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Raj Patel and Michelle Lofthouse

LSN's Centre for Innovation in Learning is an independent think tank which develops new thinking to bridge the gap between policy and practice. We identify key thinkers, social innovators, stakeholders and influencers across learning and skills and create a space where they're free to develop, debate and challenge new ideas.

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Foreword from John Stone, Chief Executive, LSN

There are few in our generation who would not accept that the application of digital technology has been one of, if not the most significant factor in changing the way we live and work. We have all seen development that justifies the use of extravagant language such as 'transformation' and 'revolution'. Whole industries are finding their business models are no longer fit for purpose. Some, such as retail, have found ways of prospering on-line while others, notably newspapers, commercial broadcasting and recording, have struggled to continue to successfully adapt and reinvent themselves.

In education there is something of a paradox. There is widespread appreciation of the benefits that technology can bring. There have been major investments in infrastructure. National support programmes and regional advice have been generously funded, but the impact of all this has been incremental rather than mould-breaking. The formal classroom experience remains at the centre of teaching and learning and to a casual observer at least, seems largely unchanged. Away from the classroom the Facebook generation is busy creating its own virtual society while elaborate college-sponsored online learning environments can struggle to attract attention. Educational tools and resources which try to harness the ways of learning which the internet and social networking can engender, are often blocked or limited within the formal educational context.

This paper attempts to take this problem head on. Where are the gaps between our ambitions and our achievements to date? What else can we do to integrate the learning taking place at school or college with the wider informal learning people are experiencing and constructing? Is there more that education and business can do together to innovate in the use of learning technologies?
No single panacea is on offer but we believe that this publication offers some robust insights into where we go from here. It has never been more important to innovate in how we learn.

Introduction

The digital technology revolution pervades all aspects of our daily lives and is a prime driver of social change and economic growth. It has now brought education to a major cross-roads, and although technology has been embraced by learning institutions, it could be debated whether it has really become part of the fabric of education and training. Notwithstanding the significant investment in technology for learning over the years, in an era of constrained public funding, the cost and impact of this investment is now attracting political debate. We cannot, of course, encourage innovation and ensure it is risk free at the same time, but we can improve on the processes for innovation and find new ways to add value to learning through technology.

In the mid-1990s cheaper personal computers, faster modems and the birth of the web drove demand; today, it is mobile, wireless and web 2.0 technologies, with smart phones, free wi-fi hotspots and social networks. According to one market analysis: 'At the end of 2008 there were 189m mobile-broadband connections (globally), generating on average 175 megabytes of traffic per month.' A year later the respective figures were 312m and 273 megabytes (Bernstein Research, 2010).

Penetration of mobile broadband is still at an early stage with 5% of the UK population connected in 2009 and significant growth levels predicted. Network operators and telecom companies are already investing in next generation networks that will be bigger, faster and not only connect people and computers but also inanimate objects such as sensors. So what will we do with all this power? According to one report, the answer is software (European Internet Foundation, 2009). From online 3D applications to moving beyond 'click and point', we will have empowered interfaces in the future.

That education is in gradual transition is a fairly safe claim but are the latest developments in technology challenging the fundamental basis on which our education models have been designed? Belief in the transformative power of technology is not new. As David Buckingham has argued (Buckingham, 2007), although predictions of its potential have a long history, and not only in education, for better or worse the traditional model of the school, and indeed, the college or university is still with us. Oft-predicted wholesale revolutions have often not materialised, or failed to deliver the transformations promised.

The truth is that technology is not meant to replace interaction with tutors or between learners. Learning is a social process, and part of the 'brand' attractiveness of an educational institution is the institutional experience itself. Neither can technology apply emotional intelligence and judgement to the learning process as well as a teacher. While the idea of an 'edgeless' university may be a model that has certain attractiveness in an era of global education, and free lectures beamed over by the world's leading professors have proven popular, this model might have less appeal for learning institutions focused on 'learning by doing'. Education though, is becoming more global and where universities lead, others will inevitably follow as the world shrinks. The most interesting educational collaborations may be thousands of miles away.

We can also not ignore our experience that the traditional business models of encyclopedias, newspapers and record labels are in various stages of collapse (Williams, 2010). Williams argues that change is required in two vast and interwoven domains. Firstly, in the future how do we create value for the learner in a digital age (how learning is accomplished)? Secondly, how do we develop a new modus operandi for creating course materials, and written, spoken and visual information (the content of what we learn)?

The pace of change and innovation in technologies is rapid, government has been keen to encourage the use of technology for learning but a central question remains: are we any closer to bridging the gap between the opportunities presented by technology and the change that is to come or are we simply focussed on automating existing processes? What are the barriers within education that need to be addressed? And, in an era of constrained public-sector funding, how do we simultaneously drive up productivity and continue to enhance learner experience?

LSN believes that a paradigm shift is taking place and current factors influencing the UK education system offer a significant opportunity for the sector to scale up its ambition in this area. The information and communications technology (ICT) sector, in some cases supported by public-sector technology investment programmes, is now the biggest research and development investing industry in the UK and provides other sectors with productivity-enhancing technologies. At the same time new solutions and tools are enabling us to combine different digital technologies including the internet, mobile devices, computer games and interactive television, and generate our own learning content with much more ease. The nature of knowledge – both in terms of volume and what counts as knowledge – is also changing and is increasingly biased towards what can be represented in digital form.

A combination of factors driving change is enabling us to develop new propositions for how, when and where we deliver learning. Back in 2004, inadequate technical infrastructure was regarded as the main obstacle; in 2006, it was equipment costs; today, it is to do with people (www.checkpoint-elearning.com). Creating quality wireless environments and ICT infrastructure is still important, but it is leadership, capabilities and pedagogically sound content rather than investment in kit that are the new challenges. Access to kit should no longer be seen as a barrier for learners from disadvantaged backgrounds – it simply requires innovative forms of funding. In terms of improving access to broadband, the government has already proposed introducing a 50p per month broadband tax that will provide connectivity to rural communities.

To examine the nature of the gap between technology and learning, LSN talked to policy-makers, practitioners and experts in the field in secondary and further education. Drawing on existing research, LSN's in-house expertise, structured interviews with a cross-section of stakeholders, and a roundtable discussion, this think piece provides some valuable insights into observable trends in technology and suggests how we might ensure we reap the full benefits associated with these trends.

With the growth in use of technologies has also come the need for shared definitions and understanding. Some now believe that the broad concept of e-learning, often used to describe myriad technological approaches, has become problematic as different people attach different meanings to it – from distance learning to mobile learning. Dr Gale Parchoma, at Lancaster University's Centre for Studies of Advanced Learning Technologies, suggests that the term e-learning should be replaced by more specific terms like technology-enhanced learning (TEL), computer-supported collaborative learning (CSCL), blended learning (BL) and networked learning (NL). Her contention is that greater differentiation would ultimately guarantee more precision and reduce ambiguity. However, for the purposes of this think piece, which seeks to focus on the bigger picture, we have used the terms technology for learning, technology-enabled learning and occasionally e-learning as referenced from other sources.

Take-up of digital technologies

The majority of adults in the UK have successfully integrated technology into their everyday lives. According to the latest Ofcom report into media literacy, 89% of adults in the UK have access to digital television, 73% to the internet and 91% to a mobile phone (Ofcom 2009). However, there are still significant sections of the community who remain digitally excluded,[1] in particular adults who are older, with low incomes, or with few or no qualifications. There is also a significant percentage of adults who, despite owning a computer or mobile device, have only limited skill in using it and adults for whom digital technology is still primarily a new experience. A February 2010 poll by Sky HD for example, found a huge gap between the gadgets British consumers own and their understanding of how to use them.

Our children, by contrast, have grown up with technology and are likely to be more digitally aware and literate compared to adults. However, as a group of academics writing in the *British Journal of Education Technology* in 2008, led by Sue Bennett of University of Wollongong, have argued, there maybe 'as much variation within the digital native generation as between the generations'.

A Becta report into the use of technology by children (Becta, 2008) suggests that the majority are consumers of multiple technologies,[2] with access to laptops, mobile phones, fixed and mobile game consoles, and MP3 players, which they use simultaneously for entertainment, to search for information and to communicate with their peers.

However, despite their frequent use of digital technology in their personal lives there is evidence to suggest that children still require training to use these media and the devices effectively. Many younger users are not critical or creative users of the vast amount of information and functionality to which technology gives them access. This is a particular concern highlighted by research into media literacy led by Professor David Buckingham:

The question is not whether to use technology, or even what technologies to use, but why and how we should use them.

Buckingham, 2007

A new digital divide is also emerging, based not on access to technology but the quality of use. According to the European Commission Digital Competitiveness Report (European Commission, 2009), which focused on the internet rather than digital technologies generally, the typology of internet use can be divided into three broad categories that are not mutually exclusive.

[1] Digital exclusion refers to lack of access to and use of the internet. In 2009, 10.2 million adults (21%) of the UK population had never used the internet; Source: Champion for Digital Inclusion, *The economic case for digital inclusion* Oct 2009

[2] The Ofcom Children's media literacy report suggests in the age group 12–15: 89% have a games console; 91% own a mobile phone; 68% have an MP3 player and 25% watch TV online.

Figure 1 Categories of internet use

Recreation use	Resource enhancing use	Instrumental use
Playing and downloading Sharing media Transferring to other devices	Learning online Social networking Work Following news (and developments)	e-banking Buying and selling online e-Government (eg. directgov in the UK)

Although the majority of internet users have a positive perception of the impact of the internet on everyday life, only 63% use the internet for resource enhancement (European Commission, 2009). However, there is now a critical mass of users who are engaging in advanced applications, particularly among those aged 16 to 34 years old.

The opportunity to use these technologies to improve the learner's experience in formal and informal learning settings is now thus clearly within our sights. Some schools and colleges have already embarked on this journey, but many have not. Emerging national and international evidence is attempting to quantify the benefits these technologies bestow on the learning process and the learner. A recent report by Becta, *The impact of digital technology* (Underwood, 2009), describes these benefits under two headings:

Impacts that bring about changes in behaviour at learner, teacher and school level; those that bring about changes in academic performance.

Underwood, 2009

The emerging evidence of the impact of technology in learning also suggests that securing better learning isn't just about the medium (Means, 2009). A combination of factors related to format, content and context determine the extent and nature of learning advantages generated for different types of learners. Here in lies one of the biggest challenges – to rethink pedagogy for a digital age, underpinned by theory. For example, is technology changing the way we read, write and interface with others? Of course one still needs a sound knowledge base, and we cannot Google our way through every activity and conversation. Rather, with today's technology, it is now possible to embrace new collaborative and social models of learning that change actual pedagogy (Williams, 2010).

Learning is more complex than shopping – the potential benefits for learning are probably more fundamental, but it takes time to get there as it involves more radical change to the business model and a re-design of the learning process.

Stuart Edwards, BIS

LSN's practical experience in delivering mobile learning projects through MoleNET supports these findings, with 21,000 learners having already used mobile learning, and over 100 schools and colleges having taken part in the project. LSN's recent report, *The impact of mobile learning* (Attewell et al, 2009), identifies wide-ranging benefits that can be achieved through structured and creative use of digital technologies including raising retention rates by 8% and achievement rates by 9.7%[3]. In addition, nearly all (89%) of the MoLeNET learners for whom we received progression data were progressing to further learning or employment.

3 MoLeNET figures are based on predicted not final, actual Individual Learner Record (ILR) figures. It was not possible to control for the many factors other than the introduction of mobile learning that could have affected retention and achievement.

The benefits for teaching and learning were that it:

- supported learning to be more convenient and accessible
- facilitated greater differentiation and personalisation
- made learning more interesting and enjoyable
- encouraged non-traditional learners and learners who have not succeeded in traditional education to engage in learning and improve their self-confidence and self-esteem.

A comparison of the retention data for nearly 5000 FE college learners with LSC national in-year retention rates for 2006/07 suggests an improvement in retention of 8%. A comparison of the achievement data for nearly 5,000 FE college learners with LSC national in-year achievement rates for 2006/07 suggests an improvement in achievement of 9.7%.

LSN, 2009

For technology-enabled learning to grow and be more effective it needs to do much more than simply bolt technology onto existing delivery and pedagogy. A fundamental change in environmental conditions is needed that stimulates and forces learning to evolve. This change will lead us to a point where providers are encouraged to respond to consumers' new expectations of learning.

Attitudes to learning

So far the education sector has not been subject to the same magnitude of forces that are changing the shape of how, what, when and why we choose to consume goods and services. It has, of course, always been easier for new entrants with more innovative models to challenge or transform private services than public services. Looking beyond the market explanation, why is this?

Our experts were not surprised that this should be the case and many identified a critical cause as being the separation between life and learning. Kirstie Donnelly of learndirect said:

People separate learning from their lives. We have an exciting opportunity to make the connection for people on how technology can enable them to learn whilst doing the things they do as part of their everyday lives.

Kirstie Donnelly, learndirect

Despite successive government policies that attempt to encourage a lifelong learning culture it appears that learning remains an unpopular activity, associated by many adults with a negative experience of teacher-led compulsory schooling.

Since 2004/05 there has been a 23% fall in the take-up of funded learning programmes (Baroness Morris report for BIS, 2009); participation by adult learners in funded education is in decline as funding priorities change and government funding declines. The NIACE 2009 adult learning survey (Tuckett and Aldridge, 2009) suggests that the proportion of adults currently learning is at its lowest level since the Labour government was elected in 1997. Although the focus of government (and therefore providers) on longer qualification-bearing courses may have helped to define and meet targets, it may be having an opposite effect on nurturing a learning culture. Most providers continue to enrol learners on classroom-based courses of fixed length once or twice a year, driven by a planning funding system that, despite reform, rewards an input-based system.

However, there are promising signs that using technology to support the learning process can be motivational and provide a hook to engage the hardest to reach groups. As we suggest in our report *The impact of mobile learning* (Attewell et al, 2009), there is evidence that technology that is used recreationally, such as PSPs, Wiis and iPods, can be also be used effectively to develop literacy and numeracy.

In a recent European Commission study *Learnovation* (Dondi et al, 2009), 44 experts from 12 member states were asked to predict the shape of learning in 2020, based on their agreement with a number of statements (using the Delphi technique). Along with a variety of predictions about the increasing use of technology in learning, the statement that learning should be re-integrated into everyday life, received a high level of support. Although the use of technology does not provide a blueprint for the delivery of learning in the 21st century it could, if used effectively, introduce flexibility and choice into the system. Becta suggest these changes may well be incremental:

While there are likely to be significant shifts in curriculum and pedagogy, these are likely to be within an education system that is evolving rather than undergoing a fundamental revolution.

Becta, 2008

Political and economic drivers

Digital Britain

The government's publication of the *Digital Britain* report (DCMS and BIS, 2009) underlined its commitment to putting Britain at the 'leading edge of the global digital economy'. As well as setting out a strategic vision for universal broadband access and investment in next generation broadband services, the report recognised the government's substantial investment in technology for education and wider public services and the potential of this investment to transform the education system in the UK.

Government has invested considerably in both ICT infrastructure and in the provision of ICT kit in schools, with most now well-equipped to make better use of technology to support learning.

DCMS and BIS, 2009

There are now initiatives driving 'digital participation'[4] and providing the most disadvantaged children, plus more than 10 million adults who are not online, with access to computers and the internet, and the motivation and skills to use them.

The Home Access initiative that was rolled out in December 2009 will cost the government £300 million and put the internet into the homes of over 250,000 low income families with children in Years 3 to 9 at school. It will not solve the problems of the digital divide but it should help to reduce them. At the same time the government also used its *Smarter government* report (HM Government, 2009) to announce a £30 million package of funding for UK Online, to support an extra million adults to get online by 2013.

Cost reduction

In research conducted by PWC for the Digital Inclusion Champion, Martha Lane Fox (PWC, 2009), concluded that a digitally enabled population could save the government between £3.30 and £12 for each transaction switched from paper to online, resulting in a total economic benefit of £22 billion.

The data used to reach these conclusions was extracted from a variety of projects and services as there is still no comprehensive business case in a single report for introducing technology across public services. Although the Government's recent *Smarter government* report recognised the importance of using technology in delivering public services, the policy emphasis in public-service reform has been on improving transactions rather than transforming services.

[4] Following the *Digital Britain* report Ofcom is leading the Digital Participation Consortium initiatives to increase the reach, breadth and depth of digital technology use.

The current level of public sector debt and, at best, sluggish improvement to the economy may well result in the reduction of education budgets in the next Comprehensive Spending Review. The Skills Investment Strategy published by the Department for Business, Innovation and Skills in November 2009, signalled a desire to achieve more for less, with a substantial reduction in the funding per learner for major programmes like Skills for Life. Capital build projects in further education have similarly experienced a funding squeeze. Where learners have sufficient motivation and technological skill to learn at a distance one solution may be to divert investment from physical assets such as buildings into systems, processes and capability, as suggested by the Learning and Skills Council (LSC) publication *Building colleges for the future*:

The LSC estimates that around 44% of the FE estate is awaiting renewal. If this 44% were renewed with modern, more flexible buildings – and if due account was taken of more modern teaching and learning methods (such as information and learning technology (ILT) led open learning) – the overall size of the FE estate would drop to approximately 6.6 million square metres. This compares with nearly 9 million square metres at incorporation in 1993.

LSC, 2008

As the ambition to raise skill levels set out by the Leitch review (Leitch, 2006) and in the government's recent Skills for Growth strategy (BIS, 2009) are likely to be unaffordable in a climate of pressure on funding, the government can be expected to search for solutions to drive down the costs of funded provision and actively look at the potential of technology to reduce both capital and revenue expenditure in the next spending review.

Public spending restraints present an opportunity; cost efficiencies can be gained from shared services across education which would also help to drive and improve the quality.

Vanessa Pittard, Becta

Interestingly, the corporate sector has already made this leap, recognising the benefits of online delivery of training to reduce costs and improve the quality and consistency of provision. Some of the most sophisticated users of technology in learning are the large corporations such as IBM and BAE Systems, where the need for large-scale, just-in-time training and cross-company knowledge exchange is fundamentally changing how learning and development are delivered.

According to Karen Price of e-skills UK (the Sector Skills Council for Business and Information Technology):

There is no doubt that there are efficiency savings in using technology for learning, this is one of the reasons why the private sector has been an early adopter. Corporates are finding ways of making learning more interactive and engaging through the use of technology; enabling personalisation, just-in-time delivery and learning reinforcement.

Karen Price, e-skills UK

Of course, the educational context is often more complex, not transactional but interpersonal, and with educators needing to factor in the application of technology to different needs and abilities. We do need stronger and more granular evidence of cost savings in different contexts. And it hasn't been plain sailing for companies in the private sector either. More than half the companies, in a Becta survey across service, financial, health, training, IT, communications and public sectors (Becta, 2009a), reported that their activities were still in the development stage, which in some cases had extended over many years. However, as e-skills has noted, companies that have applied sophisticated e-learning strategies, within a context of an established learning culture, 'have often seen a significant percent output to input improvement ratio in regard to their learning-technology investments'.

Targets and qualifications

Many of the experts we interviewed raised the need for change in the qualification system to make it more accommodating of different styles, sizes and types of learning. They welcomed the introduction of the Qualifications and Curriculum Framework (QCF), which recognises units of learning, but emphasised the need for it to be backed by a flexible unit-based funding system. Such a system has been talked about for decades and the LSC's latest approach as outlined in November 2009 was to look at how to fund shared and other units on the framework to 'provide the sort of flexibility necessary to realise the benefits of credit accumulation and transfer under the QCF' (LSC, 2009). Although there is an expectation that the Skills Funding Agency (SFA), one of the successor bodies to the Learning and Skills Council (LSC), will be looking at the possibility of having a credit-based funding methodology, much testing of approaches will be needed – and even then funding may still largely be prioritised for 'full-fat' qualifications.

A funding and audit system based on inputs provides little incentive for systemic change. As Stuart Edwards commented:

There is a lack of a business model for return on investment particularly in the publicly funded sector. The way that we fund e-learning doesn't make it easy to do. A world in which our core assumption is about guided learning hours doesn't help.

Stuart Edwards, BIS

The government has replaced its aspiration for a 'demand-led system' with 'skills activism', but will still have to balance the need for economically valuable skills with the increasing demand from learners for flexibility in what, how and where they learn.

Research from the National Science Foundation Life Centre (NSF, 2008) suggests we only spend a tiny proportion of our adult life undertaking formal learning. Between the ages of 5 and 16 we spend almost 20% of our waking hours on formal learning. This drops to 5% at graduate level and to an insignificant amount in our adult working life. By comparison, the vast amount of our learning is achieved informally.

In an age where more and more information is accessible, self-directed and informal learning has a substantial role to play but is still largely ignored by the current UK education and training system. Our experts identified the rise of informal learning as a key socio-economic trend.

Qualifications remain the primary measure of skills and academic achievement, so the awarding bodies who accredit these qualifications, need to adjust their examination and awarding practices accordingly. Many have already introduced technology into assessment, from the delivery of online high-stakes tests[5] to the use of e-portfolios. Schools, colleges and learning providers remain the main customers of awarding bodies and so the speed at which they will make the transition to new modes of assessment will be largely set by those delivering these qualifications.

5 A high-stakes test is a test with important consequences for the test taker. Passing has important benefits, such as attaining a qualification, a scholarship, or a licence to practice a profession. The use and misuse of high-stakes tests is a controversial topic in public education, especially in the United States.

Socio-technical trends

It is hard to keep pace with technological change now and even harder to predict how technology might be used in five years' time. We asked our experts to comment on what they thought were the top three emerging socio-technical trends with the potential to affect education. By then mapping those trends to research carried out through the Beyond Current Horizons[6] (DCSF, 2009) project we identified the four key trends we think will have the greatest impact on education in the next five years.

1 A weakening of the links between formal learning and life

This is being driven by the requirement for us to work longer and to learn throughout our working lives and an information landscape which is 'denser, deeper and more diverse'.

Continual improvements in the quality of web search will enable us to find information on almost anything and prepare the way for more informal learning, with people using peer and expert networks to improve their knowledge in addition to formal learning. Although the precise nature of the split and relationship between formal and informal learning maybe disputed, there is growing recognition that informal learning is crucial to performance improvement and it is technology-enabled learning that can provide sustainable support for such a culture of learning. The rise of interest in sites such as School of Everything is evidence of this trend.

I am struck by the dominance of user-generated content in the IT sector. There is so much high-quality content out there that is free and readily accessible that it starts to call into question the viability of the traditional e-learning industry.

Karen Price, e-skills UK

Another aspect of the blurring of lines between learning and life is that technology previously used largely for leisure is becoming an increasingly important in how we learn. Our experts identified 'gaming' and Internet Protocol Television 'IPTV'[7] as having the greatest potential to affect education. LSN's gaming report Games technologies for learning (LSN, 2010) demonstrates how gaming technologies can benefit teaching and learning through assessment, increased flexibility, improved learner performance and skills development.

6 Beyond Current Horizons was a 2008 research programme, sponsored by the Department for Children, Schools and Families (DCSF) and run by Futurelab. It sought to investigate a range of social, technological and cultural future scenarios that would shape education and training in 2025, to help the government to develop the means to support the country's children and families.

7 Internet Protocol Television (IPTV) refers to a system through which a digital television service is delivered using the internet

Computer and video games are as relevant a cultural medium as books, film and television for many of today's young people. As such, they have the potential to be an effective means of delivering a wide range of educational and training material. Mobile devices designed for gaming, and familiar to young people, are being used for visual learning, data handling, developing interactive skills and team play, and supporting learners with learning difficulties and/or disabilities.

The customisation of existing commercial games through the use of freely available development tools (a process known as modding) is becoming increasingly widespread in corporate environments and some government environments, including the Ministry of Defence.[8] Cisco-certified engineers, for example, complete an online video game teaching them the basics of wireless networking before they go near the more formal 'classroom' environment. Grass-roots organisations have developed applications that use combinations of graphics, gameplay and training technologies to create a compelling training experience.

Gaming for learning has both advocates and critics (see Williamson, 2008). Criticisms range from the cultural content of games to whether 'fun learning' is simply part of the sales pitch by entertainment companies. When done well it provides a highly interactive learning experience based on the application of skills that would be hard or expensive to replicate in a physical training environment. Caspian's Learning[9] rapid 3D authoring tool 'Thinking Worlds', for example, combines gaming with virtual worlds and makes development of educational applications accessible to educationalists.

The jury appears still to be out on whether IPTV has the potential to be used in the classroom although the long experience of the Open University suggests that educational programming does indeed have an audience. If TV can be used as more than just a one-way broadcast media it surely has the ability to engage a wide audience, as LSN work on IDTV highlighted (Atwere and Bates, 2003). Following the success of Freeview, the BBC Project Canvas is attempting to bring broadband and television together in one box, allowing access to the internet through your television. We will be watching with great interest to see its potential for use in formal learning settings.

2 The rise of 'cloud' computing

This refers to a constant connection to knowledge, resources, people and tools that is independent of any one institution. 'Cloud' computing involves data being held in cyber-space and accessible regardless of location. Such 'clouds' could allow seamless sharing of information and data between people in a user's cloud and could significantly reduce the need for educational organisations to maintain in-house servers, and the costs associated with this. The use of 'cloud computing' is still new in education and there are data security risks that may limit its adoption in the short to medium-term.

There are already some colleges trialling the use of 'clouds'; this could reduce the need for individual institutions to host their own data.

Vanessa Pittard, Becta

8 Futurelab literature review in Games and Learning, report number 8, Games and Learning Interim Report Survey of existing research and criticism, Becta and Futurelab

9 www.thinkingworlds.com

Mobile learning is already with us: we can store, transmit and exchange data between a wide variety of hand-held devices. Cloud computing offers the potential to take this a step further with all the user's data and relationships managed in cyber-space through the creation of personal 'clouds'.

Current innovations will enable us to do more at a distance, expanding the number and variety of locations in which we choose to learn; technological developments will help to increase a 'sense of presence' in remote interactions, using technology such as Voice Over Internet Protocols (e.g. Skype) and virtual environments.

We can also learn in 'situated' places, e.g. linking workplace and classroom learning – bringing together theory and practice. And with an increasing number of locations offering wi-fi hotspots, from McDonalds to public libraries, flexible learning is also becoming less of a barrier. As the Beyond Horizons project suggests, people will continue to link their identity to their physical location and face-to-face contact will continue to be important but there is now potential for developing new forms of flexible learning, not separated from location, but an integral part of it.

3 Computing devices can enhance or replace human interventions – ubiquitous computing

Ubiquitous may be a longer term trend but one that could make tracking, managing and storing information about learning easier[10]. Already sophisticated learner management systems are part of the corporate learning landscape, helping both learners and tutors to automate the management of learning, and virtual learning environments (VLEs) are widespread in colleges and universities. Taking this a step further we may also identify areas in the teaching process where computing devices could replace human intervention, which could then be deployed more effectively. As Seb Schmoller of the Association for Learning Technology comments, formative assessment is one area where there would be substantial benefits in using intelligent technology with the ability to process huge quantities of pre-marked scripts, determine the characteristics of those scripts linked to grades, and use this to predict performance in public examinations.

A model for this would be statistically based machine translation, in which software offers the statistically most likely translation for a phrase based on the way that phrase has occurred (and been translated) in the large corpus of human-translated texts held in the machine translation system. In this kind of translation, software draws meaning from very large aggregations of data. Awarding bodies hold very large aggregations of data about the performance of learners in tests. The challenge seems to me to be how such large aggregations of data could function as a corpus of human-marked work against which an individual learner's performance could be compared, and individualized formative feedback provided to that learner.

Seb Schmoller , Association for Learning and Technology

[10] The practice of making computers so common and accessible that users are not even aware of their physical presence or the ability for everyday devices to be programmed to read and react to external stimuli, imperceptibly to the user. The ideal of ubiquitous computing could be defined as a high-speed network that covers any kind of geography and is easily installed and automatically maintained (http://substratum.ca/subs/Resources/TechTerms/?letter=U)

We could also point to e-ILP (Individual Learning Plan), a personal development tool used by colleges in Northern Ireland as an online tool recording information about the profile, grades, work experience, assessments, learning plans, personal development and hobbies of individual students which, can then be accessed by the staff relevant to that individual, from different course leaders to pastoral support officer to the careers adviser. The pastoral tutor can conduct online interviews with students and record information on the system; or use the system to set goals and targets with the student. Because the e-ILP aggregates everything and can control who can see the information, it allows for much greater awareness among staff involved with an individual leading to more collaborative support and personalised programmes for the student.

Personalising learning can also be enhanced by new applications. For example, tests could assess learners' abilities as they work through them and adapt or change questions to make the tests harder or easier. This would enable learning to be stretched not only within a group environment but also against one's personal benchmark.

4 Keep up now! From social networking to formal and informal learning

Social networking[11] is the best example of how technology has affected how interaction between people. It has seen massive growth in the last two years, particularly from adults. Ofcom's research (2009) suggests that 38% of adults have set up their own social networking profile, up from 27% in 2007 and 66% of children aged 12–15, up from 55% in 2007.

In sectors and industries where technical knowledge is continually changing, blogs and peer groups are becoming important mechanisms for sharing knowledge and informal learning. The government's ambition to create a new 'technical class' offers an opportunity to pioneer new forms of learning where peer-to-peer learning is designed in at the beginning rather than an afterthought.

Social networking presents an opportunity. There are natural learning networks online based on interest and profession, and those that are user developed. They represent a bridge between informal learning and formal learning.

Vanessa Pittard, Becta

It is not possible to predict with any accuracy what learning will look like in five years' time, but as the corporate sector is often an early adopter of technologies relating to learning and development, this is a good place to look. Some employers are beginning to address the challenge of effectively integrating and engaging a new generation of 'digitally always-on' employees who may be turned off by traditional forms of induction, training and learning. As Karen Price of e-skills UK explains:

At IBM for example, all staff are encouraged to learn. As an employee, you know the competency frameworks that are in place, you know where you need to go to learn and the learner management system shows you all the learning open to you. Innovative technologies are used to deliver learning, for example a 15-minute game designed to cover key areas of knowledge which is computer marked. Employees will gather in virtual classrooms to collaborate and share knowledge, using second life technology. You can even have a 'virtual' coffee with a colleague as follow-up.

Karen Price, e-skills UK

[11] Social networking consists of commonly recognised online communities that enable individuals to post and exchange information through sharing and collaboration tools and social media such as MySpace, Facebook, Twitter, etc.

Barriers to adoption of technology in learning

In the context of the changing political, economic, social and technological environment we wanted to consider the barriers facing various institutions that are looking to adopt new technologies as part of their learning processes.

Workforce capabilities and concerns

Most teachers and lecturers use technology for lesson preparation and there are some good examples of institutions that have embraced new technology. Interactive whiteboards are now standard in most classrooms but therein lies the issue: we continue to associate learning with bricks and mortar. VLEs, where they exist, are often not fully utilised and most institutions have yet to adopt e-portfolio tools or any form of online tutoring. Use of whiteboards is often cited as an example of the widespread of embedding of technology but how new or transformative is the teaching practice that accompanies them? Does teacher training explore transformative use of technology enough? Individual teachers and tutors are often innovators but they can also be formidable obstacles to change, often due to lack of confidence or concerns for their jobs.

In a recent research project to inform the priorities for improvement in teaching and learning, the Institute for Learning (IfL, 2010) found that some technologies were more likely to be used by its members for work or continuing professional development (CPD) than others. The use of VLEs were the technology respondents found most helpful for their teaching and learning, 30% using it 'a lot'. By contrast 30% of the smaller number who had used social networking reported that it had been 'not helpful'. Overall, the need for staff to become more skilled and more confident in the use of technology emerged as an important priority for CPD.

There are now more opportunities for teachers to access CPD related to the use of technology in learning and Becta has recently launched a new online database of technology-focused CPD and training opportunities for those working in further education and skills[12]. There is more emphasis on technology in initial teacher training (ITT) and the Institute for Learning (IfL) also requires members to achieve 30 hours of CPD per year, part of which can of course be on technology for learning.

However, teachers who are excited about digital technologies are often accused of using them regardless of whether or not they are pedagogically effective. In their book *Rethinking pedagogy for a digital age* (2007), Beetham and Sharpe have coined the phrase 'design for learning' to help bridge the gap between thinking about learning and teaching practice.

[12] www.thenationalprospectus.com/

Protectionism

There are still frequent examples of schools and college IT departments preventing access to many internet sites, and especially to web 2.0 services with collaborative potential, citing a desire to remove distraction from learners or to protect them from risks associated with being online.

Cybersafety has become a major societal concern and is a challenge for institutions. Its complexity and importance were highlighted by the 2008 Byron Review (Byron, 2008) and the subsequent establishment of the UK Council for Child Internet Safety (UKCCIS), which will lead policy in this area. Continuing campaigns from government such as 'Click clever, click safe' and 'Zip it, block it, flag it' show how seriously cybersafety is taken and lessons in internet safety will be part of the curriculum from 2011. Organisations such as Childnet are actively developing suites of resources for teachers, parents and carers to help promote safe and positive uses of the internet.

Unfortunately, some teaching and IT staff use safety concerns as an excuse to resist the introduction of new technologies and associated culture change, perhaps because they fear a loss of control. Restrictions ranging from web 2.0 services to the use of smart phones and gaming technology risk creating a growing digital divide between learning and life – and prevent the development of solutions to some of the real problems that open access can present.

Channel 4 provides a good example of how a highly protectionist approach can affect the tools that can be used in a formal learning environment. Using a project called Smokescreen,[13] an online game and social network, it aims to help teenagers to develop computer literacy skills and learn about online safety. However, since broadcasters' sites are often blocked by schools and colleges, the somewhat ironic result is that this project is often not accessible to its target audience. This example reinforces the importance of all staff who contribute to defining ICT and teaching and learning strategies taking part in CPD activities to help them explore and understand the potential of the internet for supporting learning.

Small is not always beautiful

The technology evangelist in an institution has an important role to play in bringing their colleagues along with them but management commitment and foresight are also required to enable innovation.

Many institutions still do not fully benefit from technology, partly because of the diverse nature of the training provider market and the number of small players.

Investments in technology and, more importantly, the accompanying capacity-building for staff are expensive and the business cases that support them often do not pay off in the short term. Although most FE institutions have technology strategies, they can struggle to plan and evaluate their impact systematically or provide costed benefits. It is therefore difficult for individual institutions to build a robust business case for investment. It is much easier to estimate the returns from investment in a new building than in a new learning environment.

[13] www.smokescreengame.com/

Even larger providers and possibly even the awarding bodies find it difficult to pursue investments at sufficient scale to be cost effective. Either smaller organisations will need to piggyback on larger ones, or there will need to be collaborative sharing of services.

Seb Schmoller, Association for Learning Technology

Our experts have concerns about the state of the market for education software and systems, which they believe is not always commercially attractive enough to bring some of what is technically possible to education institutions. For example, there is machine translation software that could machine mark examination scripts, providing a high level of consistency and quality although critics points to the high levels of cost in developing such systems and the danger that nuances in much writing will be missed or misunderstood (BBC Online, November, 2009). It is also possible that this approach could ultimately constrain the style of questions being asked. Such an innovation would obviously have cultural as well as technical implications, but is likely to require a public–private partnership on a significant scale to make it happen.

Interaction and collaboration with the private sector is both a demand and supply-side problem. There are many ways to understand and segment the e-learning market, but it is generally (although not universally) accepted that there are three sub-markets – technology, content and services – with companies operating in multiple markets. Globally, the content segment of the market is by far the largest, being made up of generic (off the shelf) content, custom/bespoke content, and open content. The technology segment is dominated by Learning Management Systems (LMS) vendors and includes digital libraries, mobile learning tools, games based learning, simulations and interactive digital television. Open source e-learning platforms and technologies are gaining momentum. Services tend to include assistance in strategy development, design, deployment, integration, management and support of e-learning solutions and their learning objectives. Interestingly, there is now a shift towards companies also offering expertise in e-learning pedagogy.

Although there are a few large providers, the e-learning market overall is thought to be fragmented. Few players have the investment potential to build high-specification innovative content and to take it to market. Even where innovative content is available, it is likely that few teachers will even hear about it as many companies work through partnerships and referrals to sell their products.

Shared improvements

Of course, not all technology-enabled learning requires substantial investment and individual institutions are home growing some of the best content and applications, but they do not always share them – or develop them collaboratively. As Seb Schmoller suggests, it is not always a lack of will but sometimes a lack of the mechanism through which these investments can be shared:

Sheffield College, where I am a governor, has some high-quality Entry level materials: these could be shared. It's not a commercial issue: it's just that the provider market as a whole is not organised to support sharing.

Seb Schmoller, Association for Learning Technology

Several education–sector initiatives and systems have been developed to overcome this challenge and encourage sharing of e-learning resources. One example is MoLeTV, developed by LSN, to enable sharing video material and conversion to a variety of formats for downloading to mobile technologies.

Recently the LSC extended its cash-strapped capital budgets to cover technology investment as well as physical assets, first outlined in 2008 for the 2009/10 tier. Here there is an obvious tension between the funding of individual institutions and projects with small amounts of money, which constantly re-invent the wheel, and the leveraging of a single pot of funding that could be used to develop national platforms such as the National Learning Network (NLN) or to pump prime the system.

Competition, as now exists in the funded education market, does not always result in positive benefits for the government or the end consumer. In some cases it has stifled collaboration among providers who are now competitors in the funded learning market.

Recommendations for overcoming barriers

The Beyond Current Horizons project from the DCSF suggests that we need to re-design educational practices to meet the needs of networked individuals and to develop systemic strategies to help learners navigate a much more complex learning landscape.

Becta is responsible for driving forward adoption of technology across the sector through the government's Harnessing Technology strategy (Becta, 2009b). The strategy creates a vision for 2020 of an FE system where learners can learn at a 'place, time and pace that suits them', and where personal learning environments, online courses and assessment transform the role of institutions and those working in them. JISC-funded programmes are also available to further education. Becta identifies 60 recommendations for government and national partners that aim to help them realise their 2020 vision.

Building on the stakeholder views gathered for this think piece and our experience of working to facilitate the adoption of technology in learning, we have developed seven priorities in two areas – institutional and system – to help us bridge the technology for learning gap.

Institutional level

1 Listen to the learners

If I am running publicly funded provision I have to make it work for everyone that comes. I can't necessarily demand that all my students have IT skills and broadband. Designing provision to work with both sides of the digital divide dampens innovation.

Seb Schmoller, Association for Learning Technology

The challenge for each individual institution is to meet the needs of a diverse group of learners with very different levels of skill in using, and access to, technology. Our advice is to seek their input on how to help engage, motivate and drive achievement through appropriate use of the technology available.

We spoke to City and Islington College who have used their 'learner voice strategy' to help identify how they could use their current VLE to provide a more effective experience for learners. Their new 'mycandi' platform provides opportunities for students to use a range of online services, from playing chess to accessing learning towards a qualification. As Kirsty Webb-Wood of City and Islington College explains, 'As quickly as we can do something our students are waiting to use it'.

By engaging learners at an early stage, institutions that might otherwise take an over-cautious approach to safeguarding, can successfully empower learners to use technology responsibly. Banning mobile phones, and blocking broadcasters' websites, social networks and webmail can drive the use of popular technologies underground. A more positive response is to tackle the benefits and the dangers head on, and teach children and young people about media usage. As David Buckingham suggests, media education can:

Provide learners with the critical resources they need to interpret, to understand and (if necessary) to challenge the media that permeate their lives; and yet it also offers them the ability to produce their own media, to become active participants in media culture rather than mere consumers.

Buckingham, 2007

2 Invest in capability and systemic change

Successful implementation of technology-enhanced learning will couple learner insight with the experience and knowledge of teachers who are already transforming practice in institutions. In addition to innovative and committed teachers, commitment from senior management is vital.

We need to get the leaders engaged and get management to understand the power of the technology.

Karen Price, e-skills UK

Systemic change in how learning is delivered does not come about by accident. As noted above, cultural change across the whole organisation requires the commitment and strategic buy-in of the senior management team. It may also be more feasible to embed technology department by department but care needs to be taken, given the evidence that staff in many cases operate in relative isolation from one another (JISC, 2006). Any such incremental approach will also require an understanding of the business case for investment: how it will affect learner outcomes and the quality of the learning experience, plus cost savings over what period of time.

Some of the emerging socio-technical trends we have identified have the potential to reduce the scale of these investments. Moodle, an open source platform, has gained significant traction in further education and is licence free. Google Apps, an alternative used by businesses looking to reduce the costs of ownership of their non core business systems, has yet to see significant uptake in UK schools and colleges but, as Samantha Peter of Google suggests, 'Colleges are currently spending up to 80% of their IT money just on keeping the system running, which leaves very little for innovation.'

Google, among others, believe that these percentages can be reversed by providing commoditised services such as email free to educational institutions. They claim that further education can make significant annual budget savings by adopting their free services. Significant changes in policy or investment at institutional level of course require a critical assessment of options, ideally set within the context of a forward-looking business model. Some universities are already deciding not to provide learners with email accounts but rather to allow them to use whichever, probably free, account they choose. There is a need for more evidence on costs and benefits in this area.

Although there are good examples of widespread innovation – for example FE adopted Moodle quickly, largely because it offered at least 80% of what they were looking for in a VLE cost effectively – some experts argue that there is a reluctance to transform their approach in any comprehensive or wholesale way. This appears to be partly because of the bureaucracy involved in public-sector procurement. This, being built on the exchange of money and subject to open competitive tendering, finds it hard to accommodate private–public partnerships (PPPs), which are more developmental or depend on non-monetary exchange of benefits.

Granted, some types of PPPs may be controversial with people working in the public sector because of their mixed track record to date and because the offer of free software or free services in return for access to a potential customer base (students) is viewed with suspicion, but as Kirsty Webb-Wood suggests, 'Colleges need to take risks, if we can get something for free through sponsorship which our students need, it's a win-win situation.'

We suggest that IT directors, or their equivalents, need to work much more closely with curriculum directors and take a more active interest in curriculum development decision-making processes and not just in the implementation of new technology. All too often organisations seek to reinvent the wheel in terms of both system design and content development.

3 Shift the balance of resources

The introduction of new technology will inevitably demand that an institution reviews how its resources can best be deployed. Becta has estimated that '£694m of teacher time would be gained if all schools used technology[14] effectively (the equivalent of over 24,000 new teachers)' (Becta, 2009a). They are currently undertaking research to determine the equivalent savings in FE and work-based learning.

Of course, specialist teachers are an expensive resource and the challenge here is about using this resource effectively. Using healthcare as an analogy – we now accept that the frontline system works through a mix of general practitioners, specialist consultants, and nurses attached to practices. Extending this analogy we also now have NHS Direct, which allows us to fulfill many of our health information needs ourselves. Although it is far from perfect system, there are some useful lessons we could learn from the healthcare sector in terms of providing differentiated support to meet user needs in education.

We need to value innovative teachers who are developing sound and collaborative padagogy and encourage them to spread their expertise to others. This should not be seen as yet another challenge to the teaching profession, who are already being asked to embrace new ways of delivering learning, but rather as a means of creating a new breed of educational professionals who can act as learning 'guides'. According to Karen Price of e-skills UK, 'More use could be made of mentors, champions, and coaches'.

More controversially, some have also suggested that linking technology adoption to teacher performance and appraisal.

There is a necessity for more innovative free-thinking education – to widen opportunities for learners to interact with facilitators. More knowledge is produced in a day than a whole year in Shakespeare's time. New teachers don't expect to be the gatekeepers of knowledge.

Stephen Dodson, DC10plus Network

[14] For discussion of what sorts of uses of technology were included in this, please see the Becta report.

Importantly, we need to invest in teacher development in this area as enthusiastically as we invest in the capability of the IT systems that underpin technology-enabled learning. Teachers need:

- CPD opportunities in a choice of formats to meet their needs and preferences
- time to experiment without fearing failure
- time and opportunity to engage in communities of practice
- coaching and mentoring
- a range of technological support for their learning including web 2.0 technologies
- recognition of their achievements built into this process of progression.

System level

At LSN we believe that in order for us to respond to the paradigm shift, fundamental changes need to be implemented, not only in our institutions, but also in the external environment in which they operate.

Widespread adoption of mobile, wireless and web 2.0 technologies have changed and continue to significantly change everyday lives. We know that young people in particular are used to being in constant touch with their friends via Facebook, Twitter, sms; having instant access to information services such as Wikipedia; and instant access to free sharing and collaboration tools such as Youtube and Etherpad. There are services such as Dropbox that allow learners to easily access their files anywhere and from any device, and such as ShoZu that provide easy transfer of picture, video and text data from phones to on-line forums. The move to smartphones, netbooks, e-books and new offerings such as the iPad continues to generate new possibilities. More recently GPS on many handheld devices offers the potential to deliver learning materials that are relevant to a learners location, for example, history or geography students receiving critical pieces of interesting information during field trips and visits.

All these services, tools and innovations are transforming the context in which learning is taking place. To test and scale up the use of these new opportunities we also need to make the system work better – as outlined below.

4 Create the conditions for innovation to happen

Many of the experts who took part in the 'Learnovation' study (Dondi et al, 2009) predict that by 2020 there will be an 'emergence of innovative institutions as grassroot leaders of change'. As discussed previously, although the sector as a whole is not characterised by innovation there are already some promising examples of positive change. Stuart Edwards of BIS suggests:

The ideal model for a sector that is receptive to innovation is one with small players who are the innovators, and large players who have the ability to take their ideas and adopt them on a large scale. The public sector often has lots of small to medium-sized producer units making it a difficult shape for the adoption of innovation.

Stuart Edwards, BIS

This process could be assisted if government funded innovative small (and large) players and put into place systems and services to encourage collaboration and sharing. Practitioner–researchers could then be trained and supported to measure the effectiveness of innovative solutions and gauge how they might best be embedded into practice.

As we move into a more competitive environment it is possible that larger players will merge or that new forms of collaboration and group structures will emerge, although with local authorities controlling the procurement of 16–19 provision, local dynamics will influence this process. It will be these large players and, potentially, new commercial entrants, who will have the capacity to test alternative technologies in the market. Some of those ideas will fail and others will succeed but an appetite for risk is only possible where an organisation can afford to fail. Private–public partnerships that can provide resources to 'scale up' innovations are likely to be important and the government may need to do more to endorse and even promote these models, taking on board lessons learnt from elsewhere.

Our experts suggest that the answer is not the prime contractor model[15] currently used by several government departments to reduce contract management burdens and force collaboration. This model inevitably depends on a master–slave relationship and, although there are examples of this working, it does not necessarily lead to good practice, sharing and innovation.

Seb Schmoller explained how, by adopting simple methods modelled on those used by Uruguayan farmers in the 1970s to share good practice between neighbouring farms, the 'Collaborative Approaches to the Management of E-learning' project (CAMEL) funded by the Higher Education Funding Council for England, developed a cost-effective process for sharing best practice. He suggests that in his experience these collaborative communities may best be facilitated by independent bodies that can provide the right sort of structure:

Innovation doesn't necessarily spread of its own accord, and process-based methods of supporting the spread of innovation are effective, don't involve lots of cost, and can help a fragmented system improve itself from within.

Seb Schmoller, Association for Learning Technology

This is the philosophy behind the Technology Exemplar Network (TEN), run by Becta, the Mobile Learning Network (MoLeNET) run by LSN and ja.net run by JISC. TEN offers a forum through which teachers can exchange experience and know-how on the use and application of technology to learning. The government announced the doubling of size of this network at the recent Learning and Technology World Forum.[16]

15 Prime Contracting is where one organisation is awarded a contract but may sub-contract parts of that contract for delivery to third parties.

16 The Learning and Technology World Forum ran from 11–13 January 2010, in London and was hosted by DCSF and BIS, sponsored by the British Council and Becta and in partnership with BESA.

MoLeNET focuses on sharing knowledge, resources and good practice to help teachers and institutions benefit from the application of mobile and wireless technologies. It is based on an innovative funding model that requires buy-in from senior management teams: they invest an amount of their own funding equivalent to 20% of the amount of capital funding they get from the government (via LSC), use this 20% to provide a support programme ensuring a minimum amount of staff development, mentoring, building on-line systems to support a community of practice and sharing of resources. This also ensures a significant amount of research and evaluation to measure impact and benefits including formal practitioner-led action research in every project.

5 Review funding policy and audit

As discussed previously, the funding system does not provide sufficient incentives for organisations to use online methods to deliver learning. For online or blended learning solutions that have guidance and support built in, proxy measures have had to be invented to equate time spent by learners online with classroom-based contact. A system funded on outputs for a certain level of block grant, with some recognition of 'distance travelled', would provide a better basis on which to fund learning.

Unless providers are given compelling reasons to examine the cost effectiveness of their delivery process, we are unlikely to achieve the change required. The replacement of the LSC by two new organisations will provide an opportunity to review the existing funding and regulatory regimes and perhaps create an environment that stimulates providers to review their delivery processes.

Changes in delivery methods need to be accompanied by relevant changes to the qualification and audit system, and technology can assist this change process. An assessor or auditor can now remotely observe interaction between tutors and learners online, watch learner-created video, or interrogate online databases of information relating to how courses and support resources are being accessed. This provides a much richer source of evidence for both assessment and audit than current paper record systems of learning plans, timetables and folders full of tutor notes, and some assessors and awarding bodies are already moving in this direction. Kirstie Donnelly of learndirect observes:

Online delivery can help us deliver an 'auditable system' that sits behind the actual learner's experience, indeed invisible to the learner, but still providing that much needed evidence for the funders of learning.

Kirstie Donnelly, learndirect

However, technology can assist the process of evidence gathering for learners in many different contexts and not just those who are learning on-line.

It is not only the assessment mechanism that must change but also, crucially, what we choose to assess. The system needs to be sufficiently flexible to fund learners not just for what they have been 'funded' to learn but also to accredit and assess the skills they have learnt in less formal settings.

6 Invest selectively in capital and capability in the sector

The government understands that investment in technology is a legitimate area on which to spend public money in education. As technology continues to transform what is possible, a revised analysis of how funding can be used and distributed is needed.

There are several organisations involved in supporting the sector to develop technological capability in systems, content and services. They will soon include the local authorities as they take back control for 16–19 provision under the guidance of the Young Persons Learning Agency. Stephen Dodson of DC10plus echoes many in saying he believes some local authorities will need help with this:

With local authorities having more responsibility for education it's a perfect opportunity. They need to be engaged in terms of how the use of technology in education can meet with local targets and priorities. Without some support and direction they might not pick it up for themselves, they can be terrified of new risks and innovation.

Stephen Dodson, DC10plus Network

Capital funding is often too widely dispersed to be effective. Giving training organisations £5000 each may help to buy a bit more hardware but will not change the way technology is used or how learning is delivered across the institution. Some training providers are therefore beginning to question whether to buy new kit or instead focus on providing infrastructure, support and permission to enable learners to use the technology they have purchased themselves. Where small amounts of money are provided for practitioners to experiment with the use of technology in their practice, the result can be positive, but decisions on small investments are often best left to individual institutions rather than taken at a sector level.

Consideration must be given to whether some funding can be more strategically invested at a national or regional level to drive new modes of delivery. As Vanessa Pittard of Becta suggests this would involve a real dialogue with the sector on where value could be added:

There needs to be a dialogue between national government and sector that builds up a view of what might be possible and desirable. This might build towards a position where there is a specification for shared or central services.

Vanessa Pittard, Becta

Although currently, the education market may not seem big enough to many technology companies, there are many industry players who recognise students of today as customers of tomorrow. New business models are starting to emerge and it is conceivable that these technology companies could be encouraged to join forces to provide what the sector requires through different mechanisms. The work of the Technology Innovation Board has started this dialogue. With a budget of £711 million up to 2011, one of the Board's strategic objectives is to increase the number of Knowledge Transfer Partnerships, which involve further education providers.

We need to get suppliers to support the change management process associated with technology adoption. They have a role in helping senior management to understand their commitments and to properly engage them in the specification of what is being delivered. In any technology project 90% of the effort needs to go into developing the people and 10% into developing the kit.

Karen Price, e-skills UK

As Karen Price points out, capital expenditure is only one aspect of any business strategy that involves the introduction of new technology. More often than not, capital funding is not matched by the revenue funding required to embed the use of this new technology. Initiatives such as the NLN, funded by the LSC for staff development, have not always found it easy to 'top-slice' from capital programmes.

Through Building Schools for the Future we will have invested in learning spaces that are well wired and well connected. My experience from industry shows for every £1 spent on **kit**, *you need to spend £9 on the capability to exploit it. We keep on investing in the technology and the infrastructure without recognising that it's absolutely useless without investing in the learning and development that is required for teachers to use it.*

Karen Price, e-skills UK

7 Transform the content industry

There are many organisations selling 'e-learning' content. Their primary markets are businesses, learners and parents but some also sell to schools and further education and skills sector. In the past, e-learning content in the private sector has been customised for a particular organisation and required both substantial investment and a long lead time. Now customers have alternatives.

The trend towards rapid e-learning[17] and the increased availability of software that allows those of us who are not programmers to develop our own content is changing the industry. Teachers often want to create their own material or at least customise it for their particular context, learners and preferences, which is perhaps why many e-learning systems including VLEs are under-used. Now they can develop their own material and make use of the new software that companies are producing. Some content is now 'open' or freely available, and companies are adopting new business models to make this possible through advertising and corporate sponsorship.

Despite the rise of the open source and do-it-yourself market for content there will continue to be a market for 'off the shelf' and niche 'bespoke' content. 'Off the shelf' content is becoming highly commoditised, making it only profitable for companies to produce this content for a relatively large market. This is what has happened in the market for IT training where there is a great deal of content, often of poor educational value and licensed to companies and educational institutions at very low prices.

If the use of technology in learning is to become commonplace then, as Kirstie Donnelly of learndirect points out, organisations that supply the education sector with products and services need to be part of that transformation, which can include educational establishments and consortia of educational establishments using their expertise in teaching, learning and technology to produce learning which can be shared with or sold to other institutions:

E-learning is largely a cottage industry and big players are focused on IT and soft skills. We need a different breed of organisations to help produce knowledge and content that can be aggregated and quality marked in some way. We need an e-learning industry that combines content development expertise with the ability to engage the consumer.

Kirstie Donnelly, learndirect

[17] Use of proven development tools and content, and reducing development times from months to weeks. Some companies are now providing 'flat packed' or 'turnkey' content solutions.

So what is the answer to ensuring we have a content industry that can meet the needs of a technology-enabled education sector? We think this can be stimulated among content suppliers through shared procurement and Knowledge Transfer Partnerships, with a focus on driving up the quality of what is produced and easier mechanisms for dissemination to share what is working. We should also remember that technology-enabled learning is not only about e-learning systems or 'content', or the distance learning, 'no teacher' model. In the education sector it is the use of a variety of technologies to enhance teaching and learning in all sorts of contexts and locations that is important.

The key to quality improvement lies in suppliers adhering to common standards for content build, and a raising of the profile of key roles in the industry, so that instructional design and web content authoring are recognised professions within education and training, with clear competency and qualification frameworks.

Providing incentives for the industry to innovate is more difficult in a market where there are more institutions using DIY content and less focus on purchased content, where individuals are using freely available tools to do things themselves and in collaboration with others via web 2.0 tools. There is a balance to be struck between small providers who are often more agile and therefore more innovative than their larger rivals, but who lack the capital to scale those innovations for a mass market. Some of the impetus for innovation may come from organisations like the Technology Strategy Board, whose sponsored competitions could provide another way of injecting investment capital into the industry.

Conclusion

Although there is now widespread consumer and business access to digital technology, for it to be used effectively in learning we have to be clear about when, where, and how we train young people and adults to be 'critical or creative users' of that technology. Evidence, albeit quite limited, is emerging on the positive contribution that technology can make motivate and engage learners, and add value to learning through collaboration.

We have identified political and economic factors with the potential to drive the adoption of technology-enabled learning including:

- a desire to increase digital inclusion
- the need to make system-wide cost savings in learning provision and drive up innovation
- the reform of qualifications.

We have also considered our experts' views on the emerging socio-technical trends in the sector including informal learning, ubiquitous and cloud computing and social networking.

In this context we have identified two sets of barriers to the take-up of technology-enabled learning; at institutional and system level. We have proposed seven recommendations targeted at institutional leaders and those in government to help overcome the barriers. Will these close the growing gap? We hope so. At the very least there needs to be a greater understanding of the challenges ahead and the recommendations in this paper are designed to provoke a strategic response to the paradigm shift we are experiencing.

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This report examines the current impact and future potential of digital learning. It contains a series of in-depth interviews with sector experts and roundtable discussions with key players in technology and learning and skills including Google, ALT, E-skills, LearnDirect, BIS, colleges and Local Authorities.

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