Technology and Education: Putting it in context

A summary of the final Capital Research Project report

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catalyst for change

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"Video Games May Hinder Learning for Boys" [i]

"...computer games are good for children and teach them essential life skills" [ii]

"Internet and mobile phones are 'damaging education'" [iii]

"Smartphones and other mobile devices improve learning" [iv]

We often hear competing media and research claims such as these about the educational value of new technologies. But often it is not clear how, or indeed if, these technologies are supporting learning. And, importantly, there is often little attention to the challenges of trying to introduce these technologies successfully into an educational context. This report aims to address these issues through a short summary of some of the work carried out by the Capital Project over the last two years– the programme which was set up to inform the UK Government strategy for progressing technology in education.

> **Box 1: Capital Project**
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> Capital (Curriculum and Pedagogy in Technology Assisted Learning) research was carried out by the University of Nottingham and Sero Consulting Ltd in association with Becta from 2008 to 2010. The work of this project can be found at
> www.lsri.nottingham.ac.uk/capital
> This site also holds a longer summary report including references / exemplars) for those wishing to explore some issues raised here in greater depth.

Introduction

During the last ten years, the drive to move technology into schools, colleges, universities and community venues has been clear. 'Success stories' contribute to the momentum but this 'success' is by no means shared by all institutions or organisations. Each has its particular context that will determine whether certain technologies will be introduced and used successfully to support learning.

Considering the differences that exist between educational contexts and how these might influence the successful uptake of technology is a key to understanding how the environment may be shaped to support the adoption of new digital tools. This report draws upon the Capital research and provides 'thinking tools' to reflect on:

- how new technologies can affect how learners interact with information and other people, and

- how certain contextual factors can help or hinder the successful introduction of these technologies.

It is hoped that presenting these thinking tools will help those working in education – teachers, lecturers, teaching assistants, carers and support staff - to reflect upon the technologies and approaches they might use to support different aspects of learning and how to shape their particular context to maximise the potential of introducing these technologies.

Background to the project

New technologies, such as tablet computers or new social network sites, emerge at great pace, often unpredictably, and are transforming work and leisure activities across society. Some technologies open up new opportunities for learners – particularly those who may have disabilities or learning difficulties. It is not surprising therefore that many believe that they offer exciting potential for improving learners' experiences in education. Yet integrating these technologies is often not straightforward. Each context is unique and the introduction of technologies needs to be coordinated with other universal factors such as ensuring learners are safe and equipment is maintained with often limited resources.

The Capital project involved interviewing many experts – teachers, researchers, policy makers, leaders and industry - and researching a wide range of materials, from formal reports to media stories. We have examined exciting new trends of novel technologies including numerous successful case studies. Throughout this work, our attention has been on factors which allow these technologies to be introduced successfully, and factors which act as 'barriers', preventing their successful uptake across different educational settings.

Technology's influence on learning interactions

Describing how learning happens in educational settings – formal and informal - is clearly complex, involving a number of interrelated factors such as the culture of the organisation, teacher, the different materials available, the learning objectives and, of course, the individual skills and interests of each learner. Very often the way in which we describe learning as an activity is guided by the structure of the curriculum: how children develop in Maths, English or Geography for example. This structure is reflected in how we often talk about the benefits of technology: technology to support different subjects, as well as teaching about the technologies themselves in ICT. Many of the skills children learn cut across these subjects hence many of the benefits of using technology are not best described according to the curriculum.

In the first year of our work, we spent time considering different types of learning interactions that occur, and how technology may influence these. We developed a framework to reflect upon different interactions – the 'Generative Framework' which can both help analyse existing situations of learning and stimulate the generation of new possibilities. Some interactions involve the learner engaging with things in the world, or engaging with representations of things in the world. Others are perhaps social – engagements with peers or a teacher. Moreover, the interactions may happen within different communities and contexts, such as in a

museum, at a sports arena, or online, away from the institution. Categorising different interactions in a simple language is difficult, but we have so far described 17 learning interactions (see link to main report in Box 1 to investigate these). This list includes interactions such as problem solving, collaboration, and assessing – learning interactions that can happen at different times and within different subjects.

The main point to take from this initial framework is that technology can influence learning interactions – how fluently and effectively they take place. It is, therefore, useful to think of these interactions separately from structures such as curriculum. We used this framework to examine how certain new technologies can change learning interactions. Four examples are described below to illustrate this. Table 1 provides a short description of the four learning interactions and how technology may affect these interactions.

Table 1: Four examples of Learning interactions and technologies that can affect these

Learning Interaction	Description	Example Technologies
Assessing	Opportunities for giving feedback to the learner	*E-assessment tools*
Collaborative	Opportunities for two or more individuals to share and build knowledge together	*Online Social Tools*
Ludic	Opportunities for playful, rewarding and relatively undirected activities	*Gaming technology*
Cross-Contextual	Opportunities for learners to bring together knowledge between contexts (e.g. between a zoo and classroom)	*Mobile technology*

Clearly, technologies such as mobiles or social sites on the internet can be used to support a range of different learning interactions. However, our aim is not to extol the virtues of any particular technology but rather to stimulate thinking about how a form of technology can be introduced to distinctively shape the form that learning interactions might take.

E-assessment tools to support the 'assessing' learning interaction

'Assessing' here refers to the process whereby feedback is given to a learner, perhaps by the teacher or exam board, regarding their learning. E-assessment tools refer to the use of digital technology to support this process. The feedback might be summative – a summary of learner progress (e.g. an exam grade); or formative – providing the learner with an explanation and possible activity to act on feedback.

Our research highlighted how technology *can* support assessing by making the process more efficient – feedback can be provided more quickly (e.g. emailing from teacher to student), and automating some marking can reduce administration. Technology also opens up new possibilities for learners to be assessed at different times in different places although the problems of preventing cheating remain a concern. Technology also opens up new ways of providing assessment evidence. E-portfolios can store media such as audio or video recordings. Evidence can be captured through mobile devices such as mobile phones or laptops.

Our research also highlighted some of the challenges of using e-assessment tools. Apart from the issue of cheating mentioned above, there are the difficulties in ensuring that the infrastructure in institutions (e.g. the network, the devices and software) is advanced and reliable enough to handle these new tools. New e-assessment tools also require teachers to integrate them into their practice, which may be particularly difficult when they do not seem to fit well with the formal assessment structure. The demands of summative assessment were a dominant feature in our investigations. Whilst schools are required to prepare learners for particular exams, it is diffcult to introduce tools that support skills outside these assessments, or to justify the use of tools that do not support specific assessment practice. Another finding was that automated assessments may help assess student performance more efficiently but meeting the demands for summative assessment (and to produce timely performance scores) may not equate to providing explanations of student misunderstandings

Online social tools to support 'collaborative' learning interactions

Online social tools include services such as blogs or wikis and networking sites such as Ning. These tools extend what we conventionally understand as 'collaborative learning'. They allow students to collaboratively create and share their own content. Students can also review each other's work with ease and publish on the internet to get feedback from a wider audience. As well as developing their own work, this can help learners build their team-working and communication skills, which can help them in work settings. Using social tools to share content also has key benefits for work-based learning by reducing costs and increasing the speed in which content can be distributed .

Considering the extent to which social tools permeate learners' lives, their use in education is comparatively limited. Some learners are reluctant to extend their social spaces into educational settings – not wishing to re-use social tools for education or wishing to retain some demarcation between their social and educational spheres. There is also a lack of understanding of how social tools can be integrated into the curriculum - simply masking traditional activities such as teacher podcasts or blogs or collaborative writing exercises in a veneer of 'social networking' does little to make them more engaging for learners; and has invited the accusation of 'coating broccoli with chocolate'. Similarly, schools have concerns over social spaces and may opt for more intranet-based or protected web spaces but these walled-gardens are often pale imitations of the social media accessible to students on the open web. Some of these challenges might be addressed through information and training but, arguably, even then the range of skills apparent is not acknowledged by current curricula.

New forms of 21st Century curricula (e.g. New Basics) were found to encourage the use of social tools more to develop skills such as collaboration although there remains the need for practitioners and students to focus on *productive* use of the tools.

Gaming technology to support Ludic learning interactions

Games have been used in learning for decades but, through technology, games have evolved, as can be seen in Massive Multiplayer Online Games (MMOG) such as World of Warcraft, where anyone from around the world can play simultaneously, immersed in virtual worlds at any time. The attraction of such games can be seen in their popularity, where the age group for players has widened and the gender gap reduced. This motivational aspect makes Gaming an attractive tool for Education, where the vision is to adapt the games to support learning concepts (such as using virtual worlds to stimulate creative writing) or actually design games with more curriculum appropriate learning goals. Games may not only be motivating but also help support learning interactions such as construction, reflection and collaboration. Given the way they can simulate the real world, these digital tools have been successfully employed for vocationally-oriented training such as first-aid situations.

The pervasive concerns regarding the safeguarding of students as they use technologies are particularly acute with online games - since popular games can be accessed by anyone. The potential benefits for students – the acquisition of, or opportunity to practice, complex skills include leadership, collaboration, cooperation and the opportunity for players to share their learning within the game – have to be balanced against risks and perceptions of risk. There are 'walled' versions (limited to certain groups) but there may still remain concerns over learners' exposure to commercial aspects and to games in general if they are played both at home and school. Many concerns might be allayed by designing games specifically for learning, however, examples of these are limited given the high costs involved, and practitioners and educational leaders may still be sceptical that immersion in such simulations has educational value. Practitioners may also not feel confident enough to take ownership of a game and appropriate it (to take a non-educational technology and apply it in an educational context) successfully into their teaching context.

Mobile technologies to support cross–contextual learning interactions

During our research, we have seen a growing trend toward the mobility of learners across school, home, workplace, museum or field-trip, and across time from the timetabled to the 'just in time'. Extending learning in this way – the opportunity for learning to be linked across the formal and informal contexts – has the benefit of opening up potentially valuable new sites for learning. This trend is supported by the ubiquity of portable devices such as mobiles that are becoming more powerful, reliable and affordable. Even Smartphones, such as the iPhone, have become more accessible and provide a platform for the ever expanding list of applications building on new features such as information on position or connection to online resources. Given

these benefits, mobile technologies offer exciting potential for practitioners to extend learning outside the classroom and timetable.

There are many examples of the successful use of mobile technologies to extend learning to contexts such as museums or art galleries. However, there remains controversy over their use in many educational contexts. Firstly there are the technical challenges of accommodating learners' devices reliably. Perhaps more significantly, there are pedagogical issues over the introduction of devices that are typically used as a social tool out of class. Perceptions of mobiles as a leisure device presents a key challenge, a situation exacerbated by media reports of inappropriate recordings being taken in school and posted to the internet. Consequently, using or even just allowing mobile technologies into educational contexts will be largely determined by perceptions of risk and the confidence to adopt this technology to support learning, e.g. where there are possibilities for using the technology as a platform for innovative teaching activities. Another determinant will revolve around economic factors. The dominant model of the institution providing students with access to a PC or laptop is increasingly challenged in the face of pressure on education budgets – student owned mobile technologies offer one potential solution (albeit a solution which brings its own challenges in terms of infrastructure, parity of experience and teacher skills).

Opportunities and challenges of adopting new technologies

The last section provided several examples of how technology can influence the way learners interact. In our research, we examined many case studies where certain technologies had been successfully used to support learning. In these, it was clear how the educational context had been shaped in order to realise these opportunities. Our research identified a range of contextual challenges for introducing technologies. We encountered some situations where technologies had not been introduced effectively or were not being used successfully.

Identifying the different challenges for introducing and using technologies to support learning can help inform strategies for addressing them. Therefore, this section tries to identify and map out some of the key challenges identified in our research. Drawing on a range of research sources, we identified some key factors that influenced the introduction of new technologies. Eight of these are listed in Table 2:

Table 2: Factors influencing the successful introduction of new technologies

Factor	Description
Home – School setting	The relationship between informal (e.g. home, museum) and formal settings (e.g. classroom)
Learning Spaces	The design of the space in which technologies may be used
Curriculum Flexibility	The extent to which the curriculum can be adapted to accommodate different tools / ideas
Assessment Culture	The requirements to obtain and utilise specific assessment information
Leadership	The role of leadership at different levels, within and beyond individual institutions
Teacher skills / confidence	Individual teacher's own skills, attitudes and experiences toward technology
Reliability	The reliability of the technology when used
Appropriation of available tools	The extent to which available tools can be adapted to teaching context

We considered how these factors fall under several overarching themes. These themes simplify the interacting aspects of an educational context and whilst they have emerged from our research, they can be related to other work in this field. These themes are: the physical environment in which the interactions take place (*Environment*), the people involved (*Agents*), the materials and devices used to help the learners (*Tools*) and what is actually intended for the learners to learn (*Learning content*). These contextual themes are summarised in Table 3, along with the influential factors that relate to these themes.

Table 3: Contextual themes and related factors

Contextual theme	Description	Key Influential factors
Environment	The different settings (e.g. home, museum, school) and how the setting space is designed	*Home – School setting* *Learning Spaces*
Learning Content	The knowledge and skills that learners are taught e.g. the curriculum	*Curriculum Flexibility* *Assessment Culture*
Agents	Teachers and educational leaders but also other people involved such as assistants, parents, technical support	*Leadership* *Teacher skills / confidence*
Tools	Tools refers to materials to support learners, in this context the technology – importantly who designed it and for whom and how well it works in different contexts.	*Reliability* *Appropriation of available tools*

Clearly, learning interactions are complex and there may be a multitude of different factors influencing why a practitioner may or may not introduce a technology and why it may or may not be successfully used to support learning. But reflecting on some of the more common factors is helpful in thinking about different contexts and how they may be shaped to encourage the successful introduction and use of technology. Below we summarise some of the challenges identified from our findings. In trying to highlight these challenges to the introduction and use of technologies to support learning, this section may appear negative at times. However, this is not the intention. Rather, we believe that by articulating these challenges, it is easier to understand the sometimes slow adoption of technology in education and, importantly, consider strategies for meeting these challenges.

Environment

Home School/College Setting

There has been increasing attention to bridging the gap between students' learning in and out of school or college (e.g. home, field-trip, library or workplace) and how this may be helped by the increase in connected households and learners' own devices. However, the gains of internet connections are often limited to providing a means of monitoring learners' progress. Providing internet links between home and school does not *itself* improve conversations and there are large differences in the content that schools make accessible online. Importantly, there are large differences between the support learners receive at home to support their work. Learners' own devices present exciting opportunities to extend learning; but following on from this, are questions of equal access as well as the challenges to the technical infrastructure of schools to accommodate these.

Learning Spaces

The design of spaces often reflects the teaching approach, and changes in the layout of spaces can have a positive impact on how technologies are used. Technology offers opportunities for taking advantage of the wider space, from taking devices outside the classroom to the use of Virtual space. Rows of computers in ICT suites may present a challenge to certain learning approaches such as encouraging conversation and collaboration. Rooms that have a couple of desktop computers in a fixed location may make it more difficult to integrate technology into the lesson. Available laptops for classes to use may address these limitations but consideration is needed for time to book these out and set them up, as well as practical issues such as space for cables. Practitioners such as those in nursery or adult education are also faced with additional challenges of integrating technologies into non-educational settings such as community centres, church halls or even prisons. However, low-cost portable devices and new ways of connecting to the internet (e.g. using GPRS) are presenting opportunities to enhance even these spaces.

Learning Content

Curriculum Flexibility

It can be quite challenging identifying how the benefits from particular technologies map onto certain curriculum objectives. This may be particularly the case where frequent changes in topics limit the gains of learning to use novel tools successfully. However, there are innovative ways to adapt the curriculum to maximise learning opportunities with technologies. Furthermore, there is growing interest in a range of new curricula that are inspired to provide students with skills more appropriate for working in the 21st Century. The development of skills such as collaboration can be supported through technologies and that, in turn, may help young people take full advantage of these technologies.

Assessment Culture

Assessment scores can not only affect learners' futures but are also used to judge the performance of schools. Consequently, it is often harder to justify the introduction of technologies that do not directly support assessment scores, for example, programs that may have been developed to focus on higher order thinking. Indeed, there is an interwoven link between what is taught and what is formally assessed, and the need for certain formal assessments may act as a barrier to introducing new forms of curricula that emphasise skills supported by new technologies.

However, these concerns reflect a focus on the challenges of summative assessment and it is important to recognise the potential of technologies to support formative assessments. There are many emerging tools, some provided free online, that present opportunities to record learners' work for reflection and provide practitioner feedback using rich media (e.g. audio). Even common tools such as email offer ways to foster

communication between learner and teacher. A key challenge is for practitioners to develop sufficient confidence with these tools to integrate them into everyday assessment practice.

Agents

Leadership

Who might be considered Leaders depends on context and our research has looked at the influence of leadership on different levels including institution, authority and policy level. Within a school, innovation can spread either from the classroom, or from the management. In either case strong leadership is needed to give encouragement to experiment within appropriate bounds, and provide good training and technical support.

Teacher skills, confidence and attitudes to innovation

What constitutes innovative practice or even 'an innovator' is often not clear but does need to be considered relative to each institution. What works or what is new to a particular classroom may not necessarily be a recent technology. Practitioners will vary considerably in their attitudes to the benefits and risks of technologies and also in their skills and confidence with introducing them to learners, particularly those who may be more familiar with the devices. Consequently, the use of technology may often reflect pedagogy. Developing the skills necessary to be confident with novel technologies is a challenge, and one that may be approached through a range of strategies, both formal and informal such as peer support or online forums.

Tools

Appropriation of available tools for education use

Many exciting technologies are already in use outside of educational contexts; for example social networking software that can present ideas in interesting ways, learn your preferences, record different media and allow feedback on work. Many of these tools are free and are easily accessible in schools. However, this does raise important questions such as safety concerns or exposure to commercial advertising. Unfortunately, tools vary on how easily they can be adapted to different contexts; whilst some such as Moodle can be tailored, others (e.g. Facebook) are quite closed.

The principle of being able to appropriate technology is also applicable to resources designed for learning. Whilst some computer programmes can be adapted by the teacher to suit the particular needs of the class (e.g. Clicker), others are closed. It is arguable though that the more adaptable programs do require practitioners to invest time in learning and adapting the program accordingly.

Reliability

Advances in technology place great demands in not only maintaining devices but the supporting infrastructure, for which there is substantial variation between institutions. There is a growing requirement for leaders to have an accurate picture of their investment in technology and to appropriately resource the technical support. If technologies are not reliable, this acts as a major deterrent, as this is difficult for practitioners to plan around. Devising strategies to keep devices reliable is a challenge, even in organisations with larger budgets for maintenance. However, many institutions are introducing industry practices such as help-desks. Some are developing the role of technicians to extend to classroom, curriculum-support or even taking advantage of the technical knowledge of learners.

Summary

We have noted that technology can act as a tool to engage learners, link learning across settings, support collaboration, assessment and presentation and can open up new opportunities to learners with disabilities or special needs. Understanding the complex range of factors that foster or hinder the introduction of technologies to support learning is difficult, thereby making it hard to devise appropriate strategies. Considering the complexity of factors and how they play out differently according to each context, it is possibly unproductive to try and provide some simple rules for best practice. Instead, this section has attempted to frame the different types of factors in order to help think about and address the challenges of introducing and using new technology effectively to support learning.

4. Conclusions

This report summarises some of the key messages from the research carried out over a two year period by Capital. Due to the limited space here, readers interested in the points covered, including references and various illustrative examples, should access the larger final year report, or indeed any of the documents from the project, at www.lsri.nottingham.ac.uk/capital. The primary aim of this document is to provide an accessible summary that puts forward two main thinking tools. These are intended for practitioners keen to consider how technologies support their learners' interactions and how their context might be shaped to maximise the opportunities offered by these technologies.

This report does not include the recommendations put forward in the larger final report because, firstly, many of these are targeted at a research and policy level and secondly, the aim here is to use the research carried out to draw attention to key issues and provide a language to discuss these issues, rather than provide simple quick-fix solutions. In light of foreseeable reductions in investment in new technologies, this report hopes to provide a timely resource that helps practitioners focus on achieving best practice with available technologies.

The first part of this report presented a tool to think about the different type of learning interactions and how they can be influenced by the introduction of technologies. The list of different interactions (described in the main report) comes from our research but is generative: we welcome thoughts to how this list might develop. Four examples were presented where it was intended to highlight the potential benefits these technologies could bring. It was also intended to emphasise the range of obstacles for realising these benefits in an everyday classroom. Whilst it is common to celebrate success stories of using technology, these obstacles may not receive the same airing, thereby curtailing productive debates around how they can best be addressed. Therefore, the second part of this report aimed to provide a simple tool to consider the range of factors that shape the likely success of introducing new technologies. This framework is simple, focusing on the key factors arising from this research. However, it is not intended to be comprehensive but rather to stimulate thought and debate when considering strategies for introducing technologies successfully to support learning. In this way, it is hoped that this report contributes to the goal of providing the best education for learners by maximising the benefits of available resources.

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