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games and learning

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a handbook from Futurelab 2005

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Games and learning

A handbook from Futurelab

By Richard Sandford and Ben Williamson

The Sims 2

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FOREWORD

One of Futurelab's primary aims is to better understand the role that digital technologies might play in education. In order to do this, we bring together expertise from practising educators, educational policymakers, children, and the creative and technological industries, as well as the academic research community, to develop and evaluate prototypes of the sorts of digital resources that might be seen in schools in the future. It is our findings from clusters of related projects, along with our intelligence about other related projects and initiatives that we report in these handbooks.

The main aims of these handbooks are:

- to provide useful and jargon-free insights into policy directions, research and projects developing in a particular area of education and technology

- to summarise the findings from the prototypes and processes Futurelab has developed in this area

- to provide useful pointers concerning the design and use of digital resources in this area.

While these handbooks are not intended as definitive statements, we hope you will find them a useful guide and introduction to areas of interest and emerging development. If you have any comments to make, or suggestions of other projects and research we should be aware of, please do let us know.

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01 introduction: why games and learning?

Current context Across the world, educators are increasingly becoming interested in the potential role of computer and video games to support young people's learning. In academic research circles video games are now a popular subject of study not only in computer science departments but in media, communication and cultural studies, literacy studies, and education departments too.

To date, the majority of the research on young people's use of computer games has focused on informal, out-of-school contexts – on what is being learned outside of the school gates. Studies in this area also tend to concentrate on mainstream computer and video games available from high street stores and their potential application to the field of learning, rather than on professional and vocational simulations or on specifically educational titles. In this handbook, too, we examine how the use of mainstream games outside of formal educational contexts can support learning processes.

Recent studies, however, have also begun to ask how games might be used or adapted for use in schools. This handbook reports on some of the latest developments in the design of bespoke educational games. Such games are designed to be as rich and dynamic as their mainstream 'cousins', but are intended for particular formal educational outcomes. It also asks whether and how schooling should be adapted to accommodate the use of games[1].

Defining games Defining a 'game' is complex and subject to multiple contesting theoretical and practical arguments. As long ago as 1971, EM Avedon and Brian Sutton Smith[2] pointed out that anybody who has ideas about games in part defines them, whether it be social scientists defining them through their psychological and social functions, anthropologists defining them according to their historical origins, or businessmen in terms of their usages. Currently, computer games researchers can still be found debating the definition of games; the entry of educators into the fray often complicates matters further.

For the sake of simplicity, this handbook uses the terms 'computer games' and 'video games' to designate digital applications that can be controlled by individuals or groups of players using a PC or a console such as a Playstation or Xbox machine. This is a basic definition, but other sources are available to guide anybody more interested in this area[3]. It does attempt more carefully, though, to define what it is about games that lend them credibility as tools and resources to support learning.

[1] References to research articles, books and relevant project websites are included in these footnotes throughout this handbook. However, a reading list is provided at the end of the handbook which will point the non-specialist reader towards the most accessible and easily-available texts in this area.

[2] Brian Sutton Smith and EM Avedon (1971). The Study of Games. New York: Wiley.

[3] Katie Salen and Eric Zimmerman's recent book Rules of Play (2005) goes a long way to unpacking this debate. See reading list.

01 introduction: why games and learning?

Defining games as learning resources

Recent interest in games and learning stems from some complex debates about the very role and practices of education in a new century, rather than just from a simple belief that young people find games motivating and fun and, therefore, that they should be exploited in educational contexts. These debates suggest, among other things, that computer games are designed 'to be learned' and therefore provide models of good learning practices, and that by playing games young people are developing practical competencies and social practices that are equipping them for 21st century workplaces, communication, and social lives.

This handbook is intended to report the main developments in this field, and to provide a number of practical examples of computer games being used in educational contexts. These vary from bespoke educational computer games, to the use of mainstream computer games in formal classrooms, to the actual creation of computer games by school children. It provides practical recommendations for teachers interested in this area to begin implementing games-based activities in their schools, and for games developers aiming to design the titles that will be instrumental in learners' education in future years.

This is not, of course, an area unfettered by controversy, and the handbook reports some of the arguments against games and the very real practical barriers to their implementation in educational contexts that need to be considered. Perhaps even more importantly, it must be stressed that Futurelab does not believe that all young people across the UK have equal access to or equal interest in computer and video games. Some of the informal activities reported in this handbook are, it must be acknowledged, far from mainstream. Rehearsing the arguments about how gender, race and socio-economic conditions affect young people's equality of access to games, though, would fill an entire book. The handbook signposts these issues, but focuses primarily on how games potentially offer fresh scope to learning processes now and in the future.

Civilisation III

02 learning from playing games outside school

Recent studies suggest that when young people are playing computer and video games they are engaged in learning activities that are more complex and challenging than most of their formal school tasks. This argument can be divided into three related strands: first, games as challenging learning environments; second, the sorts of things gamers may learn through game-play; and third, the social factors that contribute to learning through games. Briefly, before outlining these three areas, it should be noted that it is highly unlikely that many games exhibit or inculcate **all** of the characteristics of learning that are listed; nor do we suppose that games are good for learning everything or for every learner.

Civilisation III

Games as ideal learning environments

Setting aside, for a moment, the question of **what** gamers may be learning through gameplay, research into games and learning increasingly argues that the ways in which games are structured and the ways they require players to act, means that games function, by virtue of a number of common characteristics, as effective learning environments in themselves.

One characteristic of games that supports learning is that they challenge and support players to approach, explore and overcome increasingly complex problems and thereby learn better how to tackle those problems in similar contexts in future. In the early 1980s, Seymour Papert[4] described this kind of activity using computers as "hard fun", while Thomas Malone[5] saw early computer games players entering a "flow" state in which they were completely absorbed with gradually increasing levels of difficulty matched to their current level of skill and ability.

A second characteristic is that games offer the capacity for players to try out alternative courses of action in specific contexts and then experience consequences – in other words to understand how manipulating systems causes particular effects. This is as true when playing The Sims, by guiding a family through a domestic crisis or a mother through pregnancy, as it is when playing a motor racing game or a science fiction shooter. 'Interactivity' is here seen as the key word, where it is players themselves, rather than games designers, who are seen as controlling and determining the experience to explore a range of different outcomes.

[4] Papert, S (1980). Mindstorms: Children, Computers and Powerful Ideas. Basic Books.

[5] Malone, T (1980). What Makes Things Fun to Learn? A Study of Intrinsically Motivating Computer Games. Palo Alto: Xerox.

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Steven Johnson[6] agrees, arguing that playing a computer game differs from most other forms of games since players rarely have to sit down and read a manual before commencing play – they "literally learn by playing":

Non-gamers usually imagine that mastering a game is largely a matter of learning to push buttons faster, which no doubt accounts for all the 'hand-eye co-ordination' clichés. But for many popular games, the ultimate key to success lies in deciphering the rules, and not manipulating joysticks.
(Johnson 2005, pp42-43)

Learning by playing games according to this view is a process of constant practice and interaction in progressively more challenging tasks through which players gradually reveal underlying sets and systems of rules.

Additionally, from the perspective of the narrative and thematic aspects of games, players are often encouraged to identify with particular characters and their identities. By playing out the D-Day landings in Medal of Honor: Allied Assault, for instance, users experience the particular identity and potential courses of action available to a combat soldier on Omaha Beach. Not only are these interactions confined to performing particular sequences of actions; the games can immerse players in the discourses associated with particular contexts, so that identifying with the identity of an in-game character might involve understanding specific vocabulary items such as technical terms and reading items of data in distinct formats such as maps and graphs.

The manner in which each individual player experiences this identity, though, differs, meaning that players are often responsible for constructing identities, for hypothesising or conjecturing about the identity of the character they are controlling on a screen. Players also, at least in part, construct these identities, merging the possibilities of action in the game environment with their own desires as players.

From these perspectives, then, games are seen to offer increasing levels of challenge, the gradual revelation by the learner of systems and rules governing individual interactions, and the experience of exploring and developing different identities and the tools and practices that support these. It is for these reasons that games are often held up as examples of powerful learning environments.

[6] Johnson, S (2005). Everything Bad is Good for You: How Popular Culture is Making us Smarter. London: Allen Lane/Penguin. See reading list.

02 learning from playing games outside school

The Sims 2

What is learned from playing games?

What has become clear as games have been theorised as ideal systems of learning is that we need to ask more explicitly what it is that players may be learning. While games may offer powerful processes for learning, we still need to ask what sorts of products in the form of knowledges and skills emerge through gameplay? Responses to this question generally tend to argue that the sort of knowledge learnt through playing games is very different from what we aim to teach in school today.

Catherine Beavis[7], however, has argued that computer games represent new cultural forms with which young people are increasingly familiar and fluent, and suggests that educational systems should not remain fixated on transferring to the young the traditional elitist vision of culture and society that they have sustained for decades. Young people, she maintains, are learning skills and practices more suited to the 21st century than anything schools prepare them for.

James Paul Gee[8], for example, has identified games as "multimodal texts" whose features include the constant interplay of visual, aural, textual, gestural and bodily modes. The argument runs that none of these modes taken singly provides much meaning for players; it is only when taken together as a multimodal whole that they make sense as a game.

These 'texts', then, require players to develop entirely new literacy practices. Unlike reading a book, playing a game demands interpretive competence with images, sounds and actions as well as written words. Successfully playing a game depends on the player's ability to recognise the game's multimodal features, what Gee describes as its "internal design grammar", and therefore to learn its underlying grammar and how it communicates meaning. He sees this occurring through a four-part process where players probe the virtual world of the game, form hypotheses about it, re-probe it with those hypotheses in mind, and then, based on feedback from that virtual world, accept or re-think those hypotheses. This process, Gee argues, is the basic procedure of the scientific method.

Some of these arguments might be accused of providing a sound basis for explaining how people learn about games themselves but not for how games might support them to learn anything else. Gee, who does not necessarily countenance the use of computer games in educational settings, suggests that really good teaching in any educational domain should be about enabling young people to 'play the game', in other words 'playing the game' of scientist, of mathematician, of writer, geographer, historian, and so on. He argues that it is pedagogy that needs to adapt to the practices that young people are bringing with them into the classroom from their use of computer games – that, as in games, lessons need to support learners to probe the rules of a system, hypothesise about it, re-probe it, and review their hypotheses. Good educational practices, he says, already do this.

[7] Beavis, C (2002). 'Reading, writing and role-playing computer games', in I Snyder (ed) Silicon Literacies; Communication, Innovation and Education in the Electronic Era. London: Routledge.

[8] Gee, JP (2003). What Videogames Have to Teach us About Learning and Literacy. London: Palgrave Macmillan. See reading list.

02 learning from playing games outside school

Others[9] working from a learning theory perspective have suggested that playing games brings young people into contact with the kinds of complexities that 21st century workplaces will require them to be able to negotiate. The range of information sources that players must negotiate during the course of just a few moments' play can, to the non-gamer, appear overwhelming. Alongside a 3D view of the virtual world being explored, players might need to monitor health statistics for multiple characters, 2D terrain maps, ammunition supplies, and so on. Strategy games such as football management titles require players to oversee and control vast quantities of statistical information that are always changing according to decisions made by the player and the complex algorithms of the program itself.

It is of course possible that these large and indeterminate amounts of data are not always fully understood. JJ Eilola[10] has said that:

To cope with environments such as these offered by [...] games, users learn to juggle multiple, dynamic vectors of information without attempting to understand them fully. Instead, they play out multiple hypotheses about connections among numerous symbolic forces. (Eilola 1998, pp194-95)

Nevertheless, it is clear that young people playing games are learning how to deal efficiently with dynamic information sources in multiple modes and media. Simon Egenfeldt-Nielsen[11] adds that what games provide are superficial information – not enough to satisfy young people's educational needs, but enough for them to get a grasp on it – and that in more overtly educational settings the role of teachers, peers and other supporting materials will be necessary to build on these superficial understandings.

Social aspects of games that support learning

The third important aspect of learning with games outside of school is in the social and collaborative practices which emerge around them. An American study of teenagers' use of video games arcades in the early 1980s by Patricia Marks Greenfield[12] identified that these were used by many as social meeting places, regardless of whether they were joining in with playing the arcade games or not.

In the current period, then, how do the social relations fostered between players assist in the learning process? Perhaps the most widespread instance of this is the role that computer games play in young people's everyday friendship cultures and conversations. Some studies[13] have reported how young people regularly visit each others' homes to play games together, and how inexperienced players are introduced to game-play strategies by more experienced friends. Within these friendship groups, support materials such as games magazines, books of hints and tips, and walkthrough guides are often shared.

9 See, for example:
Facer, K, Furlong, J, Furlong, R, and Sutherland, R (2003). ScreenPlay: Children and Computing in the Home. London: RoutledgeFalmer
Prensky, M (2001). Digital Game-Based Learning. New York: McGraw-Hill (See reading list)
Burn, A and Leach, J (2004). 'ICT and moving image literacy in English', in R Andrews (ed) The Impact of ICT on Literacy Education. London: RoutledgeFalmer.

10 Eilola, JJ (1998). 'Living on the surface: learning in the age of global networks', in I Snyder (ed) Page to Screen: Taking Literacy into the Electronic Age. London: Routledge.

11 Egenfeldt-Nielsen, S (2005). Beyond Edutainment. See reading list.

12 Greenfield, PM (1984). Mind and Media: The Effects of Television, Computers and Video Games. Fontana Paperbacks.

13 See, for example:
Facer et al, op cit (see note 9 above).
Williamson, B and Facer, K (2004). '"More than just a game": the implications for schools of children's computer games culture'. Education, Communication & Information, 4(2/3), 253-268.

02 learning from playing games outside school

Other studies[14] report how the internet is also now allowing young people to find groups with affiliated interests despite geographical and cultural separation, and to join informal 'exchange networks' in which material resources and immaterial advice are always circulating amongst members. Drawing from the work of Jean Lave and Etienne Wenger on the idea of "communities of practice"[15], James Paul Gee describes these as "affinity groups" whose members are responsible for jointly negotiating games titles.

The most extreme example of this to date is the website apolyton.net, an 'online university' set up by fans of Civilization III which offers advice, mentoring, and even modules of study to assist players who wish to play the game more successfully. Many other websites are dedicated to other titles, with hugely popular discussion forums allowing players to discuss games, make queries, and share advice. In other words, it is the members of the affinity group who are responsible for designing and agreeing the practices associated with playing particular titles, and for developing consensus on the rules of play depending on changing social circumstances and contexts. No single title, then, can necessarily be seen as static, since it is players' interactions with them and their social negotiation of them that assigns meaning to them.

The recent successes of Massively Multiplayer Online Games (MMOGs) such as Everquest, Lineage and World of Warcraft makes this and associated arguments about the potential learning merits of games more apparent. These 'persistent worlds' available on the internet can accommodate thousands of players simultaneously, support text-based chat, and are open-ended. They have been described as "the learning environments of the future"[16].

In these environments, players take on specific roles by choosing avatars (virtual characters) with particular skills such as medics, magicians and warriors. Nominally, success in the game is determined by individual players gradually increasing their skill set and gaining level points. However, what makes these enormous games so unique is the in-game communication they facilitate. Players are able to carry on informal conversations, join 'clans' or 'guilds', discuss strategies, and form groupings with the variety of skill sets that all need to be mobilised to overcome particular challenges.

Notably, what these games offer players are "apprenticeship into doing"[17]. More experienced or 'expert' players are often seen mentoring or tutoring less experienced 'apprentice' players, lending them objects or skills, showing them around environments, and generally introducing them into what they have to do, how they should behave, and what discourse standards they should employ. The designers of these games, it might be said, simply provide the tools that make it possible for players to design the experiences of the games themselves. To outsiders, for instance, the language employed in these games can appear incomprehensible because it mobilises distinct lexical and grammatical items that are contextualised within the game world.

14 See, for example:
Beavis, C (2004). '"Good game": text and community in multiplayer games', in I Snyder and C Beavis (eds) Doing Literacy Online: Teaching, Learning and Playing in an Electronic World. Cresskill, NJ: Hampton Press
Tobin, J (1998). 'An America "otaku" (or a boy's virtual life on the net)', in J Sefton-Green (ed) Digital Diversions: Youth Culture in the Age of Multi-media. London: University College London Press..

15 Lave, J and Wenger, E (1991). Situated Learning: Legitimate Peripheral Participation. Cambridge: Cambridge University Press.

16 Steinkuehler, CA (2003). Massively multiplayer online videogames as a constellation of literacy practices. Paper presented at the International Conference on Literacy, Ghent, Belgium.

17 Steinkuehler, CA (2004). The literacy practices of massively multiplayer online gaming. Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, USA.

02 learning from playing games outside school

What might now be argued in summary about the relationship between games and learning in out-of-school contexts is that we have thousands of young people across the world engaged in complex multimodal information-handling tasks that are at the edge of their competencies; that they are exploring and hypothesising about systems and rules and receiving feedback on how well they are manipulating those; that they are mobilising distinct literacy skills in particular social contexts; that they are using the internet to support each other informally, despite potential geographical and generational dispersal; and that they are mobilising practices and skills suited to the workplaces of the 21st century.

Problems and criticisms Many of the statements provided in support of games are contested, and it must be acknowledged that much of the recent theorisation around games and learning is based on only small-scale studies, personal reflections, or even conjecture. Many studies read computer games as texts and presuppose that players read them in much the same way. And it should also be noted that a great many computer games are simply banal, or overly complicated, or barely playable.

More important, however, are the genuine concerns of some parties that computer games are responsible for eroding young people's social lives, or that they are even dangerous.

There is a terrible contradiction in the UK at present that while young people's activities in public spaces are being policed with ever-more feverishness, their use of television, computers and games at home is also being criticised. On the one hand are safety-related fears over allowing them to play outside and a widespread conception that groups of young people are always 'up to no good'; on the other, fears that playing on computers leads to obesity, aggressive behaviour, or grooming by predatory adults. These fears do, in the most part, need to be taken into account.

Obesity is on the increase amongst the young, and it is clear that there is a need to engage them in healthy physical exercise away from computer games and television[18].

The Sims 2

Similarly, concerns over children developing repetitive strain injury from playing games should be noted, although the evidence to support this claim is very difficult to find. The aggressive behaviour debate also continues. Some research is now beginning to use sophisticated analytical techniques to ascertain whether particular types of players may be more susceptible to aggressive arousal from playing games leading to actual aggression than others[19], instead of totalising all players as violent games-crazed public threats. And furthermore, of course, all young people need a balance between actual experiences and encounters in their social and cultural worlds and in the virtual worlds of their computer games.

The negative aspect of games that receives less mention in the media but prickles the attention of many academics is their tendency towards misrepresentation. Representations of female characters in games still err on the overtly 'sexy' side; the majority of protagonists still tend to be represented as male, white and Western; and enemies, particularly in war games, are still Japanese, German, Vietnamese or Middle Eastern. Indeed, it might be argued that most games persist in representing the ideology of male-led, white Western capitalism that should have had its day back in the last century[20].

18 Anecdotally, some computer games developers have recently begun marketing games for electronic dance-mats where the challenge is to dance increasingly complex, exhausting steps – one such game, Sonica, helps to learn Spanish along the way: www.rm.com/Primary/Products/Product.asp?cref=PD326564&position=1

19 Bolton, A (2005). Styles of playing violent games. Paper presented at DIGRA 2005 conference, Vancouver, Canada.

20 For a discussion on gender and games see, for example: Cassell, J and Jenkins, H (1998). From Barbie to Mortal Kombat: Gender and Computer Games. Boston: MIT Press.

03 using games inside school

The news that commercial entertainment games support learning out of school is steadily leading to an interest in using such games within more formal educational settings. Teachers and researchers have begun using games within lessons and developing schemes of work as resources to support the other activities undertaken in the classroom, though this is, as yet, an under-explored area.

Many of the gains in learning that games are alleged to promote in school can be matched to the characteristics of learning from them in out-of-school use, as illustrated in the table on the centre pages of this handbook. Using games in schools also comes with its own particular opportunities and problems.

This section briefly outlines a number of existing approaches to the use of games in schools, then identifies a number of characteristics (both positive and negative) associated with the use of games in school, before describing three illustrative case studies.

Existing approaches to the use of games in school

There are different approaches to using commercial games in formal settings. At the simplest level, a game might be used in a motivational capacity as a reward for good behaviour or excellent performance. After-school initiatives are also flourishing, such as the 'e-games league' in Nottingham[21], which seek to encourage disenfranchised youngsters back into school by acknowledging their interests and abilities as expert gamers. There are also anecdotal stories of teachers who have re-engaged disruptive students by allowing them to 'tutor' their peers in games titles[22].

In other more formal educational approaches, games have been used as a starting point for discussion based on a teacher demonstration, perhaps asking why the developers chose to portray certain elements in the way that they did, or examining the content of a game to see if it matches with what the class have learnt in other lessons (how historically accurate is Sid Meier's Pirates!, for example?). Games that are based on movies or feature similar scenarios to books might also be used in classrooms to support media studies work, with students analysing the different structural 'grammars' of games, books and films. Students might also investigate how particular games such as the Grand Theft Auto series have been demonised in the media.

The use of games within wider sets of activities is perhaps the most prevalent model in use today. In the US, the urban management game SimCity has been used as the basis for a national FutureCity competition[23]. The initiative aims to enable young people to develop skills and understandings related to engineering and mathematics. Students manage a city in the game, create physical models, produce graphical representations of maths and physics concepts, and write essays supporting their vision of the city of the future. This approach, then, centres around a game, but embeds it in a much wider selection of educational activities that support the development of team working, communication and presentation skills, as well as maths and science applications and computer skills.

There are many other examples of games used in schools, from electronic dance mats to support PE lessons, to the use of School Tycoon as a stimulus to develop students' numeracy and fiscal skills. Few if any of these approaches, however, have attempted to incorporate purely entertainment-based titles into the classroom as resources for young people to play rather than study.

What, then, might be the characteristics that would lead us to consider an entertainment-based computer game as potentially enabling play as a learning activity in and of itself in a school classroom? The following provides a brief summary, with further considerations discussed in the table that forms the centre pages of the handbook.

21 Nottingham e-games league website: www.nottinghamschools.co.uk/eduweb/sites/egames-template.aspx

22 One such example was reported in: McFarlane, A (2002). Listening to children, parents, teachers. Paper presented at Game On: The Conference, Edinburgh, UK. Proceedings available at: www.ltscotland.org.uk/Images/gameonproceedings tcm4-122140.pdf

23 www.futurecity.org

Civilisation III

Characteristics for selecting games for play in school[24]

Authentic challenges As with games played out of school, games played in school need to be sufficiently challenging to stretch students' abilities. Unlike games played outside school, games played in school are more likely to need to be rooted in some firm reality, or present strong internal consistency and logic such that actions are connected with logical outcomes. Much has been made of the potential educational use of SimCity, yet no one would propose it was a wholly accurate representation of urban planning and governance. Its system and rules, however, are consistent. Players can try out alternative courses of action and experience the effects of the decisions they have made, often encountering technical language used contextually, and receiving immediate feedback on how they are progressing – are they raising the employment and economic profile of their city and the health and well-being of its population, for example, or are they sending it hurtling towards anarchy?

Experiencing alternatives and consequences
Another use of games in classrooms is to have students play politically or historically based strategy games, such as Rise of Nations or the Civilization series. These games can support learners to explore how particular actions in the past could have changed world history. For example, what would have happened if indigenous South Americans had been able to defend their territory against the Spanish Empire?

This approach does not necessarily support the teaching of political and historical facts, but arguably engages learners by allowing them to explore, manipulate and discuss the underlying factors and variables that have contributed to historical processes, and to try out alternatives.

Cultural appropriateness Using a computer game in a school context is, of course, fraught with all sorts of culturally-specific implications. Should a World War II game be used in a history class if members of that class are of Japanese or German origin? To what extent is it appropriate to use a game that features a high degree of violence? What sorts of games will engage both boys and girls? For the most part, these questions can only be answered by teachers 'on the ground' based on their understanding of their students' sensitivities, dispositions, and according to the aims of their intended scheme of work. Having a Japanese or German student in the room while playing a WWII shooter produced in the US may prove to be an excellent learning experience if the teacher wishes to focus students on that game's ethical and cultural values, its biases and its exploitation of stereotypes.

Assessment The place of assessment in the use of computer games in schools remains, as yet, under-explored. Feedback such as scoring systems can, to a certain extent, provide some indication of progress in a game, although the application to learning is unclear. For instance, is the success of a player as embodied in the game an indication that something has been learned? Can that be transferred outside of the game at all? Much more important questions are at stake if games are to become integral to schooling, particularly around the formative assessment of players' current progress and the possibility of setting goals for further progress.

[24] These characteristics have been identified by researchers at Futurelab through a range of different ongoing projects. They are presented as a stimulus for debate rather than a definitive statement.

Racing Academy trials

Reflection Players' ability to reflect on what they have achieved through gaming also need further investigation. Much learning theory holds that students should perform an activity, then abstract from it to explain what it is they have learned. Playing a game does not support this process. Should it? Should players have to have developed quite specific ideas about what they have learned from a part of a game before they are allowed to progress further? Or do games support quite different forms of knowledge and skills acquisition? Is learning through games a holistic rather than serial experience? The goals of the individual teacher and school will dictate the extent to which these questions of assessment inform the selection of a game.

Teacher's role When using traditional computer-based learning tools, the teacher's role is recognised to be paramount in securing a successful learning experience. The outcomes of any lesson-based computer activity will depend on the introduction of the task, the interventions made during the activity and the way that the activity is set in the context of students' wider educational experience. There is every reason to expect this role to be even more central to the successful use of commercially-developed computer games. In two examples of the use of mainstream games in classrooms reported below, teachers to some extent underestimated the depth of knowledge required about the game to fulfil this central role adequately. It is clear that teachers need a detailed and thorough understanding of the game, both in order to identify learning opportunities and to develop students' understanding of the game sufficiently for them to be able to learn by using it. The time teachers have to become familiar with the game therefore provides one important criteria to consider in selecting games for use in schools.

A few words of caution Formal educational environments are very different to the informal contexts in which games are usually played, and bring with them many constraints that make introducing games as learning tools more of a challenge than might be thought.

A point to consider is that there is little point in introducing a commercial game as a learning tool where other established tools can perform the same task adequately. It might, for example, be worth thinking whether a spreadsheet might fulfil the same role as some resource management games such as Championship Manager. Similarly, a computer game does not necessarily have to be the latest, cutting edge edition. It's not competing against other games but against a whiteboard. In a formal environment games look very different from in the living room.

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The following examples of recent use of computer games in formal classroom settings highlight some of the opportunities and difficulties specific to this use.

Civilization III: re-playing history? Civilization III (2001) is a turn-based strategy game and world history simulation. The player is ruler of a stone-age tribe and has to guide their progress from building their first cities to the space age through managing the use of trade, technology, diplomacy and combat. In his PhD fieldwork, Kurt Squire[25] introduced the game into a US high school as the basis for a unit on world history in urban learning environments.

The study found that students who played the game responded to it very differently, although most began to develop approaches that moved away from simple 'one cause = one effect' understandings. Instead, the students developed complex strategies that tended to follow a pattern of problem identification, causal interpretations, brainstorming solutions, implementing these solutions, examining results, and repeating their interventions. As they interacted with the rules of the game, then, students developed alternative approaches to the system as a whole.

In terms of learning specific concepts, the study reports that students did not necessarily develop or increase their knowledge of, for example, the socio-political roles of monarchy, despotism or government. They did, however, observe, experience and begin to explain in broad conceptual terms the effects of these institutions on their civilisations. There was a clear need for students' understandings to be supported towards deeper intellectual engagement with these concepts.

Squire's study concludes that there are not strict outcomes related to the use of games in educational contexts, but that the diversity of responses from students can lead to instances of shared intellectual thinking:

The most important point in understanding how games engage players in educational environments may be that good games engage players in multiple ways and the interplay between these different forms create dynamic learning opportunities. Different play styles and tastes enriched classroom conversations, often leading to discussions that produce important 'taken-as-shared' meanings. [...] Discussions between different player types drove them to articulate and defend different strategies, even rethinking their orientation to the game as when Marvin, a builder/explorer, implored Joey to rethink waging war. (Squire 2004, p241)

Europa Universalis II: concrete experience Europa Universalis II (2001) is a real-time strategy game set in Europe between 1419 and the Napoleonic era. Players control the direction of a European state as it struggles to survive the Hundred Years' War, resist the efforts of Spain to colonise the world and last through to the rise of Napoleon. In Simon Egenfeldt-Nielsen's PhD study[26], 72 Danish high school students played the game to support a history course.

Like Squire, Egenfeldt-Nielsen reports problems with developing students' understanding of history. Their lack of prior appreciation of historical events, for example, proved problematic for some students, who were unable to make links between elements in the game and history, or who were insufficiently literate with the game itself to recognise these elements were present.

25 Squire, K (2004). Replaying History: Learning World History Through Playing Civilization III. Unpublished doctoral dissertation, University of Indiana. Url: website.education.wisc.edu/kdsquire/REPLAYING HISTORY.doc (retrieved 08/09/05).

26 Egenfeldt-Nielsen, S (2005). Beyond Edutainment: Exploring the Educational Potential of Computer Games. Unpublished doctoral dissertation, IT-University of Copenhagen.

The following table sets out the key features of learning with games in informal contexts and describes how these might be interpreted in schools.

On the back of this centrefold, some key issues about games in school contexts have been summarised, particularly those which may have an impact on how and why particular titles are chosen for use in school.

These characteristics are by no means definitive or final. We certainly acknowledge that it is highly unlikely that any single title could ever exhibit all of the positive characteristics we have attributed to games here. If you have anything you wish to add, please do get in touch with us.

learning with computer games in and out of school

Characteristics	Outside school
Challenging & adaptable	Games tend to be at their most enjoyable when they are difficult but 'just do-able', rather than when they are too easy; they make demands that are at the edge of players' competence.
Absorbing & immersive	Playing a good game can immerse players in a state of 'flow', the condition in which they are completely absorbed in an activity that closely matches and stretches their abilities.
Non-didactic & practice-based	Games do not have to be explained and players do not have to read manuals or practise activities before beginning to play; the rules are learned through practising 'in the game'.
Authentic & experiential	Tasks have immediate application; challenges must be overcome 'just in time' and are consistent with the experiences within the context of the game environment.
Interacting with rules, alternatives & consequences	By interacting with the game system and its rules, players experience what it is like to exercise alternative forms of control and authority, and to experience the consequences of particular courses of action.
Feedback & 'assessment'	Games provide immediate feedback on players' performance, offering scores, visual and audio cues, and notification when individual goals have been accomplished.
Social & collaborative	Games are central to friendship cultures, where peers exchange their views and knowledge about games; these exchanges also occur over the internet amongst geographically and generationally dispersed groups.
Material exchange	Verbal advice and material resources such as magazines and demo discs are a currency of exchange amongst game players; players are often not just playing a game, but gathering data and information and forming knowledge about it.
Expertise & apprenticeship	Some players are expert at particular games, while others are new to them; expert players can take on new players as apprentices, guiding them through titles by playing together, tutoring them online and sharing other materials with them.
Identities	Players experience what it is like to inhabit particular alternative identities, such as military medics, warrior trolls, city planners, sportspeople or pregnant mothers; they experience and practice the actions peculiar to each.
Literacies	Games situate players in particular literacy practices associated with the identities being played, immersing them in peculiar vocabularies and social customs; often these literacy practices are associated with real-world professional domains, or are consistent within the fantasy.
New media literacy	Games prepare players to deal with complex electronic environments, to negotiate and handle data in multiple formats simultaneously, to interact with images, sounds and actions, and to interact with others through electronic channels.
Reflective practice	Players are often involved in reviewing and rethinking their performance in games, reconsidering the strategies they have employed to overcome challenges and thus reflecting on how well they are able to manipulate and exploit the system and rules of the game being played.

In school

Games to be used in school should provide progressively complex challenges which are clear and finite and can be repeated; players should be able to adapt the level of difficulty (from novice to expert) if necessary.

Players need to be absorbed in meaningful activities whose aims and goals they clearly understand and the accomplishment of which stretches their current competence.

Using a game in the classroom should not necessarily need players to be 'trained' beforehand; players should be allowed to practice playing, often by failing and revising and re-trying tactics, but may need support from staff or peers.

Tasks should be related closely to real-world practices and concrete experiences or be consistent with the fantasy, and not staged as practice for some later test or exam, or, worse still, as reward for completing a 'learning activity'.

The game demands that players interact with the rule system, by taking responsibility for actions in alternative contexts, and by seeing their impact on the outcomes of the game as a whole.

Players should be able to infer from the feedback supplied how their actions have caused particular effects, and whether these effects are the ones that were desired; scoring systems provide immediate and constant 'assessment' of progress and accomplishment, although cannot as yet provide any improvement or further progress.

Games to be used in classrooms should promote dialogue and the exchange of knowledge and opinions; they don't need to be multiplayer titles, but should have some cultural relevance to the participating players.

Playing a game should be supported by the availability of additional resources such as walkthrough guides and hints and tips on the internet in order to promote wider understanding and knowledge about it.

It should not be assumed that all players in a classroom have the same expertise; some may be recruited to 'tutor' others how to play, including pointing them towards relevant resources or sources of information.

Games in the classroom should allow players to take on new identities and to experience these identities' demands and challenges, and to consider their potential courses of action; players may begin to understand alternative perspectives in particular social and political contexts.

The literacy demands in games vary from the fantastical to the professional and are often as complex as the literacies of subject domains as diverse as science, literature and history; in-game literacy demands may extend and stretch players' linguistic repertoire in particular contexts.

Playing games in classrooms can prepare players for 21st century working and learning practices, by dealing with diverse media and complex data, multi-tasking, communicating and working with others, making decisions, analysing pictures, audio and actions as well as written words, and to engage in ongoing development through 'on the job' practice.

Space for reflection is rarely present in games; players in classrooms should be provided space to review their performance and what they have learned by playing, eg to ask why particular courses of action always fail or how it is they have learned to overcome particular problems.

other considerations associated with using games in schools

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 & 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 nervous 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.
Health & 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 their time sedentary performing repetitive tasks on a joypad, and to ensure that they do not associate aggressive behaviour in a game unproblematically 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 .

Case Studies

Racing Academy trials

He concludes, however, that using the computer game provided most participants with a rich concrete experience on which they could build understandings. The game became part of an entire resource pool including other media, peers and teachers, as well as other instructional and social activities. The study supported the idea that relevant and engaging games can invite investment from players, but not necessarily from students; in other words the participants in the study enjoyed playing the game, but did not make the links with education, between play and study. Egenfeldt-Nielsen therefore concludes by stating that games used in classrooms need to be framed by specific educational goals and directions for exploration, and that educators must not presume that curricular learning opportunities reside within the games in isolation.

The findings from these two studies also seem to reflect some common difficulties. Notably, in both instances, the teachers were found to underestimate the depth of game knowledge required of them and their class. It was also found that the complexity of the two games required that students became familiar with the game interface. A period of learning **about** the game was required before learning **through** the game could become possible, and encouraging this familiarity required work from the teachers too.

As with any game-based educational tasks, there were difficulties with assessment. How, for instance, do you know whether any observed improvement is due to the game? How do you reward playing a game? Though there are no conclusive answers to these questions, it is possible to conjecture that assessment in games could be based on comparing evaluations of students' progress within the whole class, or by relating their game achievements to existing forms of assessment. In the example provided below of Myst being used in a primary school, the teacher referred to SAT results.

Computer games such as Civilization III and Europa Universalis II do not necessarily fit into any single specific curriculum, either. Indeed, what many critics have identified as being powerful about computer games are the sorts of skills and capacities they mobilise in players that are not normally mobilised by schools. Although, then, the two examples above both have a basis in history, they do not necessarily support learning about history in the same way that more conventional activities might.

Perhaps more surprisingly, these two studies reveal some counter-intuitive student engagement patterns. For example, 'clever' pupils were reportedly annoyed that their skills were ignored. Knowing that they could excel in the more conventionally scholarly activities of text analysis and composing essays, they were less confident using the games. Additionally, student buy-in was revealed not to be a given; many students needed convincing of the value of playing in lessons, having inherited some wider social assumptions about games. On the other hand, in both studies the researchers reported success with traditionally disengaged groups of students.

Case Studies

Myst

Myst: literacy learning through games The Myst series of PC-based fantasy games is one of the most successful in the history of the industry. In the game narrative, the world of Myst is contained within a mysterious book, while travel between the worlds contained within is through special 'linking books' – the power of literacy is central to the game, lending it special relevance for classroom use.

Tim Rylands[27], Becta ICT in Practice awardee 2005, uses the Myst titles in his Year 4 literacy classes to develop his students' expressive and creative use of language. Sitting in the centre of the class, facing the whiteboard on which the game is projected, Tim takes his class 'for a walk' through the detailed first-person landscapes of the game, narrating as he goes or sharing the task with a member of the class. Every student has a journal in which they record their impressions and reactions to the scenes in front of them, other children's turns of phrase or good examples of writing from the game itself. These recorded snippets of language inform their own written and spoken language abilities. The class also reads sections of Tolkein's The Hobbit, and compares the visual and written accounts of the two fantastical imaginary worlds.

Using these techniques, Tim Rylands has seen a significant improvement in literacy and communication amongst his students, particularly amongst boys in his class.

Principally this use of a computer game is as inspiration for creative activities. Rylands' approach is not to immerse children in the complexities of digital worlds, but to use these environments to inspire and engage learners. Much of its effectiveness, it should be acknowledged, comes from the work put in by Tim Rylands himself, both in preparing associated activities – designing maps of the areas explored, or writing a manual for looking after the plants encountered in the game environment – and during the class, when he spends much of the time working hard to elicit sophisticated responses from his class. For this particular approach to succeed, teachers would be required to work as hard as or harder than they do currently when preparing and giving a lesson.

Myst

[27] Tim Rylands maintains a useful website outlining his approach to using games in his primary school classroom: www.timrylands.com.

04 games designed for learning

The research into how games can support learning both in and out of school has led to a recent interest in developing bespoke educational games. Of course, many websites already offer digital games designed to support a specific curricular agenda. The recent interest differs in that it proposes to develop games that have the same quality, level of playability, and immersiveness of the bestselling mainstream games. Given that most commercially available games these days cost upwards of £1 million to produce, this is an ambitious undertaking. However, a number of prototypes are emerging that provide a rationale for such developments, and which are beginning to demonstrate what might be possible to achieve in this arena.

What these developments are consciously seeking to avoid are the pitfalls of earlier learning games, such as those which only offer a period of play once a multiple choice question, a mathematical equation, or a spelling test have been completed successfully. Such games imply that they are only 'for fun' and that their role is simply as a reward for the hard 'educational' work previously completed. Current developments seek to blend hard educational work into the act of playing a game.

Like mainstream games, these bespoke titles are designed 'to be learned', the principal difference being that they are designed as systems whose rules and content are based on educational principles. Sometimes these principles take the form of specific curriculum-related content, such as periods in history or engineering challenges. Other times, however, these games are intended to develop young people's competency in skills that are at present not recognised by the curriculum.

The other notable difference with some of these games is that they are designed for learning not simply in lesson-sized 'chunks' but as experiences that need to take place across an entire afternoon, a day, or even weeks. For example, Homicide, developed by the Learning Lab in Denmark, teaches science, communication and organisational skills to students who take on roles as crime scene detectives. Computers provide clues, data analysis tools, evidence, video footage and scientific data such as fingerprint and DNA analyses, and students in the classroom carry out their investigation with their teacher operating as 'chief of police'[28]. Homicide is designed to take place over many days, during which the students' usual timetable is abandoned.

[28] Homicide: www.futurelab.org.uk/showcase/homicide/homicide.htm

Case Studies

Racing Academy

This section identifies how many of the considerations described above have been incorporated into the design of two prototype games developed in collaboration with Futurelab. These games are attempts to merge compelling and challenging gameplay with specific educational outcomes.

Racing Academy: authentic tasks and expert-apprentice networks Racing Academy is a prototype for an online motor engineering and driving game in which players are expected to have to deal with increasingly complex engineering principles, including those based in maths, physics and design technology, in order to construct and race motor vehicles against each other. The underlying vehicle and travel surface physics are highly accurate, meaning that the vehicles in the game behave almost exactly like their real equivalents; making an adjustment to a car in Racing Academy has a very accurate effect.

It is an attempt to accomplish three distinct video game-related aims. First, to tap into the potential motivational value of motor racing games in order to engage teenagers. Second, to investigate the potential of a motor racing game to support young people to learn about engineering, including maths and physics, through 'authentic practice', ie in a context with real-world application. And third, to explore the potential benefits to learners of having access to text-based 'chat' facilities, as in MMOGs, that might allow them to support and challenge each other.

In order to complete the Racing Academy prototype successfully, players have to beat a computer competitor by racing as fast as possible down a quarter-mile drag strip over three levels of increasing difficulty. In the first level, players have to select the most suitable engine for their vehicle from six available. Statistical and graphical

Racing Academy

information indicating the available power of each engine is provided. In level two they can select from four different sets of tyres, choosing on the basis, again, of a set of statistical and graphical data. To complete the third level, players have to adjust the gear ratios of their car by manipulating slider-scale settings.

Setting up a car in Racing Academy is not, then, simply a case of choosing components from a hierarchical list on which it is clear which ones are the 'best' – as it would be in most commercial car racing games. Instead, it is designed to direct players into an analysis of complex mathematical and graphical data, mastery over which allows players to set up vehicles that are sufficiently fast to beat the computer opponent.

This sets it apart from other educational games titles in which gameplay comes as a reward for completing other decontextualised tasks such as multiple choice questions. It is in this sense that Racing Academy might be said to support authentic tasks. The engineering tasks themselves are part of the game, as it is the manipulation of the vehicle settings that is as important as actually racing the vehicle. Players are therefore engaged in tasks rooted in specific contexts that are meaningful in the sense that they are an intrinsic part of the game as well as related, in an accurate way, to real-world practices outside of the game. One participant in a trial of the game reported that he enjoyed it because, unlike most racing games, "it made me think". It is envisaged that players in a full version of Racing Academy should learn how to handle the same sorts of data that motor vehicle engineers must master.

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For the prototype, an online messageboard environment was developed which allowed players to communicate with each other through typed messages during the game. Players during the trial worked together in teams of five, with team scores, rather than individual scores alone, privileged. This team-based scoring system was intended to promote a spirit of cooperation, and especially to promote the idea that players able to succeed more easily in the game should assist anybody less able to do so.

Some players quickly proved themselves to be more adept in the Racing Academy game than others. While choosing an engine in level one that could be used to beat the computer opponent was not especially difficult for any of the students, setting the gear ratios in level three proved an especially challenging task. While playing this level in particular, there were a number of notable instances during which some students adopted the role of the 'expert', tutoring more 'novice' or 'apprentice' players by sharing with them advice and ideas to improve their chances of success in the game.

The potential benefits to learners playing online games such as Racing Academy are in the social dynamics they promote, and in how the negotiation of complex data in meaningful contexts becomes an integral part of the experience of playing them. Racing Academy illustrates that it is possible to map specific information for young people to learn onto the functionality of a game, and still maintain some of what makes similar games fun in the first place. Racing Academy makes the knowledge of engineering that young people need to learn context-specific, and demands that they put it into practice. Through an iterative process of trying out solutions, revising their assumptions, contacting peers for help, and trying out alternatives, the students who played the prototype were developing understandings by mobilising, testing and consolidating them through shared practise in a social context[29].

Savannah: feedback and reflection Savannah is a location-based game that challenges children to survive as a pride of lions on the African plains. It is divided into two distinct elements. One part of the game sees children enter the 'virtual savannah'. This is located outside in a playing field, and its sights, sounds and challenges are accessed through GPS-enabled hand-held computers connected with headphones. Research, planning and reflection activities take place in 'the den' – a classroom space where the challenges are set and where there are a number of different resources, including books, information sheets, video tapes and web pages, to allow children to research lion behaviour. The game itself occurs over three levels on the virtual savannah, with time in the den in between each level for players to review past performance and plan strategies for action in subsequent levels.

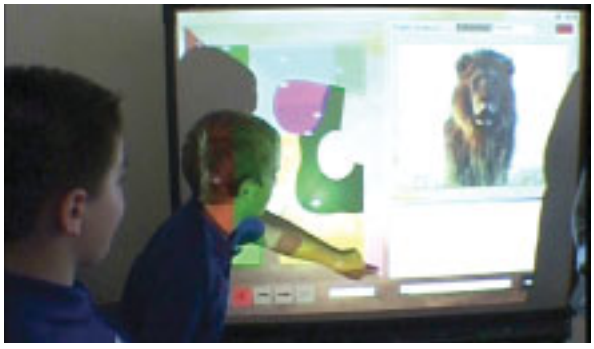
Savannah differs from other computer-based games in that it provides a determined time and space in which players are encouraged to review their progress, receive a score and feedback on their performance, and to plan how they will approach subsequent levels.

During play on the field, however, a number of feedback mechanisms indicated to players how well or how badly they were playing. An 'energy bar', familiar to players of most action and adventure role-playing games, was always indicated on the PDA screen. If players were doing particularly poorly, they would also receive text messages such as "You are getting dangerously hungry"; if they failed in killing an animal the message would read "Your attack failed". In the event of a successful attack, players would receive a text confirmation along with added points to their energy bar.

29 The first prototype of Racing Academy can be downloaded from the Futurelab website to try out now. We are looking for feedback from teachers and students on its use in order to improve later versions. www.futurelab.org.uk/download/projects/racing_academy.php

Case Studies

Savannah trials



Savannah trials

More subtly, however, the game system provided feedback in the form of images and sounds that indicated to the students where they were located in the virtual savannah, and what other animals or objects were in proximity. The sound of rustling grass, buzzing flies or a trickling river alerted them to the different areas they were travelling through, and potentially what benefits or hazards awaited them there. If they chose to 'scent' an area, they would see a picture of a lion 'spraying'; if eating another animal, an image of a bloody-faced lion gorging on meat, and so on. These feedback mechanisms are all important elements in informing players on an ongoing basis whether they are having any sort of impact whatsoever on the game, and in motivating them to continue playing it.

In the den area, players were encouraged to review their performance and to plan strategies for better success. An interactive whiteboard was available, on which the players were able to view a map of the territory of the virtual savannah. They were able to view their 'tracks' on the territory by using a 'time slider' which showed where and when events on the map had occurred, where attacks had occurred, and where some of the potential prey had been placed. This facility proved significant, in that it prompted the players to consider what had and had not worked well during their period of play on the field. In this respect, then, players were able to identify not just 'what' had happened, but 'how' they had made it happen, for instance identifying that attacks on large animals by single players were inevitably unsuccessful, and that in subsequent levels they should therefore team up. Playing Savannah was not just a passive process of proceeding through designed levels, but in many respects was an experience at least partly designed by the players themselves as they modified their strategies and tactics in order to make the best possible use of the time and space offered to them by the game rules.

The players also developed some interesting strategies that subtly modified the game itself. After seeing the savannah map, a number of children set about drawing maps on pieces of paper that they could then take outside with them as navigational aids. One group, notably, even requested boxes and poles that they could then take onto the field in order to use as physical markers for the locations of prey or waterholes.

It would seem, then, that some players of Savannah were able to make effective use of the 'reflective' time provided for them in the den by identifying how their strategies and actions on the field had impacted on their overall success. They were then able to modify those actions in order to maximise the possibility of improving how they played.

05 young people designing games for learning

Alongside the interest in how young people might learn from playing games there is a growing recognition that the processes of enabling young people to make computer games is worthy of further exploration. The act of designing games is seen to be motivational, to raise self-esteem and perceptions of self, and to contribute to learner voice. The fact that games authoring might enable young people to create their own games-based learning environments might even be said to contribute to the current personalisation agenda of tailored education, individualised learning goals, and increased participation of students in defining what and how they are going to learn in school.

It also comes in large part from the understanding that video games are a part of children's cultural life, in much the same way as books, film and TV are, and therefore need to be understood by young people as distinct cultural and social artefacts that are authored. Numerous studies of young people's engagement with media[30] have indicated a sometimes troublesome relationship between young people and the media to which they are exposed. Whether they are watching television, surfing the web, or playing games, it is usually necessary to intervene formally in order to develop sophisticated critical awareness of the processes of authoring such media and their 'impacts', including how those media construct their audiences.

It is now increasingly being acknowledged that if we wish to develop young people's ability to use and consume media safely, then they need to be taught to adopt critical questions about its production – questions which may arise if young people themselves participate in its production. This argument broadly fits under the New Literacy Studies banner, an increasingly popular school of thought which sees literacy not just as a discrete set of skills but as social practices related to time and space and to contested relations of power. In the current era of proliferating media and communications channels, young people are increasingly becoming party to contesting and contested literacy practices.

This interest is, in short, about knowledge, about how different groups report knowledge according to their differing world-views, and about how those world-views always insist on being the dominant discourse. Young people should, then, be allowed to develop their awareness of these contesting discourses. The argument for supporting young people to create their own games can be formulated as an attempt to develop their critical awareness of media and interested media authorship.

From another perspective, the idea of children as games designers arises from research in the 1980s and 1990s which saw game design promoting the understanding of mathematical systems and logical reasoning. Seymour Papert's[31] group at MIT, for instance, used the programming tool Logo to help children construct their own mathematical games, the logic being that making these environments enabled the children to construct their understandings of the material they were working with. Yasmin Kafai and Mitchell Resnick[32] claim that by making computer games, students are able to learn computer programming skills and associated skills in mathematics. Making games, this argument maintains, makes mathematics and computer programming an active and subjective, authentic rather than decontextualised, process of investigation and knowledge construction.

30 See, for example:
Sefton-Green, J (ed) (1998). Digital Diversions: Youth Culture in the Age of Multimedia. London: UCL
Buckingham, D (2003). Media Education: Literacy, Learning and Contemporary Culture. Cambridge: Polity Press.

31 Papert, S (1980), see note 4.

32 Kafai, YB and Resnick, M (eds) (1996). Constructionism in Practice: Designing, Thinking, and Learning in a Digital World. Mawhaw, NJ: Lawrence Erlbaum Associates.

05 young people designing games for learning

Case Studies

The initiatives reported here in particular are working to promote children's capacity to generate and understand games with the same fluency encouraged in film and print.

Making Games: learning new media literacy

The Making Games program at the Institute of Education[33], working with software developers Immersive Education, will provide students with a game authoring tool. It will allow them to plan their game in a 2D map and transform this map into a rich 3D environment, which they can then furnish with items from the tool's menus. Game narratives can be decided using simple decision trees, allowing students to program consequences for player actions and decide on the events that can take place within their game. The whole game can be exported into a standalone player small enough to be e-mailed to a friend for testing.

Researchers on the project are looking at how making games supports young people to combine and productively use knowledge drawn from English, maths, media studies, design and technology and ICT. The theoretical basis for the project is that young people need to develop a critical and analytical awareness of games, just as they do for print journalism and television. These 'games literacy' skills, according to researchers on the program, will allow users to become much more than simply unquestioning, uncritical consumers of games media. It therefore aims to involve both the creative production of students' own games through the use of the authoring tool, and the critical analysis of games. The project also investigates how pedagogies to support the development of games literacy might be designed and supported through use of the tool.

Gamelearning.net: games as visual expression

Jacob Habgood at the Institute of Learning Sciences, Nottingham[34], has taken a similar approach to integrating learning with computer games. Using the inexpensive authoring tool Stagecast Creator, he set up an after-school computer club at a Sheffield primary school, working with 40 students to create their own games in order to explore the educational benefits of authoring games (for example, developing logical thought patterns, mathematical understandings and creative skills) and to discover ways to better integrate learning within a game.

The Stagecast tool allows users to program games using pictures. For young learners, this shifts attention away from the complex mathematical programming and graphic design associated with making games, and allows them to concentrate on creating rules and narrative frameworks. During these clubs, the children made up back stories to accompany their games, and many sketched out their ideas on paper before approaching a computer.

Habgood's research reports that this allowed children with poor literacy skills to begin creating rich and complex playable environments without the need for lengthy written work. Consequently, the boost in confidence this lent some children meant their confidence in other subjects rose too. Although the project has illustrated the value that some children gain from making games as an educational activity, it also acknowledges that for some children making games is neither motivational nor educational. Games, in other words, are not a panacea for all.

33 www.lkl.ac.uk/research/pelletier.html

34 Gamelearning.net provides links to game authoring tools suitable for children, as well as to research findings from the project: www.gamelearning.net

05 young people designing games for learning

Case Studies

Adventure Author: games as story writing

Adventure Author is a prototype developed by Dr Judy Robertson of the Edinburgh University School of Informatics and Glasgow Caledonian University, with support from Futurelab[35]. The application is designed to allow young people to create adventure games for others to play. Users can choose from a selection of characters and environments, and can then set puzzles and riddles for other players to solve.

The project is intended to support young people's literacy through interactive storytelling. By authoring their games, users are encouraged to think about and design plots and characterisation, and to arrange coherent links between individual scenes, as well as to write meaningful dialogue to assist players. Research trials also indicated the importance of critical feedback: authors of the games received reviews from peer players, and then revised their games accordingly. The process of using Adventure Author as a creator, then, was one of authoring, arranging, editing, reviewing and revising. The benefits here were seen to reside with the game authors, with game creation scaffolding them into multimodal narrative creation, as well as with the game players, who were engaged as critical reviewers of games media.

Machinima and Gamics: re-using games media

As well as these overtly educational enterprises in young people's use of digital tools to author games, there have been a number of developments related to wider games culture that have potential implications for the future of games and learning.

Machinima is a growing trend in the use of games media to create movies. Usually created in multiplayer online games, Machinima movies can be made easily by players who meet online, create and perform scenes within the environment of the chosen game, and then edit those scenes together into a continuous narrative. Some of these players control characters, while others act as 'cameramen'. Numerous examples, many of them very ambitious, may be found at www.machinima.com.

Adventure Author

Gamics is similar, but tends to use existing games as the basis for the production of comic-strip narratives; its name is derived from 'games' and 'comics'. Gamics creators, like Machinimists, use the raw material of games – the environments and characters – to create new and novel narratives that often share few if any thematic or narrative similarities to the games from which they have been made. Examples are available at www.gamics.com.

Both Machinima and Gamics, though still niche exercises, illustrate how many people are beginning to use games not just as items for consumption, but as vehicles for production. As yet under-researched, these emerging new media forms have not originated from major corporations, but from the grassroots of game culture. In future years, it will certainly be worth keeping an eye on this field, and it is almost certain that increasing numbers of school-age young people will be actively producing their own media in these modes during their out-of-school time. What educators may be able to learn from such practices is, as yet, unclear. As ever with games media, it may well be educators who will need to run to catch up with the emergent understandings, skills and capacities of their students.

35 www.futurelab.org.uk/showcase/adventure_author/adventure_author.htm

06 recommendations

Recommendations for further research

Although this is a rapidly expanding field, there are outstanding questions that would merit further exploration:

- **Which** children benefit from learning with games in **which** contexts?
- To what extent are existing research findings from small-scale studies still valid when learning with games is introduced in mainstream settings with large numbers of teachers and children?
- What measures or tools can we develop to assess (in a way accessible to children, educators, industry and policy communities) what children are learning through gameplay?
- To what extent can games themselves act as assessment mechanisms?

In many of these areas, collaborative research between industry, the schools sector, assessment bodies and research communities is likely to be needed.

Recommendations for the policy community

The policy community can play an important role in:

- Providing a forum to facilitate dialogue between the different sectors likely to be involved in games and learning, to ensure clear understanding of complementary and conflicting goals between, for example, commercial games companies, educational institutions and assessment bodies.
- Funding the further research required to provide answers to the questions raised above.
- Offering schools the opportunity to explore the potential of games for learning by allowing flexibility in curriculum and timetabling.
- Providing support for the creation of 'serious games' to the standard and scale likely to be needed to fully explore their potential for education at a time when industry is unlikely to take this risk.

Recommendations for educators

There are a number of schools already using games for learning; for those considering taking this step, we would recommend the following:

- Educators should be clear about the exact learning goals they are hoping to achieve when using games. Motivation, reward, curricular objectives, development of skills and competencies are all valid modes of use; students need to know in advance what they are expected to get out of playing.
- Educators should not feel that they have to use every aspect of a game in a lesson. It is more likely that there is a particular mode or game area that suits the area of study. Reciprocally, teaching with games may be beneficial in extra-curricular twilight or 'event' activities.
- Without support from the teacher, students may not make the link between game activities and the wider concepts that are the focus of the lesson. Time for review and reflection during and after play is likely to be important.
- Teachers should be able to assess the impact of using a game. Will existing forms of assessment be sufficient? Or do more specific forms of evaluation need to be planned?
- Educators need to be aware that not all children will enjoy playing games, have equal competence in playing or have access to them in their leisure time. It is also possible that some students will not value the use of games for educational purposes. They may feel comfortable with their ability to complete more conventional schooling activities, and threatened by weaknesses in their ability to play games.

[1] For more on engaging teachers and students in the process of designing educational resources, see "Designing educational technologies with users" (Facer, K and Williamson, B 2004), available at www.futurelab.org.uk/research/findings/handbooks/02_01.htm

06 recommendations

- Teaching with games requires significant familiarity with games on the part of teachers. However, many young people are very good game players, and their expertise can be employed to develop other students' and their teachers' competence.
- Teaching with games will require planning in conjunction with school technical support staff in order to identify any potential network or specification difficulties.

Recommendations for designers and developers

These recommendations address both developers and publishers of commercial games interested in introducing these to school settings, and designers of 'learning games':

- Games oriented towards classroom use should include enough information to advise teachers which parts of the curriculum the game addresses or, if the game is not oriented towards a particular curriculum, what alternative learning benefits it offers.
- The environment in which the game will be played should be considered. Questions to ask include whether gameplay episodes fit into a lesson period, or whether the game demands long periods of play that it would not normally be possible to accommodate in a single lesson? Are there plenty of opportunities to save the game? Will students have to play at the same machine every time they want to load a saved game?
- A range of video and audio settings should be provided in the game options, such as the graphics resolution. School equipment is often more limited than domestic equipment, and currently schools are only likely to invest in games that will run easily on their existing equipment.
- Supporting network distribution should be considered, as many schools do not have CD-Rom or DVD drives on individual machines, preferring to distribute software from a central server.
- If possible, options should exist to allow game states to be imported and exported easily, allowing teachers to set the game up to a certain place and specify which challenges their students should then solve.
- In the development of 'learning games', games designers should work closely with teachers from the beginning of the development process, to ensure the end product is appropriate from a pedagogical and practical viewpoint.
- Space for reflection should be built into the game, where players are able to consider and review their achievements and failures and have the opportunity to make connections between their gaming activities and the learning goals.
- Learning should be integrated with gameplay, rather than dividing the game content between 'learning' and 'fun'. It should not be assumed that compromises can be made with fun purely because the game is designed to be educational.

07 annotated reading list

This is a small selection of recent media related to the field of games and learning. Although not exhaustive, it provides a pointer towards some of the useful books, articles and resources in the field.

Books and articles

Clark, A (2005). Learning by Doing: A Comprehensive Guide to Simulation, Computer Games, and Pedagogy in e-Learning and Other Educational Experiences. Pfeiffer Wiley.
Aldrich describes the role of games and simulations currently in use in educational contexts, and argues the case for developing new game and simulation genres to support young people to learn the skills essential to 21st century workplaces.

Gee, JP (2003). What Video Games have to Teach Us about Learning and Literacy. London: Palgrave Macmillan.
Gee extends his expertise in linguistics and literacy learning to argue that video games are complex multimedia texts; to be able to play them, players must develop competencies in multiple 'literacies', including visual, auditory and gestural, as well as verbal, literacies. These skills, he suggests, are shared by social groups playing and communicating together.

Johnson, S (2005). Everything Bad is Good for You. London: Penguin/Allen Lane.

Johnson argues that many modern mass media, including television soaps and video games, are much more demanding than conventionally thought. He refers to schools as being "too dumb" for children, who are becoming accustomed to much more complex demands from their video games.

Kirriemuir, J and McFarlane, A (2002). Literature Review in Games and Learning. Bristol: Futurelab Series.
Concise review of the research literature in computer games and learning, which seeks to identify what is happening while playing games that educators might benefit from understanding, how games might be used in formal classrooms, and what features of games might be useful in other learning practices and software.

Koster, R (2005). A Theory of Fun for Game Design. Scottsdale, Arizona: Paraglyph Press.
Entertaining, illustrated text from a respected and successful game designer which argues that the most effective games are puzzles that challenge the mind and require players to analyse patterns. The fun of solving these puzzles is what acquaints games with learning.

Prensky, M (2001). Digital Game-Based Learning. New York: McGraw-Hill.
Prensky suggests that today's learners have changed, and that video games players are developing skills and competencies that others are not learning, such as decision making, data handling, multi-tasking, and information processing.

Salen, K and Zimmerman, E (2004). Rules of Play: Game Design Fundamentals. London: MIT Press.
Comprehensive review of what makes a good game, which discusses many types of games including board games and sports as well as computer games.
It outlines what should comprise the 'design' of a game, detailing the sorts of rules that will make people want to play it.

07 annotated reading list

Online dissertations

Squire, K (2004). Replaying History: Learning World History Through Playing Civilization III. PhD dissertation
Squire provides an in-depth report on the theory of games and learning, and the practicalities of using the computer game Civilisation III to support formal classroom learning activities.
website.education.wisc.edu/kdsquire/dissertation.html

Egenfeldt-Nielsen, S (2005). Beyond Edutainment: Exploring the Educational Potential of Computer Games. PhD dissertation

Describes the practicalities of introducing the strategy game Europa Universalis II into a scheme of lessons in Denmark. www.itu.dk/people/sen/egenfeldt.pdf

Websites

Becta Computer Games in Education project:
www.becta.org.uk/research/research.cfm?section=1&id=2835
A small-scale pilot study project involving the use of six computer games in school settings, offering some insights into various aspects of games in education, some points for developers, and some areas for further research.

Entertainment Software Rating Board (ESRB):
www.esrb.org
American organisation providing age ratings and information about video games

Gamasutra: www.gamasutra.com
Industry-oriented site with an academic bent, containing articles on all aspects of games design from theory to code: "the art and science of making games"

Game Studies: www.gamestudies.org
Game Studies is an online journal dedicated to publishing the latest articles on research into all aspects of computer games.

Game Research: www.game-research.com
Database of articles and other items related to the art, science and business of computer games.

Game Learning: www.gamelearning.net
Reports on working with children as young as 7 years old as games authors, as well as the wider research on games and learning.

Pan-European Game Information (PEGI): www.pegi.info
European equivalent of the ESRB: providing information on video game content and ratings, for parents and children.

Ren Reynolds: www.ren-reynolds.com/bibliography.htm
Games journalist and thinker's vast bibliography of articles related to games, most of them available online.

Silversprite: www.silversprite.com
Independent research in games, particularly their educational relevance, including surveys of teachers' use of games in schools.

The Independent Game Developers Association (TIGA):
www.tiga.org
Organisation representing the interests of UK game developers and publishers.

Tim Rylands: www.timrylands.co.uk
Website of a primary school teacher in the UK who uses computer games to support the literacy development of his students.

Water Cooler Games: www.watercoolergames.org
Regularly updated website dedicated to exploring the non-commercial use of games, such as in education, politics and advertising.

07 annotated reading list

E-mail discussion lists

GamesNetwork:
listserv.uta.fi/archives/gamesnetwork.html
Includes searchable archive of online discussion threads on all aspects of games.

Becta Games in Education:
lists.becta.org.uk/mailman/listinfo/gamesandeducation
A practical information-sharing forum for those interested in examining the potential of computer and video games in education: archives are available to members.

Serious Games:
www.seriousgames.org/maillist.html
This list encompasses a wide range of discourse within this area but most is focused on education, training, as well as policy and management exploration initiatives:

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