pilot projects and the survey of the London school are supplemented by data emerging from a separate enquiry into pedagogical leadership in the twenty-first century (Male & Palaiologou, 2012 & 2013) for which headteachers and leaders of early years settings were interviewed, along with teachers and students within those organisations. Finally, a focus group comprising headteacher, project leader and parents of a Scottish primary school were interviewed in relation to their views relating to the introduction of personal devices into the school which proved controversial and resulted in wide media coverage.

The Challenges to Schools

Schools, like most other education institutions, are organised around spatial and temporal considerations such as buildings, timetables, calendars and internal structures which are designed to classify and manage students. This, is "getting out of step with how students perceive the world they live in and […] changes are needed to [remain] aligned to a changed and mobile society" (Traxler, 2010: 7). It now appears there is "… a sharp disconnect between the way students are taught in school and the way the outside world approaches socialization, meaning-making, and accomplishment " (Klopfer, Osterweil, Groff, & Haas, 2010: 5).

> Schools are currently still training autonomous problem solvers, whereas as students enter the workplace, they are increasingly being asked to work in teams, drawing on different sets of expertise, and collaborating to solve problems. (Jenkins, Purushotma, Clinton, Weigel, & Robison, 2006: 19)

We do not see the end of formal schooling as a result of digital technologies, but do anticipate a much greater emphasis on continual learning and, in line with contemporary thinking by contributors such as Stephen Heppell, recognising the value of learning outside the classroom (Lee, n.d.). Two issues thus emerge from this scenario: firstly the capability of personal digital devices induces a challenge to pedagogy; secondly, student demand to use such devices in school (and parental acceptance of such devices) is increasing, yet school management is reluctant to allow such use. (Heinrich, 2012: 7-8).

In the first instance, as we point out in the evaluation of a pilot project in eight Scottish schools, the use of personal iPads:

> … 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. (Burden et al, 2012: 56).

As we mention later in the same report the availability of a personal internet enabled device, controlled mainly by the student and not the teacher, is changing the traditional dynamics and pedagogical patterns of the classroom, in ways which are considered to be transformational (Burden et al, 2012). These are findings which demonstrate how such technologies:

> … challenge the role of the education professions and educational institutions, progressively demystifying their roles as gatekeepers, custodians, and arbiters of technology and knowledge. This is not to ignore their role as guides or intermediaries, nor is it to ignore their work in nurturing intrinsic motivation and providing extrinsic motivation, but serves merely to place them all in a more complex context. (Traxler, 2010: 10)

Learning that makes appropriate use of personalised digital technologies thus has the potential to induce change to schools in the twenty-first century. Knowledge is no longer separate to the learner, but instead can be challenged, shaped and even changed through what is referred to as a "participatory culture" which "reworks the rules by which school, cultural expression, civic life, and work operate" (Jenkins et al, 2006: 9). To be successful in such an age the teacher "has to move from deliverer of content to the curator of a learning journey. If we do not move to this role we are making ourselves redundant as teachers" (Headteacher, Scottish primary school).

Teachers, we can deduce from these contributions to the debate, do still have a responsibility to "do the teaching part", but need to change their practice in order to "find less didactic ways of teaching that didn't involve spoon-feeding students" and to become "a facilitator encouraging students to participate in independent and collaborative learning" (Hague, 2010: 16-17). Schools in the twenty-first century have the opportunity to embrace digital technologies through use of personal (or personalised) devices:

> Personalisation and choice […] emphasise how access to an internet capable device equipped with powerful construction tools, enable learners and teachers to have a far greater degree of agency and choice in how, when and where they undertake learning. (Burden et al, 2012: 105)

Such an approach moves responsibility for learning (and engagement) beyond the confines of school and classroom and into the student's personal life to a far greater extent than most educationalists had imagined. As Traxler points out (author emphasis), the boundary between "*formal* learning activities *in* our institutions *on* our equipment, and *self-motivated* learning activities *outside* our institutions *not on* our equipment" becomes blurred if we embrace student devices" (Traxler, 2010: 11). Formerly he argues, educators had a duty to regulate the former and had no mandate to regulate the latter.

This may be one reason why school managers seem reluctant to embrace such technologies, a factor that will be explored in greater depth later in the article when we explore the concerns of parents, teachers and administrators in regard to allowing student access to a world beyond their control. Other reasons for this seeming reluctance will also be explored, particularly the shifting emphasis on teacher behaviour in a digital age. As Hague (2010: 18) suggests, for example: "a change in pedagogical process and an emphasis on independent learning could often be perceived as risky for teachers whose performance reviews depended on moving students up by a certain amount of National Curriculum levels", a view further supported by Rheingold who suggests "the political and economic necessity of teaching to the test leaves little room to fit these kinds of skills lessons into mandated and standardized curriculum" (Rheingold, 2008: 99). This led us to conclude in relation to our work in Scotland that:

> … 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. […] 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 (Burden et al, 2012: 29).

Barriers to change

It has been suggested there are a number of central factors, each with its own critical variables, which interact with one another to produce barriers to implementing technological innovations in educational settings (Groff & Mouza, 2008). They identify six factors in total: research and policy, district/schools, teachers, students, the project and the technology itself. Whilst these factors are inevitably evident in all technology related projects, for the purpose of this article we assume factors associated with the students and the technology are not worthy of greater consideration in relation to our data. This is because we do not see any evidence of reticence amongst the student body to engage with the type of personal digital technologies that are synonymous with the twenty-first century (see Table 1 below); neither do we

consider there to be any questions in relation to such technologies. We do note a small difference in use of mobile technologies at home with secondary school students making greater use of instant messaging, chat forums, social networks and downloading of music (see Table 1 below). In this instance we have compared the final year primary school students (P6) from both Scottish projects with first year secondary schools in Scotland and Year 10 pupils in England (age 14-15 years).

How often do you do these online activities outside of school?	Primary (n=32)	Secondary (S1) (n=113)	Year 10 (n=83)
Send or read e-mail			
Daily/weekly	44%	44%	46%
Sometimes/Never	46%	56%	54%
Send or receive text messages from your mobile			
Daily/Weekly	40%	89%	85%
Sometimes/Never	60%	11%	15%
Send or receive instant messages			
Daily/Weekly	23%	79%	83%
Sometimes	77%	21%	17%
Research on the Internet for school related work			
Daily/Weekly	41%	45%	65%
Sometimes/Never	59%	55%	35%
Use chat forums			
Daily/Weekly	14%	45%	38%
Sometimes/Never	86%	55%	62%
Use social network sites (e.g. Facebook)			
Daily/Weekly	29%	80%	72%
Sometimes/Never	71%	20%	28%
Download video or music from the Internet			
Daily/Weekly	21%	48%	59%
Sometimes/Never	79%	52%	41%
Upload images or video you have created (e.g. to YouTube)			
Daily/Weekly	10%	23%	32%
Sometimes/Never	60%	77%	68%

Table 1: Compared use of online activities outside school by primary and secondary students

Similarly secondary students made greater use of mobile and laptop devices at home for school based work than their primary counterparts (see Table 2 below)

How often do you currently use the following technologies at home to complete school work?	Primary (n=32)	Secondary (S1) (n=113)	Year 10 (n=83)
Desktop computer			
Daily/Weekly	23%	27%	42%
Sometimes/Never	77%	73%	68%
Laptop or notebook			
Daily/Weekly	33%	53%	61%
Sometimes/Never	67%	47%	39%
Mobile device (e.g. your mobile phone, an iPad)			
Daily/Weekly	27%	68%	54%
Sometimes/Never	73%	32%	46%

Table 2 - Use of technology at home for school work by primary and secondary students

As can be seen from the discussion and data presented above, we see these technologies as central and necessary to the learning environment now occupied by students in schools and perceive very little difference in the attitude or perceived ability of primary and secondary students (see Table 3 below).

How far do you agree with the following statements?	Primary (n=32)	Secondary (S1) (n=113)	Year 10 (n=83)
I learn better when I use technology			
Strongly agree/Agree	81%	97%	96%
Disagree/ Strongly disagree	19%	3%	4%
Technology makes learning more enjoyable			
Strongly agree/Agree	96%	98%	99%
Disagree/ Strongly disagree	4%	2%	1%
I am good at learning things			
Strongly agree/Agree	89%	92%	92%
Disagree/ Strongly disagree	11%	8%	8%
I can use technology better than my teachers			
Strongly agree/Agree	44%	78%	50%
Disagree/ Strongly disagree	56%	22%	50%
I use technology frequently at school			
Strongly agree/Agree	89%	88%	88%
Disagree/ Strongly disagree	11%	12%	12%
I use technology frequently at home			
Strongly agree/Agree	88%	98%	99%
Disagree/ Strongly disagree	12%	2%	1%
I am better with technology than my parents			
Strongly agree	69%	88%	88%
Disagree	31%	12%	12%

Table 3 – primary and secondary student attitudes towards use of technology

Consequently we report our findings, emerging implications and conclusions in relation to the following categories of factors:

(a) policy;
(b) issues associated with schools and teacher;
(c) issues relating to parents and the family home.

As indicated by Groff & Mouza, however, these factors are seldom discreet and do interact with each other, so there may be times in the subsequent discussion where issues cross over these somewhat artificial boundary classifications.

Factors Associated with Policy

There is fear evident amongst politicians, local authority officials and the public face of schools that places a major barrier to the use of twenty-first century technologies to support the education of young people. The main concerns are with control (sometimes of knowledge) and with the safety of children in online environments. As Prensky suggests in a prescient manner:

> New technology still faces a great deal of resistance. Today, even in many schools with computers, Luddite administrators (and even Luddite technology administrators) lock down the machines, refusing to allow students to access email. Many also block instant messaging, cell phones, cell phone cameras, unfiltered Internet access, *Wikipedia*, and other potentially highly effective educational tools and technologies, to our kids' tremendous frustration. (Prensky, 2005)

Prensky's overview remains relevant with our research demonstrating network service providers and some school based controllers to be zealous, perhaps overly so, in the use of firewalls designed to prevent access to internet sites and resources. Similarly the use of personally owned handheld devices, particularly those with instant messaging and social networking capability, was officially denied in all schools in our project. No school, for example, sanctioned the use of mobile phones in the learning environment although, interestingly, many turned a blind eye (particularly in secondary schools) to the use of such devices in break times and occasionally in lessons where it was considered easier and quicker to search online than to use other communication devices. Officially, however, the need for security on all devices was paramount and of a higher priority than open access. The experience of young people in school, however, often contrasts sharply with their everyday practice within their home environment or their peer group interactions.

> Many students feel that when they come into school they have to "power down" to fit into an environment that offers fewer options for

> learning than are available in the life they live outside of the school. (Ontario Public School Boards' Association, 2009: 7)

The restrictive online environment was the norm in most schools and caused concern among students and teaching staff with a sense of lost opportunity. In a different evaluation of the use of iPads in schools, for example, students found the filtering restrictions on school networks frustrating and the main source of student complaints (Heinrich, 2012). As the headteacher of a Scottish secondary school that was piloting 1-1 devices pointed out, corporate systems that "lock everything down, means teachers can't do the kind of things that they want to do with kids", a view graphically illustrated by the school's project manager:

> Where it falls down is the categories which are justified as being inappropriate. 90 per cent of fantastic resources I often find at home, I go "fantastic", just click that and give that to my senior kids tomorrow. Then I come in to set the thing up on a computer and of course it comes up says "Block - this is classified as games content, or this is social media content" and so on. So you run into a lot of problems like that (1-1 Project Manager, Scottish Secondary School)

Traditionally, education has been impeded by the security and other potential dangers of employing social networking technologies (Klopfer, Osterweil, Groff, & Haas, 2010). Our research demonstrated there were two elements to this desire to maintain security; the first is technical, the second is concerns about eSafety.

Most schools in our research were using corporate networking systems. In other words their hardware provision and connectivity were managed by a controlling agency such as a local authority which, invariably used Windows based systems running on corporate servers. This often caused problems for those schools using devices like the iPod Touch and the iPad which were not designed to support a corporate or networked technology solution which "still underpins the technology paradigm evident in most local authorities and schools" (Burden et al, 2012: 29). This challenge is summed up by one education adviser in a Scottish local authority who reported:

> Part of the challenge working in such an environment is that Corporate want you to tell them what you're going to have so that they can enable that and nothing else and the pace that they can deal with change is totally incompatible with the users' experience.

The major concerns, however, were with an almost evangelical desire to ensure that no child could be exposed to inappropriate material or engagement with the Internet. Whilst all schools we worked with had access

to broadband this was a highly regulated environment, unlike at home, where most children had access to commercial service providers. Consequently teachers and schools had to fight hard to get access to some highly desirable resources with many stories emerging during our research of headteachers and project managers spending unsustainable amounts of time overcoming the resistance of corporate IT, a common situation represented by the story of a headteacher of a primary school in England:

> We had to fight to have Twitter released, we had to fight to have Youtube released to go on our site, yet they are fantastic resources. We have had awful difficulties in getting them released.

Corporate services and schools within our research had sought a number of ways of 'ensuring' safety. In Scotland, for example, there was general use of an on-line intranet (GLOW) together with commercial safeguarding software both of which were designed to provide a safe learning environment. Individual schools made use of safe participatory collaboration sites specifically designed for schools, such as Edmodo and LearnPad. As indicated above, there was an almost blanket ban on the use of mobile phones especially ones with internet access. Similarly there was no evidence of a 'bring your own device' policy with all schools adopting an acceptable use policy (AUP) in regard to portable equipment and devices they provided. Those schools using Apple devices gave praise for its strict management of applications through its online store which gave them a sense of security not always provided by windows based or android applications. Despite all of these measures, however, there was clear recognition for a change of policy, for a more liberal attitude towards new technologies and to move away from the centralised management of institutional provision which had led to a "a narrow prescription of the hardware, peripherals, connectivity, operating systems, applications, and privileges that could be accessed by students and lecturers" (Traxler, 2010, p. 10). The emerging view, discussed more fully below, is that students "should learn to manage risks, whenever and wherever they go online, and understand safe and responsible behaviour in using technology at their learning provider, in the workplace, in the home and beyond" (BECTA, 2010: 3), an approach perhaps best summed up by the headteacher mentioned above who had to fight for access to Twitter and YouTube:

> Now I know well and truly there are things on Youtube that you wouldn't perhaps wish children to see, but the point is children have computers and access at home and at their friends homes and therefore you have to go there. You can't uninvent it, so you have to therefore educate the children and the families to prepare the children for what they may come across and how then to proceed and deal with it. Ignoring it and pretending that you protect them in this cocoon is

> ridiculous because once they have walked out your front door, and maybe before they have walked out your front door, they are accessing all sorts of stuff.

Factors Associated with Schools and Teachers

Schools facing the challenge of adapting to and adopting twenty-first technology have to address a number of issues that relate to both the policy issues outlined above and to the difficulty of managing change within their own institution. Change is complete when an innovation is no longer deemed novel, but has become a way of life. The issues emerging from a review of the relevant literature indicate the conservative nature of the teacher workforce can present difficulty in allowing students to access learning opportunities that are available through new technologies.

Although schools are famously conservative with "teachers who are wonderful passive resistors" (Headteacher, Scottish primary school) conversely our initial research in Scotland demonstrated high levels of enthusiasm and engagement with the personalised use of iPads (Burden et al, 2012). Later research undertaken in three Scottish schools which were piloting the use of android devices and netbooks showed a similar level of engagement with teachers and pupils (Male & Burden, forthcoming). In part we consider this may be a feature of the nature of change processes where innovators and early adopters (who between them typically account for about 16 per cent of the population) tend to enthusiastically embrace a new initiative with a further 34 per cent (the early majority) following quite quickly once persuaded the advantages outweigh the disadvantages (Rogers, 1962). In the case of our first evaluation in Scotland there was a probability that we were working almost exclusively with innovators and early adopters, whilst in the second evaluation in city schools we saw evidence of greater engagement across the secondary schools with one project leader commenting that:

> In any other technology launch that we've run it always falls to somebody like me to drive it and the problem with that is if I'm driving it then everybody else is kind of following my lead, and this time around it's been the complete opposite of that and it's been really, really interesting to see that happening.

Conventional wisdom would generally support the view, however, that schools are generally more resistant to fundamental change than our pioneers. Typical in that regard was the account provided to us by an education adviser in Scotland of a typical middle class secondary school with an established reputation for good examination results:

> [..] a lot of staff who go there never leave it because it's quite an easy school I think. But they're very resistant to the idea of one to one personal digital devices … "Oh, that'll never work here, that'll never work here. Our wains'll be, you know …". They can't see beyond the logistic issues about damage and theft and all the rest of it, even, you know, bringing in porn on it, that kind of thing, they can't see how that would not happen.

Henrich concludes that rather than opening up to the affordances of twenty first technologies schools it seems, like the local authorities we encountered, prefer to retain control of learning:

> There is broad agreement on the potential of such tools, notably around the idea of anytime, anywhere learning and the facility for learners to access courses and resources at will and to both ask questions of and to publish to an audience far beyond school. This has not, however, translated into radical pedagogical approaches in schools which wish to remain in full control of a pupil's learning through restrictions on web access, virtual learning environments (VLEs) that are largely document repositories with little or no student participation and where learning is directed along narrow and sometimes shallow paths. (Heinrich, 2012: 9).

Factors Associated with Parents and the Family Home

The major stumbling block with the provision of personal digital devices is finance, described by one education adviser in Scotland as the "elephant in the room". The provision of useful, stable and reliable personal devices is still seen as an expense that is beyond most schools and one that needs parental contribution. Devices were provided in the schools involved in the two Scottish projects mainly through a combination of local authority and schools' devolved funding. The only attempt to allow purchase by the parents through a leasing scheme fell foul of adverse media coverage based on the notion that education should remain free to students. One parent, for example, asked:

> If it is a tool for use in the classroom in the same way that a smart board is or a pen and pencil is, and it's something that's required in the classroom, why does that have to be something that's paid for by parents and taken home?

This situation is compounded by the reluctance of schools (and education systems) to allow the use of personal devices, the 'bring your own device' approach to resourcing. At this stage, therefore, schools are not able to adequately resource all students with a personal device leaving the potential for universal adoption of the affordances of twenty-first technologies seriously compromised on financial grounds alone.

Some parents were also concerned with the concept of eSafety and saw this as a barrier to adoption of personal devices that transcended the gap between home and school. Fears of on-line grooming, inappropriate use of the internet and over use of the device were expressed in some cases. Other issues expressed of safety related to personal security for students who may be a target of robbery on their way to and from school (and, in some cases, from within the school by other students who did not have such a device).

There were also concerns in regard to equity if there was a "possible disparity that worries parents and the concept almost of a division being created by the quality of the device that's provided or used" (Education Adviser – Scottish local authority). These concerns about equity were extended further with some parents feeling whilst the use by some students of personal devices would initially place them at advantage they may later find that further progress was delayed whilst they waited for "other children to catch up" (Parent – Scottish primary school).

Discussion

Despite these many barriers the general consensus amongst the adult participants in our research was that students need to be encouraged to use twenty-first century technologies as integral to their school (and home) life, a view perhaps best summed up by the headteacher of a Scottish primary school who considered "we are selling ourselves short if we do not see this as a way of life". The concerns of policy, pedagogy, finance, eSafety and equity have all, in their own way, led to the scenario of 'access denied', however, and to the probable detriment of most students. Whilst we have yet to overcome this range of issues we do have many clues and worked examples of how this may be done.

Policy: As we reported on the iPad evaluation in Scotland, 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. (Burden et al, 2012). Here we can see the dilemma – we have the potential to unlock fantastic resources yet as an education system we have grave concerns over safety. To us the most powerful part of our work is the notion that we cannot "uninvent" technology and a clear message from all participants in our various research projects was that we have to learn to manage it. Internet access is "equivalent of King Canute, you cannot stop it" (1-1 Project Manager, Scottish secondary school), views echoed by a deputy head of an English secondary school and a local authority education adviser in Scotland, both of whom recognise the futility of denying access to the young people of the twenty first

century many of who will make use of a proxy server to get to those parts of the internet their school server cannot reach. The general consensus was that this was a behavioural issue where students had to be taught responsibility and undertake self-control. The analogy of road safety is applicable here:

> 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 encourage them to use it (Headteacher, Scottish primary school)

If anything there is frustration as illustrated by a secondary headteacher in England :

> We don't want our kids to be passive learners, they can't be passive people, they can't be passive citizens. We had this big debate [in school] about where the future and the world is going and if we don't actually enable our youngsters to be able to question their world from a point of knowledge, then actually they haven't got a future have they … they will be forever manipulated and I think the potential to be manipulated in the future will be so much greater through technology, so there is again a moral imperative.

The key issue in policy terms seems to be trust, to work on a responsible use approach. All schools we studied had an Acceptable Use Policy, with many of them retaining rights to view browsing history and to log activity, whilst similarly recognising they did not have mechanisms in place to deal with the activities that go on outside the confines of the corporate network or the school 's filtering systems. Ultimately this was considered to be an issue of behaviour rather than a technology with misuse frequently considered as being the same as bringing in any kind of inappropriate content in paper and magazine form. The emerging scene is one perhaps best summed up by the project leader of a primary school in Scotland that was introducing digital tablets for school and home use:

> I think ultimately it comes down to trust. And there will be people who will probably abuse that trust to a point, but I think the majority of people, parents and children, will honour that. That's certainly what I've found in the past with, you know, having led IT in a number of different schools, that the vast majority of children respect it very, very clearly.

Pedagogy: What we have witnessed pedagogically is that most teachers adapt to the inclusion of personal digital devices in the school with enthusiasm and flair, often demonstrating innovative approaches to learning even when not considered to be pioneers. Our evaluations of the Scottish projects show

the process of change being radically altered in such circumstances with project leaders ('experts' in their own right) often struggling to keep pace with so-called 'novices' (Burden et al, 2012; Male & Burden, forthcoming). The natural tendency of teachers to be conservative seems to dissipate, therefore, with the introduction of a portable digital device such as an iPad, digital tablet or netbook. We have witnessed substantial shifts in classroom organisation, student learning and stronger links between home and school as a result of introducing personal digital devices. In the evaluation of the iPad pilot in Scotland we found:

> 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. […] 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. (Burden et al, 2012: 105 &110).

Finance: The provision of personal devices for all students may be achieved in two ways, either the school leads on the process of purchasing (but retains a measure of control) or a 'bring your own device' (BYOD) policy is implemented. What we know is that most school age children use mobile technology in their life outside school on a daily basis with all parents in the city pilot in Scotland allowing use of a mobile device with internet access in the home (see Table 1, above). The major problem with a BYOD approach is consistency of operating platforms and connectivity; what schools require is consistency of both. Assuming that is argument enough to not recommend a BYOD approach at this stage (although this may become inevitable in the future), then the issue of purchase (and maintenance) of personal devices has to be addressed at the school level. Our findings tend to demonstrate that parents typically make a substantial financial contribution to the children's education through the purchase of school uniform, sports kit, additional equipment and consumables, so perhaps it is time to also consider the personal device as an essential requirement for school. Various leasing schemes in England have demonstrated that the cost per month per pupil can be as low as an entry level internet phone, with such schemes also managing to cater for those parents who find it difficult to make their contribution in much the same way as the social benefits system works. All such schemes we have seen in operation have also included insurance for breakage and loss in addition to warranty.

eSafety: We found the vast majority of parents and all school based staff to be aware and, in accordance with national guidelines in that they "must be engaged with e-safety in order for responsible behaviours to develop" (BECTA, 2010: 9). As an Education Adviser in Scotland pointed out,

however, there has to be an acceptance that in encouraging use at home there was an inevitability that children would be exposed to inappropriate material but we "just have to deal with it, not make a big thing about it necessarily, but make it clear that this device is for education and yes, sure you can play games on it, but your big brother isn't allowed to do what a big brother wants to do with it". What we found in our research was that whilst 95 per cent of parents applied rules generally parents adopted a flexible and liberal position as regards the use of technology at home (Burden et al, 2012). The response of most parents to home use and eSafety was perhaps best summed up by a parent in a Scottish primary school who ran the lunchtime IT club and managed her own children in their use of the device under the principle:

> It's nothing to do with how many protections you put on it, my children know what is bad and what is good and it's all about in the mind and my child would be repulsed by any of the things you mentioned. It's about the ethics of your child, it's not about the safety monitors that you put on your website or any of your internet sites.

Equity: Although this is an issue of concern to the universal provision of personal digital devices there were few instances of such concerns in our research. The provision of twenty-first century technologies, particularly hand held devices (smartphones), appears almost ubiquitous with both students and teachers making extensive use of them on a daily basis (see Table 1, above, for example). In addition as the head teacher of a secondary school in a socio–economically challenged part of a major Scottish city was of the view that "poorer homes tend to have more in the way of technology than people expect – and often that technology will give them access to the Internet". As a consequence he was more concerned with access to quality learning resources, with that process to be directed:

> If we can be directing them both in school and out of school at the right kind of resources, and getting them to create things, then we can only be making a powerful impact on learning and teaching.

In summary, therefore, the spectre of inequitable access or use did not appear in any of our research and we consider this may be more of a myth than a reality. We are of the view, therefore, that whilst examples of inequity may be seen in the wider context there is little reason for this to be the case in the twenty-first century when virtually all students have the device necessary to achieve access and it is generally only policy and intransigence that deny them.

Conclusions

Two responses from headteachers who participated in our research resonate loudly with us when drawing conclusions: firstly that we cannot “uninvent” these technologies and, secondly, we should treat them the same way for young people as we do with use of the road system. In denying access to such technologies (particularly portable handheld personal devices) the various parts of the school system are effectively enacting a twenty-first century of King Canute and his impossible ambition of turning back the sea. What we have witnessed in the schools where such devices have been used liberally (and effectively) is that the potential gains are enormous in terms of enhancing the learning environment. The four barriers to widespread adoption of twenty-first century were related to policy, pedagogy, finance, and eSafety. We consider that none of these issues is insurmountable and, given the evidence we have gathered in our various recent projects, can be overcome with a mixture of determination and confidence from those in decision making roles within the school system. Finally we note that concerns over eSafety have been successfully dealt with in schools through approaches based on behaviour management and the development of trust of students, rather than restricting or denying access. This, to our mind, is an appropriate response to the challenges presented by twenty-first century technologies rather than the unfortunate (and largely unnecessary) situation of ‘access denied’.

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