1 Integrating technology in classrooms: from the microcomputer to ‘the cloud’

Overview
The objective of this chapter is to provide the reader with an historical overview of events, which led to the wide-scale expansion of the use of technology in classrooms in the UK; to review past uses of technologies in schools and to examine how computing technology has been introduced into the classroom over the past three decades.

Gaining an understanding of this history will provide a context from which subsequent developments can be understood. The chapter draws on research into the identifiable phases of technology adoption in schools and from the perspective of practitioners, whose voices on the history were captured in the research conducted by Hammond et al. (2009).

The history of technology in education is charted through an account of how computers first came into schools, the changes in hardware and software which followed and then the introduction of the micro-computer and, more recently, mobile technologies. These changes were experienced by practitioners as phases in developments which, although not necessarily distinct, were nonetheless definable by changes in processing speed, reliability of storage and connectivity, diminishing size and portability coupled with increasing personal ownership of sophisticated mobile technology devices. However, while the use of technology in UK schools has changed dramatically over the last three decades, what has not changed to any significant degree is the nature of schooling and teachers’ ideas about learning and teaching.

Introduction and context
From the introduction of mainframe computers in the late 1960s, mainly in higher education, to the introduction of micro-computers into schools in the early 1980s, from storage on cassette tape to more reliable disc drives and cloud computing, from Acorn to PC machines, from standalone to networks and wireless hand-held devices,
the changes have been and continue to be challenging to education practitioners. The challenge is on two fronts: the speed of development; and the increasing possibilities for the different forms of technology to support improvements in teaching and learning approaches.

In 1981, in the UK, the British Broadcasting Corporation (BBC) Computer Literacy Project for the first time put micro-computers within the reach of teachers from a wide range of curriculum areas (Millwood 2009). One million units were sold in five years (McMordie, undated) and the government supported the Technical Vocational Education Initiative (1984–1990), which ensured these BBC machines were available in schools. Prior to this time mathematics departments in secondary schools often had links to mainframe computers elsewhere, usually in universities.

What is clear from research is that ‘computers found their way into schools without a clear [pedagogic] rationale’ (Hammond et al. 2009: 49). Consequently, an examination of the phases of development needs to be understood alongside the political agenda driving technology in education; these developments do not stand in isolation: ‘it is very difficult to talk about technology without considering parallel developments in policy and pedagogical thinking’ (Hammond et al. 2009: 47).

**Theory and research base**

The chapter draws on research conducted with leading practitioners involved in technology and education over the past thirty years, which involved in-depth interviews with those who have used technology in their teaching, conducted research and worked with teachers (Hammond et al. 2009). This research, known as the ‘Voices Project’ and funded by IT in Teacher Education (ITTE), aimed to capture the ‘living history’ of technology developments in schools from those pioneers who were involved from the very beginning. Alongside this, Millwood’s (2009) history that supplements the National Archive of Educational Computing provides a narrative to explain the development of artefacts. Using the archive’s materials, Millwood outlines the story of technology in learning from the 1970s in the UK (before the microcomputer), through the 1980s (before the office) and 1990s (before the Internet) to 2000 (before the cloud).

**Phases of technology development in schools**

Since the first expensive and large mainframe computers in the 1960s, there has been continual development in hardware and software and concomitant challenges arising from the changes in the speed, storage and connectivity of machines. Each development required teachers to acquire technical knowledge (how do I operate this?) and think about practice (how does this interact with my pedagogy?). These dual demands highlight the complex relationship between technology (as machines) and teachers’ beliefs about teaching and learning. Hammond et al.’s (2009) research noted that teachers held remarkably consistent beliefs about how to teach throughout their
careers and their experiences with technology, despite shifting contexts and technological changes.

There was also a time lag between advances in technology and their adoption in schools. It must be stressed that at each stage of progression, the changes were driven by Research and Development (R and D) in industry (Selwyn 1998) and the military (Millwood 2009) rather than in response to pedagogical demands from educators. Teachers were left to adapt these technological advances for school and classroom purposes: ‘this deprived participants and education at large, of a coherent narrative of what computers in education was all about’ (Hammond et al. 2009: 57).

Historically, the first phase from the 1960s up until the end of the 1970s can be identified with the introduction of mainframe computers, which were chiefly used in industry or in a higher-education context and led to widespread need for programming skills. Teacher trainers involved in these developments straddled the university and school environments and were fundamental in helping industry produce teacher-friendly resources; this was achieved through writing specific programmes for use in the classroom. There was a close working relationship between technology developers and educationalists at this time, and small-scale collaborative projects were characteristic of this era.

A second phase can be identified with the introduction of the micro-computer into schools from the early 1980s until the end of that decade. Typically a pupil would access information in a library and printed encyclopedias, but this changed in the late 1980s to the use of CD-ROMs. A further phase was detected by Hammond et al. (2009) with the introduction of a graphical user interface (GUI) in 1991, which practitioners saw as an important shift in the move to personal computers in schools and commercial software. Then, from the mid to late 1990s, a more advanced phase can be identified with the introduction of the Internet and the rise of school networks. For the first time, teachers had access to suites of connected computers and pupils could access information through search engines with Web 1 technology. Then, by 2005 Web 2.0 tools and Wikipedia heralded the rise of collaborative, peer-to-peer knowledge building. More recent developments can be seen in the use of wireless hand-held devices, which offer greater portability and potential for personalized learning, alongside the move to greater social and professional networking for information sharing and the use of ‘the cloud’ for storage of data.

In outlining phases of developments in this way, it must be acknowledged that this history of technology requires further analysis of a critical political nature, because the new ways of working made possible by using technology brought concomitant developments in education policy and pedagogical thinking.

Phases of hardware: introducing the micro-computer into schools – 1980s

In 1981 the newly appointed Conservative Minister for Information Technology, Kenneth Baker, launched the ‘Micros in Schools’ scheme, which placed an emphasis on the vocational aspect of technology (Dawes 2001). ‘I want to ensure that the kids of today are trained with the skills that gave their fathers and grandfathers jobs . . . And that is the reason why we’ve pushed ahead with computers in schools. I want
youngsters leaving school at sixteen, to actually be able to operate a computer’ (Scaife and Wellington 1993: 15).

Research which has captured the experiences of practitioners highlights how the micro-computer marked ‘the first decisive moment in the use of computers in school. The new machines offered immediacy and interactivity’ (Hammond et al. 2009: 48). All 15 prominent practitioners in the field of educational technology in this research saw the introduction of the micro as a seminal moment in the history of computing in schools.

In the beginning, in the 1980s, funding for the hardware came from the Department of Trade and Industry (DTI), which provided £16 million to subsidize the purchase of British computers in schools. British companies, Research Machines, Acorn and Sinclair (the latter though to a lesser extent) competed with American and Japanese manufacturers (such as IBM, Apple, Atari, Commodore) to equip UK schools with computers (Scaife and Wellington 1993; Millwood 2009).

In addition to purchasing hardware, the Department of Education and Science (DES) provided £23 million to launch the Microelectronics Education Programme (MEP), which was an initiative to explore how computers could be used by teachers in schools. MEP was implemented by the Council for Educational Technology, under the directorship of Richard Fothergill at Newcastle Polytechnic, who led a team of teachers in gathering information, creating materials and disseminating training opportunities. As MEP literature stated, the vision was to ‘promote, within the school curriculum, the study of microelectronics and its effects, and to encourage the use of the technology as an aid to teaching and learning’. This ran from 1980 until 1986.

The central team of teachers in MEP worked alongside programmers and publishers to develop software, and 14 Regional Information Centres were created to demonstrate materials to local practitioners. This was a significant part of the MEP vision, as very few education authorities had specialists in the early 1980s and Fothergill understood how multidisciplinary teams working in regional networks were needed to build knowledge, skills and expertise.

Supporting the early use of micros in schools through teachers’ centres enabled a powerful mix of facilitating curriculum software development and teacher education, which generated conditions for creativity and emerging innovation. This was part of Fothergill’s vision:

> Fothergill’s real genius lay in knowing how to inspire people without frightening them, and in his staunch belief that we do things better when we do them together. His conviction about what was possible and his healthy disrespect of bureaucracy and pomposity provided valuable lessons. Many were the battles he fought with civil servants of limited vision.
> (Anderson and Page 2004: Obituary)

Many credit Fothergill with the vision of generating the first network of expertise in the UK in the form of specialist teachers, ICT coordinators, advisors and consultants. Indeed, it was Fothergill’s untimely death that inspired the ‘Voices Project’ (Hammond et al. 2009) to capture the experiences of the early pioneers who shaped the beginnings of
computer use in schools, particularly, since this history had not been recorded from those involved.

What was deeply understood in this vision was how to create innovation in practice and enable change, through collaborative knowledge building. Leask and Younie (2001a), summarizing the outcomes of research funded by the European Union from 1997–2000 into the pedagogical applications of technologies, identified this way that educators work with technologies as communal constructivism. Early educators used communications technology to create and publish knowledge for, and by, one another (Holmes et al. 2001). Previously such knowledge production had been costly and slow.

Through teachers’ centres and professional associations small computer programs were developed that teachers could use in the classroom. Teacher professional networks also provided assistance, which was vital as the technology would frequently break down. In a more recent development teachers are using Twitter to provide each other with just-in-time support within personal and professional networks.

Some of the early computers relied on programs which had to be run through tape-recorders. It was not until the introduction of disk drives that a key shift occurred; thereby replacing the unreliability of cassette tapes used previously for the storage of programs. As practitioners recall, the consequences of this lack of reliability were high:

> The cassette recorder turned off a whole generation of very frightened teachers, because it failed so often in the classroom. They put it in even before it was anywhere near reliable. When we got disk drives the world changed, but you’d already lost a whole group of teachers. It was a long, long hard job getting those back in again.‘

(Hammond et al. 2009: 49)

Alongside advancements in the reliability of storage came important shifts in software. The development of a graphical user interface (GUI) brought a more user-friendly machine, for teachers and pupils alike, with Apple Macintosh and Acorn Archimedes machines among the first to innovate with GUI (Hammond et al. 2009). This increasing user-friendliness of the interface shifted educational computing out of the ‘specialist’ domain and into the mainstream of schools.

Early educational computing had focused on programming within the context of specialist ‘computer studies’ lessons usually located within Maths departments in schools, but the introduction of the micro-computer with pre-prepared software for use in a range of subjects shifted the use of computers to more generalized support across the curriculum.

These developments were further supported in the 1980s by other complementary government initiatives: 1982 was designated ‘Information Technology Year’ by the Government to increase national awareness of computer technology (Dawes 2001). In 1982 the BBC’s Continuing Education Department ‘noted the rise of the microcomputer as a pervasive influence on society’ and proposed a national campaign (Millwood 2009: 10). Consequently the ‘BBC Computer Literacy’ project was launched; this involved a book, of which 60,000 copies were sold; a TV programme that reached 300,000 people; a course on the computer programming language
BASIC; and BBC micro-computers, of which 12,000 machines were sold (Hawkridge 1983: 57). This specially commissioned BBC computer was manufactured by Acorn.

This was followed by another major technology initiative launched by the Conservative government in the early 1980s, entitled the Technical and Vocational Initiative (TVEI), which provided further financial aid for schools to purchase computers. However, it transpired that TVEI schools had on average almost twice as many computers as non-TVEI schools (Scaife and Wellington 1993: 16). This highlights an emerging disparity of funding between schools for technology procurement: a theme that has continued to re-emerge throughout the succeeding three decades. Also, importantly, TVEI triggered a major political shift in the balance of power in UK education. TVEI was an initiative that radically altered the locus of control in education, being imposed by central government without consultation with the Local Education Authorities or the teaching profession (Leask 1987). However, it did reflect a government commitment to develop technical and vocational education in the 1980s.

As Dawes (2001) reports, this government investment can be seen in 1986, with the Modem Scheme, funded by the Department of Trade and Industry, putting £1 million into enabling schools to buy a modem to link up their micro-computers. In the same year the Microelectronics Support Unit (MESU) was set up with £3 million funding to carry on the work of the Microelectronics Education Programme (MEP), which ended in 1986. Then the White Paper ‘Working Together – Education and Training’ announced national expenditure of £90 million over ten years to extend the TVEI programme. The Conservative government’s commitment to TVEI clearly indicated the importance of technology and in 1987 Kenneth Baker announced Educational Support Grants of £19 million for the expansion of IT in schools.

Phases of software development

In coming to use the same software that has dominated business and industry, schools have adopted commercial applications for word processing, databases and spreadsheets (such as Word, Excel and Access). This has taken away the specialized software designed for education that computers in education first had and has led over the past two decades to a uniformity in schools of software and operating platforms that derive from the business sector.

Prior to this commercial software adoption from business, there were content-free programs, which were especially designed for schools. Hammond et al.’s (2009) research discovered that, among the early programs used in schools, practitioners cited Branch, a sorting program, which provided a first step in the idea of artificial intelligence and was often used in primary schools; Grass data base; Cricket Graph, a data display programme for Apple machines; and the spreadsheet Grasshopper. Data logging became popular, particularly in science lessons. There was Scoopnet, a newspaper front-page simulation program and the text-revealing program Developing Tray, which was popular among adopters.

There was also Granny’s Garden, which was an early computer game that could be played on the BBC micro. Set in a magical kingdom in the mountains with pupils locating the missing children of the King and Queen, it required the completion of
a number of simple problem-solving activities, including logic puzzles, spelling tests and maths quizzes. *Granny’s Garden* was later released for use at home on the ZX Spectrum and Amstrad CPC home computer. Another program was the *BBC Domesday Project* with micro-computers, which involved schools collecting data from across the UK (pictures, maps, video, surveys, statistics and personal testimonies), which could be used in conjunction with the BBC Domesday material. The original BBC data was digitally etched into two laser discs and was one of the major interactive projects of the 1980s (Millwood 2009).

Alongside these early programmes came the development of simulations. These modelled real-life contexts, allowing interaction between the user and the software. For example, of those cited by practitioners, there was an archaeological simulation called *Dig*; another programme *Droplet*, which ‘simulated the passage of rainfall through the hydrological cycle and, like others, contained a randomising element in it so that the user would get a different output each time the programme was run’ (Hammond et al. 2009: 51). As the quality of the graphics has become enhanced, so the sophistication of simulations has increased, with immersive environments gaining in popularity with the development of 3 and 4D (Johnson et al. 2011).

Software development in the 1980s was marked by a significant movement away from educationalists and teachers to commercial providers. Originally, starting with small programs, collaboratively developed between practitioners and programmers, software was created and trialled in educational settings. By the end of the decade general-purpose software could be run on significantly more sophisticated machines and these expensive programmes could only be provided by bigger commercial producers. ‘The close link between teachers and developers was being lost and this was marked with regret by all participants’ in Hammond et al.’s (2009: 59) research.

**Connectivity: the rise of the networked age – 1990s**

The introduction of the Internet, in the mid to late 1990s, heralded a new dawn as schools entered the networked age. This signalled the rise of the computer suite. This shift is not to be underestimated as, prior to this development, teachers would only have one or two computers in a classroom. This made whole-class use problematic. Suddenly, with teachers having access to a suite of computers, a whole class could interact with the technology at the same time. Previously the pedagogy of the stand-alone machine meant that teachers tended to ‘bolt on’ an activity, for pupils to do as part of a rotation exercise with the other lesson activities, or as an extension piece for the more able learners.

While this was the age of networks it was also the time of large-scale introduction of interactive whiteboards (IWBs) in schools. In using interactive whiteboards the focus shifted back to the teacher and their interaction with the whole class. This encouraged more ‘leading from the front’ with lengthy presentations and ‘didactic teacher-centred pedagogy’ (Somekh et al. 2007).

However, some practitioners in the Hammond et al. (2009) research felt that, used well, the interactive whiteboard was an ‘incredibly powerful, useful resource’. The effect on teaching and learning was largely dependent on the way in which the
interactive whiteboard was used. The pedagogy is not inscribed in the technology, but is dependent upon teacher agency and how individual teachers appropriate the technology for their professional practice in the classroom.

Mobile learning and hand-held devices are emerging as the next phases in technology development in schools. As technology develops to provide higher quality computing on ever smaller devices, mobility is going to become a key feature of teaching and learning in schools. This would offer anytime, anywhere learning (AAL) and enhance opportunities for creativity, personalization and support for out of school learning. Table 1.1 below outlines the key developments in technology in schools.

Table 1.1 History of technology in schools

<table>
<thead>
<tr>
<th>Dates</th>
<th>Technology available in schools</th>
<th>Access</th>
<th>Information storage + retrieval</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970s</td>
<td>library</td>
<td>1 room – multiple books</td>
<td>printed encyclopaedias (Encyclopaedia Britannica)</td>
</tr>
<tr>
<td>1980s</td>
<td>micro-computers</td>
<td>1–2 machines per secondary school – in maths department</td>
<td>cassette tapes</td>
</tr>
<tr>
<td>1990s</td>
<td>desktop computers + commercial office software</td>
<td>1 machine per classroom – primary &amp; secondary schools</td>
<td>floppy discs / CD ROMs (Microsoft Encarta)</td>
</tr>
<tr>
<td>2000s</td>
<td>multiple PCs – in computer labs/hubs</td>
<td>ICT suites – hardwired</td>
<td>Internet + search engines Web 1.0 (read only)</td>
</tr>
<tr>
<td>2005</td>
<td>laptops – class sets (mobile trolleys with 15–30 laptops)</td>
<td>wireless connectivity – move to wireless rooms in schools</td>
<td>Web 2.0 (read and write) Wikipedia/wiki collaborative/ peer to peer social/professional networks</td>
</tr>
<tr>
<td>2010</td>
<td>mobile devices</td>
<td>wireless – across campus</td>
<td>cloud computing semantic Web digital literacy</td>
</tr>
<tr>
<td>2015</td>
<td>enhanced mobile devices</td>
<td>4G learners devices</td>
<td>Web 4.0 advanced digital literacy</td>
</tr>
</tbody>
</table>

Teachers and technology: policy and practice

Throughout these phases of technology developments in schools, from the early 1980s to now, the crucial factor has been teachers – who are after all the key change agents in the implementation of any technology. It is important to document not only the technological advancement in hardware and software, but also to outline how teachers interact with these developments and attempt to build a knowledge base about the use of technology in classroom practice for learning and teaching.
Just as Teachers’ Centres had provided vital support for knowledge sharing and building in the early days of the micro-computer in the 1980s, so the Internet has led to the emergence of discussion forums in the late 1990s for supporting the building and sharing of new practice. Professional networks have become established for teachers through their subject and professional associations, and special-interest groups, such as Teachers.net and Mirandanet (www.mirandanet.org). More recently, an online teacher network that exploits Web 2.0 tools for knowledge sharing has been created by the *Guardian* to support teachers’ professional practice (www.teachers.guardian.co.uk).

The need for teachers to learn from one another about technology for learning and teaching has been a central theme throughout the history of technology developments in schools. Bowles (1999: 31) argued that, since 1984, when TVEI first bought computers into secondary schools, ‘teachers have struggled with the new concepts and skills’. The Trotter Report of 1989 identified three specific skills relating to the use of technology that an experienced teacher might be expected to have: practical technology capability; capability to relate technology to the curriculum area and the ability to manage and evaluate technology use. Developing teachers’ capability in these three specific skills has been an ongoing challenge (Dawes 2001; Younie 2007).

In fact, there has been rather variable progress in actually developing the technology skills identified by the Trotter report (Bowles 1999). When government evaluators were asked, ‘what went wrong in the 80s?’ with respect to technology development in schools, the answer was an immediate identification of ‘teachers’ as a key obstacle. As Scaife and Wellington (1993: 19) found ‘this complex chemistry of teacher attitudes has probably been the major barrier to success’. Locating a lack of progress with technology in schools as being the fault of teachers was documented by the National Council for Educational Technology (NCET). In the 1990s NCET published an information sheet, ‘Teacher Education and IT’, which highlighted how technologies potential to harness education had been largely unrealized – again, due to teachers’ lack of capability in employing technology in the classroom.

The learning potential of IT is far from being realized. There remain large numbers of teachers, in all phases of education, who are not familiar with IT and are therefore not using it in their teaching.

(NCET 1997: 5)

The notion of ‘teacher resistance’ emerged as a significant concept in the literature of this time and was held accountable for hindering the development of technology in education. However, Dawes (2001) and Younie (2007) believe this is a contestable concept, with little empirical evidence of its existence, and a lot of rhetoric in its explanatory value as to why technology has not transformed learning in the ways visualized by politicians.

Following the development of major technology initiatives across the three terms of Conservative office (1979–1997), the government commissioned a seminal national assessment of the impact of ICT in schools: the ImpacT Report (1993). Conducted by Watson, this was the first major evaluation, which notified government that:
1. the use of technology-based work is primarily dependent on individual teachers’ initiatives;
2. in-service provision was a major concern as many teachers felt they needed an ongoing programme of in-service training and,
3. knowledge and awareness of software was not in itself sufficient for effective implementation: instead, issues of management, teaching styles and the need for on-going support for professional development were identified as critically important.

In 1997 there came the influential Education Department Superhighways Initiative (EDSI), a synoptic report that first explored the educational opportunities afforded by the Internet, which rightly drew attention to ‘. . . the considerable managerial and organizational demands placed on those introducing technology of this complexity . . . ’ (Scrimshaw 1997: 11).

The EDSI report highlighted the multi-dimensional nature of change and showed that many conditions had to be met in order to utilize the educational potential of technology, one of which was: ‘the immediate obviousness to teachers of the educational potential’ (DfEE 1997: 29). It was clearly evident from this report that teachers would be instrumental in unlocking the educational potential of technology.

Similarly, the School’s Curriculum and Assessment Agency (SCAA) report on technology identified the training of teachers as the most significant component for ‘future work’, alongside ‘the need for a long-term strategy’ (SCAA 1997: 12): ‘IT training should be a fundamental requirement in initial teacher training and form part of qualified teacher status. There needs to be a strategy for the continuing professional development of all teachers’ (SCAA 1997: 14). It is here that the origins of NOF ICT training for serving teachers and the TTA Circular 4/98 that made ICT mandatory to trainee teachers can be found. As Robin Squire, Parliamentary Under-Secretary of State for Education and Employment, asserted in his keynote address at the SCAA conference; ‘. . . answers can only be produced if teachers themselves become knowledgeable about the technologies and their uses, and confident in their ability to shape them for curricular use’ (SCAA 1997: 5).

However, most significantly, the SCAA report also identified that ‘there is often a gap between the rhetoric of schools’ IT policies and classroom reality’ (SCAA 1997: 3).

Common concerns about technology in schools from government reports – 1990s

There are a number of common threads that run throughout the reports considered above. Although the balance of emphasis differs between them, all the reports raise four key issues:

1. Technology Training – specifically, the need for thorough training in technology for all trainee teachers and serving teachers that is clearly targeted by phase, curriculum area and previous experience; the reports recommended that this training should cover not just the use of software, but its application to curriculum areas, technology pedagogy and classroom management.
2. Technology Resourcing – specifically, the need for more up-to-date hardware, software, more broadband connections to external networks and cheaper connection charges, improved access to computers by pupils and teachers. Also, more human resources in the form of technical staff and teachers with expertise and training in leading technology as a major curriculum area.

3. School Management – specifically, the need for senior managers to take responsibility for developing a whole-school policy for technology and the strategy for its implementation; setting realistic budgets for purchasing technology hardware and consumables; training staff and clearly establishing support for technology use at management level, giving technology a high profile.

4. Curriculum application – specifically, the need for schools to get a balance between direct teaching of technology skills and their application across subject areas; teachers to evaluate their use of technology and to share good practice; to review how access to networks can help both teachers and learners.

While these four issues were reiterated across all the reports, there were also elements that occurred in some reports, but not in others. For example, raising standards of achievement was referred to explicitly in the documents that originated from government agencies, like Ofsted, but were an implicit sub-text in other reports. All the reports discussed the need for change, to make more use of technology and the benefits of making that change. However, one issue that seems to have been either ignored or disregarded is ‘the nature of the change that the use of technology will have on a teacher’s work in his or her classroom’ (Bowles 1999: 24). More technology use by teachers was to become imperative with the election of a new Labour government in May 1997, which made statutory the use of technology across all subjects.

Learning theories and developments with technology in schools – 1980s to now

Research has shown that it is very difficult to consider technology without understanding parallel developments in theories of learning that informed teachers’ thinking (Hammond et al. 2009; Woollard et al. 2010). In the 1970s pedagogical thinking was greatly influenced by the work of Piaget (1963) with a focus on discovery and learning as inquiry rather than a traditional instructional pedagogy. This can be seen in the work of Papert who created LOGO at MIT in 1967.

LOGO was an accessible way into programming, which was learner-centred and enabled pupils to control a small turtle-shaped robot. In an open-ended and playful context, LOGO enabled children to learn generic problem solving with a mathematical element and fostered creativity (Millwood 2009). Practitioners in the Hammond et al. (2009: 50) research talked about their enjoyment of seeing pupils ‘program’ each other around the room as a preliminary to on-screen work with the turtle commands and of giving what they felt was control to pupils over the computer. In turn, the influence of Piaget was superseded by Vygotsky (1978) and a social-cultural view of learning. Today this influence can be seen in the social constructivism of learning.
with technology in the classroom – for example, the development of dialogic learning with interactive whiteboards (Warwick et al. 2010). Further developments in learning theories such as communities of practice (Wenger 1998) and distributed cognition (Hutchins 1995) can be seen in the collaborative knowledge building of Wikipedia and professional networks of peer support and information sharing.

Applications to practice

Much of the innovation described in this chapter was supported by central government policies. This was intended to keep the curriculum meeting the emerging needs of society. Research into technology adoption in different countries, which was carried out for the EU and the British Council (Leask and Younie 2001) showed that, without central direction and support, innovation and the adoption of new practices in schools was limited. The UK government elected in May 2010 adopted a hands-off approach to curriculum development with their first act being the abolition of the government agency with responsibility for supporting technology innovation in schools (Becta). The evidence suggests that this hands-off approach from government does not advance improvement in education. However, various top-down initiatives undertaken by Becta were also not likely to embed change. A typical approach by Becta was to focus on infrastructure and getting equipment into schools before an analysis of pedagogical applications was available to support adoption by teachers.

In the UK there was a preoccupation with whether introducing computers into schools would lead to measurable outcomes in terms of learning. The most obvious benefit, that in a technologically rich society everyone needs to have the skills to use technology for their own purposes seemed to have been ignored along with other benefits which are difficult to measure. However, all teachers need to manage their professional lives by balancing professional priorities with political initiatives and interventions in education. This is a challenge which teachers cannot avoid and one which calls for continual reflection.

Conclusions

The introduction of technology innovations into an education system provides an opportunity for major change and review through engagement of leading practitioners in developing a curriculum fit for society’s emerging needs. Critical to the success of any innovation however, is the engagement of practitioners who have to create the new pedagogies for the new contexts that technologies afford. A particular problem with technology integration into schooling has been the lack of knowledge on the part of decision-makers – both policy-makers and school leaders – about the opportunities opened up for new pedagogical approaches with technology.
Further reading


Websites

National Archive of Educational Computing http://www.naec.org.uk/. This website documents the development of learning with technology; through its invention and application over the past half century. In addition, the archive houses technology artefacts, including the original Domesday equipment.
The BBC Computer Literacy Project http://www.mcmordie.co.uk/acornhistory/bbchist.shtml. This website charts the history of the BBC micro-computer and accompanying Computer Literacy Project.