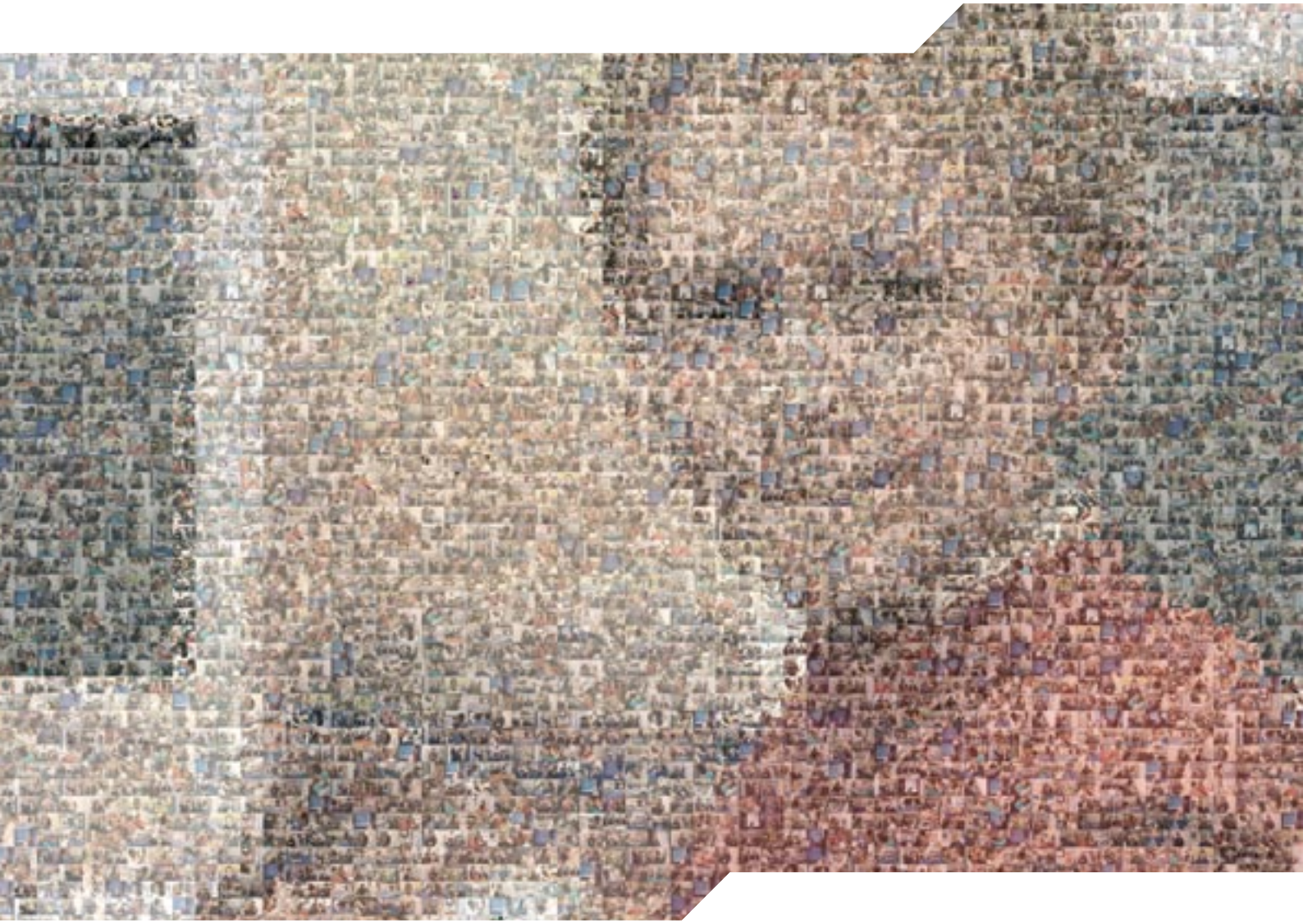
Entertainment and Leisure Software Publishers Association

Unlimited learning

Computer and video games in the learning landscape



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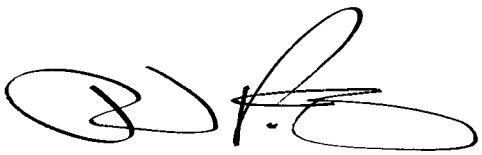
Foreword

Imagine a time when, instead of reading about city planning in geography textbooks, children play SimCity™. When, instead of sitting with textbooks and tapes, learners of Spanish participate in online games with players in Spain. When, instead of listening to descriptions of professional practice, nurses, lawyers and social workers are able to engage in complex simulations of real life tasks. When, instead of GCSEs, NVQs and even degrees, a learner can claim that having reached the 'boss' level of a computer game is evidence enough of applying theory and understanding practice.

It may sound outlandish, but there is an increasing consensus that computer games should be taken seriously as both learning and assessment tools. In fact, Henry Jenkins of MIT describes computer games as 'the most powerful learning technology of our age'.

In order to fully exploit this potential, we need to think creatively about what education and gaming might look like in the future. We need to acknowledge that changes to assessment techniques and the curriculum might be required. We need to acknowledge that the games industry has to develop its reputation beyond its sometimes perceived obsession with first-person-shoot-outs and explore the wider and more complex realms of human activity. We need to acknowledge that new ways of working and whole new forms of collaboration will be required between our entertainment and education sectors, and that this in turn may require new economic and commercial models to be developed. Finally, we need to work closely with learners and games players, and involve them in the conversation about how best to develop compelling new learning resources.

This report is an important step in beginning the challenging and exciting process of developing potentially powerful new partnerships between the games industry and education. I hope that it will serve to provoke new thinking, action and alliances.



Lord Puttnam of Queensgate, CBE
President of UNICEF UK
September 2006

Introduction

It didn't take long for the very first, very simple, computer games to catch the attention of education. Even with the simplest of graphics and moribund processor speeds, children were gripped, and education was fascinated. But that attention was characterised by two entirely different perspectives: some saw a 'glass half-full', where others saw a 'glass half-empty'.

In the 'glass half-full' camp were observers who could see that children whose attentions wandered elsewhere in their lives, for example at school, were unexpectedly very, very focused. For this camp, a journey began in what has become something of a quest for the Holy Grail. In this case, the Grail was learning software that was as seductive and engaging as computer games.

Some of the earliest educational software was seductive, engaging, challenging and evocative because it was written by the same teams that were in parallel developing the cool games. On-screen snooker became an exploration of bearings, while virtual football an exercise in maths and probability. Schools mattered in the market because a lot of the nation's best computers were in schools. There were more computers in school than on the high street.

The 'glass half-full' perspective would reveal that the skills and capabilities of the new creative economy were different from those needed in the last century. Learning would need to move on, and the collaboration and problem-solving of games were exactly the strategies required for the industries that had grown up on the back of new technologies.

But at the same time, the 'glass half-empty' camp were furrowing their brows. Where the other camp saw concentration, they saw addiction; where there was intense competition, they saw social dysfunction and isolation; where there was delight they saw distraction. Children were 'lost in a world of make-believe' when they should have been out 'kicking a can around the streets with friends'.

Information and Communication Technology (ICT) has offered a host of new opportunities: companies are becoming more collegiate and agile, hierarchies are flattening, the word 'centralised' has become an insult. Helping people to help each other is a simple recipe for 21st century economic success. Communication has come to matter more than either technology or information. Games have been quicker to respond to this than education. While schools struggle to connect children around the world, consoles like the Nintendo DS™ offer a naturally wireless environment and a host of connected collaborative games. In modern language lessons, children rarely phone a friend in France for a chat on Skype™, but on the way home they might assemble a global team for a game of virtual football. If wireless collaboration and fun is so easily carried in their pockets and so much a part of their computer gaming world then, they might not unreasonably ask, where is it in the classroom?

Unfortunately education has been rather slow to notice this (phenomenon). We have too few global schools. Inside schools there are very few formal collaborative assessments; 'learning stuff' is still valued more than 'critiquing stuff' and working alone is assessed ahead of working together.

Interactive games, characterised by players making choices, are becoming eclipsed by participative games, characterised by players making contributions. The strategies for successful game playing are increasingly complex, sophisticated, challenging and cerebral. This edges games towards the very heart of where learning is headed.

My own research work has revealed that a very clear set of strategies has evolved by children playing computer games. To succeed in even the simplest platform game, children have to lock their problem-solving into a tight cycle of observe, question, hypothesise, test. Curiously, this exactly matches the scientific method that education has been trying to embed in young scientists since the birth of science. The problem back in the early 1990s was that because teachers and policymakers didn't play those early games, they had no idea just how sophisticated their young learners' iterative strategies were. As a result, the opportunity to build on those strategies and bring science to life was missed.

This might not happen a second time around. Optimism is strong because learning is seductive too. The huge global trends in learning, away from one size fits all towards personalisation, away from age phases towards 'no age limits', away from simple notational assessments towards new media-based e-portfolios, and away from individual towards collaborative, opens up a wide embrace to cerebral learning games. Education and games are literally starting to speak the same language. It may well be that, just as all the success stories of the

21st century are about helping people to help each other, the success stories around learning and games playing will all come about as a result of the two industries helping themselves to help each other.

People love to learn, people love to play. It should not have taken quite so long to make progress towards putting those two together seamlessly. In the 21st century, the glass is neither half-full nor half-empty; for the first time, it is simply overflowing with opportunity.

Professor Stephen Heppell

Executive summary

The first generation to grow up with Pac-Man and Pong has established itself in the fabric of working Britain, bringing childhoods of digital interactivity to 21st century workplaces.

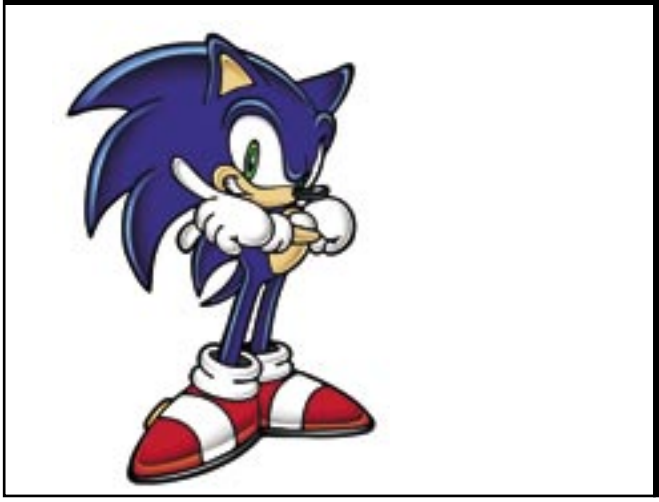
This exposure to digital technologies has created a culture which rewards creativity, lateral thinking, technological adeptness, communication and dispersed community.

The hours they spent with fingers on controllers has transformed how we do business and has set the benchmark for the next generation of digital citizenry. Grown-up gamers' cultural consciousnesses are suffused with interactive experiences, and it is through interactive methods that they are training the future of Britain.

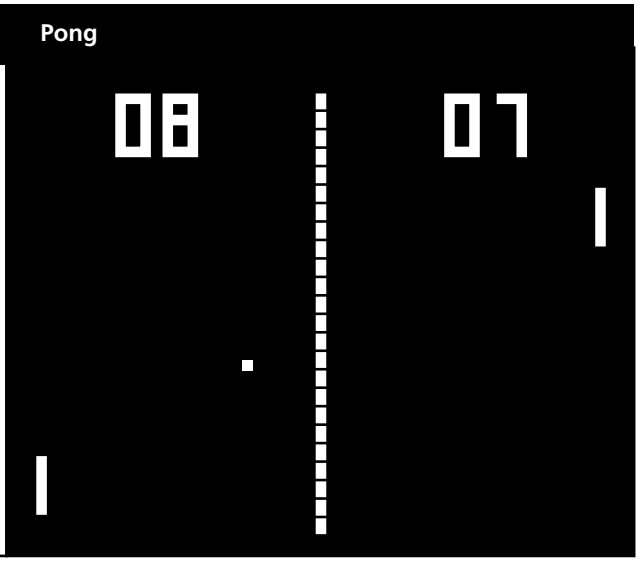
Technology has saturated workplaces, homes and classrooms. The availability of ICT hardware and software in the classroom means that a nation of young citizens will push out the possibilities for the Britain of the future in the global digital economy. We no longer need to predict when this will happen – it's already happening.

Generations have become familiar with the opportunities afforded by technology by playing with, experimenting in and exploring digital game environments. Tomb Raider's Lara Croft, Sonic the Hedgehog and Mario have become informal teachers in problem-solving, lateral thinking and hand-eye coordination since the computer game revolution crash landed into our living rooms in the mid-1980s. And now, in the 21st century, electronic games are no longer solely the domain of home entertainment; they have infiltrated corporate offices, doctors' clinics and the classrooms of schools and colleges.

Sonic the Hedgehog



Pong



Tomb Raider's Lara Croft

SimCity

Games allow players to enter environments that would be impossible to access in any other way, eg going back in history, understanding the complexity of running a major city, managing entire civilisations or nurturing families. They require engagement with complex decisions – exploring the effects of different choices and a multiplicity of variables. They offer ongoing and responsive feedback on choices – calibrating closely to the ability level of the individual, and then encouraging them to discover new limits to those abilities. They stimulate conversation and discussion; players share ideas, hints and tips in what increasingly tend to be lively and supportive learning communities.

Games hold out the tantalising potential of a fully personalised, responsive and enjoyable learning experience, one in which part of the pleasure lies in overcoming difficulties and challenges while experiencing the excitement of personal growth.

They are tools for learners' own creativity and innovation. In the future, the outcome of games will no longer solely be pre-defined and predetermined by developers. Instead, we will see the relationship between players and games developing in a new and radically different way, where players are encouraged to both play and create their own games.

Equally, pedagogical directions are leading learners towards a paradigm of personalisation through interactivity. Play has historically been acknowledged as an important part of learning, and has been present in learning environments through simulations, role plays and quizzes. As digital versions of play have evolved, interactivity-savvy entrepreneurs, professionals, academics and teachers have naturally introduced the palate of technologies afforded them by the modern world into formal and informal learning spaces.

This report is an important step in beginning the challenging and exciting process of developing the potentially powerful new partnerships between gaming and education.

Super Mario © Nintendo

Games in a social context

Over the past 20 years, the UK's computer and video game industry has grown into a multimillion pound business. Some sources estimate that 59% of 6–65 year old Britons play games (BBC, 2005).

With revenue figures rivalling the output of Hollywood, computer and video games are a powerful presence in today's media-saturated landscape. But beyond the statistics, what role do they play in contemporary British society? This section seeks out the answers as it navigates through the terminology, the history and the cultural contributions of the modern commercial games industry.

Definition of 'computer games'
Computer and video games are virtual play environments which feature challenges, rules, goals, feedback, interaction and story (Prensky, 2001). They can be played on:

- television-based systems ('consoles'; eg the Sony PlayStation® series, Nintendo GameCube™, Microsoft's Xbox® and Xbox 360™) which use the TV as a display monitor for the software disk and are controlled by devices connected to the console
- DVD-Roms or CD-Roms on personal computers either connected to a network (eg the internet) or disconnected, controlled by the keyboard and mouse or other device plugged into the hardware
- games-specific handheld consoles (eg Nintendo's Game Boy® and DS™ series, Sony's PSP™), which use software on cartridges or discs and are manipulated using buttons and joystick controls on the device
- other handheld units (eg personal digital assistants (PDAs), portable computers or mobile phones) which use each machine's unique input mechanisms to control pre-loaded or downloaded software.

For the sake of simplicity, the terms 'games' or 'computer games' will be used to refer to software played on any machine, unless otherwise indicated.

Content
In the 20 years since the first arcade and home console gamers were introduced to the medium, consumer tastes have become more demanding, more sophisticated and more literate. As a result, game plots have developed added depth, elements of self-expression and personalisation. Games have incorporated plotlines from literature, poetry and film, and these cultural artefacts have also found inspiration in the bits and bytes of digital entertainment.

Control mechanisms for games systems

Like other media, computer games are often categorised into discrete genres, but in practice there are currently almost as many genres as there are games – from elaborate simulations of entire 3D worlds to intricate puzzlers which last 30 hours of playtime or more. Broadly speaking the primary commercial categories include (British Academy of Film and Television Arts, [BAFTA] 2006):

- Action and Adventure
- Casual
- Children
- Massively multi-player online game (MMOG)
- Puzzle
- Role playing game (RPG)
- Simulation
- Social
- Sports
- Strategy

Educational theorists have also added knowledge-based, drill-and-practice and maths (Prensky, 2001; Griffiths, 1996; 2002; see Appendix A for definitions of each genre).

Titles in most genres can be played cooperatively, via a network connection or multiple input devices, or individually. Most games are played on a single machine, although internet technologies now allow dispersed players to access the same game on distributed devices, a category known as online gaming.

The control mechanisms for the console systems can range from joypad controllers to specialised controllers that are relevant to the actions of one or more games (eg dance mats, infrared cameras). While there are few existing commercial adaptations for users with limited mobility, there is an active development market for this demographic that promotes and produces products for use with traditional and adapted games (eg OneSwitch.org, ACE Centre and the Independent Game Developers Association Accessibility special interest group).

Gaming history

The UK has been a driving force in the global computer games scene since the early 1980s when British inventors released accessible micro-computers to the mass market. The predominance of home computing systems in the UK meant that a generation of young people developed key skills while devising, designing, programming, publishing and distributing interactive products from their bedrooms, establishing the foundations for the globally-recognised creative development industry that exists today.

New and powerful machines like the BBC Micro and Sinclair's range of micro-computers for the home permeated the public consciousness throughout the 1980s. They were available, affordable and provided simple platforms on which to develop new software. As a result, British game development companies flourished, importing and exporting products to international audiences.

The UK games consumer

Computer gaming is now a mass-market leisure activity, with millions of players throughout Europe. There are over 15 million active game players aged between 15–24 years, but the average age of a gamer is 29 years (BBC, 2005). A huge installed base of 51.2% of British men and 25.1% of British women aged 10–35 play games regularly (Dromgoole, 2004).

Since 1995, over 25 million dedicated computer games devices were sold in the UK (discounting PCs), enough for one in every UK household. In addition, almost 280 million units of leisure software were sold in the UK during the same period, enough for every household in Britain to own 11 titles each.

On average, UK gamers between the ages of 6–35 spend 12 hours per week playing computer games (Parker, 2006) and have been playing for 10.4 years – a period of time that roughly coincides with the release of the first Sony PlayStation in 1995. It follows that younger players have spent a greater proportion of their lives with interactive entertainment, and are more likely to play daily (BBC, 2005). Research into the playing habits of younger gamers indicates that children in Key Stage 2 (7–11 year olds) play

Sinclair Spectrum

Sinclair Research released the Spectrum in 1982. It quickly became a hugely popular machine with over 20,000 home-grown titles, ranging from practical applications to an enormous cache of entertainment games. By most accounts, the Sinclair Spectrum is responsible for creating the enthusiasm for and the momentum to create games in the UK. It is also valued as the machine which introduced a generation to the potential of information technology (IT).

The hardware was designed to be used by hobbyists to create software. Many of today's most well-regarded UK developers began their programming and designing careers on the Spectrum. Many of today's British publishers, responsible for the marketing and distribution of software, were established in the Sinclair era.

The hardware was also an asset for educationalists. It was incorporated into the Department of Industry's programme to distribute microprosessing hardware and educational materials to education authorities throughout Britain, and was used in most schools in England, Scotland and Wales.

BBC Micro

The BBC Micro emerged from the Computer Literacy Project of the BBC's education department in the early 1980s after it was forecast that computing would become an important economic, industrial and cultural driving force in the UK. The machine was developed by Acorn systems, and with the benefit of the BBC's first-party support, it made influential appearances in a specially commissioned broadcast programme.

The machine's greatest asset was the accessibility of the hardware, and the subsequent release of a large library of educational and entertainment software. Its reach surprised even the creators who had anticipated sales of 12,000 units; sales of the Micro surpassed one million within one year of its release.

The Micro was adapted by schools for educational purposes, and was used to develop computer literacy and IT skills.

more than those 14–16 year olds in Key Stage 4 (McFarlane, Sparrowhawk & Heald, 2002), a trend most marked in girls, who tend to play games when they 'have nothing better to do or are bored'. This gender drop-off does not suggest that computer gaming is irrelevant to pre-school and school-age girls; results of a 2005 BBC study indicate that 100% of children between 6–10 and 97% of 11–15 year olds play computer games (BBC, 2005).

Software choice

Gamers' software choices reflect interactive versions of existing leisure pursuits. The top five commercial games in 2005 fell into three categories: football simulations, driving simulations and action and adventure (see Appendix B for a description of the top 10 games in 2005).

Children report that they enjoy commercial games for their visual representations, graphics, design structure, the type of activity on screen and the challenge which the games offer (McFarlane et al, 2002). These are consistent factors important to older players, but adults also choose titles for their entertainment value. They also increasingly cite innovation, depth of story and depth of character as important to their playing experience. Because they play fewer hours per day than children, they tend to prefer titles that allow them to dip in and out of products without punishment for lack of commitment. Further, they report that they enjoy titles from which they can learn (Graner Ray, 2004; Krotoski, 2004; Krotoski, 2005).

Gamer spending

From a global perspective, the UK is a world leader in the consumption of computer games products. It is the third-highest consumer of gaming software after North America and Japan (Parker, 2006), making it a major player in the global industry.

The UK gamer spends more on games, buys more games at an average of £150 per month and plays for longer than others in Europe (Parker, 2006). One-third of all Western European software sales are made in the UK, almost twice that of the next highest country in the EU. Not surprisingly, then, the UK's consumers have the highest number of console and handheld platforms in Western Europe. Only Germany supersedes Britain in the PC games domain.

These spending patterns translated into a £1.2 billion software economy in 2005, with 57.5 million units of gaming software sold through retail outlets, making it the second-most lucrative entertainment activity in the UK (Parker, 2006). Almost half of these purchases were for Sony's PlayStation®2, which has an installed base of 8.03 million units.

Football simulation

Driving simulation

The average price of software in 2005 ranged from £22.64 for a PlayStation 2 to £44.68 for a Microsoft Xbox 360. The disparity between the prices reflects the length of time the hardware associated with the software has been on the market; the PlayStation 2 was released in 2001, and is considered a 'current generation' console. The Xbox 360 was released in November 2005 and is the first widely available 'next generation' console on the market. This distinction is resolved in the technological prowess of the hardware (see Appendix C for technological descriptions of the consoles).

The longevity of a games platform machine/console lasts as long as there are interested parties. Games continue to be made for a console after its shelf-life has run out. The commercial releases for obsolete hardware are cheaper and the drop in hardware prices makes gaming more affordable. This opens up real potential for budget-strapped developers who may not have the economic resources of the commercial sector, but are keen to exploit those hardware platforms widely available in the market.

Contributing to culture

Computer games are as much a part of the UK's media repertoire as television, radio and film. Increasingly, cultural institutions are recognising the role of games as both economic drivers and social artefacts.

In 2002, the Barbican and the National Museums of Scotland organised GameOn, one of the first computer games culture exhibitions in the world. The event showcased the history and culture of computer gaming

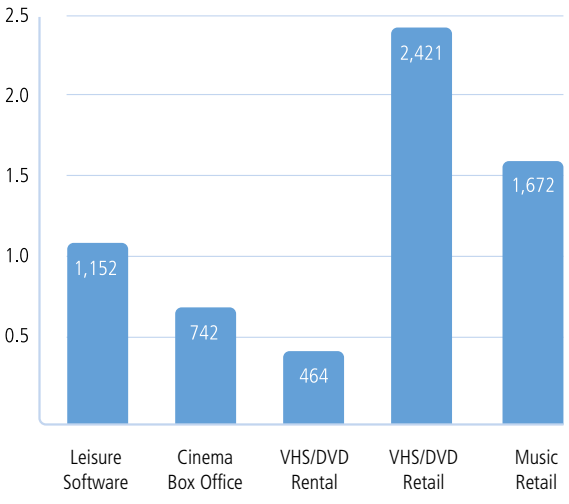
Demographics: UK games industry

The UK industry is the third-largest interactive entertainment market in the world with the highest number of games development companies and publishers in Europe. In 2005, the export value of the UK games market was up 5.6% from 2004 at £451 million (Parker, 2006). There are 150 development studios in the UK employing 21,000 people, some of which have produced some of the best-received video games of all time.

The games industry represents a 30% share of the UK's entertainment media (film, games and TV). It is a thriving, significant, creative and economic force in contemporary Britain. On a global scale, the world market has almost tripled in value since 1995 and few, if any, other media markets can show comparable growth. The global interactive leisure software retail market was worth £19.1 billion in 2005 (Parker, 2006).

The UK industry's best-selling series now sell close to one million copies each per year across all games hardware formats. Some titles sell one million copies within weeks or even days of release. Such selling power can bring gross retail revenues approaching £50 million for each title, making the best-selling games' earning potential comparable to that of the biggest films, around half that of video/DVD best-sellers and twice as lucrative as music's biggest earners (see Figure 1).

Figure 1: Graph showing UK entertainment market comparison 2003



Source: Screen Digest

from its origins in 1962 to the present day. In November 2006, the London Science Museum and Nintendo will co-sponsor the GameOn exhibition as it returns, updated, from its international tour.

In 2006, as part of the BBC's *Culture Show* and in conjunction with the Design Museum, two British-made computer games were shortlisted for the Great British Design Award. Twenty five UK inventions from the past 105 years were selected, including the London Underground Map, Concorde, the Dyson vacuum cleaner and the World Wide Web. Tomb Raider, created by Core Design in Derby, came in eighth place. The Grand Theft Auto franchise, created by Rockstar North in Edinburgh, came in ninth, ahead of the K2 phone booth, the E-Type Jaguar, Penguin Books and the Sgt Pepper album cover.

In March 2006, BAFTA announced that they had elevated computer games to the same status as television and film, recognising interactive entertainment as an important and culturally significant creative medium demonstrating artistic innovation. This new direction recognises computer games as a separate entity from web, mobile and interactive TV. The 17 awards distributed at the BAFTA ceremony recognise best game in each genre, best game overall, audio, soundtrack and original score, technical and artistic achievement, screenplay, gameplay, innovation and character.

GameOn, games culture exhibition

GameOn, first exhibition hall

Jez San

Jez San was the first interactive entertainment professional to be awarded an OBE for services to the computer video games industry in 2002. San's interest in gaming began in the 1980s when he established Argonaut Software at the age of 16. Two years later, he released Skyline Attack, his first best-seller, and soon after created Starglider, his first game and one of the first titles to appear in 3D. San and Argonaut developed the Super FX chip, the first 3D graphics accelerator chip, and sold it to industry giant Nintendo for use in 3D gaming on their Super Nintendo gaming system in games like StarFox.

San is the co-author of the book Quantum Theory, published by Century in 1984, and was voted Entrepreneur of the Year by the European Technology Forum in 2001. He co-founded The Independent Game Developers Association (IGDA) the same year and has sat on BAFTA's computer games committee.

Peter Molyneux

During Peter Molyneux's 18-year career, he has worked on numerous top-selling computer games that have attracted immense critical acclaim and which cumulatively have sold in excess of 10 million copies.

Molyneux formed Bullfrog Productions in 1987. Sales of the studio's games topped 10 million copies. In 1997 Molyneux left Bullfrog Productions to form Lionhead Studios, a company which has produced multimillion-selling BAFTA and EMMA award-winning titles.

In 2003, Molyneux received an honorary doctorate from the University of Abertay, Dundee. He was also inducted into the Academy of Interactive Arts and Sciences Hall of Fame, and was awarded an OBE in the 2005 New Year's honours list for services to the computer video games industry.

Ian Livingstone

Ian Livingstone's business background is peppered with a wide range of interactive development experiences, from co-authoring the multimillion-selling Fighting Fantasy interactive gamebooks to seven well-received board games.

As executive chairman of games publishing company EIDOS plc, Livingstone secured many of the most well-received and best-selling major UK game franchises, including Tomb Raider, Championship Manager and Hitman.

He is an honorary doctorate of technology from the University of Abertay, Dundee, the recipient of the BAFTA Special Award for his outstanding contribution to the interactive entertainment industry and received an OBE in the 2006 New Year's honours list for services to the computer video games industry.

Livingstone is also the Creative Industries advisor to the British Council, a Creative Industries Luminary for London and the non-executive chairman of Bright Things plc.

The UK also leads in recognising games as cultural artefacts on an international scale. The British games industry celebrates its role in the wider media fabric as part of Edinburgh's annual August events. The Edinburgh Interactive Entertainment Festival (EIEF) draws a wide range of media, academic and business professionals interested in discussing and exploring the opportunities gaming technologies offer. It celebrates the convergence of these media, and the potential for games to promote the work of artists, engineers and educationalists across the professional spectrum. EIEF is the first major annual festival dedicated to the cultural contribution of computer gaming in the world.

More recently, October 2006 sees the first ever London Games Festival: *'a celebration of interactive entertainment. The festival, backed by some of the biggest names in the games industry and Creative London, part of the London Development Agency, is the first of its kind for a country that continues to be at the forefront of video game creativity.'*

In addition, formal recognition of the games industry has also come with the award of the OBE to three industry professionals, Jez San (2002), Peter Molyneux (2004) and Ian Livingstone (2006), for valuable services to Britain.

Summary

Commercial computer and video games encourage debate, adaptation, analysis and celebration. Their increasing presence in homes, classrooms and public cultural institutions is testament to how they have become enmeshed in the fabric of the nation's cultural identity.

Edinburgh Interactive Entertainment Festival (EIEF)

What games teach

In an educational context, play is regarded as an important part of the development of knowledge. Computer games take this further by situating formal or informal learners in complex circumstances which may be relevant to the lesson plan but are beyond those available in daily life.

Theoretical foundations

Computer games also offer safe situations in which to explore solutions to unique problems. Since the 1980s there has been a growing body of theoretical and applied research concerning the use of computer games in teaching, learning and education. Much of this research has been driven by two principles:

1. The desire to harness the motivational power of games in order to 'make learning fun'.

2. A belief that digital games offer a powerful learning tool.

The second point has been demonstrated by countless researchers (eg Inkpen et al, 1995; Higgins, 2000; Whitebread, 1997), and James Paul Gee (2003) who argues that the learning principles which are incorporated into the design of good games are close to the best theories of learning in other contexts, including formal and informal learning environments. He describes 36 principles which are essential for a good game (see Figure 2).

Specifically, Gee suggests that each game has a unique language which can be learned, and the more fluent players are, the more they can do within that context of the game. As they become more familiar with the signs and symbols of computer game culture and resources, games consumers become active learners, able to apply knowledge critically and laterally across domains.

Engaging in computer games and adhering to their rules means that users have a framework in which to explore, probe, hypothesise and test. This active discovery places the learner as co-producer of knowledge, an important aspect in the personalised learning paradigm.

Children's use of computer games also plays a significant role in developing the effective use of IT-based information and interactive resources. Matthew Mackereth (1998), for example, argues that game playing can increase confidence with ICT facilities in other professional circumstances. He suggests that children unfamiliar with video games may lose out.

Collaboration and group decision-making in the classroom

There are numerous other research-based indications that digital games have some potential in teaching, learning and education. For example, games can be particularly effective when 'designed to address a specific problem or to teach a certain skill' (Griffiths 2002b, page 47), encouraging learning in curriculum areas such as maths, physics, languages and arts, where specific objectives can be stated (Randel et al 1992). Even simple types of game can be designed to address specific learning outcomes, such as recall of factual content or as the basis for active involvement and discussion (Dempsey et al 1996; Blake and Goodman 1999).

Finally, researchers argue that multi-player options encourage collaboration and group decision-making by placing multiple parties in contexts where the group must interact on-screen towards a common goal. Professor Angela McFarlane et al (2002) and others (eg Sanford and Williamson, 2005) suggest that this stimulates problem-solving based upon complex tasks.

Figure 2: Gee's 36 learning principles essential in good gameplay (see Appendix D for full definitions)

1. Active, critical learning principle
2. Design principle
3. Semiotic principle
4. Semiotic Domains principle
5. Metalevel thinking about semiotic domains principle
6. 'Psychosocial Moratorium' principle
7. Committed learning principle
8. Identity principle
9. Self-knowledge principle
10. Amplification of input principle
11. Achievement principle
12. Practice principle
13. Ongoing learning principle
14. 'Regime of Competence' principle
15. Probing principle
16. Multiple Routes principle
17. Situated meaning principle
18. Text principle
19. Intertextual principle
20. Multimodal principle
21. 'Material Intelligence' principle
22. Intuitive knowledge principle
23. Subset principle
24. Incremental principle
25. Concentrated sample principle
26. Bottom-up basic skills principle
27. Explicit information on-demand and Just-in-time principle
28. Discovery principle
29. Transfer principle
30. Cultural models about the world principle
31. Cultural models about learning principle
32. Cultural models about semiotic domains principle
33. Distributed principle
34. Dispersed principle
35. Affinity group principle
36. Insider principle

Tim Rylands – Commercial off-the-shelf (COTS) game

Winner of the 2005 Becta ICT in Practice Award: Primary, Chew Magna Primary School Project: using Myst for literacy and creative writing.
Audience: Key Stage 2 (Ages 7–11)

Tim Rylands uses the games in the Myst series as a stimulus for discussion, to develop speaking and listening skills, to inspire children's descriptive writing and as a way of improving all-around confidence in language work. The games are not designed for use in education but their incredible cross between reality and fantasy make them ideal as a stimulus for all kinds of creative work.

He projects them onto a whiteboard and sits with his students as they explore together. They 'walk' through the environments, describing the sights and sounds in the games. Rylands observes that they need very little encouragement. Even the most reluctant writers seem to consider it an experience worthy of recording.

'Myst has made my writing more descriptive and has got me thinking about the difference senses I could write about, like what things feel like or what they smell like, and what sounds I can hear,' explains Catriona, one of Rylands' students. 'It has made me understand how to balance quality and quantity,' she says.

In addition to the language work, Rylands and his students also compose music to accompany their 'walks' and artwork to record their travels.

'I have seen a very big increase in children's literacy skills in particular,' he says. 'As the 'ages' have been written into existence, it makes the power of writing very obvious and books 'cool'.'

'The most difficult thing about using Myst at first was having to make decisions as a group to solve the problems,' says Catriona. 'We needed to learn a lot of negotiation skills so that we could work our way towards the solutions together,' she observes. 'It's fun to talk about where you have got up to in the game and how to solve different problems.'

Meeting educational needs through ICT

Interactive whiteboard in action

Technology supporting social engagement

Digital games as stimuli for learning

When engaged with a game, players must rely upon inference rather than direct questioning. Recognising this, developers have moved away from skill-and-drill interactive learning paradigms towards situational and constructionist approaches, encouraged by embedding practical knowledge in a game context. The challenge provided by the game design encourages strategic thinking away from the interactive context because it is positioned within a variety of actions rather than on one linear approach.

McFarlane et al (2002) found that one of the primary uses of games in today's classrooms is to stimulate discussion, writing and collaboration. Indeed, most games are embedded within a wider set of activities relating to the context or subject under discussion. It is argued that they work best when integrated into the lesson plan, rather than when they replace it.

Development of key skills

There is extensive evidence that students at all key stages develop skills related to the context and the content of bespoke and commercial gaming software. In addition, teachers report that learners' social skills benefit because of the emphasis on the collaboration, negotiation and shared decision-making required to complete the games (McFarlane et al, 2002; see Appendix E).

Rosas et al (2003) identifies four main categories into which 15 key skills fall, including school achievement, cognitive abilities, motivation towards learning and attention and concentration (see Kirriemuir, 2005b). Results of particular interest to the curriculum are positive trends in reading comprehension, spelling and grammar and the development of complex thinking and strategic planning. Mitchell and Savill-Smith (2004) add examples of games which support basic skills, engage students in learning, support information retrieval, encourage social learning and support multi-disciplinary skills. Other evidence confirms these findings.

Computer games as an enabler

Case study GameOn!

Claire has athetoid cerebral palsy and has problems controlling her limb movements. Her enthusiasm for learning has been transformed by access to a computer and printer. A special joystick and a switch have enabled her to create designs and write music.

'Creative use of software can raise motivation and self-esteem,' Mick Donegan, a deputy director at the Aiding Communications in Education (ACE) Centre, explains. 'We would like to motivate those with leisure time who might otherwise watch TV. With games, they can interact and excel at something, and use their leisure time constructively.'

The ACE Centre is developing a website called GameOn!, which includes a database of accessible games and leisure software, including a list of the devices required to play them. Some games such as flight simulators, for example, can be accessed with voice control devices.

'We are focusing on PC games since they support a wider range of input devices and are more commonly used by children with physical and communication needs. The database will include information on speed of control and feedback from user trials, and will allow users to sort games by their interests.'

The GameOn! website will also refer to available hardware. Joysticks can be used to improve dexterity and hand-eye coordination, while web cams and the Sony infrared EyeToy camera for the PlayStation consoles can be used to improve spatial and body awareness.

Removing the barriers to learning

Case study Kar2ouche: Social Communication

Immersive Education's Kar2ouche software range is based on a visual, game-like interface. 'We try to make all our products suitable for learners with special educational needs, because we take the view that every child has a special need in some way,' explains Donna Burton-Wilcock, Immersive's Director of Education.

Kent Local Authority (LA) and Immersive Education worked together to develop a software programme to help special needs students develop their social skills. It allows children to role play everyday situations at home and at school, add thought and speech bubbles, record in their own voices and save the role play as a movie.

For children with an Autistic Spectrum Disorder (ASD), the inclusion of wooden stick figures has helped them tell stories without the intimidation of facial expressions. They can also print their work as evidence of their learning.

Liz Connors, a specialist advisory teacher for autism at Kent LA, is using Kar2ouche: Social Communication alongside other Kar2ouche products. 'We want inclusive practice rather than separate provision for students with ASD.'

Many researchers indicate that there are aspects of learning in games which lie outside the current national curriculum's key skills. Across the literature, practitioners and researchers recognise that there is a disconnect between some of the important skills which are encouraged by gameplay and are relevant to life outside of school, and the national curriculum (eg Kirriemuir, 2005; McFarlane et al, 2002). The researchers at Teachers Evaluating Educational Multimedia (TEEM) highlighted that both teachers and parents rate the thinking, conversing and collaborating skills which some of the games demanded, yet it was frequently reported that there was no time in school for these products because they do not match key skills requirements.

Removing barriers to learning

Gaming technologies are also useful tools for reaching students who have difficulty learning in traditional classroom contexts.

Nearly one in six English children are considered to have special educational needs (SEN; DfES, 1994) and many children will have a special need at some time during their education (Parents Centre, 2006). Children with SEN may need extra or specific help for some or all of their time in school. This can be due to a range of needs including physical or sensory difficulties, emotional and behavioural difficulties, problems with thinking and understanding, or with speech and communication.

Strategies that support teaching for SEN children, such as differentiation and the use of multi-sensory approaches, can benefit all children. The Government's policy of increasing the number of interactive whiteboards in classrooms, for example, has also meant that children with sensory impairments can focus on a larger screen with clearer words and images.

Computer game software allows learners to work at their own pace providing auditory as well as visual stimulation. They can stimulate and engage, encourage collaboration, and appeal to disaffected students.

Although barriers to learning can be broken down through interactive experiences, game technology works best when combined with teaching and group activities. 'Interactivity is a major part of engagement,' explains Alistair McNaught of TechDis. 'But tasks that are set by teachers can be engaging, even when the interactive resource is not. The social context for learning is just as important.'

Interactive learning and computer games can be motivational and accessible. They can stimulate and simulate, educate and entertain. They promote skills which extend beyond the acquisition of ICT, encouraging learners to consider conceptual problems and objective solutions. The technology supports learning in a way that allows users to make choices which are relevant to their unique learning needs.

Summary

Digital games may become important tools for encouraging personalised learning, using these technologies has highlighted that they enable social engagement and collaboration.

As the models of learning move from prescriptive to non-prescriptive, from blanket learning objectives to personalised learning goals resource requirements may change. It is envisaged by some educational professionals that computer and video games may prove to be an appropriate resource in this context.

Games in an educational context

Formal and informal learning contexts use digital games to help develop deep knowledge of important concepts. Digital games are formal play activities, with rules and procedures to master (Kirriemuir, 2005), and reward successful demonstration of procedures within the framework of their rules.

Learners report that using computer games in formal settings makes the educational process more fun, as they place the learning objectives in a framework which has relevance to the task at hand.

The aim of this section is to:

- position electronic interactive products in the classroom by providing an overview of digital game models which have already found a place in the learning environment, and
- address concerns which practitioners have with them.

Interactive learning

According to the *Journal of Interactive Learning Research* (Reeves, 1999), learning is 'interactive' if the learner is required to navigate through an environment which is represented or supported by computer technology. The types of interaction can vary, but within the scope of this document, it includes negotiating, selecting and responding to challenges, tasks and problems via computer and games console input devices. Also important to this definition is the potential for collaboration with others in immediate or dispersed networks.

Learning may be explicit or implicit, but key is that the learner engages meaningfully with the informational content in order to create knowledge representations of the subject matter. This paradigm reflects the personalised learning model in which the learner is an active participant in the construction of knowledge at a pace and in a style which, in the case of interactive learning, is supported by the technology.

There are two approaches to incorporating interactive learning into the classroom: development of bespoke interactive learning products, and the adaptation of commercial off-the-shelf (COTS) games.

Bespoke interactive learning products

Educational game products promote learning via interactive resources which are explicitly subject or curriculum-focused. They tend to be created by educational games/software developers from scratch, using tools and resources specifically designed for hardware already or easily available in classroom settings.

Historically, educational games titles have centred on drill-and-skill models, particularly in mathematics and science. The relationship between the informational component and the game-entertainment has been explicitly divided, an aspect most contemporary developers of interactive learning software aim to avoid. The two most successful alternatives to the drill-and-skill paradigm have been simulations and adventure games which challenge users to take on the role of detective in order to problem-solve and explore.

Most games implemented in the classroom are PC-based, although recently there has been an

Bespoke interactive learning products in the classroom

upswing in the number of products developed for alternative technologies, like handheld PDAs. This software is developed to address the learning objectives and requirements and needs of a particular population of students; therefore their commercial reach is limited.

Budgets for commercial computer games can rise to an average of more than £1 million, but bespoke educational products can be much more limited in their developmental costs, and therefore their scope. Key to the disparity is that the educational computer game sector anticipates sales to a very specific audience and curriculum-relevant segment.

Despite the disparity in development costs, educational games can have a longevity that many COTS products do not. One example is MECC's Oregon Trail, developed in 1974 to simulate the trials of crossing the United States in the late 1800s – the title is still in use in US classrooms today. This example is in contrast to a typical entertainment product for a home game console released in 2000 which could be commercially obsolete in 2006.

COTS: Adaptation of entertainment products

Increasingly, games-savvy educators are incorporating computer games originally developed for commercial entertainment into their lessons to address the needs of the learner.

While there is varying relevance to the use of computer gaming software content in the curriculum, a body of evidence suggests that informational content can be introduced with great effect through the use of bespoke and commercial computer games. Two commercial genres in particular translate well in the classroom environment: simulation games and online games (Kirriemuir, 2005).

Simulation games

From the range of interactive activities available using COTS products, most educators have found that simulation titles have the most confluence with learning objectives. Explicit learning benefits, such as fiscal planning and mathematics, are more obvious in this genre of game, making them attractive to teachers and parents.

Typically most computer game simulations either attempt to re-create an historical era, an environment, social relationships, a political system, scientific principles or a business model; or they present a fantastic environment which adheres to game-designed rules based upon existing social, political, historical, scientific or economic theory. Science and economic simulations are the most frequently adapted for classroom use, and have an important role in business and private sectors as well.

Simulation products allow players to experiment with a problem in a 'sandbox' (Kirriemuir, 2005). The emphasis is on the scientific principle of hypothesis testing; while the orientation is on testing and re-testing the effects of actions on entities.

Kirriemuir (2005) argues that simulations appeal to practitioners because they are physically safe and can be controlled. Irrelevant distractions, chaos and random elements and time can all be removed or adjusted. They provide the instant feedback which makes the

Mobile collaboration

David Whyley
Headteacher, e-Learning Consultant, Wolverhampton Local Authority
Project: Learning2Go
Audience: Key Stages 2 and 3 (Ages 7–11 and 11–14 respectively)

Learning2Go uses mobile handheld computers to engage learners by delivering multimedia content, internet and authoring tools. It involves teachers, learners and their families. It has also involved collaboration between Wolverhampton Local Authority, hardware and software manufacturers and academics and government agencies keen to research the impact and development of mobile learning.

'Learner voice has been key to the success of the project so far,' explains Whyley. 'The Learning2Go project has, as its ethos, the belief that learners should have the choice and self-confidence to learn when, how and where they want. The project promotes a personalised learning experience in which the learner is responsible for managing their own device and helping to shape their own learning.'

Whyley explains that the mobile devices have become like a 21st century hi-tech pencil case. It's used for authoring, harvesting digital data, creating digital content and managing and integrating ICT into other infrastructures.

The implications of this project are already being evaluated and considered by the Department for Education and Skills (DfES), British Educational Communications and Technology Agency (Becta) and the Qualifications and Curriculum Authority (QCA). While there is still much to find out and learn, there is an increasing view that mobile learning is a glimpse into the future. 'Our understanding of how best to use the technology for the benefits of those 21st century citizens and their families is only just beginning!' offers Whyley.

Interactive learning

Alan Carpenter
Creative Director, 3T Productions Ltd
Project Sonica Spanish
Audience: Key Stage 2 (Ages 7–11)

Sonica is a fully supported language service on PC, commissioned by the DfES. It was designed to help teachers, who are not Modern Foreign Language (MFL) specialists, deliver Spanish language teaching within their curriculum lessons. The overall aim is to help children develop a love of languages at an early age.

The content is designed to engage pupils across Key Stage 2. There are 240 separate activities which are divided into 15-minute chunks of learning in order to be integrated easily into current lessons across all areas of the curriculum. Future products include a handheld version for PDA, an audiovisual dictionary, and other language versions.

The content is varied and aims to engage pupils with several activity types, including Dance Mat games, karaoke and Game Boy Advance-style mini-games, that are valued as successful elements of the commercial entertainment gaming market. There is clear evidence for these activities' potential for motivating and developing key skills if implemented in the right way.

use of these games particularly effective, and are more cost effective than re-creating the context under scrutiny in the classroom context. Teachers report that they are most useful in provoking further discussion after the simulated exercise.

Simulations do have their limitations, notably the hypothetical, complex or qualitative models which they implement often lack real-world validity.

Online games

Another COTS genre which is increasingly finding a place in UK classrooms are online games. These products are accessed and played over the world wide web by users connected to the internet by a PC or a games console. Kirriemuir (2005) explains, the internet has become a predominant channel of communication and access. Internet games tap into an existing paradigm enjoyed by children. The Children Go Online Survey (UKCGO) 2005 found that 71% of young people have access to the internet via a home computer, 38% via mobile phone, 17% via digital television and 8% via a computer game console.

An exciting innovation in the online games space is the emergence of the massively multi-player online game (MMOG) genre which situates the player in an internet-based virtual world populated by hundreds of thousands of internationally distributed individuals who share game goals and experiences via networked servers. Increasingly, MMOGs are being used as virtual spaces for teaching and collaboration because they offer platforms which allow for multiple users, group activities and content creation.

There are two types of approaches which fall into this genre: goal-oriented virtual worlds, and social virtual worlds. In the former, users have almost complete autonomy in their approach to resolution; these spaces are clearly created with stages, steps and processes.

The latter, on the other hand, are characterised by an open-ended experience with the intent of creating a space which is used by 'players' to socialise and collaborate.

Gee (2003) proposes that online games such as World of Warcraft and EverQuest assist in the development of social norms through the activation of distributed knowledge. The networks which players develop place them in a framework of cultural activity. He suggests that the kind of collaborative learning which goes on in online games is situated in a collective workforce.

Constance Steinkuehler's (2005) research concurs. She suggests that the real-time, perpetually accessible online social interaction in persistent virtual worlds, lays a benchmark for learning. Further, she suggests that users develop skills relevant to practical work environments through the collaborative

Access to online games via home computers and mobile phones

problem-solving and collective intelligence which emerges among participants who hold different community roles. Users become both insiders and producers of knowledge.

COTS games in the classroom
The classic approach to incorporating COTS games into classroom settings is for each pupil to use a copy of the game on a computer, working/playing in isolation. Kirriemuir (2005) points out, however, that the most effective examples are from group or collaborative game-based learning.

Issues and concerns
Several researchers have assessed the effectiveness of using COTS games for classroom-based learning, returning a somewhat mixed and complex set of results and conclusions (eg Squire, 2004; Egenfeldt-Nielsen, 2005).

Recent surveys of predominantly UK teachers who had attempted, or wanted, to use mainstream digital games in the classroom (eg McFarlane et al 2002; Kirriemuir 2002) have revealed a number of issues and concerns. The most frequently cited are:

COTS simulation in the classroom

Stephen Fessey, Park View City Learning Centre, Birmingham
Project School Tycoon
Audience: Ages 10–11

The School Tycoon project is an example of a COTS game being used to promote deep knowledge of a subject. Learners were required to transfer information conceptually between the modes of study (Kirriemuir, 2005).

'We were originally going to use SimCity 4 but thought it too detailed for the 1.5 hours we had the children. School Tycoon allowed us to get the children to develop their spatial thinking skills, fiscal skills, numeracy and even social awareness. Many did not realise the jobs that are entailed in running a school and how essential they are.

'Two teachers at the centre coordinated it and it was played by 90 Year 6 pupils (10–11 years old) in three groups of 30.

'The pupils were given cards to make their own 'physical' school within a budget and were then shown the software. They were allowed to play in the 'sandbox' mode for an hour and then we print-screened the final school with financial and academic results to determine who had been successful.'

Active learning

Steve Casey, PE teacher
Matthew Arnold School, Surrey
Project: Circuit training with the Kilowatt machine and a PlayStation
Audience: Key Stages 3 and 4 (Ages 14–15)

'The Kilowatt machine is a mechanical frame with electronic output which conects to a console or laptop. During PE lessons at the Matthew Arnold School, they connected it to a PlayStation 2 as part of an exercise circuit.

'The pupils' reactions were excellent. Using the machine provided a very different environment. Rather than using a joypad to move, all movement is done by the whole body while holding on to the handles of the Kilowatt. The resistance on the handles provides a muscular workout. Between one to eight players can play.

'It proved to be very successful and a big hit with the kids.'

- the difficulty teachers faced in identifying the relevance of a particular game to some component of the statutory curriculum, as well as the accuracy and appropriateness of the content within the game

- the difficulty in persuading other school stakeholders as to the potential/actual educational benefits of computer games. Parents, other teachers, school governors, headteachers, local authorities and other bodies have an influence on how a school operates. Many people still see games in the classroom as a controversial – and incompatible – combination; teachers are concerned about how much time they would have to spend defending their choice of learning tool

- the lack of time available for teachers to familiarise themselves with the game, and methods of producing the best results from its use

- how the effects of using the game on learning, content and skill improvement can be measured

- the amount of irrelevant content or functionality in a game which could not be removed or ignored, which (often repeatedly) took up lesson time.

This last point is one mentioned frequently by many teachers. Loading screens and unavoidable tutorials are cited as the worst offenders; compulsory viewings of the same full motion video are also considered by some teachers to make some games unusable within an efficient, classroom learning situation.

Further, many teachers are wary of using games with either implicit or explicit violence, as they are concerned about the reaction from parents, governors and the wider media. However, there are other issues that can make game use problematic. Research by Bristol-based research group Futurelab (2006) indicates that both students and teachers are sensitive to the cultural representations in games and believe that they can reinforce stereotypes and have other similar negative effects.

Other issues raised by teachers include:

- the lack of support materials, such as lesson plans, for using specific games within a curriculum-based lesson

- the lack of verification (preferably by an independent body) that a game is suitable for a particular purpose – for example, that the content is accurate and appropriate for the learning age range

- software licensing agreements. Those imposed on schools can restrict what software is used, especially games-oriented titles

- the age of classroom-based computer hardware, which is often several years old and lacks the necessary power or capability to run contemporary games titles

- the lack of an anytime ‘save’ function in many games, so that game use can stop when the lesson ends and resume, without the need to repeat previous progress, during the next lesson

- the learning objectives may not be congruent with game objectives, a point picked up by Clark (2003)

- the imbalance caused if some pupils are already very familiar with the game, while others in the same class are not

- the cost of buying multiple copies of COTS games for use in the same class (educational digital games usually have some kind of classroom use licence)

- debriefing – after gameplay, what are the best models for debriefing, discussion and learning reinforcement

- differing enthusiasm and perceptions, especially between boys and girls. Stoll (1999) agrees, arguing that ‘what seems like a game to someone will feel like work to another’.

To address some of these concerns, researchers have proposed elements which, if incorporated into computer game design, would make them of greater use in educational contexts. They suggest COTS developers produce a handbook of the structure, content and underlying theoretical (eg economic, physical) models, which would be made available with the software. Designers might also propose ideas for using the product in the classroom. Further, to counteract the often confusing and technical manuals included with COTS games, the handbook could include guidance notes for non-gamers (McFarlane et al, 2002).

Other suggestions include (eg McFarlane et al, 2002; Sanford & Williamson, 2005):

- noise-off features
- pre-set scenarios which could be editable for teacher adaptation
- a form of assessment built in to the design
- increasingly simplistic interfaces, so time spent developing an understanding for the mechanics of the game is reduced
- reconsideration of how race, gender, age and disability are represented
- pre-designed outlets for reflection.

(See Appendix F for further considerations.)

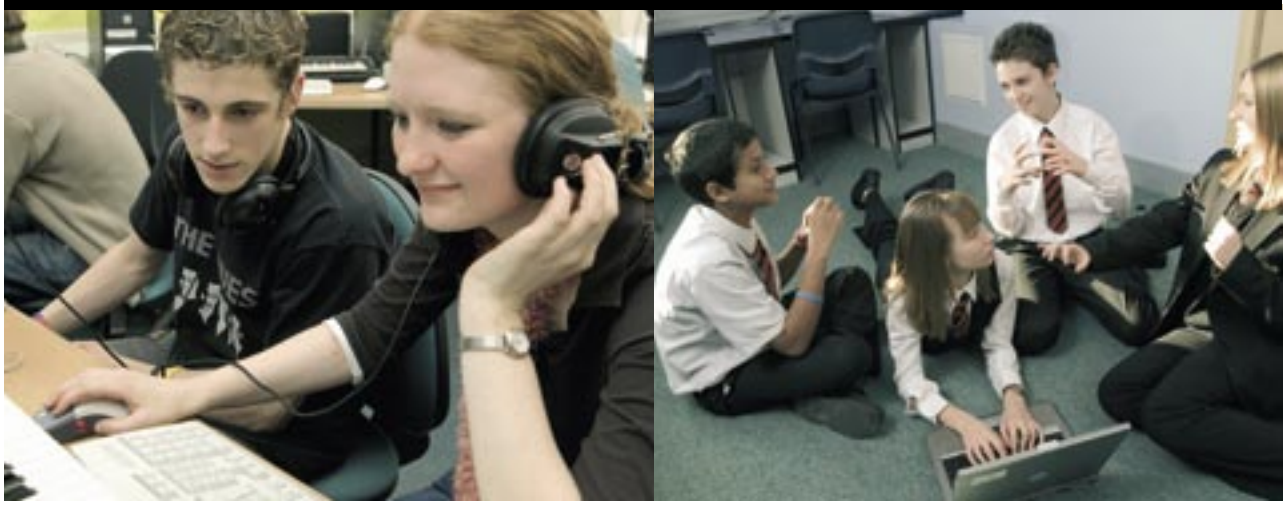
Online gaming and online safety

Many of the games designers and publishers involved in products that support online gameplay and related online services are assessing and seeking to address issues of online safety. Research suggests that there are strong reasons for understanding the issues, namely:

- the use of online technologies in bullying. An MSN/You Gov survey found that 11% of UK teenagers had experienced bullying involving online and mobile communication
- the potential exposure to explicit and upsetting content. The LSE's Children Go Online final report [www.children-go-online.net/] found that 38% of children surveyed had unintentionally seen pornographic content online
- the potential risks of sharing personal information online. The UK Children Go Online survey found that 46% of children had given out personal information online.

The games industry has responded at different levels, with industry bodies, online games service providers, government organisations and independents to take online safety seriously.

COTS games in the classroom help encourage collaborative learning



The role of COTS in decision-making

Joy Thompson
St Nicholas School, Yorkshire
Project: using Zoo Tycoon to facilitate group decision-making
Audience: Ages 9–11

'I've been using Zoo Tycoon with a Years 5 and 6 group of about a dozen who score less than level 2 in maths. These are a group of special needs children (two of whom have significant behavioural difficulties), who have trouble cooperating and concentrating for any length of time.

'I use the game a few times a week with a data projector and PC for maybe 15 minutes of a lesson. I hold the (radio) mouse and pass it round as required. I use it as a discussion 'tool', a sort of playing by committee. We discuss what we can afford to put in the zoo, how much fencing, terrain etc. We've been playing a couple of weeks; so far a giraffe escaped because we didn't get the right sort of fencing (false economy) and we've had two baby penguins because we've lavished loads of money on them.

'Fun aside, playing the game together calls for lots of cooperation, taking turns, strategic planning and talking. I believe in maths terms it comes under the national numeracy unit 'money and real-life problems'.'

- the UK Home Office Task Force on Child Protection has produced the Good practice guide for the moderation of interactive services for children. http://crimereduction.gov.uk/Internet05.htm
- UK government and leading businesses are working together on Get Safe Online, a free, public service developed to help you protect against internet threats and providing resources and advice for parents, teachers and young people. www.getsafeonline.org
- the Child Exploitation and Online Protection Centre (CEOP) coordinates police powers and relevant expertise in the UK and is linked with child protection initiatives around the world. www.ceop.gov.uk/
- for education Becta offers a comprehensive information service and provides advice for schools on how to use technology safely. www.becta.org.uk

Summary

Two methods of introducing computer gaming technologies into the classroom have been 1) to create bespoke educational software products and 2) to adapt COTS products for classroom use. Both present benefits, but also have problems: bespoke products have limited commercial appeal but high confluence with the curriculum, and COTS products lack the support materials to map effectively in a structured way to the desired learning outcomes. If COTS products are intended to be integrated in classroom activities, practitioners recommend that appropriate materials such as lesson plans are provided to assure them that the products are applicable and appropriate.

Technologies in the classroom

The research revealed in the previous sections of this report recognise that computer games can be important tools which can assist in the learning and education process. This section illustrates some issues concerning where and how interactive learning is formally and informally implemented in English classrooms.

Technology in the classroom
In 1997, government funding for ICT in schools for the year was £102 million. In 2007, government funding in this area was projected to increase to £741 million. 100% of schools have access to computers and spend £119 million on digital learning materials every year (BESA Resources In English Schools 2005).

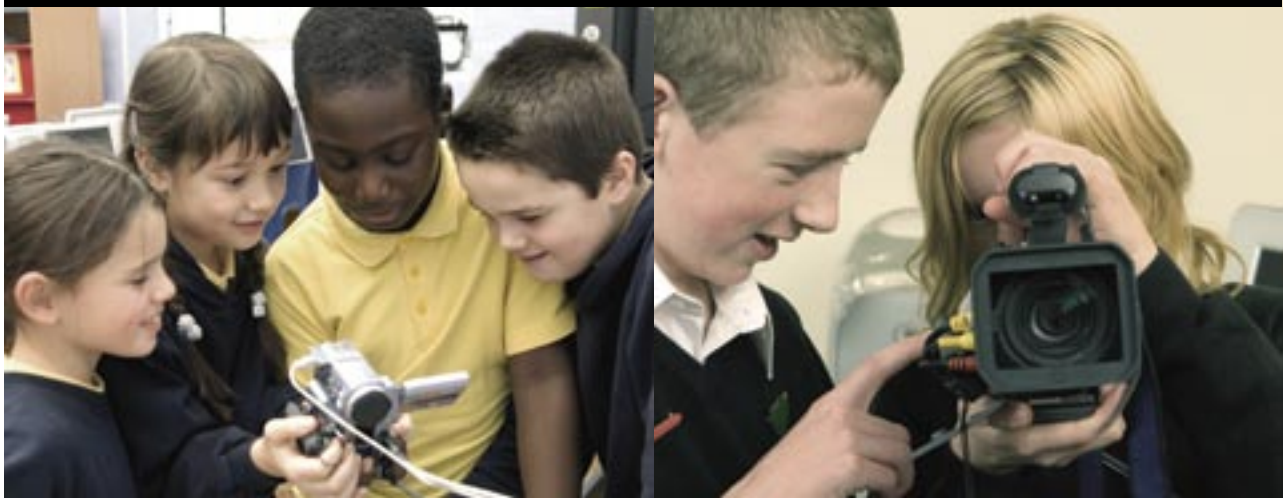
In January 2006, there were, on average, 37 desktop computers per primary school and 275 computers per secondary school used solely for teaching and learning purposes (BESA, 2006). In practice, there are currently 6.2 primary school pupils and 3.6 secondary school pupils per computer throughout the English school system.

Of these computers, 96.6% in primary and 99.8% in secondary schools are networked. More than 99% of schools throughout the UK have access to the internet. 100% of schools in the M25 district have broadband connectivity (BESA, 2006).

In higher education, the saturation of computer technology increases phenomenally. All universities are networked and have broadband internet access.

Besides desktop computing facilities, other technologies have transformed learning environments, and have made the potential for computer games' introduction into classroom settings possible. In 2006, primary schools have on average 14.3 laptops; secondary 63.1 (BESA ICT in English Schools).

Technology transforms learning environments



Technology transforms learning experiences

92% of schools had an average of 2.3 digital cameras/digital video cameras. On average, primary schools now have six interactive whiteboards; secondary 16. While there was less than one palmtop computer per child in primary and secondary schools in 2002, since that time, the number of palmtops has increased by an average of 0.2 in primary and an average of 2.2 in secondary. Indeed, all facilities have increased.

The cost of ICT in 2002 used solely for teaching and learning purposes was just over £21,000 per school. The greatest expenditure was in secondary schools, where almost £7,000 was spent on software and digital content alone, compared to the average spend of £2,400 (DfES, 2002). BESA (2006) estimates that the funding for ICT in 2006/07, including eLearning Credits (see next column), will total £13,910 in primary schools and £60,130 in secondary.

Government/public broadcaster initiatives

Interactive learning has witnessed a commendable amount of support from the UK Government. On the world stage, its involvement is an outstanding example of the type of initiatives that enable and encourage collaboration between industry and research (Egenfeldt-Nielsen, 2005).

Further, the role of public broadcasters in interactive learning has been key, consistent with their other education initiatives inspired by the establishment of the BBC's charter in 1922 as a public service, and later the Open University in 1967. The BBC's relationship with learning technologies expanded in 2003 with the establishment of the Digital Curriculum (now BBC jam: http://jam.bbc.co.uk), an online service for 5–16 year olds.

Curriculum Online was set up by the Government in 2001 to encourage the use of ICT in schools. The aim was to stimulate a vibrant digital content market and to increase the choice of software available for teachers to use in lessons. One component of the programme is the eLearning Credit scheme, announced in early 2003, which distributes eLearning Credits (eLCs) direct to schools for the purchase of multimedia learning resources, including interactive learning software which supports the national curriculum.

£330 million had been provided until 2006, and a further £125 million was made available in January 2006, to be spent by August 2008. On average, primary schools have £3,500 to spend from an eLC allocation, and secondary schools have £10,200. The definitive list of products available for purchase with eLCs is at www.curriculumonline.gov.uk.

Overwhelmingly, the products available are educational digital resources designed to support the national curriculum in England. This includes educational games, but no COTS products.

In March 2006, there were several thousand software applications available through Curriculum Online. The greatest proportion was for maths Key Stage 3, ages 11–14 (1,200+), followed by English Key Stage 1, ages 5–7 (just under 1,200). The core subjects, mathematics, English, science and ICT, were the best-represented. The areas least represented were law Key Stage 4, ages 14–16 social science Key Stage 4 and engineering Key Stage 4.

Interactive for fun

Jacqui Atkinson, Head of Mathematics
Ralph Allen School, Bath
Product: RM's MathsAlive
Audience: Key Stage 3 (Ages 11–14)

Jacqui Atkinson was a MathsAlive pilot teacher who got hooked on the resources and now uses its library of materials in conjunction with MyMaths.co.uk and other resources she's created in her classroom. It's one of the interactive learning solutions available to purchase with eLearning Credits from Curriculum Online, and was a BETT award winner in 2005 (the annual awards identify and reward innovative technological products and services; www.bettawards.co.uk). The resource has over 2,000 activities which include classroom work, individual worksheets, games and multimedia tools.

While initially Atkinson had trouble with getting to know all the elements available, she finds it easy to use now and appreciates how it motivates pupils.

By making lessons more interesting and fun, she's found that MathsAlive aids students' learning – particularly visual learners. The most effective use has been to link an interactive activity with practice, although she admits this requires more administrative work.

Atkinson has become so adept at using the software that she now frequently adapts resources to fill in the gaps. She argues that MathsAlive fits well with the core and extension curriculum work, but less well with support and lower ability needs.

Using the interactive resources included with the software has caused her to reflect on her teaching more and to spend more time planning how to teach, rather than what to teach.

A recent BESA report highlighted perceived gaps in the software provisions. At primary, they noted Early Years, Humanities, Games/PE, Music, Control and Monitoring (for Macintosh computers) and Special Needs (for Macintosh computers). At secondary, they noted a lack of Humanities material and quality packages to cover whole key stages.

Primary and secondary teachers report that they choose software based upon its curriculum relevance, on how easy it is to use, and on how interactive it is. Primary teachers also indicate that good graphics, fun and configurability are important factors in choice. Secondary schoolteachers choose their software based upon its focus on learning and how well it keeps pupils' interest (BESA, 2006).

Technologies already adapted for classroom use

Almost all technologies have already been adapted for classroom use in one way or another. PCs and laptops represent the highest proportion of ICT hardware in learning contexts, but other equipment, including palmtop computers, interactive whiteboards, digital cameras and video cameras, DVD players, video conferencing and digital televisions have found homes in UK schools (DfES, 2002).

Dedicated computer game consoles, whether television-based or handheld, have made fewer paths into formal learning contexts; however this is beginning to shift as game-literate teachers are incorporating them into their lesson plans in order to utilise their unique potential.

Video cameras adapted for primary children

Video conferencing for Key Stage 4

Future lessons

Futurelab, Electronic Arts, Interactive Software Federation of Europe
Project: Teaching with games
Audience: Teachers and industry

In August 2005, leading games industry publisher Electronic Arts, education and technology think tank Futurelab and the Interactive Software Federation of Europe (ISFE) announced a one-year research project investigating the potential for COTS products in classroom settings. The project aimed to provide practical evidence of the implications of the use of mainstream gaming entertainment in schools, and to set out a strategy for their inclusion in future lesson plans. Findings included:

- *Over two-thirds of students think that computer gaming in school would improve their ICT skills and almost 50% believe games will improve their problem-solving and strategic thinking skills.*
- *ICT provisions fulfil needs specific to schools which are different from those in the home or office. Schools have a need for more rigorous user account management software, which can conflict with copy-protection measures designed for domestic PCs.*
- *Even where teachers believe digital games can be useful and constructive learning tools, they often feel they aren't able to recognise these skills while remaining within the boundaries of the national curriculum.*
- *Teachers must be very familiar with the software in order to make best use of it as a teaching tool. Students also need to be able to play the game being used.*
- *There are skills which make it easier for teachers to integrate these games into their teaching, including fluency with ICT as a teaching tool and playing the games themselves.*

With this research, Futurelab and its partners hope to make it easier for teachers to be aware of the ways in which games may be used in their teaching, by describing the barriers and successes encountered by the teachers with whom they have been working.

PS2 console	Microsoft Xbox 360 console and controller
	

Technology and barriers to use

While many technologies are present in schools, it is important to recognise that they may not be capable of running computer gaming products. Titles specifically developed for classroom interactive learning use are created for machines which have very basic technical specifications; COTS products are often designed for high-end PCs or require dedicated hardware, which limits their applicability to schools with limited hardware spending budgets.

Console products (eg Sony PlayStation series, Microsoft Xbox series, Nintendo Game Boy) do have the benefit of being relatively affordable. The next generation of machines have been designed to be internet-ready, thereby reducing expenditures for network-ready computers. Unfortunately, a major barrier is that these consoles only support software created for each platform. In other words, Microsoft Xbox titles are not compatible with Sony PlayStation hardware and vice versa. Furthermore, if more than one machine needs to run the software at the same time, another disk must be purchased for each console. This problem is also applicable to PC titles, as school PCs may be of minimal specification, and computers that learners access may not have the required components to run COTS software.

Summary

Provisions are available for incorporating computer gaming technologies into classroom contexts; however at present there are limitations, technological, financial, pedagogical and cultural, to introducing them into schools.

Games in a global context

Digital gameplay is an increasing global phenomenon although we do not all play the same games in the same way. For example, in Germany the market for games consoles is almost non-existent but PC-based games are popular, in Japan there is an active market in downloadable games for the mobile phone whereas in the UK people rarely go beyond the pre-installed games that come with their handset.

Increasingly, the global picture is that adults are playing digital games at an unprecedented level, and the average child in the developed world has more options for entertainment than the average 20th century potentate.

It is no wonder then that the clear engagement qualities of digital game play have come to the attention of those who wish to be attended to, perhaps none more so than those who wish to educate us. It is beyond the scope of this report to give a comprehensive review of how the relationship between computer games and learning is being explored and developed globally. Rather a selection of some of the more advanced development and research projects from the US, Europe, South America and China are offered here to give a flavour of some of the best work in progress.

In the US, a group at Wisconsin-Madison works on a range of game-related themes from MMORGs to epistemic games. This last is a term coined by David Shaffer to describe an advanced form of immersive role play game where learners are inducted into the ways a

Urban Science: An epistemic game for innovative thinking – United States

David Williamson Shaffer
University of Wisconsin-Madison

Urban Science is a computer-based game in which high school students work as urban planners. The game begins when players get a project directive from the mayor: create a detailed redesign of the local pedestrian mall. They get a city budget plan and letters from concerned citizens about issues such as crime, revenue, jobs, waste, traffic, and affordable housing – the kind of materials and issues that urban planning students read as part of their training.

Like real planners, players have to balance the costs and benefits of alternative choices. After completing a land use plan, players present their proposals to the city planning office.

As a result of playing by the rules of urban planning, students learn to think like urban planners. For example, after the game, one player said: 'I really noticed how [urban planners] have to think about how the crime rate might go up – or the pollution or waste – depending on choices.' Another said that after playing the game, she walks down the street and notice[s] things, like, that's why they build a house there, or that's why they build a park there.' Players' thinking about urban issues becomes, on average, 72% more complex after playing the game.

Screenshot of Urban Science

Uncharted Depths

range of professionals think and act in their disciplines. In this way school subjects become more than the 500 things you are supposed to know about, and turn into truly constructivist experiences where the learner comes to understand and even think like a scientist, town planner, engineer or journalist.

Taking this approach one step further the Uncharted Depths project is a collaboration between a commercial game company and researchers to create a complex immersive 3D world within which players experience what it is like to be an active researcher exploring a new environment and conducting a variety of field work and experiments to try and understand it. In particular, the constraints and tools offer a very realistic experience of science in action, even though the world itself is somewhat fantastic. The production values are of sufficient quality to equal those of COTS games.

Uncharted Depths – United States

Dan White
Filament Games

The Uncharted Depths project is a collaboration between a commercial game company and researchers to create a complex immersive 3D world within which players experience what it is like to be an active researcher exploring a new environment.

In Uncharted Depths, the 'field' is a mysterious and unexplored alien ocean ecosystem. The model is simple enough to be digestible, but complex enough to accommodate experimentation with a wide variety of research methodologies. The game attempts to model many of the systemic phenomena that make the natural world tick.

Behind this topical layer of information is a second, more empirical layer that can only be detected using specialised equipment. All other equipment must be acquired with grant money.

These tools represent the 'verbs' that help students frame their inquiry. Since players can only carry four tools at a time, they must have a specific agenda in mind when loading out their submersible and conducting a dive. Because the teacher is in charge of approving grant requests and distributing game currency, they can embed this process with as much freedom or structure as they deem necessary for each student/classroom.

Students walk away from the game with solid personal experiences upon which to base future learning about research practices and the field of science at large.

Collaborative gaming – Chile

Miguel Nussbaum
Universidad Catholica, Santiago, Chile

In learning to work with diverse viewpoints the children come to realise that a variety of conceptions of the world is what enriches a discussion.

Groups of three each have their own PDA wirelessly connected to the other two. One of our aims is to develop social and communication abilities. In this game, a series of obstacles must be overcome in order to spell a word. The activity starts when the machine speaks a word the children have to construct. Before they start they have to find out how the word is spelled and determine a strategy to achieve this aim. Each player can see three characters, controlled by team-mates, and each has a specific ability.

In order to complete the game each player needs to complete tasks. Only one of the characters has each necessary skill, but each player can also help their fellow learners. All the children are responsible for the outcome and have to work as a team to succeed.

The children's previous knowledge, mutual feedback, and own and shared reflection allow them to build their answer as a group. The children contribute their ideas and knowledge socially, interacting and negotiating strategies and roles. All the necessary information and a game and pedagogical structure are provided through the PDAs. Thanks to the small size of the device, face-to-face interaction is encouraged as they sit facing one another, not a common screen.

Global Countdown – Norway

Vibeke Guttormsgaard
Universitet de Oslo

Global Countdown is a collaborative project funded and provided free to schools by Telenor, the main communications provider in Norway. It provides a technology based role play strategy/ negotiation game for groups of high school children. It takes around two hours to play through the game.

The game is played at set locations (Telenor has set up 7 game rooms in Norway, one of them portable). There are four teams of players, representing four regions; east, west, north and south. Each team has a president and a board of advisors. Each president negotiates with the other presidents, and communicates with his/her advisors through a phone headset, camera and a tablet PC. The advisors get a lot of information through different mobile devices (phones, PDAs, cameras etc.), and the presidents get information through film clips and text on a screen the advisors can't see. Together they interact in a story (presented as film clips and graphic presentations) following a research ship in the North sea, accidents on board, threats of corruption etc. The choices being made by the presidents have direct impact on the next part of the story, and finally on the outcomes.

The mission of the game is to save the planet from a nuclear disaster through negotiation with the other leaders and communicating good advice based on information from different sources. The teams also compete in – while saving the planet – generating values for their own region.

The aim is to increase ICT ethics and safety, political and environmental awareness, negotiation techniques and cooperation. The game has relevance to several curriculum subjects; history, science, media studies, and uses state-of-the-art technology in an advanced way.

In Chile an interesting project working with younger children had explored a very different approach using a different technology. Here children work in groups of three, each with their own PDA. This is a well developed model that this group has used successfully in a range of managed collaborative learning activities with learners from pre-school to adult. The latest and arguably most ambitious implementations consist of a collaborative game scenario. Each player in the group sees the same vista, from the same perspective on their own device and take turns to operate their own character, which only they can activate. In order to complete the game, each character must play its part and in the correct sequence. The design aesthetic is reminiscent of some handheld console games, but the collaborative model is unique.

A recent study of game related productive online communities in China reveals how the fan production associated with game play is not restricted to the Anglophone world. Chinese Paladin is a series of fantasy role play games that is extremely popular with 15-30 year olds in mainland China. In common with games played elsewhere, player generated websites attract many thousands of participants who seek tips and hints on successful game play, or to share their own creative response to the game and its characters. Anything from music to song lyrics, drawings to short stories and novels are shared in this way. One site, Pal Union, in September 2005 had nearly three-quarters of a million such postings from a community of nearly 50,000 players. A remarkable feature of these communities is their willingness to share opinions and expertise in order to help one another improve their work. The level of response and assistance evident in this community would be the envy of most e-learning advocates, and very rare in formal learning attempts to establish such exchanges and genuinely collaborative learning communities (Chen and McFarlane, 2006).

Summary

All the activities explored in this section are collaborative in nature, reflecting the latest developments in leisure-based computer games. The development of the necessary skills to accomplish a strategic collaborative task is an important element of all these games. Players do not play alone; indeed they need to play and cooperate with others in order to succeed.

The most interesting projects worldwide also seek to develop games that have authenticity for the players and relevance to the world beyond the game. They are truly engaging and in the process of playing, the content, as Gee (2003) explains, 'comes for free'.

Of primary importance in these projects is the design of the whole computer gaming experience. The digital elements range from sophisticated tools and content, to communication systems and fully-fledged immersive worlds. The power of the learning is related to the use of these elements within the whole game context. For example in the role play games, the set up and debrief elements of the task are recognised as critical to the learning. In the fan fiction communities, the learning comes not just from the process of producing game-inspired music, art or novels but from the feedback from critical friends in the community.

Lifelong learning

Education does not, of course, start and end at school. Before school there are important opportunities for learning. After GCSE or A level there is further education, college and university. Beyond these, retraining, evening courses and home-based learning.

The emergence of ICT and the internet as learning tools, and changes in demographics and work patterns, have raised the profile of continual learning and re-skilling from cradle to grave.

This section examines the potential of digital game technologies for learning opportunities with audiences outside formal classroom environments, paying attention to how the commercial games sector is adapting interactive learning for these audiences.

Pre-school learners

Key audience segments for computer games technology makers include pre-school children and their parents. Already there are game-like learning applications and technologies used to prepare young people for school, from video and DVD-based phonics programmes to child-friendly laptop computers with software which drills basic pattern recognition, language, colour and shape knowledge.

Adult learning

The use of computer games for educating adults is not as widespread in implementation as it is for teaching children; this is primarily due to marketing opportunities. A few adult-oriented subject areas (most notably business, economics and the military) have been adopters of such technology for some time. Within the UK, various organisations such as Learndirect, which provides directional signage and support to provide high quality post-16 learning have trialled the use of digital games in adult education, while networks such as special interest group SigGlue promote this use of technology.

The spectrum of learning needs among adults incorporates a wide range of issues. Some have had a negative past learning experience, or lack the confidence to re-enter learning after a long absence. Others have issues with access, cost or time.

Many have difficulties with basic skills. The 1999 Moser Report stated that up to seven million adults in England had difficulties with literacy and/or numeracy. A number of initiatives have focused on the development of these key skills.

For disaffected adults, who may have had a bad experience at school, there is a stigma attached to learning. Games and interactive learning can offer an alternative. Activities that can be completed informally, and at a pace that suits the learner, may be more appealing than a formal, qualification-based course.

The organisation TechDis is a higher education academy based in York supporting learners with complex needs in the post-16 arena. In further and higher education, learners who require assistive technologies are more able to use them appropriately but face difficulties with systems and a lack of awareness among staff.

Technology links the home and school

'Establishing confidence, communication, strategies and equipment will help,' according to John Sewell, a senior advisor. As with students in a school setting, strategies that benefit learners with additional needs can benefit others as well. 'Students with learning disabilities are just part of a spectrum of different learning needs,' adds TechDis' Alistair McNaught.

'Serious' Games

An emerging area of lifelong learning is the Serious Games development community which creates and promotes interactive products for commercial distribution that adapt the entertainment paradigm from the entertainment games industry with training and learning from educational paradigms.

Family learning

James Edwards, parent
Product: VTech V.Smile, ArtStudio
Users: William (6), Thomas (8), Harriet (9)

'We use VTech's V.Smile console, Pocket and ArtStudio,' explains James Edwards, father of William, Thomas and Harriet. 'We chose them because we didn't want the children playing commercial console games and preferred the learning aspects of the V.Smile System,' he says.

James Edwards' reaction to traditional digital games consoles is one of the reasons VTech launched in 1976 with the aim of developing systems and games that parents could feel confident in allowing their children to play, and still educate and entertain them in a healthy, age-appropriate manner. Edwards' children use it between two and three hours per week, 'taking the Pocket with them wherever they go, which is better than watching videos in the car!'

Edwards says that the biggest initial difficulty was getting accustomed to the input device and the interfaces. 'It took William a few weeks to master the hand-eye coordination it takes to manipulate the joystick. ArtStudio was difficult to use at first, but the kids improvised and were using it after a few hours. Harriet has created some great artwork with ArtStudio, including a particularly good drawing of the Eiffel Tower!'

Mobile learning for post-16 year olds

Audience: adults

Imagine sitting in a comfy chair with a phone in hand, getting ready to learn. Or taking a practice quiz on the bus. The m-learning project has focused on the use of mobile phones and PDAs to support adults who would prefer informal learning to classes in schools and colleges.

'It takes quite a lot of courage for some adults to enter learning,' explains Jill Attewell, research manager at the Learning and Skills Network. 'They may have had a bad experience of school or have basic skills difficulties, for example a dyslexia that wasn't recognised. M-learning offers a different route into conventional learning.'

Learners found the technology attractive but also valued learning where and when it suited them. Short quizzes and key skills tasks were included within resources such as practice activities for driving tests.

'A mobile phone is an increasingly popular bit of kit for those aged 16–24,' she says. 'It is also a personal device that people feel very attached to. It can be used individually, at times that suit the learner, but it can also be used for collaborative activities.'

m-learning trials have taken place across Europe, and a toolkit is now being developed so that teachers can generate their own quizzes.

Stimulating the desire to learn

Neverwinter Nights Learning Environment
Audience: College

Achievement in key skills by students at West Nottinghamshire College has increased dramatically since the college introduced learning based around the use of a modified computer game.

Staff in the Department of Computer Science have built learning activities into the popular adventure game, Neverwinter Nights. 'We work with learners who are 16+ who have not achieved well and are struggling with maths and English,' explains Nigel Oldham. 'We decided to target their culture of playing games to drive their desire to learn.'

Learners might need to travel in the right-sized ship to reach the next stage of a quest, but if their maths is wrong the quest can't be completed. Staff will stop and teach the skills they need. About 1,500 learners have now passed through the course and the success rate is 94%, compared with a national benchmark of just 22%.

Entry to Employment learners have also used Neverwinter Nights as part of a 10-week course. 'These are highly disaffected learners, learning a variety of life skills, yet 25% gained a level 1 qualification. The team are planning a package targeted specifically at disaffected learners. They are also developing activities for level 2 key skills to appease other students who've complained that level 1 learners are having all the fun.'

They apply existing libraries of resources from entertainment and computer games development into their finished output. These games have a wide international reach as the emphasis is on both learning and entertainment and are distributed, often for free after an initial commercial investment, via the internet.

Serious Games products have been developed by computer games designers since the late 1950s when the US Air Force developed the inventory management simulation title Monopologs (Egenfeldt-Nielson, 2005). This stimulated a surge in similarly-designed simulation titles across higher education environments, particularly in the business and military learning spaces. Since that time, almost every business environment has been simulated. Most have been specifically created for that subject, commissioned by the business or enterprise, with the aim of placing the learner in a consequence-free exact simulation for low-cost training.

According to Egenfeldt-Nielson (2005), explicitly educational computer games have followed a similar trajectory as other forms of media which have attempted forays into the learning sphere. He positions Serious Games as a modern equivalent to informational television and film, often beset with issues of relevance and content.

However, to counteract these criticisms, the Serious Games phenomenon has tried to incorporate the interests of the spectrum of institutions interested in the potential for lifelong formal and informal learning – from higher education to health to government organisations. Most of these disciplines have maintained their interest in the simulation potential of computer game technologies for cost-effective training and learning environments.

Commercial digital games

The major players in the commercial games industry are tentatively making moves into the interactive learning market, expanding their output to the needs of their ageing audiences.

There are only a few commercial software developers who have dedicated Serious Games teams, although there is a growing interest by first-party publishers in the Serious Games sphere. Those involved with the movement anticipate that this may inspire more companies to dedicate portions of their development teams to serious gaming applications.

Sega were the first of the recent generation of commercial game makers to apply explicit learning as entertainment with their tongue-in-cheek title Typing of the Dead (2000). The game, based loosely on one of its key franchises, challenged players to type sentences with a keyboard attached to a console before zombies attacked. The aim was to teach typing skills in an entertainment context.

More recent forays have been limited to the major publishers' handheld consoles which allow for cognitive exercise on-the-go, replacing non-digital forms of busywork like crossword and number puzzles. The best received product is Nintendo's Brain Training with Dr Kawashima, a title which puts players through the cognitive paces, marking their progress over days and months.

Serious about games

Ben Sawyer, co-director
Serious Games Initiative
Audience: Lifelong learners

'The number one thing the UK has going for it in the Serious Games sector besides the very active Government funding of prototypes and projects,' Serious Games Initiative's Ben Sawyer explains, 'is that it has a very robust commercial games industry with lots of good programmers and lots of good game design talent.'

Sawyer, the co-director of the Serious Games Initiative, argues that the workforce is the most important aspect of the Serious Games genre.

'More and more, if this space is going to mature,' he explains, 'the key portion of the talent will have to come from people who have a rigorous background in the commercial games industry. Without that sense of design or their technical relationships, it will be harder for this space to flourish.'

'Lifelong learning is one of the major questions which will emerge as the demographics get greyer,' he says. 'Serious gaming is going to become an important force in the cognitive activity of an increasingly older population.'

Inclusion for all

Dr Kawashima's Brain Training: How Old Is Your Brain?
Publisher: Nintendo
Audience: All

Released on the Nintendo DS handheld console in Japan in May 2005 and in Europe in June 2006, Dr Kawashima's Brain Training: How Old Is Your Brain has become a revolution in interactive entertainment consumption, spurring sequels, rip-offs and an enormous upsurge in the numbers of 'grey' gamers. In Japan, where the market has been the most bullish, the game has sold over 2.3 million copies.

The title is marketed at adults as part of Nintendo's casual gaming catalogue, based upon a popular book written by Tohoku University's Professor Ryuta Kawashima called Train Your Brain: 60 Days to a Better Brain.

Professor Kawashima's book proposed simple cognitive activities which would 'exercise' the brain. This made for an easy transfer to the interactive realm. Brain Training challenges players to spend 10 minutes per day performing simple arithmetic, word memory and concentration tasks using the touch-screen input device to scribble, draw or select options.

The exercises are wrapped up in a game-like package, providing self-directed challenge. The goal of the software is for the user to 'reduce' their 'brain age' to an 'ideal age' of 20.

The best received Serious Games application on the Sony PSP is TalkMan, translation and pronunciation software. As with Nintendo's Brain Training product, the 'serious' element is buried within a gaming paradigm, so that the educational aspect is cloaked in fun.

Indeed, the commercial game publishers (Sony, Nintendo and Microsoft) are adamant that they keep their entertainment libraries separate from education products to ensure that their brands do not lose their 'fun' emphasis. While they are keen to attract and maintain a more varied consumer base than their traditional demographic by offering opportunities for serious and educational digital products to be represented on their platforms, they do not anticipate developing fully 'serious' game branches for their in-house development or publishing teams.

To compensate, there have been informal calls for the development of a corporation for public gaming in the US to ensure that there is a pool of money available to explore such issues (Rejeski, 2006), and the UK's Office of Communications (Ofcom) Public Service Publisher proposal may take steps towards the realisation of this in the UK.

Summary

In formal learning contexts, games are tools to help overcome traditional barriers to learning. This is a trend which has been replicated outside the classroom as well. A thriving Serious Games community has worked to create titles which are relevant to the lifelong learning context, and some suggest that we will witness a generational shift, which will support the use of computer gaming in adult contexts in future.

Access all areas

Talkman
Publisher: Sony
Audience: All

Talkman was created by Sony Computer Entertainment for its PlayStation Portable (PSP) handheld console. It was released in Europe as Talkman after the huge success of the Japanese version of the software in March 2006.

It is a voice-activated translation package which operates in a variety of languages including English, German, French, Spanish, Japanese or Traditional Chinese. Using the USB microphone included with the software, players can use the software for direct translation between any of the languages supported.

The software is ostensibly designed for travellers needing translation software, although it does claim some entertainment elements including mini-games which challenge the player to replicate pronunciation accurately or to select the word that matches the foreign language definition. It includes slang and travel phrases.

The future of learning

According to practitioners, educationalists and software developers, the future of interactive learning will be characterised by a greater movement online. Therefore encouraging the development of a personalised learning community network via ubiquitous computing devices.

This trend will be supported by new digital gaming technologies which lead the way in developing innovative consumer electronic products.

Consistent with future visions of computer and video games, greater bandwidth will translate into digital distribution of content and greater personalisation through user-generated materials. This section will explore these areas in the interactive learning market by looking at examples of existing and prototypical technologies which will help shape formal and informal learning in the next 10 years.

Digital distribution

Ubiquitous broadband has changed the landscape for traditional publishers who in the past have produced hard copy versions of their content for consumers. Increasingly, this process has moved online, with digital items delivered directly to the user.

The commercial computer and video games industry is currently experimenting with downloadable content for its console hardware, reserved on an external server and accessed upon demand. The potential benefit for education is that the content can be downloaded as the context and the learning situation deem it appropriate. It can then be stored on a local machine's hard disk for later repeated use.

Espresso, an educational software publishing company, has been leading with this distribution model in the educational sector. They host audiovisual content and interactive software via a subscription service for Primary. Their services are currently available to over 8,200 subscribing schools in England (which is approximately 45% of all primary schools), offering a digital library of interactive learning resources.

The BBC's digital curriculum service BBC jam is also an example of digital distribution. The aim with this curriculum-oriented, internet-based resource is to open up learning beyond the school classroom.

Learner as tutor

User generated content

Delivering the content to schools

Lewis Bronze, CEO, Espresso
Project: Espresso for primary
Audience: Primary

The award-winning Espresso content service has been operating for seven years, pioneering 'rich-media' curriculum services to primary schools.

Bronze suggests that the Espresso service is an original take on a traditional model. In the past, he argues, teachers had a resource box filled with clippings from newspapers and other items of interest. Espresso has updated this idea with audiovisual and hyperlinked digital assets for the contemporary age. Video and interactive resources are gathered by the Espresso team, or from agreements with licensed sources like ITN and The Times. The service has approximately 45,000 pages of content and 3.5K curriculum-focused videos.

Using an innovative networked distribution model, Espresso delivers the content to schools who store it in a cache on-site, updating it weekly. Students and teachers then access the content via PCs and, in some local authorities, via PDAs. Espresso has also offered a commercial version of the service for home use.

User-generated content

User-generated content is a new direction in the interactive learning space. Educational software developers are experimenting with the tools which allow learners to apply their knowledge and ideas in new forms, often for the benefit of other students and teachers.

Increasingly, both educational and commercial providers are developing packages which provide the templates and assets for users to create their own gaming applications. Caspian Learning, a software based e-learning organisation has created QCreate software and encourages educators to combine it with their Thinking Worlds prototype online world, so users can generate games applications that challenge other users. This process benefits the creators who must balance learning principles with game objectives, educational content and entertainment.

Thinking worlds

Chris Harte, St Robert of Newminster Roman Catholic School and Sixth Form College, Tyne & Wear
Product: Caspian Learning's Thinking Worlds and QCreate
Audience: Primary (Year 7)

Chris Harte used Caspian Learning's tools in his classroom to inspire his pupils to develop new thinking applications for other students. He worked in partnership with Caspian Learning and Andy Williams at the Sunderland CLC.

Harte argues that the software was easy to use for editing and creating, but that the basis upon which the project was a success was the preliminary theory work. Spending time with the children looking at the different classifications may have been a bit dry but, Harte admits, they took it on board and realised the crucial importance when they developed the higher-order tasks in their applications.

'The pupils involved in the development of the application have undergone the biggest shift in looking at the way they and others learn, as well as understanding the different levels of thinking,' he says. But Harte is most pleased with the pride the children now have in their work.

Personalisation in the classroom

Max Wainewright, 2Simple
Products: 2Create
Audience: Key Stages 1 and 2

A commercial game like EA's The Movies reflects a mainstream application similar to the products published by 2Simple Software, like their 2Create series and their Toolkits which provide the workspace to generate multimedia presentations, animations, models, interactive books, music and other creative output.

'Our most widely-used product is a video tool for primary,' Wainewright says. 'It lets kids write their own stories and enhance them with animation and sound.'

Their library of software includes a range of simple tools-based systems that cover the ICT curriculum in Key Stages 1 and 2. With these applications, they aim to cross the gulf between the entertainment-based appeal of home console software and the drill-and-practice of some educational software. 'It has to be more sophisticated than software which rewards correct answers on 40 questions with applause and a dancing clown,' explains Wainewright, 'but it also has to track kids' learning for teachers.'

They have kept very close to their users; Wainewright tests new applications with students in his classrooms and adapts them between lessons to enhance the balance between playability and learning objectives

Commercially, user-generated content is best-represented in the online game and PC spheres, but new innovations in technology have expanded this market to the home consoles. For example, players can create and trade assets for commercial games on Microsoft's Xbox Marketplace, the central online community accessed with the Xbox 360 games console.

A PC title like Activisions' The Movies, which challenges users to develop, write, animate, voice and publish films using the interface provided with the software, and the online distribution channels associated with the game publisher, have stimulated some exciting output. Political commentary and social documentaries are shining examples but the process of creating a finished product offers skills to users of all abilities.

Summary

Game developers recognise their important role as entertainers and appear keen to work with educationalists in the development of their products. New hardware ensures universal access to the internet via a range of devices, expanding the reach of learning possibilities beyond the PC.

Video cameras adapted for primary school

Conclusion

The relationship between interactive computer games software and learning has been evidenced in both academic research and applied results. They encourage debate, analysis, lateral thinking and cultural celebration and have become a part of the UK's cultural identity.

Increasingly games are being adapted for learning settings. Practitioners and learners alike recognise the benefits of using interactive entertainment technologies, for both classroom objectives and life skills. Collaboration, communication, teamwork, lateral thinking and problem-solving are part of both the learning and the playing experience.

However, as this document has demonstrated, there is still a disconnect between the commercial games industry and the classroom.

The demands of bringing COTS into educational settings have proven the primary challenge, particularly in the time it takes for teachers to adapt the software to suit the context. It has been proposed that by making the design of such products more transparent, and providing guidance materials for teachers, COTS games may find a new channel for ready adoption into mainstream education.

Similarly, the mainstream entertainment industry appears reserved at present to commit to the development of educational products for fear that such an approach may subvert their reputations or could undermine their commercial interests.

Yet, the games industry recognises the need to engage with today's educational and cultural settings. New products that entertain and educate are opening the doors to new audiences. Best sellers in the commercial sphere have inspired a burgeoning development culture which aims to meet the needs of lifelong and school-aged learners. Success stories like Nintendo's Brain Training have added new destinations to the entertainment map for both consumers and creators.

The Serious Games development community continues to be supported by major government, military and private institutions. Their presence at the annual entertainment games industry conventions and festivals indicates that they have managed to overcome the early reticence towards educational software and are perceived as contributing important new models to the commercial sphere. Entertainment developers are increasingly keen to learn from educators, in order to apply important pedagogical techniques to the next generation of interactive software.

Networked communication and distributed collaboration

Interactive games designers continue to generate products which have real relevance to the curriculum. The emphasis upon ubiquitous computing and communication is pushing a paradigmatic shift in the way knowledge is constructed by learners, and the means through which it becomes relevant and personalised.

The solution at this point is to open a dialogue between the traditional entertainment games developers and those in the educational sector in order that knowledge gaps in design, structure and content may be reconciled. Further, independent Serious Games and interactive learning games developers may benefit from the next generation technologies as the potential for networking capabilities opens up opportunities for these populations for new markets.

There is no question that computer games are important to the education and development of the next generation of digital citizens. As they grow, their cultural contributions will be inherently linked with their interactive pasts, and their work practices will be geared towards networked communication and distributed collaboration. The participatory involvement that they experienced during their formative years will create an engaged, knowledgeable, critical and enthusiastic citizenry prepared to continue the UK's long tradition of innovation through technology in the 21st century.

Appendix A: Definitions of genres

Action and Adventure:	typified by exploration, puzzle-solving and interaction with computer-controlled agents with a focus on narrative rather than reflex. This focus allows the genre to draw from other narrative artforms, adapting elements from, for example, literature and film. Their settings can range across most literary genres.
Casual:	a term used to describe any game targeted at a mass audience. Casual games are usually quick-fire, engaging activities with few rules requiring no special skills, making them very easy to pick up and to put down. They require no long-term commitment.
Children:	any genre of game aimed at this demographic.
Massively multi-player online game: (MMOG)	large-scale, internet-based computer games which support hundreds of thousands of players simultaneously. They are set in persistent virtual worlds.
Puzzle:	any game which emphasises puzzle-solving, including strategy, logic, pattern-recognition, word completion or sequence solving.
Role playing game: (RPG)	a genre in which players adopt a character and collaborate with computer-controlled characters to create a story. Player choices shape the direction and outcome of the experience. For example, there are many options which a player can choose from when developing an RPG character which helps to personalise and direct the course of game play.
Simulation:	games which simulate a particular aspect of reality, from airplane flight to city management. The play includes a mixture of skill, tactics, chance and strategy.
Social:	a genre which encompasses any virtual environment in which the intention is to socialise. Such titles often have no overarching goals, but may include game-like elements in the design.
Sports:	a game which seeks to replicate, either realistically or not, a sporting activity.
Strategy:	while most games have an element of strategy. This genre is typified by the decisions which players make to achieve an outcome. There are variations on the strategy theme – real-time strategy, turn-based strategy, God games – but in each, the emphasis is on the decision-making skills of the user.

Appendix B: Top 10 software

Compiled by Chart-Track, copyright ELSPA

Top 10 Games 2005 (Chart-Track)

1 FIFA 06
(Electronic Arts) (Sports Simulation)
2 ProEvolution Soccer 5
(Konami) (Sports Simulation)
3 Need for Speed: Most Wanted
(Electronic Arts) (Racing Simulation)
4 Gran Tourismo
(Sony) (Racing Simulation)
5 Star Wars Episode III: Revenge of the Sith
(LucasArts) (Action Adventure)
6 FIFA Street
(Electronic Arts) (Sports Simulation)
7 Star Wars: Battlefront II
(LucasArts) (Shooter Game)
8 Grand Theft Auto: San Andreas
(Take2) (Action Game)
9 King Kong: Official Game of the Movie
(Ubisoft) (Action Adventure)
10 Sims 2
(Electronic Arts) (Simulation)

Top 10 Games 2000

1 Who Wants To Be A Millionaire
(Eidos Interactive) (Puzzle Game)
2 Pokemon Yellow
(Nintendo) (RPG)
3 Gran Turismo 2
(Sony) (Racing Simulation)
4 WWF Smackdown 2
(THQ) (Action Game)
5 Pokemon Red
(Nintendo) (RPG)
6 Pokemon Blue
(Nintendo) (RPG)
7 WWF Smackdown
(THQ) (Action Game)
8 Fifa 2001
(EA Sports) (Sports Simulation)
9 Toy Story 2
(Disney Interactive) (Adventure Game)
10 The Sims
(Maxis) (Simulation)

Top 10 Games 1995 (CD)

1 Fifa Soccer '96
(Electronic Arts) (Sports Simulation)
2 Destruction Derby
(Sony) (Racing Game)
3 Command & Conquer
(Virgin) (Strategy Game)
4 Discworld
(Psygnosis) (Adventure Game)
5 Star Trek: The Next Generation – A Final Unity
(Microprose) (Adventure Game)
6 Dark Forces
(LucasArts) (Adventure Game)
7 Wipe Out
(Sony) (Racing Game)
8 Tekken
(Sony) (Action Game)
9 Rebel Assault
(US Gold) (Action Game)
10 Theme Park
(Bullfrog) (Simulation)

Top 10 Games 1995 (Cartridge)

1 Fifa Soccer '96
(Electronic Arts) (Sports Simulation)
2 Fifa Soccer '95
(Electronic Arts) (Sports Simulation)
3 The Lion King
(Virgin) (Adventure Game)
4 Theme Park
(Bullfrog) (Simulation)
5 Mortal Kombat 3
(Acclaim) (Action Game)
6 Killer Instinct
(Nintendo) (Action Game)
7 Mickey Mania
(THQ) (Children's Game)
8 Brian Lara Cricket
(Codemasters) (Sports Simulation)
9 Micro Machines '96
(Codemasters) (Racing Game)
10 Premier Manager
(Sega) (Sports Simulation)

Appendix C: Technological specifications for current and next generation hardware

Nintendo	
Wii™ (2006)	Nintendo's forthcoming console emphasises accessibility with its unique controller, which resembles a TV remote control and has motion sensing capabilities. Wii is Wi-Fi compatible and has 2 USB ports. It has 512MB internal memory which can be expanded using an SD memory card.
GameCube (2001)	Nintendo's uniquely designed and compact home console uses 3 inch proprietary Nintendo GameCube Discs. It has a port for a broadband and modem adaptor and can be connected to the Game Boy Advance.
DS Lite (2006)	Nintendo's dual-screen handheld console features touch-screen and microphone controls. The DS can connect to Nintendo's wireless gaming network, the Nintendo Wi-Fi Connection, and allows wireless internet access through the Nintendo DS Browser. Game Boy Advance games can be played on it.
Microsoft	
Xbox 360 (2005)	Microsoft's next generation console features a powerful central processing unit (CPU), 20GB of removable storage, Wi-Fi capability, and the ability to stream audio, music and other media from a PC. It has a DVD player and supports High Definition formats. The Xbox 360 is backwards compatible with most popular Xbox titles.
Xbox (2001)	Microsoft's last-generation console features a 733 MHz CPU, plus a 64MB internal hard drive. It supports DVDs and CDs and is broadband enabled.
Sony	
PlayStation 3 (2006)	Sony's next generation machine supports CD, DVD and BD (Blu-ray Disk). Built around the Cell processor – dubbed a super computer for the living room, it is internet-ready, with Ethernet, and wireless Bluetooth connectivity. The PS3 is backwards compatible with previous PlayStation and PlayStation 2 products, comes with a built-in hard drive disk as standard, and will be the only home computer system to offer true High Definition at optimum 1080p output.
PlayStation 2 (2000)	Sony's current generation machine has a 128 MHz CPU and 32MB of memory. It supports DVDs and CDs, and was the first games system to offer full backwards compatibility with the full range of games for its predecessor's (PlayStation) games.
PSP (2005)	Sony's handheld machine features a large screen with a high-resolution display. It is wireless and can be used for browsing the internet. It reads software from proprietary Memory stick(r) and Universal Media Discs (UMDs). It can be used to listen to audio (ATRAC, MP3), watch video (MPEG 4 movies, 'location free TV), and photo images (JPEG). In future it can be used as a device for wirelessly downloading compatible content stored on PS3.

Appendix D: 36 learning principles essential in good gameplay

Gee's (2003)

1. **Active, critical learning principle**
   All aspects of the learning environment (including the ways in which the semiotic domain is designed and presented) are set up to encourage active and critical, not passive, learning.
2. **Design principle**
   Learning about and coming to appreciate design and design principles is core to the learning experience.
3. **Semiotic principle**
   Learning about and coming to appreciate inter-relations within and across multiple sign systems (images, words, actions, symbols, artifacts, etc) as a complex system is core to the learning experience.
4. **Semiotic Domains principle**
   Learning involves mastering, at some level, semiotic domains, and being able to participate, at some level, in the affinity group or groups connected to them.
5. **Metalevel thinking about semiotic domains principle**
   Learning involves active and critical thinking about the relationships of the semiotic domain being learned to other semiotic domains.
6. **'Psychosocial Moratorium' principle**
   Learners can take risks in a space where real-world consequences are lowered.
7. **Committed learning principle**
   Learners participate in extended engagement (lots of effort and practice) as extensions of their real-world identities in relation to a virtual identity to which they feel some commitment and a virtual world that they find compelling.
8. **Identity principle**
   Learning involves taking on and playing with identities in such a way that the learner has real choices (in developing the virtual identity) and ample opportunity to mediate on the relationship between new identities and old ones. There is a tripartite play of identities as learners relate, and reflect on, their multiple real-world identities, a virtual identity, and a projective identity.
9. **Self-knowledge principle**
   The virtual world is constructed in such a way that learners learn not only about the domain but about themselves and their current and potential capacities.
10. **Amplification of input principle**
    For a little input, learners get a lot of output.
11. **Achievement principle**
    For learners of all levels of skill there are intrinsic rewards from the beginning, customized to each learner's level, effort, and growing mastery and signalling the learner's ongoing achievements.
12. **Practice principle**
    Learners get lots and lots of practice in a context where the practice is not boring (ie this is a direct quotation, which must remain in the text in a virtual world that is compelling to learners on their own terms and where the learners experience ongoing success). They spend lots of time on task.
13. **Ongoing learning principle**
    The distinction between learner and master is vague, since learners, thanks to the operation of the 'regime of competence' principle listed next must, at higher and higher levels, undo their routinized mastery to adapt to new or unchanged conditions. There are cycles of new learning, automatization, undoing automatizations, and new reorganized automatization.

14. 'Regime of Competence' principle
The learner gets ample opportunity to operate within, but at the outer edge of, his or her resources, so that at those points things are felt as challenging but not 'undoable'.

15. Probing principle
Learning is a cycle of probing the world (doing something); reflecting in and on this action and, on this basis, forming a hypothesis; reprobing the world to test this hypothesis; and then accepting or rethinking the hypothesis.

16. Multiple Routes principle
There are multiple ways to make progress or move ahead. This allows learners to make choices, rely on their own strengths and styles of learning and problem-solving, while also exploring alternative styles.

17. Situated meaning principle
The meanings of sighs (words, actions, objects, artifacts, symbols, texts, etc) are situated in embodied experience. Meanings are not general or decontextualized. Whatever generality meanings come to have is discovered bottom up via embodied experiences.

18. Text principle
Texts are not understood purely verbally (ie only in terms of the definitions of the words in the text and their text-internal relationships to each other) but are understood in terms of embodied experiences. Learners move back and forth between texts and embodied experiences. More purely verbal understanding (reading texts apart from embodied action) comes only when learners have had enough embodied experience in the domain and ample experiences with similar texts.

19. Intertextual principle
The learner understands texts as a family ('genre') of related texts and understand any one such text in relation to others in the family, but only after having achieved embodied understanding of some texts. Understanding a group of texts as a family (genre) of texts is a large part of what helps the learner make sense of such texts.

20. Multimodal principle
Meaning and knowledge are built up through various modalities (images, texts, symbols, interactions, abstract design, sound, etc), not just words.

21. 'Material Intelligence' principle
Thinking, problem-solving, and knowledge are 'stored' in material objects and environment. This frees learners to engage their minds with other things while combining the results of their own thinking with the knowledge stored in material objects and the environment to achieve yet more powerful effects.

22. Intuitive knowledge principle
Intuitive or tacit knowledge built up in repeated practice and experience, often in association with an affinity group, counts a great deal and is honored. Not just verbal and conscious knowledge is rewarded.

23. Subset principle
Learning, even at its start, takes place in a (simplified) subset of the real domain.

24. Incremental principle
Learning situations are ordered in the early stages so that earlier cases lead to generalizations that are fruitful for later cases. When learners face more complex cases later, the learning space (the number and type of guesses the learner can make) is constrained by the sorts of fruitful patterns or generalizations the learner has found earlier.

25. Concentrated sample principle
The learner sees, especially early on, many more instances of fundamental signs and actions than would be the case in a less controlled sample. Fundamental signs and actions are concentrated in the early stages so that learners get to practice them often and learn them well.

26. Bottom-up basic skills principle
Basic skills are not learned in isolation or out of context; rather, what counts as a basic skills is discovered bottom up by engaging in more and more of the game/domain or game/domains like it. Basic skills are genre elements of a given type of game/domain.

27. Explicit information on-demand and Just-in-time principle
The learner is given explicit information both on-demand and just-in-time when the learner needs it or just at the point where the information can best be understood and used in practice.

28. Discovery principle
Overt telling is kept to a well-thought-out minimum, allowing ample opportunity for the learner to experiment and make discoveries.

29. Transfer principle
Learners are given ample opportunity to practice, and support for, transferring what they have learned earlier to later problems, including problems that require adapting and transforming that earlier learning.

30. Cultural models about the world principle
Learning is set up in such a way that the learners come to think consciously and reflectively about some of their cultural models regarding the world, without denigration of their identities, abilities or social affiliations, and juxtapose them to new models that may conflict with or otherwise relate to them in various ways.

31. Cultural models about learning principle
Learning is set up in such a way that learners come to think consciously and reflectively about their cultural models of learning and themselves as learners, without denigration of their identities, abilities, or social affiliations, and juxtapose them to new models of learning and themselves as learners.

32. Cultural models about semiotic domains principle
Learning is set up in such a way that learners come to think consciously and reflectively about their cultural models about a particular semiotic domain they are learning, without denigration of their identities, abilities, or social affiliations, and juxtapose them to new models about this domain.

33. Distributed principle
Meaning/knowledge is distributed across the learner, objects, tools, symbols, technologies and the environment.

34. Dispersed principle
Meaning/knowledge is dispersed in the sense that the learner shares it with others outside the domain/game, some of whom the learner may rarely or never see face-to-face.

35. Affinity group principle
Learners constitute an 'affinity group' that is, a group that is bonded primarily though shared endeavors, goals, and practices and not shared race, gender, nation, ethnicity, or culture.

36. Insider principle
The learner is an 'insider', 'teacher', and 'producer' (not just a 'consumer') able to customize the learning experience and domain/game from the beginning and throughout the experience.

Appendix E: Key Stages 1–4 skills developed through gameplay

McFarlane et al (2002) (pp13–15)

Key Stage 1 (ages 5–7)

Personal and social development

I. Provide interest and motivation to learn
II. Maintain attention and concentration levels
III. Can work as part of a group and can learn to share resources

Language and literacy

I. Encourage children to explain what is happening
II. Sustain attentive listening, responding to what they have heard by relevant comments, questions or actions
III. Use talk to organise, sequence and clarify thinking, ideas, feelings and events

Mathematical development

I. Use everyday words to describe position

Creative development

I. Recognise and explore how sounds can be changed, sing simple songs from memory, recognise repeated sounds and sound patterns and match movements to music
II. Respond in a variety of ways to what they see, hear, smell, touch and feel
III. Use their imagination in art and design, music, dance, imaginative role play and stories

Knowledge and understanding of the world

I. Use early control software to investigate direction and control

Physical development

I. Fine motor control can be developed with the increased refinement in using a mouse for navigation and selecting objects

Key Stage 2 (ages 7–11)

'At Key Stage 2 teachers specifically focused on communication skills and on the skills of planning and strategy as well as some value in estimating and budgeting. In the games evaluated at this key stage it was difficult to identify specific targets within the curriculum that the games directly served. However there was evidence from a number of evaluators that the games were seen as a valuable tool for skills development and collaborative working.' (p14)

Key Stages 3 and 4 (ages 11–14 and 14–16)

Communication:	communication with the game is important and the setting up of scenarios/the hiring and firing of staff/playing the markets – all generate discussion and debate among pupils.
Application of number:	budgeting is a critical part of the game; quite clearly it lends itself to the delivery of application of number.
Working with others:	as for communication.
Problem-solving:	this lies at the heart of the game as pupils make the appropriate decisions that will keep them in the game.
Financial capability:	as with application of number a sound understanding of numeracy is critical to success in the game.

Appendix F: 'Other considerations associated with using games in schools'

Sanford and Williamson, 2005

Age appropriateness	Games are now categorised and sold according to age ratings defined by the Pan-European Game Information (PEGI) group in Europe or by the Entertainment Software Rating Board (ESRB) in the US. These ratings also include a description of the content, and may help to illustrate the appropriateness of a title being considered for use in school.
Accessibility	Few games are designed for people with any sort of motor, visual, auditory or cognitive impairment, and specific titles or aids from specialist developers may need to be sought.
Equality of access	Inequality of access to computer games at home may negatively affect how easily or comfortably some young people adapt to the use of games in schools – as true of gifted and talented students who choose not or are forbidden to play games at home as of students from economically deprived households who cannot afford them.
Save and exit points	Many games require a large investment of time from players to pay rewards, and must provide appropriate, regular points for players to save their progress and exit the game if being used in short lesson-based blocks.
Teacher expertise	Some teachers report being wary of using computers generally in schools due to some students' superior expertise and teachers' perceived 'loss of authority' if unfamiliar with a program being used; teaching with games may require teachers to become very familiar with the titles intended for use in their classrooms.
Formative assessment	There are as yet no hard and fast rules for assessing what or how young people are learning from games, particularly for identifying progress and for setting further goals; this is an area for essential future investigation.
Technical infrastructure	There are many areas in which the technical demands of a game will limit its appropriateness for classroom use. For example, many schools don't have CD-Rom or DVD drives on individual machines, preferring to distribute software from a central server. Students are unlikely to have administrative rights on computers. Additionally, standard on-board graphics cards might be insufficiently powerful for recent games and students might not be able to use the same machine every time they play a particular title, meaning their saved games might be inaccessible.
Heath and Safety	Obesity, repetitive strain injury and aggressive behaviour have all been attributed to playing games. Games alone are unlikely to cause any of these, but care must be taken to ensure young people do not spend all of their time sedentarily performing repetitive tasks on a joypad, and to ensure that they do not associate aggressive behaviour in a game unproblematically (this is quoted directly from a published paper) with approval for behaving similarly in their real lives.
Cultural representation	Gender, nationality and racial difference are often misrepresented in games, where, for example, often females are 'sexy', often heroes are white, male and Western, and other racial groups represented by negative stereotypes.

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Hilary Ellis
Hilary Ellis is a freelance journalist whose articles about ICT in education have featured in a number of publications including the *Times Educational Supplement* and *The Guardian*. Hilary currently works as an Executive Producer at Illumina Digital, an integrated new media company, who produce accessible and media-rich educational and cultural projects for a wide range of clients including the BBC. Prior to joining Illumina Digital she worked for over 10 years in educational publishing and consulting. This included time at learn.co.uk, *The Guardian*'s education resources arm, where she wrote, commissioned and project managed content across a range of media for both learners and practitioners. She also developed CD-Rom games for Dorling Kindersley Interactive Learning and children's books and software for Usborne Publishing.

Her background is in psychology and she holds a degree from University College London. In her spare time Hilary is interested in the history of North Wales and has written two books: *North Wales Landscapes* and *Times Past North Wales*. She is also a fan of travelling and playing Guitar Hero and Katamari Damacy on the PlayStation.

Professor Stephen Heppell
Stephen, Founder of Ultralab, CEO of Heppell.net, spent around a quarter of a century building Ultralab which established an exceptional, unique, reputation as a world-leading learning technology research centre. He has been a professor for 18 years, including nowadays a number of visiting chairs too, but he now heads his own policy, research and practice consultancy Heppell.net, at the heart of a network of innovative collaborators worldwide. Stephen chairs or sits on a number of boards and committees, including Notschool.net, Teachers' TV; the Government's Building Schools for the Future working group and has a guiding role in the BBC's Digital Curriculum project, and UNESCO groups in Europe and SE Asia.

He is working on a variety of current major projects including building a Learning Metric to help governments measure what improves when they innovate in education, hosting the annual 'Be Very Afraid' DfES/BAFTA event showcasing children's digital ingenuity, and much more besides, across diverse sectors including health, cinema, sport, architecture, policy, finance and of course education.

John Kirriemuir
John Kirriemuir's research career began with nine years research for various digital library services and initiatives within UK academia. Following this, he became an independent researcher and consultant in the use of computer and video games in learning and teaching. In this role, he conducted analysis and consultancy work for education and ICT bodies in the UK and Europe, and was an invited speaker and presenter at many national and international conferences. He has advised education/IT bodies such as the JISC (www.jisc.ac.uk) and Becta (www.becta.org.uk) on the relevance of contemporary digital games to education, teaching and learning, and has advised a number of digital library organisations on the relevance of gaming technologies to their work.

John's core interest is the use of internet-based technologies to ultimately provide access to all information, for anyone, from any location. He lives on the island of Berneray (population

130) in the Outer Hebrides, off the west coast of Scotland. He spends much of his time teleworking, and experimenting with new information technologies, from some of Europe's remotest beaches (silversprite.wordpress.com).

Aleks Krotoski
Aleks Krotoski is a columnist for *The Guardian*'s Technology section and for *Guardian Unlimited*, where she writes about the social dimensions of computer game entertainment, emerging community experiences in virtual worlds and other aspects of social software. She writes about broader dimensions of social computing for MIT *Technology Review* and the BBC.

She is currently working towards a PhD in social psychology at the University of Surrey, examining the social networks of cyberspace. In particular, she is interested in understanding online social influence.

As a digital strategy consultant, Aleks has written industry reports covering demographics, age ratings and regulation; she's worked with broadcasting regulators on strategies for future communication protocols; she also regularly speaks about interpersonal processes in online communities with financial, telecommunications and governmental organisations.

Professor Angela McFarlane BSc PhD PGCE
Angela holds a chair in education in the Graduate School of Education at the University of Bristol where she is currently Head of Department, and she is a visiting Professor at the University of Oslo. She was a founder of the TEEM project on evaluation of digital content in the classroom, ran a software Research & Development unit at Homerton College, Cambridge and has experience of educational software development from concept to market. Angela has designed and directed national UK research and evaluation projects on ICT and Learning, and was part of the team that designed the longitudinal study of the impact of networked technologies on home and school learning – Impact2. She has also evaluated the £350 million Curriculum Online investment, and is currently working with Learning2Go, Europe's largest handheld learning project in Wolverhampton.

Angela was a member of the OECD expert group on quality in educational software and the first Evidence and Practice Director at Becta, the UK government agency for ICT. Angela, a widely published author and speaker, is a member of the boards of the government-funded Teachers' TV and the blue-sky Futurelab project as well as the Becta Board Education Committee. She has made keynote presentations at a range of international conferences including the UK, US, Chile and Norway.

Credits

Department for Education and Skills (DfES)
The use of video games beyond merely entertainment is attracting increasing attention globally.

So-called 'Serious Games' are predicted by many to tackle some of the learning obstacles for citizens yet to achieve competency in, for instance, literacy, numeracy and problem-solving.

In so doing Serious Games may offer a unique technology-based route for some learners. In 2005 the DfES commissioned a meta review of existing research (Kirriemuir 2005, 2005b) on the role of games in learning which confirmed that:

- games offer a context and a catalyst for improved communication and collaboration between learners and tutors
- games can extend existing learning opportunities as young people, in particular, enjoy learning more when they have a sense of their own progression
- games have a specific role in motivating disaffected, hard to reach or previously excluded learners.

This report from ELSPA offers a snapshot of what is already happening in the context of games in education and, importantly, offers an evidence base from which informed decisions can be made by practioners, policy makers, the games and education industries.

Entertainment and Leisure Software Publishers Association (ELSPA)
ELSPA is the collective identity of the UK interactive entertainment industry, protecting, promoting and providing both for its members and for the industry as a whole. Its activities include industry reports and research; official games charts and analysis; Volume Sales Awards; management and funding of the Anti-Piracy Unit; industry and media communications and government lobbying.

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