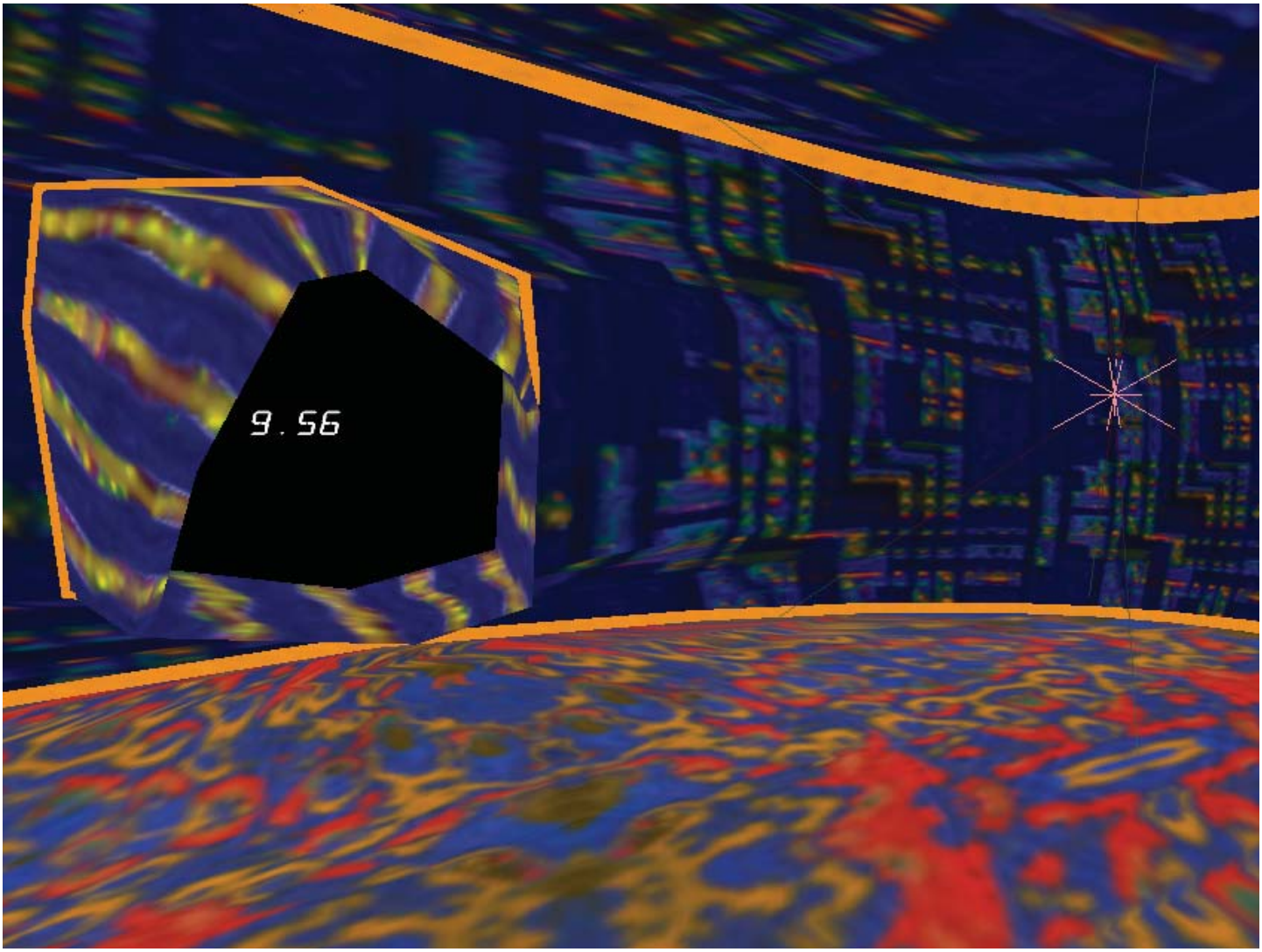
JISC

# Learning in Immersive worlds

## A review of game-based learning




Prepared for the JISC e-Learning Programme

by Sara de Freitas

# Contents

# Background and acknowledgements

The report has been produced to inform practitioners who are considering using games and simulations in their practice. Towards this end, the work includes a review of the literature and a series of case studies from practice to illustrate the range of uses of games and to synthesise key issues and themes arising from learning in immersive worlds. The report also includes outputs from a consultation with experts in the field (see Appendix A) and with the JISC Pedagogy and e-Learning expert group. Selected findings of the survey with the expert group are included in this report – full details are listed at: (http://www.jisc.ac.uk/uploaded_documents/Summary_report.pdf). Thanks to Russell Francis, Paul Hollins and Richard Sandford for their comments on the draft report. Last but not least, many thanks to Sarah Knight and Heather Williamson from the JISC Team for their extremely helpful comments that have informed this report.

# Foreword

Back in the 1980s when computer games had all the sophistication of hitting a plate with a brick, it was already clear that, where post- war parents had been captured by passively staring at a glowing TV screen, the generation that followed them were captivated by actively using and controlling that screen. A generation of passive couch-potatoes struggling with the TV controller were being superseded by a generation that would grow to become active cyber-athletes who in their turn would control TV.

Those early game pioneers, many of whom wrestled with 1st, 2nd and 3rd generation programming languages simply so that they could make better games, went on to become the heart of the UK's biggest economic success story of recent years: the Creative Industries. Game play is about problem solving, applying ingenuity, anticipating the programmers' challenges, and their humour, in a tough cycle of "observe, question, hypothesise, test" that any science teacher would be ecstatic to see evidenced. Vast networks of peer to peer support sprung up and these new game playing learners reached out around the world for support, camaraderie and competition. The games weren't always great, but the players were often awesome.

So, by the end of the 20th century we had on the one hand a games industry rich with collaborative endeavour, with active challenge, delight and ingenuity, while on the other hand we had an education system dangerously close to moribund, where conformity and individual endeavour were rewarded and "passive" was all too often a desired state. The 25 years of clear research evidence that game playing had a role to play in learning had had about as much impact on policy as throwing pebbles at an asteroid.

But then, something changed. We entered a new millennium, a new century. Education began, slowly, to realise that many of the attributes of great game playing, from the intellectual challenge to the provision of multiple learning styles, had an immediate part to play in learning. And, at the same time, the games industry began to realise that for many players cerebral = cool. We love to learn and overtly cognitive games are delightful to play and to share. So, rather helpfully, just as education started to take seriously the weight of clear evidence that this report admirably chronicles, the games industry too started to look at learning's movement towards personalisation, at its clearer understanding of brain-science and of learning styles, and at its new found fervour to rekindle a love of learning throughout life. Suddenly they need each other.

Sitting on my race-boat in the St Katherine Docks the other evening a parent and child paused to chat. I was in the cockpit playing a game on my little Nintendo DS lite. The parent looked, rather admiringly, at the big black steering wheel. "Carbon fibre?" he asked. I affirmed and he nodded, smilingly impressed. But the daughter's attention was on the pocket console. "Animal Crossing?" she guessed, unable to see the screen, but deducing from my engagement. "No, it's Big Brain Academy" I replied "I'm at 1,436 grammes". Her face lit up as she responded with "Cool" and a thumbs up, hoping no doubt to hit the vocabulary and gestures of an older generation.

Now, a world in which a primary school child thinks an ageing professor playing a brain game is cool holds out some very considerable hope for the future. Britain has a long track record of being world class in learning and in play. Putting them together makes a lot of sense doesn't it? I think the Noughties generation have already done it.

Stephen Heppell,

October, 2006. London.

# Executive Summary

The earliest games have been used to support training and learning objectives (Coleman, 1971). The first games and simulations, for specifically educational purposes, were in fact war games, and this trend may partly explain the diversity of 'first person' shoot 'em up games available in the leisure games market today.

Against a context of the development of computers and in particular personal computing and most recently the internet, the broadening use of leisure games and simulations has produced an increased interest in how 'immersive learning' can be used to support educational practices.

Simulations to date have been widely employed to support specified training needs, in particular to support professional and vocational training needs, e.g. military, surgical, medical and business training. These approaches have not necessarily been taken up in areas of more abstract learning, e.g. to support conceptual and higher level cognition. Simulations, and more recently games, have been used more frequently to practice scenarios and skills in advance of taking up a professional employment opportunity. The trend for using simulations in this way has perhaps had an influence upon how games might be used for education and although these are different forms, there are clear links between the two, not least historically. However while simulations are regarded as acceptable training tools, games due their association with violence and leisure time activities have been more widely resisted by tutors and parents alike.

The particular 'perceptions' about games is that they are violent and promote aggression, and this partly explains why learning games are only now becoming part of the toolset of the tutor. Although this trend is clearly changing, not least because of the widespread success and uptake of games in the leisure field, another contributing factor has been because developers have begun to realise the educational potential of opening up a market for selling these newly branded types of games.

This report presents the findings of a literature review alongside a set of case studies of game-based learning from everyday practice contexts.

## Key findings from the literature

The key findings of the literature review demonstrate that:

- Motivation is a key aspect of effective learning but motivation needs to be sustained through feedback responses, reflection and active involvement in order for designed learning to take place (Garris *et al.*, 2002). Therefore the key challenge for effective learning with games is for the learner to be engaged, motivated, supported and interested but also importantly for the learning to be undertaken in relation to clear learning outcomes as well as being made relevant to real world contexts of practice. A key challenge for designers then is to get the correct balance between delightful play and fulfilling specified learning outcomes.
- Key factors that had an impact upon players' motivation related to: player sense of challenge, game realism, opportunities to explore or discover new information and learner control.
- One of the main obstructions to uptake of games in learning contexts is a lack of empirical data to support the fact that they work, as well as a lack of understanding about how these games might be used most effectively in practice.
- The main barrier to using games in schools was cited as a lack of access to equipment and in particular the availability of up-to-date graphics/video cards – making it difficult for teachers to run games on their own personal computers (PCs) – a problem also faced in higher and further education (HE/FE).
- Multiplayer online games are one of the most powerful forms of modern gaming allowing as they do the possibility of reliving situations and conflicts in different settings and conditions in groups.
- Cognitive tools, such as discussion forums, bulletin boards, concept mapping software, may be used to support multiplayer online games through the mediation of social interaction and by encouraging discussion.
- Game play does not always involve sitting in front of a screen, new forms of games including mobile and augmented reality gaming offer scope for using games in outdoor contexts.

## Key findings from the case studies

The key findings from the case studies include:

- Game spaces are often highly immersive and can be collaborative.
- While in the past immersive worlds have been used to support primarily professional development and training requirements in large numbers (due to high costs), today the approach is being adopted in schools and colleges. Universities are also using this form of learning (esp. in business training) for smaller numbers of learners.
- Many of the cutting edge examples of games use are currently being piloted in schools rather than in HE/FE, reflecting a broader uptake of game-based approaches amongst younger learners.
- Different modes of uses of games identified include games: as metaphors, as tools, for therapy and for the rehearsal of skills, for supporting higher cognition in microworlds and as open ended spaces for experimentation.
- By creating games as metaphors, children and adults can utilize role play and narrative forms to imagine and empathize with other people, events from history or with potential scenarios from the future and to experiment and rehearse skills in safe, protected environments.
- There has been a dominant perception of gaming as a leisure pursuit with no pedagogic value. The perception of gaming as a learning tool for post-16 education is changing and Games Design and Game Theory courses are being introduced in HE/FE contexts leading to more critical approaches to game play.
- Prensky (2001) and others (e.g. Stone, 2004) argue that games and their uptake and use is often tied to conversancy with new technologies. This creates generational perspectives to gaming e.g. digital natives vs. digital immigrants, where digital natives can use and switch between different technologies fluently.
- Differing definitions of immersive learning abound and create problems when discussing the subject of educational or serious games. There is a need for educational games to appropriate their own terminologies (as different from those used in leisure gaming contexts), although this may create greater confusion when researchers and games developers attempt to work together.
- Game-based learning is often experience-based or exploratory, and therefore relies upon experiential, problem-based or exploratory learning approaches.
- Role play and identification with virtual avatars are central to learning in immersive worlds, but learners need choice over characters adopted (Francis, 2006a).
- The design of game spaces and the use of games spaces are becoming closer as gamers start to modify games engines and use software development toolkits to add features and functions. However, one of the problems with modifying games is that the available toolsets are designed for leisure games which can affect development of games for educational purposes.
- Convergent forms of gaming are becoming more widespread, e.g. TV/games, mobile/games etc.

## Selected trends affecting game-based learning

Selected trends affecting game-based learning include:

Widespread use of games technologies and serious games movement

- Wider use of games technologies in the home is increasing the interest in the use of games in educational contexts, and in turn this is leading to increasing use of games particularly in schools and colleges, but also in universities.
- The serious games movement is a trend towards designing and analysing the use of games (and simulations) for supporting formal educational and training objectives and outcomes. The movement aims to meet the significant challenge of bringing together games designers and educationalists to ensure fun and motivation as well as demonstrating educational value.

Authoring and development of immersive worlds (e.g. development of content creation tools)

- Through modifying existing games applications for educational purposes there is great potential for learning with games. This approach may have implications upon instructional / constructional learning design, as well as changing the traditional role of the tutor towards one of facilitator, collaborator, producer or author.

- The approach of self-authored content may also promote greater opportunities for team and cross-disciplinary teaching and learning.

Growth of online gaming and online gaming communities

- The growth of online gaming and their communities may have uses for formal education, having the potential to provide greater support for learning outside of formal learning contexts and providing support for distance, lifelong and distributed learning groups.
- This trend may also produce more seamless learning experiences – lessening the hard lines between learning at work, home and formal learning institutions. Learning that follows from online experiences may place a greater emphasis upon team learning, collaborative learning and forming and maintaining dedicated learning communities of practice.

## Conclusions from the study

The main conclusions arising from this study include:

Games need to be embedded into practice to ensure effective learning

- Use of both leisure (commercial-off-the-shelf) games and proprietary games need to be embedded in practice effectively and in accordance with sound pedagogic principles and design.

More research is needed to provide empirical evidence for how game-based learning can be used most effectively

- Need for more rigorous baseline studies that can quantify how much and in which ways games and simulations are currently being used most effectively to support learning.

More effective supporting materials are needed to support practitioners wishing to use game-based learning approaches

- There is a need for guidelines, case studies and exemplars from current practice to inform and improve the quality of delivery of games-based learning across the sector and to support better future planning and resource allocation.

New developments including the serious games movement are informing the development of games for learning

- New developments such as the serious games movement are facilitating collaborations between academic, industrial and government agencies seeking to develop proprietary learning games. However, further work still needs to be done to bring the games development and education communities closer together in order to build shared vocabularies and expectations, as well as to inform new learning designs to support effective game-based learning experiences.

Great potential and need for tutors and practitioners to become involved with games development for learning

- The potential for educators to become involved in the development of learning content associated with these new games formats at this stage is substantial. This may be further encouraged using participatory development methodologies to ensure that tutors and learners have a greater say in dedicated content developed for games-based learning, and importantly to ensure compliance with sound pedagogic design principles as well as alignment with learning outcomes and assessment.

Need for more opportunities for staff development to support tutors wishing to adopt game-based learning in their practice

- The potential of game-based learning in practice can only be supported by a more coordinated approach to staff development and opportunities for buying out staff time to allow tutors time to explore and experiment with existing tools and game spaces.

Potential for learners to become more empowered with game-based learning

- Game-based learning presents new opportunities for re-considering how we learn. Using immersive spaces, learners may produce their own materials, share learning experiences and rehearse skills for the 'real-world'.

# Part One: Introduction

The earliest games have been used to support training and learning objectives (Coleman, 1971). The first games and simulations, for specifically educational purposes, were in fact war games, and this trend may partly explain the diversity of 'first person' shoot 'em up games available in the leisure games market today.

Against a context of the development of computers and in particular personal computing and most recently the internet, the broadening use of leisure games and simulations has produced an increased interest in how 'immersive learning' can be used to support educational practices.

Simulations to date have been widely employed to support specified training needs, in particular to support professional and vocational training needs, e.g. military, surgical, medical and business training. These approaches have not necessarily been taken up in areas of more abstract learning, e.g. to support conceptual and higher level cognition. Simulations, and more recently games, have been used more frequently to practice scenarios and skills in advance of taking up a professional employment opportunity. The trend for using simulations in this way has perhaps had an influence upon how games might be used for education and although these are different forms, there are clear links between the two, not least historically. However while simulations are regarded as acceptable training tools, games due their association with violence and leisure time activities have been more widely resisted by tutors and parents alike.

The particular 'perceptions' about games is that they are violent and promote aggression, and this partly explains why learning games are only now becoming part of the toolset of the tutor. Although this trend is clearly changing, not least because of the widespread success and uptake of games in the leisure field, another contributing factor has been because developers have begun to realise the educational potential of opening up a market for selling these newly branded types of games.

There are two main confusions around games for learning, the first confusion lies in the conflation of leisure games and educational – or serious games. The second confusion lies in the myriad of definitions surrounding games, this has led to different terminologies being used by different groups.

The conflation between leisure games and educational games is an understandable confusion, as the terms for both are also used synonymously. However the confusion has, and to an extent still is, leading to misconceptions and ineffective use of leisure games in classroom and seminar room settings. The jury is still out on how effective leisure games may be in achieving set learning objectives. There are two main explanations for this, first the way leisure games have been used and tested in learning contexts has not always followed the principles of good learning design, that is, operating from learning outcomes and objectives and not just being used as a break in the learning. Second, is a more speculative explanation, indicating that game-based learning may not work in the same way as previous learning activities, and therefore may need a different pedagogic or learning framework in order to be used most effectively.

While the earliest educational games were simulations, the earliest computer games were part of the academic computer science departments in the 1960s, *Spacewar* the first computer game was developed by Steve Russell, a young graduate in 1961, on a PDP-11 computer at Massachusetts Institute of Technology. Arguably this first game already exhibited learning capabilities as well as being collaborative in its application (Herz, 2001: 169).

> Programming the physics simulations, allocating resources and representing scale and perspective – all were necessary to make the game better (Herz, 2001: 170).

Today's games developed on games engines can be played on personal computers, on games consoles, on handheld devices, on mobile phones and using mixed interfaces, e.g. augmented reality and mobile devices, and can be created without the use of programming languages (using editing tools and software development toolkits). See call out boxes on games consoles and engines. Increasingly these software applications are being regarded as *interactive technologies* that can be used flexibility and interchangeably with other ICT tools and devices, e.g. social software, to support many different activities and for supporting small and large communities of practitioners and learners (DfES, 2005). The potential of game-based learning to take advantage of these diverse delivery mechanisms and to offer truly immersive learning experiences seems a possibility now, although making game-based learning effective and relevant to all still presents substantial challenges.

## Game consoles

**A game console is an electronic machine for playing dedicated video games. Game consoles may need a separate output device e.g. television or a PC monitor. The main input device is a games controller, e.g. hand controller, joystick. Games consoles include: Microsoft Xbox, Sony Playstation/2, Nintendo GameCube. Games can also be played on personal computers using different operating systems such as Microsoft Windows, Linux, Macintosh OS, but this normally requires high computing power and a high specification graphic card to handle the processing of high quality motion images.**

## Game engines

**Each computer, video game or interactive application with synchronous graphics has a game engine. The game engine is the central software component, providing the underlying technologies. The engine greatly simplifies the task of games development, and often allows the game to be used on different platforms, e.g. different game consoles and PC operating systems. The main function of a game engine is the rendering engine for 2D or 3D graphics, in addition the game engine includes a scene graph and a physics engine which allows for collision detection, audio, scripting scenes, animation of scenes, a level of incorporated artificial intelligence (AI) and scope for networking. Examples of advanced games engines include: CRYengine2, Gamebryo, Unreal Engine 3 and Visual3D.NET, these particular engines programmed in C++ object oriented programming language, increasingly also offer additional visual development tools. For a comprehensive list of games engines see: http://www.devmaster.net/engines/. Increasingly games engines are being made available to user communities to enable them to create and inhabit their own games environments (mods).**

Juul (2003) and others (Salen and Zimmerman, 2004) have debated the issue of defining games and play at length, and there is no real consensus between the disciplines on shared terms and their definitions. For example, games have been defined as rule-based play (Suits, 1978; Salen and Zimmerman, 2002) or as a voluntary and free activity (Huizinga, 1980; Callois, 1961) outside of 'ordinary' life. In many cases the way that games are defined affects the kinds of uses and learning experiences that result. Hence, when games are defined as rule-based play, there is an emphasis upon choices (Dickey, 2005), games as choices foreground decision making skills facilitating a greater emphasis upon decision making as a learning component, that is, as ideal for supporting business and management training needs. When games are defined as voluntary and free activity there is an emphasis upon using games for leisure purposes and to give time for relaxation or breaks between learning. In this way, definitions are formative for supporting the use of games in practice. An example of the myriad of definitions and terms associated with games is demonstrated in *Table 1: Definitions and terms of games*, and this is why it will be increasingly important for those engaged in producing games for learning, such as games developers and educational content developers including tutors and trainers, to begin to share some of the same definitions and approaches to the process of games development and implementation.

Towards facilitating greater opportunities for using games, this report adopts a fairly neutral approach, defining games for learning as:

> applications using the characteristics of video and computer games to create engaging and immersive learning experiences for delivering specified learning goals, outcomes and *experiences*.

The definition aims to encompass the immersive and engaging characteristics of games with the educational and training effectiveness of simulations to foster the development of learning applications that can support different sectors of learning, whilst providing language that is comprehensible and sufficiently neutral to different stakeholder communities, such as learners, tutors, training organisations, educational institutions and policy makers. However, it is notable that due to the fast changing nature of the field that these definitions are rather more fluid than are generally usual in other educational and academic contexts. See **Appendix B** for a glossary of the other key terms used in this report.

| Term used | Related or synonymous terms | Descriptions & references |
|---|---|---|
| Educational games | Computer games; video games; serious games; game-based learning; instructional games | Games in general can be defined in surprisingly numerous ways, often changing the way games are used and perceived (Wittgenstein, 1958). Games as a series of choices or as rule-based play are popular definitions. For the purposes of this report educational games for learning are defined as: applications using the characteristics of video and computer games to create engaging and immersive learning experiences for delivering specified learning goals, outcomes and *experiences*. |
| Online games | Massively multiplayer online role play games (MMORPGs), massively multiplayer online games (MMOGs), persistent games, MMORTS (massively multiplayer online real-time strategy), MMOFPS (massively multiplayer online first-person shooter) | Online games are becoming more widely used since their emergence as multi-user dungeons / dimensions (MUDs) in the 1980s. Online games include simple text-based games as well as games that involve complex graphics and virtual worlds that are used by large numbers of players simultaneously. Broadband access to internet resources has made massively multiplayer online role play games (MMORPs), massively multiplayer online real-time strategy games (MMORTS) and massively multiplayer online first-person shooter games (MMOFPS) very popular. In addition the wider usage of Flash and Java has allowed gaming websites to use streaming video, audio, and introduce greater user interactivity. |
| Serious games | Educational games; video games; game-based learning; instructional games; sim games; gamesims | Michael and Chen (2006) give the following definition: 'A serious game is a game in which education (in its various forms) is the primary goal, rather than entertainment'. It is worth noting that Huizinga defined games as a free activity standing quite consciously outside 'ordinary life', as being 'not serious' (1980), following this definition games cannot be serious. Callois similarly defined games as voluntary and therefore also conflicts with the notion of serious games (1961: 10-11). This gives a good indication of the kinds of contradictions found in comparisons of the available literature. |
| Simulations | Electronic simulations; virtual reality systems; training simulations or simulators | A computer simulation is a way of modelling a real-world situation on a computer. By altering variables, predictions about the behaviour of the system may be made. Simulations have traditionally been considered as types of games. But equally the earliest simulations were war games. The relationship between games and simulations has been close, even when virtual reality systems were being pioneered the power of immersive environments for learning was recognised. Also, simulations may be defined as non-linear exploratory environments (Aldrich, 2004, 2006). |

Table 1: Definitions and terms of games – as used in the report.

The confusion does not just lie in the choice of terminology alone, this belies a deeper problem that philosophers, psychologists and programmers have all found difficult to grasp, leading to greater confusion. The problem is perhaps unsurprisingly in fact one of definition. A succession of theorists and philosophers have found 'games'

and 'play' both difficult concepts to define (Huizinga, 1980; Salen and Zimmerman, 2004; Wittgenstein, 1972), and equally complex is the comprehension of the process or sets of processes that facilitate game play. Wittgenstein for one despaired of finding a suitable way to define play. The reason is also because few studies have managed to agree on one definition of either games or play, and few, if any, studies have managed to adequately analyse the processes of human play. The problem is exacerbated by the myriad attempted definitions, typologies and classifications that have emerged. Not unlike learning theory there are many different takes on this process. It is hoped that breakthroughs in neuroscience may help us to understand these processes more clearly in the future, throwing more light on the neural connections and cerebral functioning associated with both learning and play, allowing us to develop better models to reflect and scaffold these processes in learning contexts.

The reason for the widespread use of different terms (and meanings) associated with games is at least partly due to a lack of cohesion within the research and development communities. This is largely due to the fact that games are inherently multidisciplinary, which while broadly a positive aspect of games and their potential, has led to fragmentation in terms of the research about games. This trend is exacerbated by the fact that some disciplines, operating in silos, have studied particular themes or issues in depth, but that an overview perspective on these themes and issues is only now becoming possible through games research networks, facilitating more multidisciplinary approaches for the study of games.

An example of key issues and themes emerging from single disciplinary perspectives upon gaming can be noted here in overview: often psychologists have focussed upon issues of violence (Griffiths, 1999); cultural theorists have focused upon issues of gender, identification, genre and game texts as cultural forms (Buckingham, 2003; Carr et al., 2006), educationalists have focused upon the learning potential and application of leisure games in schools contexts (McFarlane et al., 2002; Egeneldt-Nielsen, 2005), while philosophers have focussed upon notions of play (Aristotle, 2004; Wittgenstein, 1958). Other related work includes developmental cognitive neuroscience, which focuses upon executive attention (Holmboe and Johnson, 2005; Rueda et al., 2005). These directions of debate have largely gone on independently with little cross-referencing between disciplines. The fragmentation has not been helped by the wider - and often negative - perceptions of what games are, as the work has rarely been brought together, due to the disparity of the communities. This is not to say that there is no benefit in the work that has been undertaken to date, on the contrary there is an enormous amount of value in the work that has been undertaken - but there needs to be a critical synthesis of the key findings of this research, a wider perspective adopted and more scope for analytical and multidisciplinary perspectives upon this work.

For this reason, this report adopts a more general approach considering *learning through play*, with games and with simulations as part of a more general process of *learning in immersive worlds*. Immersive worlds are taken here to mean 'microworlds' that is the space of the game, the game-world. See call out box on microworlds. Realising that some games and simulations may be puzzles, board games or adventure-style games, this report focuses rather upon games and simulations as *facilitators of virtual experiences* rather than as sources of data or information which can be assimilated. Learning in immersive worlds itself is a process of learning, of *flow* or of *activity* (Csikszentmihalyi, 1992) that is a set of interactions or constructed reasoning that may or may not be transferred into lived experiences, expressions or outputs.

### Microworld

**The concept of 'microworlds' was introduced by Minsky and Papert (1971). Microworlds are given domains or environments which may be explored in a non-linear way by users or learners, the environment includes artefacts and objects, and learners may learn through exploring the environment and its objects in a relatively open-ended way.**

For learning to be effective in immersive worlds, or indeed any contexts, a relationship needs to be made between what is learnt and how it is applied in practice. This broadly follows Kolb's experiential learning cycle (Kolb, 1984) although connections are *not* always made between what is learned and how it is applied in practice. This is the reason why post-exercise reflection and correct embedding of the 'virtual experience' into a learning context is so important. The phrase 'exploratory learning' will be used in this report therefore to mean the learning process that takes place in an immersive, virtual context, that may (or may not) then be transferred into lived experience in the real-world, a real-world experience, or abstract reasoning or imagining at a later time or in another similar or usually dissimilar context. *Exploratory learning* is in a sense taken to mean play as rehearsal or 'pattern formation' or in a

neurological sense as a 'mapping of types of maps' (Edelman, 1992: 109) See call out box on exploratory learning.

### Exploratory learning

Learning through exploring environments, 'realia', lived and virtual experiences with tutorial and peer-based support. This notion of learning is based upon the notion that learning patterns can be helpfully transferred to dissimilar situations through meta-reflection. Unlike Kolb's experimental learning this process is not always circular (although it may be), and does not rely upon lived experience. Rather the approach acknowledges the cognitive process that help individuals to use their imagination and creativity to draw out lessons from interactions as well as extracting meaning from data. This process can be complicated and happen on different levels of understanding. That is, learning can be supported through different media, and through multimedia, interactions and textual engagement.

Whether the learner is playing games, training on a simulation, watching films or television, surfing on the internet or listening to music, it is their approach to that activity, and the support of peers, mentor or tutor that frames how and when learning will take place. If they are immersed in the activity they are more likely to engage in the learning activity.

Motivation here is a key aspect of effective learning but that motivation needs to be sustained through feedback responses, reflection and active involvement in order for designed learning to take place (Garris *et al*., 2002). Therefore the key challenge for effective learning with games is for the learner to be engaged, motivated, supported and interested but for the learning to be reflected upon in terms of what is being learnt - and clarified in terms of being made relevant to real world contexts of practice.

Games have been described as particularly motivating in terms of the duration of time that player's play, and in terms of keeping high attention levels:

> Games are motivational, in part, due to their uncertain outcome and the focus on a goal or challenge that the user needs to accomplish... Multiple game goals or different levels of goals provide incentives and challenges for players once an initial goal is accomplished. Game players, therefore, must develop skills and strategies in order to win or achieve a goal... Unlike most formal training or education, in games there are multiple paths into success (Bonk and Dennen, 2005: 3).

The success of games to motivate, engage and maintain attention levels is not widely disputed, however there are still questions about whether commercial-off-the-shelf (COTS) games (Sandford, 2006) or proprietary games - developed specifically for learning - would provide the more effective approach, and while these are critical debates, it is interesting that *perceptions* about the suitability of games to support learning are changing (de Freitas, 2006a).

This change of perception may be due to the wider diversity of genres and titles available leading to wider appeal. It may also be due to the fact that manufacturers are cottoning on to the educational aspects of gaming, or it may be due to the widespread popularity of games in the home. In fact, there are probably elements of all these factors at work. What is clear though is that the change of perception is leading many to reconsider the use of games and their immersive worlds as new educational tools worthy of use in schools, colleges and universities, not only to provide a break in the learning, but also to add substantial value to what is learnt, and in some cases, to support under-served learners.

Research and games development teams are beginning to work more closely together now, and cross- disciplinary and cross- sectoral networks and alliances are forming to crack the hardest problem of *how to design and use games effectively in learning contexts*. To achieve this it is beginning to be acknowledged that designers, tutors and learners will need to work together, perhaps adopting models such as those drawn from film and television production teams. While the main preconceptions of games, reflected in the research, have centred upon: violence of representations (Griffiths, 2002), the solitary nature of game play (Chumbley and Griffiths, 2006), the addictive qualities of games and the lack of educational value of games (O'Neil *et al.* 2005), a range of studies have confuted these negative perceptions (e.g. Williamson and Sandford, 2005; de Freitas, 2006a) and meta-reviews of games - and simulations - have begun to synthesise findings from the literature, identifying games as particularly motivating and engaging for learners of all ages (e.g. de Freitas *et al*., 2006; Garris *et al.*, 2002; Kirriemuir and McFarlane, 2004; Mitchell and Savill-Smith, 2005).

The success of games in educational contexts however is not a precise science, there have been a dearth of scientific studies analysing their usage. In addition the confusion about what constitutes a learning game is still problematic and the varied types and genres of games have added the challenge of diversity. The studies that have been conducted have

primarily focused upon leisure-based games used to inform and support curricula objectives to varying degrees of success (Egeneldt-Nielsen, 2005; Facer, 2004; Sandford *et al.*, 2006). Failings of the games to support defined learning objectives in these contexts may have been due to incorrect experiment design - and this is partly explainable by a dearth of available methodologies. Other research (Sandford, 2006; Francis, 2006) has indicated learning taking place but not always the learning that is strived for, an equally frustrating outcome.

Interestingly when we review the simulation-based literature there is also a paucity of this kind of empirical data, although some studies do exist (Delanghe, 2001), these empirical studies were developed after the fact, that is after simulations had been in use for sometime, and had effectively proved their worth. The plain fact is that once a product, software tool, simulation or game has been produced and used successfully there is little incentive to conduct empirical studies to prove the point. One of the main obstructions to uptake of games in learning contexts therefore is a lack of empirical data to support the fact that they work, and a lack of understanding of how these games might be used most effectively in practice. However, there is widespread anecdotal evidence of success and guidelines and frameworks are coming on stream to aid practitioners prepared to take the plunge and use games with their learner cohorts (e.g. Williamson and Sandford, 2005; de Freitas and Oliver 2006).

While this report aims to provide an overview of games and simulations, there are clear differences in the literature and application of these at present, while simulations have been used for a longer period and are used more often to support training and learning, they have often been focused upon training contexts rather than education, such as military and surgical training (de Freitas *et al.*, 2006). Furthermore, the expense of using simulations widely has in the past been prohibitive and has led to their application in contexts that can support the costs such as where large numbers of students need to be trained or where the costs of traditional training approaches are very high. While a similar picture has been developing in early examples of using games, the relative costs of games software are reducing, and the availability of software over the internet makes the use of games software more appealing to tutors in educational contexts particularly when compared with the costs associated with the early Virtual Reality (VR) systems of the 1990s (Stone, 2003).

However, while simulations and games are considered separately at present the trend of convergence between these and other forms are leading to greater crossover potential for immersive learning forms. The coining of the term 'serious games' is an example of new forms that are borrowing from both games and simulations, opening the door for other convergent forms such as those that crossover between games and mobile and pervasive technologies and mixed media environments that bring TV and video together with games and simulations. While these new developments are interesting and may have implications upon games for learning in the future, they make comprehension of the landscape of games in practice more complex, so they are discussed in more detail in part four of the report.

## Methodology

The report aims to identify key issues and themes arising from the literature reviewed, the case studies produced and the consultation undertaken. The review comprises a meta-review that is a review of literature reviews, and literature has been grouped in relevant categories according to selected themes or issues. Literature was sourced from keyword searches of electronic databases, key journals in the field and a general search of the internet. Selected criteria include significant meta-reviews, relevance to game-based learning and empirical studies of the use of games. The criteria were used to identify relevant literature for inclusion in the report. Recommendations from experts in the field were also used to identify key articles and texts relating to examples from practice.

Part two of the report comprises a meta-review of the literature providing an overview of different approaches to using games and simulations for supporting learning, the use of commercial-off-the-shelf (COTS) games, particular skills supported by game-based learning, pitfalls to using games and developing, selecting and analysing games in practice. In part three, examples of games being used in practice, selected according to recommendations from the consultation and arising from the literature review are illustrated according to three categories: games as metaphors, as microworlds and as tools. Part four includes an overview of selected future trends for gaming and game-based learning, including the use of mobile and online gaming, social software and social gaming. Part five of the report summarises the main conclusions from the review and survey of current practice, assessing some of the key messages to emerge. The glossary of terms is included in Appendix B.

# Part Two: Using games in practice

Young children today are part of the 'net generation' or the so-called 'digital natives' of the digital age (Oblinger and Oblinger, 2005; Prensky, 2001, 2006). They 'require multiple streams of information, prefer inductive reasoning, want frequent and quick interactions with content and have exceptional visual literacy skills' (Van Eck, 2006) - aspects that are well supported by game-based learning approaches.

Teachers in primary schools are already teaching members of this generation - and they will be part of our higher education cohorts over the next ten years. This provides a significant challenge for a system that is used to supporting more text-based approaches and is applying traditional methods that have remained relatively unchanged since the invention of computers during the Second World War. However, it is becoming clear that the traditional methods are not engaging or stretching children sufficiently and examples of using games in schools to re-engage and refresh learning are in evidence (see Case study 1: The Sims School). This new interest in games therefore is being driven by a new generation who have grown up or are growing up with games. Games metaphors are commonplace to them (and many readers of this report); for example they may already belong to a fanzine community, have a presence on MySpace, have 'modded' a game and take part in online gaming activities on a regular basis.

A number of studies and statistics support the prevalence of game play. A recent Mori poll of teachers and learners in the UK has found that 72% of teachers never play computer games in their leisure time, while 85% of the children polled did play computer games at least once every two weeks (Sandford ***et al.***, 2006). A report undertaken for Pew Internet and American Life (Jones, 2003) polled US college students and found that 70% had played video, computer or online games at least once, while 65% were regular or occasional players. In the same survey 20% of those polled saw games as a social activity, and as a way to make friends, while 60% used games to fill time when friends were not available.

Games are becoming more prevalent in teaching contexts, with the UK survey finding that despite not playing games at home, still 36% of primary school teachers and 27% of secondary school teachers are already using games in the classroom (Sandford ***et al.***, 2006). This increasing use of games has not so far led to a plethora of widely available guidelines and handbooks to support good practice. One exception is the handbook published recently to support educators in their selection and use of games (Sandford and Williamson, 2005), providing a starting point for good practice guidelines for school teachers (see Appendix C: Useful links and resources). For further and higher education, reflecting less uptake of game-based learning, fewer generic guidelines exist in the literature. Although some tools have been presented in the literature, for example, a framework has been developed by de Freitas and Oliver (2006; see figure 2), for the effective selection and use of games by tutors, and other work suggests key principles to be followed (Gee, 2003). While design and use of games is often distinct in the literature, examples where both are considered jointly are becoming more prevalent (e.g. de Freitas and Jarvis, 2006; Squire, 2003), reflecting the trend towards the use of 'software development kits' and 'modifying games software' [See Call out box on 'Modifying games software'].

## Modifying games software

**Modding is a slang term for modifying software or hardware. Modding is when software or hardware is modified in order to perform a function that was not originally intended. In the games context, mods are created 'user modifications' of leisure games and can offer new content for an existing game or 'total conversion' mods that change the game significantly. An example of this is *Revolution*, which completely transforms the original Neverwinter Nights software.**

A recent small-scale survey conducted by the author found that 4 out of 26 tutor practitioners from further and higher education were already using games to support their learning and teaching practice[1]. While those using games and simulations together only accounted for 15% of those polled, as compared with half the proportion of those currently using games in schools (31.5% - average), this percentage may well increase as the generations currently using games in the classroom progress into adult education (de Freitas, 2006b). If this straw poll survey could be supported this may indicate a truly learner-driven tendency to the use of game-based learning.

[1] **For full report details, see** www.jisc.ac.uk/uploaded_documents/Summary_report.pdf

Although practitioners are beginning to become more interested in using game-based learning particularly with younger learners, Squire has noted that educators have been slow to notice the potentially paradigmatic shift implied by the way that learners are using games:

> Games are an important site of a shift toward a *culture of simulation*, whereby digital technologies make it possible to construct, investigate and interrogate hypothetical worlds which are increasingly a part of how we both work and play (Squire, 2006: 2).

This notion of a paradigmatic shift echoes the quite simple assessment of one elementary school student at a Game Developers Conference who asked:

> Why read about ancient Rome when I can build it? (Squire, 2006: 2, quoted from Moulder, 2004).

This section will aim to explore approaches used with games, some of the pitfalls to using games and indicate research methods and conceptual tools available for supporting practitioners with the selection and use of games.

## 2.1: Approaches to using games

Learning games have been piloted and used in a range of different contexts, and towards different ends. The flexibility of this usage is reflected in a range of different approaches that have been used to support learning.

Areas that have already used games include subject areas where learning is often experiential in nature such as for professional development, where virtual experience can save on real life costs or where learning is essential, areas such as medical and legal practice, security and defence training, business and management studies, citizenship and governance are notable. In many of these cases cross-training, e.g. between armed and emergency services or between governance and legal trainees, would be desirable not only for honing skills needed but for gaining a better 'worldview' to inform decision making and more coordinated strategy and policy development. Games and simulations particularly when enhanced by drawing from a range of different ICT sources such as, internet, email databases of documents - or 'realia', offer greater opportunities for scenario-based and exploratory learning.

The following table groups together some of the identified *uses* of games found in the literature, relating to game-based learning with adult learners.

| Selected uses of games | References |
|---|---|
| To motivate and engage learners, e.g. underserved learner groups (e.g. with low literacy/language levels) | Amory et al., 1999; de Freitas et al. 2006; Garris et al, 2002; Gee, 2003; Mitchell and Savill-Smith, 2005 |
| For skill or part-task rehearsal and practice e.g. literacy and numeracy skills | de Freitas et al. 2006; Delanghe, 2001 |
| For providing therapy for pain relief and cognitive difficulties | Pelletier 2005c |
| To role play particular jobs and professions in advance of real life practice | Aldrich, 2004, 2006; Maharg, 2006 |
| To empower learners as authors and producers of multimedia, mixed media and game-based content | Pelletier, 2005b; Druin, 2002; Dickey, 2005 |

Table 2: Selected uses for games

Although the uses of games have been varied, no single approach for using games for education has so far emerged, although key aspects of employment of games have often followed the effective use of simulations and other e-learning approaches and therefore have often involved several steps, including:

1. Define learning outcomes
2. Select a simulation, activities, set of activities or game to support this required learning outcome with an appropriate form of assessment

3. Consider an ordering of the game within this set of activities, assignment and assessment process
4. Undertake the session/s with proper consideration given to outlining the session, learning outcomes strived for and post session reflection (debriefing)
5. Undertake assessment of the session participants (peer, self, tutor based or a combination of these)
6. Evaluate the effectiveness of the session (using feedback from learners and other participant/s)
7. Re- organise/design the session according to feedback given

Taking a linear approach to learning design with games may be problematic, as learning with games - and in immersive worlds - puts a greater emphasis upon learning experiences as a whole or as a process, rather than as specified learning objectives and outcomes, although more empirical research may be needed to highlight these issues more clearly. However, a more open ended approach to learning in this way need to be considered as part of the overall lesson planning, and to take advantage of the benefits and strengths of experiential and *exploratory* approaches. Further, the need for more complex or multidimensional approaches, as has been demonstrated in recent studies of using games in the classroom (e.g. Squire, 2005; Egeneldt-Nielsen, 2005), need to evolve into examples and case studies from practice that can be shared between practitioners. In particular, where learning seeks to use game-based learning and be cross-disciplinary then standard class durations might not be sufficient (Sandford *et al.*, 2006). Greater flexibility may be required for these approaches to be more effective, and this may require institutional as well as pedagogic sensitivities as well as sufficient technical support and staff development strategies.

## 2.2: Using commercial off-the-shelf games for learning

The use of commercial-off-the-shelf (COTS) games for learning has been a popular approach to using games due to its relatively low costs. COTS games have been used widely as they are (e.g. *Civilization*), and increasingly in modified - or 'modded' - forms (e.g. *Neverwinter Nights*). In general potential learning has been noted in pilots undertaken with both categories of COTS games. However, where games are tailored or customised for specific learning outcomes or groups good results in terms of completion and pass rates have been noted (e.g. Galloway, 2006; N. Oldham, email communications, 12th June 2006).

A recent study by Futurelab and Electronic Arts (Sandford *et al.*, 2006) is looking at the use of *Sims 2*, *Roller Coaster Tycoon 3* and *Knights of Honor* [sic] in four schools and has produced some interesting findings. Their MORI poll of teachers found that while 31.5% of teachers have used 'games designed for entertainment' in their lessons 59% would consider using them in the future (Sandford, 2006). Their study found that 63% thought players learn higher order thinking skills and 62% thought players learnt specific content knowledge. Although many did think that games teach stereotypical views (62%) and anti-social behaviour (71%). The main barrier to using games in school was cited as a lack of access to equipment and availability of up-to-date graphics / video cards – making it difficult for teachers to run games on their own PCs – a problem also faced in higher and further education. Another barrier identified in the study is the level of games literacy required by teachers and students, with large amounts of time needed to learn to play the game, in advance of using them as a resource in learning contexts. Another key issue identified was the difficulty of using games in the context of the national curriculum that is how to embed games, how to assess with them, how this form of learning would be accredited. [See call out box on: Barriers to uptake of games in learning practice].

### Barriers to uptake of games in learning practice

**There are significant barriers to uptake of games in educational practice. These include:**

- **access to the correct hardware including PCs with high end graphics video cards;**
- **effective technical support or access to suitable technical support;**
- **familiarity with games-based software;**
- **community of practice within which to seek guidance and support;**
- **enough time to prepare effective game-based learning;**
- **learner groups who would like to learn using effective game-based approaches;**
- **cost of educational games software or licenses.**

## 2.3: Skills supported by game-based learning approaches

Recent research from educational sources has focused upon specific skills that can be learnt through game-based learning. For example, a study by Green and Bavelier focused upon the use of video games for developing perceptual and motor skills, finding positive results in particular for visual selective attention (2003).

Although Bonk and Dennen (2005:14) recommended future research on accelerated 'perceptual processes and enhanced task management capabilities', they could find no evidence of higher order cognitive thinking skills in their study. Process and strategic planning skills have also been examined in previous research (ThoughtLink, 2001, 2002; Beal and Christ, 2004), such as a study evaluating *ScudHunt*, a multiplayer game, where players had to collaborate to seek and destroy scud missile launchers. The study found that while recognised leaders scored more highly within the game...

> The availability of a communications tool, whether direct (e.g. text, chat or voice) or indirect (e.g. shared visualisation), was a major contributor to the quality of decisions (Thoughtlink, 2001; quoted in Bonk and Dennen, 2005:14).

Interestingly, this finding was supported by empirical studies conducted by Bonk and Dennen (2005) who found that: 'in addition to using post-game reflection, another way to build conceptual knowledge is to engage in dialogue with peers or experts about the game during game play. Specific cognitive tools such as discussion forums, bulletin boards, debate tools, concept mapping tools, surveys and polling tools, might be used to support [Massively Multiplayer Online games] MMOG by mediating social interaction and fostering depth of discussion' (2005:29). They found that groups with cognitive support tools outperformed those without the tools. Strategic planning scores were also found to be higher with teams that had access to 'cognitive tools'.

Another study exploring the motivational aspects of *America's Army* (Belanich *et al*. 2004) found that the key factors that had an impact upon players' motivation related to player sense of challenge, game realism, opportunities to explore or discover new information, and learner control. According to the researchers, 'all four motivational variables should be considered in game development and use' (Bonk and Dennen, 2005:15). Yee's survey research on Massively Multiplayer Online Roleplay Games (MMORGs) polled a sample of 4,000 participants; he found that more than half had learned mediation skills as well as leadership skills, such as reducing hostilities in groups and resolving conflicts (2003).

Multiplayer online games are one of the most powerful forms of modern gaming allowing as they do the possibility of reliving situations and conflicts in different settings and conditions. Herz argues that:

> Historical and quasi-historical simulations like Sid Meier's *Gettysburg* allow gamers to replay military conflicts under different conditions... The flexibility of the framework allow and encourage non-expert, individual players to ask questions, explore the solution space around a particular scenario, and create novel scenarios that might not have occurred to the game's designers (Herz, 2001:177).

Notably the level of engagement is high because player feedback and collaboration is incorporated into game design before, during and after the software is launched formally. The shared goals of the player-community provide many opportunities for team skills and inter-working:

> Mastering the game in an online, networked environment is a team sport. There are ways for groups to form, bond and collectively succeed (Herz, 2001:184).

Squire argues that 'games are not just static code, but rather socio-technical networks' (Squire, 2006). The social interactive dimension of game play has potential for supporting learner cohorts, even those who are geographically distributed, and also has potential for developing team-based skills, not least leadership, coordination and communications skills.

The process whereby individuals are assessed and rewarded, upon completion of levels, tasks or specific group-based activities is an important aspect of assessment within game-based learning. Grades may be assessed based upon individual and collective performance, and through self-, peer- or tutorial- based assessment modes. Bonk and Dennen, for example, found that groups with peer and mentor reviews scored better than self-review groups, and also displayed greater meta-cognition skills and strategic decision making skills (2005:33).

## 2.4: Pitfalls to using games

While some studies indicate that games are not effective (O'Neil *et al.*, 2005), the majority of studies seem to indicate that games are increasingly effective learning tools, particularly when embedded effectively into practice (de Freitas *et al.*, 2006; Francis, 2006; Squire, 2006; Sandford, 2006).

Earlier work identified that the period of most rapid development in animals is linked to the period of most intense play (Byers, 1998). While work has not been identified to support the same findings in humans, the absence of play in childhood can have a negative impact upon social development and socialization (de Freitas *et al*., 2006). However, while the importance of play for development is clear, where games are inadequately used, selected without clear criteria or incorrectly embedded into practice there are indications that this may lead to negative learning experiences. Even with the use of simulations it has been noted by practitioners that some learners do not like learning in this way (de Freitas *et al*., 2006). Some of the main pitfalls of using games have been outlined in research projects undertaken over the last few years (Egeneldt-Nielsen, 2005; Francis, 2006; Futurelab, 2005; Squire, 2004), and are summarised here.

## Assessment and accreditation

How are learning outcomes of game play assessed and measured for effectiveness? O'Neil *et al*. (2005) found that games were not supportive of instructional approaches, it is important to note that O'Neil's meta-review was conducted according to specified learning outcomes achieved. This is significant, as other studies have also found that the connection between specified learning outcomes and learning with games is not always a certain one (Egeneldt-Nielsen, 2005; Squire, 2005). This may, as O'Neil *et al.* have surmised, mean that learning is not taking place or it may indicate that learning through immersive worlds involves a more complex understanding of learning, one that is not so easy to tie to specified learning outcomes. This of course has implications for understanding *how we learn through play* – but critically also has implications for how we *assess* learning in this mode. If assessment is not conducted through measurement against set outcomes how might it be assessed?

Heppell and others have explored the use of self-assessment in the context of new technologies, as well as using portfolio based approaches, while these are still learning outcomes, they are measured by self- and peer-estimation as well as through tutorial evaluation (Heppell, 2006; Moss, 2005). Assessment in this way may involve the use of journals, group discussion and communications, portfolio creation, peer evaluation as well as tutorial views upon the content developed or the mission completed, to support reflection upon learning outcomes. Also, the use of games may lead to more innovative and flexible modes of assessment. Interestingly, the survey outlined in Sandford and colleagues (2006) found that concerns over curriculum and assessment were influential in game selection. But there is clearly a need to understand these issues in greater depth and assessment must be integrated with the learning design of e-learning content including learning environments (Beetham and Sharpe, 2006; Mayes and de Freitas, 2006).

## Context

Not contextualising the games into a meaningful learning context has been posited as one of the main failings of studies by Egeneldt-Nielsen (2005) and Squire (2005), and has been observed in the mobile gaming learning *Savannah* project (Facer *et al*., 2004). The literature around simulations gives a great emphasis to the effectiveness of learning with simulations as predicated upon the context of use (Steadman *et al*., 2006; Moizer *et al*., 2006). As important as debriefing, matching the context to the correct simulation in industrial and training contexts has led in at least one sector to the need for rigorous training needs analysis (TNA) methodologies (Bee and Bee, 2003).

Matching the correct simulation or game to the correct learner group offers educators similar challenges, and in education there is no one training or learning needs analysis methodology that has emerged, although Biggs learning outcomes based method of approach is used by many in higher education (Biggs, 1999; Mayes and de Freitas, 2006) this is specifically weighted towards learning outcomes as matched to learning objectives and specified according to modular learning content.

Learning in immersive worlds requires a longer view of the learning process, or regarding learning as rehearsal of professional skills, that is based upon experiences, interactions and interchanges - or transactions. While these may be aligned with learning outcomes they tend to be more wide-ranging and cross-disciplinary learning objectives, though potentially more rich and applicable to real world experiences, they are harder to measure and assess using standard assessment formulae.

## Learner expectation

Finding frameworks and processes that align with learning in immersive worlds will be a major challenge of the adult learning institutions should they opt to use game-based learning more widely to adapt to the methods being implemented in schools. These cultural forms are being used in many young learners' homes and expectations are being set by the increasing use of the internet, social software and shared communications (e.g. blogging,

wikis, MySpace) by children in schools who are forming diverse social networks, locally and abroad, along shared interests, rather than formal groupings. Although this exploration lies outside of the scope of this report it is perhaps worth considering that a starting point for this might involve:

- An assessment of how young children are using games today including an investigation of social activities used to support game play in informal settings;
- A projection of the kinds of changes that may need to be made in the institutions to address game play and to support under-served learners more effectively;
- Collaborative activities bringing learners, developers, tutors, government policy and institutional representatives together to provide a route map for supporting these activities;
- Piloting games usage in wider further and higher education learning contexts;
- An evaluation of the most effective approaches to the use of games in formal settings (assessment, guidelines, selection, pedagogy, learner characteristics).

One of the pitfalls to using games and simulations is 'confirmation bias' that is that once a learner has an hypothesis they look to support rather than 'disconfirm' their working hypothesis and this bias may be problematic if learners are to develop balanced critical skills in virtual learning spaces (Bonk and Dennen, 2005: 19).

It has also been noted in studies (e.g. de Freitas, 2006a; Sandford *et al.*, 2006) that some learners do not like using simulations or games, in these instances it may be useful to have additional choices of presentation of learning materials, such as textual, or have other more differentiated activities planned. In addition, the level of gaming ability exhibited by young learners in the classroom, for example, has been found to be varied, competency levels can be very different even within one learner cohort, and this may have an impact upon lesson planning, with opportunities for more learner differentiation (Sandford *et al.*, 2006).

## Tutor engagement, support and professional development

The general perceptions about the usefulness of games in support of learning will increase over the next few years, as the generations learning with games in the classroom reach tertiary education, and as those tutors who are thinking of using games in their practice are given the best tools to develop their own game-based learning activities to support changing learner groups with differing skills levels and competencies. While the effectiveness of using games relies upon tutorial engagement, there is little evidence that colleges and universities would have the extra capacity needed to actively support innovative practice in this area with strains on higher education funding spare resources for supporting innovation may seem extravagant. However, the potential of learning in immersive spaces could lead to significant benefits not least accelerated learning, skills transfer and provision for the under-served learners. At a time of increased competition through globalised learning opportunities and requirements for greater personalisation of learning, as well as the need for ongoing lifelong learning skills development the need to keep learners engaged and motivated within formal education life is paramount.

Finding and developing sustainable models for innovation is a considerable challenge potentially affecting many institutional processes. To achieve step change in this area will require commitment at all levels: policy, institutional and tutor/learner, and this will take time. Infrastructure, technical support, pedagogic support, buy-in from learners and adequate staff development and training provision are central for making innovation dynamic within organisations.

Tutors surveyed in schools (Sandford *et al.*, 2006) found that fixed lesson duration was a constraint in both the planning and implementing of game-based learning. Lack of familiarity of the game with the teachers was cited as another reason for game-based learning failing (Futurelab, 2005). To assist tutors with using game-based learning may therefore require more flexibility in terms of learning duration as well as adequate time for lesson preparation and good technical support. In addition tutors may require dedicated guidelines, toolkits and frameworks for supporting innovative practice. These may be produced by the research community who in all probability will continue providing a leading role incubating development and fostering initial collaborations. Interestingly, Sandford and colleagues (2006) have found that while school teachers need a familiarity with the game, the successful 'achievement of educational objectives was more dependent upon a teacher's knowledge of the curriculum…than it was on their ability with the game' (2006: 3), furthermore the teacher played a central role in scaffolding and supporting students' learning' (2006: 4). [See Call out box on: Key points for implementation of game-based learning].

### Key points for implementation of game-based learning

**When implementing game-based learning in your learning contexts you may need to consider the following points:**

- **Do background reading on how to learn effectively with games (see useful links and references);**
- **Consider the context of use (e.g. technical requirements, place of game-based learning activities);**
- **Consider the learner and learner group specification (e.g. level of ICT skills, knowledge of gaming, expectations and needs etc);**
- **Consider the pedagogy to be adopted and its fitness for purpose of game-based learning (e.g. experiential learning, problem-based learning);**
- **Consider the specific game-based aspects fully before designing the learning activities (e.g. level of immersion, quality of representation, level of fidelity, gaming specifics);**
- **Consider the technical support needed - and run the software on your institution's PCs before designing learning activities to ensure that the hardware is sufficient and that firewalls do not prohibit use.**
- **Consider the costs for using game-based software with your learners – and seek dedicated funding from your department that covers the use of the software with your learners.**
- **Consider accessibility issues (e.g. will the learners be able to access the game from home, will all students be supported by this form of learning).**
- **Plan your learning activities as a whole including enough time for pre- and post- reflection upon the learning individually and in groups.**
- **Make the game a part of learning rather than an end in itself, and explain how the game will help the learners to learn.**
- **Ensure that a feedback loop is in place and be prepared to change things regularly to reflect learner comments.**
- **Become part of a community of practice to ensure that you are supported throughout the process.**

## 2.5: Developing, selecting, analysing games in practice

One of the main problems with supporting effective learning with games has been the often negative perception of leisure games and scepticism about whether leisure games can effectively aid learning. On the other side of the argument, Seymour Papert, for example, argues against taking the fun out of games by making them conform to current curriculum requirements (Papert, 1998). It is certainly true that the development process of games is currently geared more for the leisure than educational market. So how do we bridge the gap and allow games developers, educationalists and learners to work together to develop more effective learning games? There are two trends which appear to be addressing this gap: 'modding' or the use of content creation tools, that is where the users modify the source code of the game to repurpose, redevelop or add to it and participatory design that is where the user becomes involved in the design process. Both approaches aim to solve the same problem that is how to make games more engaging and effective for learning purposes.

### Modding

Modding (a slang term for modifying software or hardware) is when software or hardware is modified in order to perform a function not originally intended. In the games context, 'mods' are created 'user modifications' of leisure games and can offer new content for an existing game or 'total conversion' mods that change the game significantly.

Modding (modifying existing software) and the use of dedicated software development kits to create immersive and 3D-like worlds is becoming a more widespread activity amongst the games community. Some studies have highlighted the significance of how gamers produce and share their own immersive worlds and experiences

with others by modifying games engines. Some research projects are exploring this trend of modding (modifying software tools) directly. Currently a number of projects (e.g. *Neverwinter Nights*) are being undertaken to develop open-source games engines for use in educational contexts. One example of this is *Revolution*, which completely transforms the original *Neverwinter Nights* software.

In addition, the development of games content creation tools ('modding') and widespread communities are springing up around the hugely popular multiplayer online games. This trend has added additional urgency to the serious games movement, and has increased the list of desirable contexts within which learning and communities of practice (Wenger, 1998) might emerge and be supported for the learning needs of tomorrow.

The approach has been influential for demonstrating the link between gaming and higher cognitive development. Papert (1981) uses the metaphor of wheel cogs as a first instance of when he began to learn more complex abstract ideas through understanding by exploration of the cogs. He used this insight to develop and use LOGO a computer programming software tool to help learners to learn about maths and computer programming. This approach underpins the modding generation who can take control of the software code to make changes to the immersive world – repurposing and personalizing it to their own specification. Games development companies are cleverly exploiting this trend by allowing online communities to adopt their games engines thereby using it to create new worlds (e.g. *Far Cry*). These software development kits (SDKs) ensure that the use of the games engine will continue on beyond the lifecycle of the commercialised game, and these kits are often available free of charge over the internet.

## Participation in design

Increasingly, the design of games and the use of games are overlapping. While the methods by which games are designed has often been neglected in research into educational games (Dickey, 2003), with the emergence of 'modding' a greater emphasis is being placed upon these methods (Dickey, 2005; Nieborg, 2004; Darken *et al*., 2005; Kiili, 2005). This trend is highlighted by the tendency for game players to modify games software to change its appearance, to build new 'microworlds' for exploration or to use the game in a different context or with a different purpose or user group to that originally intended (e.g. *Neverwinter Nights*). The trend has led to new methodologies, which in a general sense aim to put the learner or user at the centre of the design process in order to meet their needs more closely (de Freitas and Jarvis, 2006).

The work on participatory design, that is where learners become more actively involved in the design of e-learning content, by Allison Druin (2002) and colleagues (Guha *et al*., 2004), and the work of Kurt Squire and colleagues (2003; 2005) are examples of this notable trend. The work of Druin and Guha *et al*. focuses upon the development of multimedia resources for children, and a similar trend is evidenced more generally in the development of user-centred design and service-orientated architecture as prevalent trends in the development of e-learning systems. Although this approach might be considered part of good human-computer interaction (HCI) practice design, evidence of formative and continuous involvement of users throughout the design process is not as widespread as would be thought, and in particular learning games have not always been developed in this way in the past.

Participatory design principles aim to foreground the specifics of the learner through modelling their behaviour and attitudes in a systematic way. Druin sees children as having four main roles: as user, tester, informant and design partner. Druin and colleagues (Guha et al., 2004) at the University of Maryland, for example utilized the Cooperative Inquiry approach for working with children to inform design. The technique they used involved a modified version of participatory design involving 'sketching ideas with art supplies such as paper, cardboard and glue to create low-tech prototypes during the brainstorming process' (Guha et al., 2004: 1), a method that Pelletier (2005b) adopted in the Making games project (see Figure 1).

Observations of children looking at other children using technologies and captured on sticky post-its was another technique used. Druin and colleagues have used this technique to create innovative technologies including a *Magic Wall* for collaborative drawing and *StoryRooms*, an interactive tool for telling stories using physical icons and physical props within an entire room. Although not strictly game-based these outputs are strongly collaborative and story-based. The approach has implications upon the design of games for adult learners as well, and methods that incorporate participant observations with video recordings are becoming more commonplace.


Figure 1: Sketch from Making Games project

Alongside the apparent shifts in designs towards more user-centred approaches, methods for researching game play in multiplayer online games have provided significant challenges, leading to the development of new research methods: to evaluate games, to design games and also to analyse participant behaviour. Alongside the traditional methods of data collection (e.g. surveys, interviews, workshops etc), other methods (e.g. participant observation and log analysis) are allowing researchers to gather a wider range of data and outputs, leading to more complex data analysis approaches. An example of this is provided by one games researcher, Constance Steinkueler, who has been an advocate of using ethnographic participant observations in multiplayer online games, her work on ***Lineage*** (2004) focused upon the transitions of players from 'newbie', or 'legitimate peripheral participant' (Lave and Wenger, 1991) to expert or central participant, concluding that the design of the system must include relevant and emergent social structures or practices.

## New London Group

Another critical approach that concerns design is the work on multiliteracies as proposed by the New London Group (1996) - established by a group of international academics including Gunther Kress and James-Paul Gee, in 1994. The group focused upon exploring notions of literacy and in particular the notion of multiliteracies.

The main argument put forward by the New London Group is that:

> ...the multiplicity of communications channels and increasing cultural and linguistic diversity in the world today call for a much broader view of literacy than portrayed by traditional language-based approaches. Multiliteracies...overcomes the limitations of traditional approaches by emphasising how negotiating the multiple linguistic and cultural differences in our society is central to the pragmatics of the working, civic and private lives of students (New London Group, 2005: 1).

Russell Francis (2006b) adopts this approach as a method of study for analysing game play with *Revolution*. Here, Francis (2006b) abstracts four phases from the work of the New London Group to provide a framework for his empirical study of game-based learning in the classroom.

1. Situated learning in a virtual environment

   Through situated role play within the virtual world students develop 'embodied empathy' for their virtual persona and gain a deep, but tacit, understanding of a web of social relationships whilst talking and interacting with dozens of player and non-player characters.

2. Overt instruction and reflective discussion

   The teacher leads discussion or devises activities that encourage systematic analytic reflection of the knowledge acquired through situated role play. This stage enables students to consciously articulate knowledge that might otherwise remain tacit.

3. Practical media production

   Students are assigned a production task that requires the re-application of the knowledge they have acquired in steps 1 and 2. Each student designs and produces a video diary, recycling visual material they have captured during the game, in a manner that explores the political conflict from the point of view of a particular character.

4. Critical framing

The New London Group (1996) define critical framing as 'interpreting the social and cultural context of particular designs of meaning' and argue that 'this involves the students standing back from what they are studying and viewing it critically in relation to its context'. Critically framing an interactive game text might require a student to question the representations embedded in the game world and consider how the 'bottom up' model of history implied by the game medium might differ fundamentally from that implied by a text book or by audio or film media (Francis, 2006b: 7).

Francis used group workshop sessions with observations, log analysis and interviews, as well as video journals for his study. But this method may be adapted for other game-based studies.

## Frameworks for selecting and using games in practice

Alongside frameworks and approaches being developed to support design and study of games, several frameworks for selecting and using games are emerging from early research. These frameworks are often aimed at practitioners, for supporting more effective use of games, and to help then to avoid the pitfalls of game-based learning (Barab et al., 2005; Dickey, 2006), although these notably focus upon frameworks for game design. One recent example of a framework for practitioners is provided by de Freitas and Oliver (2006), they have developed a four-dimensional framework (FDF) for selecting and using games in formal learning contexts (2006). However, recent work indicates that the framework also may support the design and development process of games (de Freitas and Jarvis, 2006).

The four-dimensional framework sets out to inform the selection of games that may be used effectively by practitioners, and picks out four generic principles: context, mode of representation, pedagogic approach used and the specifics about the learner, as in need of consideration in order to support effective learning outcomes. The FDF represented here (see *Figure 2: The Four Dimensional Framework*), builds upon the earlier work of Mayes and de Freitas (2004, 2006), advocating a pedagogic approach that utilizes associative, cognitive and situative approaches to learning, through an alignment of learning outcomes with learning activities and modes of assessment. The four dimensional framework applies the mapping to identify key gaps and omissions in the current theory and research relating to game-based learning. This process will allow for a further evaluation of properties and factors that may be used to validate future research, action research based studies and design issues and to inform future design parameters.

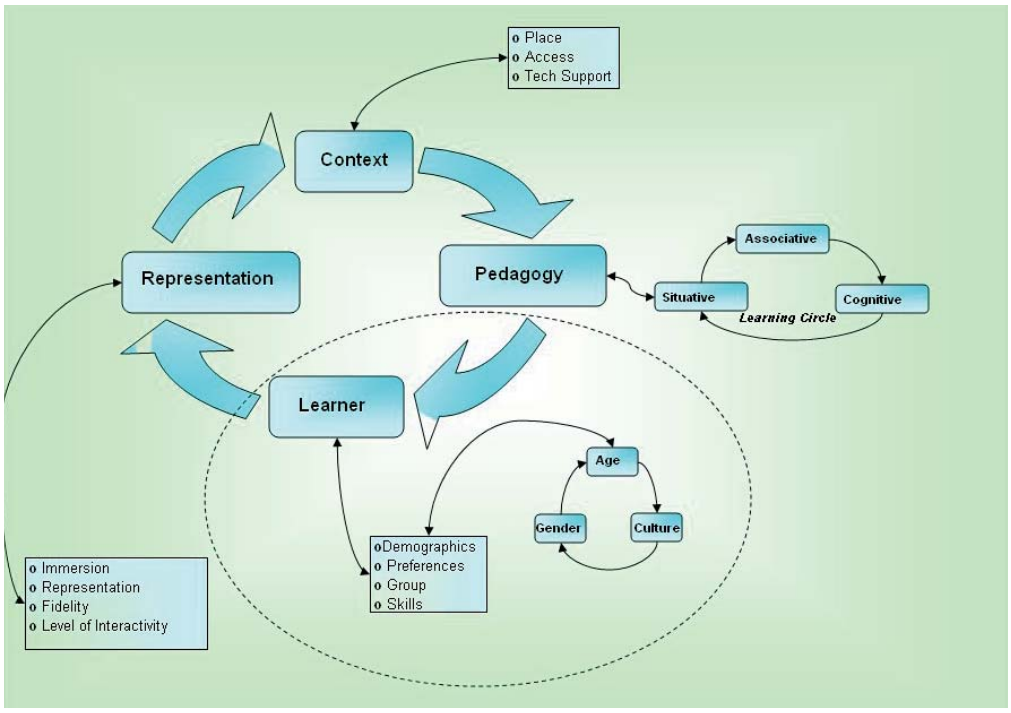



Figure 2: Four Dimensional Framework. Source: de Freitas & Oliver, 2006

In the figure, four dimensions are represented: context, learner, representation and pedagogy. These are dimensions or factors that need to be taken into consideration when selecting and using games for learning.

*Context.* The context of the game and its use is central to the effectiveness of how the game is utilized. Contextual factors include where a game is used, what technical support is provided and what is the general environment for game play – is the environment conducive for play or not (e.g. classroom, home, outside)? The context will therefore have a direct bearing upon which game is selected. Socio-political contexts and institutional contexts may also play an informing role in selection and use of games.

*Learner specification.* The learner or learner group is also central to which game is selected and used. Aspects such as age, stage of study, demographics, conversancy with ICT and games technologies and past learning experiences will all have a bearing upon the selection of games used. Also groups familiar with using ICT technologies widely in their social lives may get more out of using integrated social software and communications to support game-based learning (e.g. bulletin boards, live chat), providing greater opportunities for group interactions and meta reflection in different contexts to support learning outcomes and activities.

*Representation.* The representation of the game itself, that is level of immersion and fidelity, familiarity of interface with the learner group and the internal reality and narrative of the game will also have a bearing upon effective learning. Although there has been a long debate about fidelity – and levels of fidelity in the literature around learning with simulations, the findings are inconclusive about how high the level of fidelity needs to be for effective learning transfer to take place. However young learners are becoming accustomed to high levels of immersion and interactivity in leisure games, so different learner groups may require different levels.

*Pedagogic model or approach used.* This is particularly important for using games in learning contexts, rather than for leisure time activities. In earlier work (Mayes and de Freitas, 2004; 2006), it was found that that learning processes are supported by associative (instructivist and often task-centred), cognitive (constructivist) and situative (learning in communities of practice) modes of learning, these three perspectives come into play rapidly at different points as learning progresses. Notably learning with a game is rarely if ever a learning experience in itself, more usually it is embedded into a set of activities and processes according to the pedagogic approach adopted – often experiential or problem-based (Kolb, 1984; Boud and Feletti, 1991). The role of debriefing is central to the use of simulations and it is also important for game-based learning, whether debriefing is through post-exercise discussion, reflection with peers or the tutor, this aspect of learning in immersive worlds is central (Crookall, 1995; Peters and Vissers, 2004).

The framework offers a starting point for tutors considering using games in their practice, mapping well onto activity theory as well as other pedagogic theories (de Freitas and Oliver, 2006). The framework may be used to frame the selection and use of games in practice, as well as for supporting more critical approaches to considering game-based learning.

This section has demonstrated how the *design*, *development* and *use* of games – and other immersive learning environments – are becoming more closely interwoven. The *interactive* technologies associated with game-based learning in this way are becoming rather more *participatory*, implying a shift that has implications not only upon *how* games are designed, developed and used in practice, but also upon the processes of learning and therefore upon how learning activities are structured in practice.

# Part three: Examples of games as learning experiences

As we have seen, although there is a wealth of both literature and research developments as well as a growing supply of freely available software tools, the central issues of definitions and learning theories to support use of games and other tools are not yet unified. This section aims to provide an overview of selected public and private sector activities in the field of education and training that may have a relevance to the reader. The section aims to provide readers with an understanding of the range of research and development activities going on at present, which it is hoped will help to inform them as well as igniting more critical perspectives upon game-based learning.

This review provides a selection of examples of how games and simulations are currently being used, with some illustrations of innovative practice. Other reviews offer more exemplars from practice, e.g. de Freitas ***et al.***, 2006, Kirrimuir and McFarlane, 2004; Leemkuil ***et al.***, 2000; Mitchell and Savill-Smith, 2005; Trondsen, 2005. While current research points to learner driven trends associated with games usage, many of the cutting edge examples of games use are in schools rather than in HE/FE, reflecting a broader uptake of game-based approaches amongst younger learners. However, independent and academic, as well as commercial research and development labs, are leading initiatives and prototyping of games and simulations to support learning. See Appendix D for a full list of projects referred to in this report.

In this section, the report takes up the notion of games and immersive worlds as ***learning experiences*** (Herz, 2001). While there has been a large volume of work charting different games typologies and classifications (e.g. Juul, 2003; Sutton-Smith, 1997; Salen and Zimmerman, 2004) these typologies have more often than not been based upon leisure rather than educational games. In the literature there have been many different ***modes*** of using games for supporting learning experiences described, and while the area is still newly forming certain key modes of use have emerged from the selected literature reviewed. These modes should not be seen as a typology of learning games, but rather as a starting point for summarising and considering some of the examples from practice.

Different modes of uses of games identified include games: ***as metaphors***, for supporting higher cognition in ***microworlds*** and ***open ended spaces for experimentation*** and ***as tools, for therapy*** and ***for the rehearsal of skills***. In addition to these modes, games are more generally associated with entertainment and for social interaction.

We have already noted the diversity of different definitions of games, and that this implies a correlation with different modes or uses of games in learning contexts. The following section illustrates the range of diverse games that are being used currently in learning and training practice, according to the following broad categories, as ***modes of use***:

1. Games as metaphors

   Games are being used to support learning communities through considering games as metaphors – e.g. metaphors of the real world, or of fantasy worlds for experimentation and exploration. This approach works well with younger learners, and has been used most widely in schools.

2. Games or simulations as microworlds

   Using games or simulations as microworlds where open-ended experimentation can take place is becoming more commonplace in educational contexts, as techniques more often associated with training for professional life are adapted. This technique, like role play and the use of narratives, may prepare individuals for exploring a range of different skills and activities within a cohesive and safe environment that may or may not be transferred to real life contexts.

3. Games as tools (for therapy and skills development)

   Games are being used as tools to support a range of activities such as therapy and to support skills development (e.g. literacy and numeracy). Games as tools for therapy include games as pain relievers (Pelletier, 2005), for supporting corrective or constructive therapy and for medical training (Begg ***et al.*** 2006). To date this approach has been used for supporting specific medical or mental health conditions, for example for burns victims or for autistic children. The potential of this approach is becoming more apparent, and a large investment is being made in particular in the United States to support wider applications.

| Category | Examples from practice |
|---|---|
| Games as metaphors | ■ Grangeton<br>■ Racing Academy |
| Games or simulations as microworlds | ■ Revolution<br>■ Neverwinter Nights<br>■ Ardcalloch |
| Games as tools (e.g. for therapy and rehearsal of skills) | ■ Second Life<br>■ Ben's game<br>■ Re-mission<br>■ Key skills trainer<br>■ Max Trax<br>■ Skillswise |

Table 3: Mapping of case study and examples from practice against key categories of different modes of use.

This section will explore a range of case studies from practice in relation to the three main modes of uses of games and simulations.

## 3.1: Games as metaphors for learning

Games are being used as metaphors, creating opportunities for learners to learn through narrative methods, role play and practical experimentation. By creating games as metaphors, children and adults can utilize role play and narrative forms to imagine and empathize with other people, explore events from history or potential scenarios from the future and to experiment and rehearse skills in safe, protected environments. This process may allow learners to formulate responses and rehearse activities within a controllable environment, allowing them to build confidence and self-esteem, as well as extend their potential and natural abilities, earlier and to further extents.

Games, e.g. *Racing Academy*, *Savannah*, *Revolution*, *Civilization III*, are being used as metaphors in school and college contexts, as pilot research projects are demonstrating. The approach has implications upon how learning is conceptualised, how it is supported and how it is delivered, but as early adopters are showing the process can be rewarding and can also improve the quality of results, through better engagement of learners and increased motivation levels.

### Case Study 1: Grangeton: The Sims School[2]

### Background

Four years ago Grange Primary School Head, Richard Gerver arrived at an underperforming school (with only 50% achieving the benchmark grades at the end of Key Stage 2). The Derbyshire school 'was providing an education that did not relate to our children or offer them the skills they needed to develop or the activities that built on their interests or experiences' (Gerver, 2006). In order to get the school back on track he conducted a review to establish what the world was like for today's children and to explore visions of what the future might be like for the children. This enquiry involved talking to the children and local businesses as well as reviewing relevant papers and reports

[2] **For more details, see:** http://www.grangeton.com/

(e.g. RSA, 1999; NACCCE, 1999; Robinson, 2001). Gerver was trying to establish what skills were needed for the 21st century and looking at innovative ways of engaging his students who were under-performing.

## The challenge

The challenge for the school was how to motivate and invigorate how children were learning, and how to raise standards to higher levels to support greater opportunities for the children and to reflect the more dynamic global economy that the children would grow up and work in over the coming years.

## The solution

The result of the synthesis of the review and consultation undertaken was an innovation not only with how the school was organised, but also with what the children were taught. Based upon the review clear messages were found: that 80% of future jobs do not exist yet, that the costs of computing will reduce considerably and that employability patterns are changing.

With China and India becoming more affluent countries with greater economic influence in the future, and therefore with the world economic balance shifting to Asia, creativity and problem-solving skills would be in greater demand and leaders with vision and creativity would be highly valued - according to the review undertaken. To facilitate this need for different kinds of skills and in order to motivate his students, Gerver decided to employ

Figure 3: Grange Primary School students at the BBC

Figure 4: Grange school students

the use of computer games as a metaphor. This approach would engage the students and provide opportunities for developing more creativity, problem-solving abilities and leadership potential.

Building upon notions of children as at the centre of a design process, as noted in the work of Druin and participatory design strategies (Druin, 2002; Guha *et al.*, 2004), the wider notion of the efficacy of games to motivate learners, and upon the notion of multiliteracies (Cope and Kalantzis, 2000; Pelletier, 2005b), Gerver identified a range of games that could be used to support learning including: *Theme Hospital*, *Sim City*, *The Sims* and *Roller Coaster Tycoon*. *The Sims* was chosen as the best metaphor for the school due in part to its widespread appeal. Gerver set about transferring *the Sims* onto his school, and today learners have control over their own TV and radio station with regular broadcasts and students run their own shop. *The Sims* school even includes a Parisian café where pupils have to converse in French. There is also a school museum (Weir, 2004) (see Figure 4). The enterprises at Grangeton run all the time and there are radio broadcasts five days a week which are run by 6-7 year olds.

Gerver argues that games provide a rich educational tool that offer scope for wide opportunities to consider real life scenarios in a safe and immersive world. Games also offer the school a potential to market its products and unique approach. Hence the virtual Sims-based town became known as 'Grangeton' and has its own council with local Mayoral elections (Revill, 2004), supporting an emerging understanding of citizenship.

Grangeton has been extremely popular with the students, and significantly has changed the roles that teachers employ to support learning. Models adopted permit tutors to guide learners allowing them to develop independence and take on responsibility, taking risks in a safe and secure environment. While seven years olds can apply to work in the enterprises, even children in the nursery are engaged in media-based activities, producing their own DVDs.

Future plans for the school include the main aim to move away from a curriculum-based approach with defined age groups towards a system based upon four themes: communication, culture, enterprise and well-being. All learning will fall into these themes with additional literacy and numeracy classes. There will be 30 simultaneous workshops (six week courses, e.g. in film-making) and the groups will include mixed age and ability students. Career entry profiles will be produced with certificates and accreditation points built up throughout their time at school.

The approach of using sessions of longer duration, and the move away from 'age and stage' approaches is reflected in other innovative approaches to school education, for example the work of Wim Veen (2006), who argues along the lines of Marc Prensky and Oblinger and Oblinger that young children are becoming more conversant with the new technologies, transforming the learning paradigm (Veen and Vrakking, 2006). The new paradigm is leading to a need for changes to how formal learning takes place, as outlined in Table 4, where Veen compares traditional and future schools.

| Traditional schools | Future schools |
|---|---|
| ■ 50 minute classes<br>■ Subject specific content<br>■ Classrooms for 30 students<br>■ Age-based groups based on yearly cohorts | ■ Four hour periods<br>■ Interdisciplinary themes<br>■ Areas for 90 to120 students<br>■ Continuing individual learning paths |

Table 4: Comparison of current and future schools from Wim Veen (2006).

An example of how a game can change the standard duration of lessons is provided by *Homicide*, a game developed by the Learning Lab in Denmark, which uses games to support learning about science, organisational and communications skills. The sessions are designed as being undertaken over a minimum of one afternoon or as long as a few weeks (Magnussen, 2005). Learners become crime scene detectives who set about investigating the crime scene. DNA analyses, data analysis tools and evidence, are provided on computers and the Chief of Police - their tutor - assists their investigation. During the period of the investigation normal lessons are placed on hold. Scope for supporting cross-disciplinary sessions such as these in UK higher education contexts in the future may be facilitated by team teaching opportunities (Yapp, 2005) using subject areas where more overlap between curriculum areas already exist or where tutors working in inter-related areas or collaborative research or action research groups have already begun working together to support leading edge research.

Grangeton shows how motivating games can be as metaphors for learning, allowing children to learn in less structured and more practically applied ways supporting creativity, problem-based learning and allowing children to acquire higher level cognition through role play, experiential and contextualized approaches to learning. The virtual town within a school not only offers children an overarching narrative but allows the children time to problematize activities and work within that context as well as supporting opportunities for meta-reflection within a virtual environment. The innovations have had a positive impact upon grades, and Grange School has gone from the bottom quartile nationally to the top 10% of primary schools.

## Mini case study 1: *Supporting literacy with Myst*

An advocate of using games as metaphors for supporting learning in schools is Chew Magna Primary School's Tim Rylands (see: www.timrylands.com). Tim Rylands has been using the leisure game *Myst*, a successful fantasy game to support literacy amongst his 9-11 year old children. His method is original, Tim sits in the middle of the classroom with his laptop, projecting the game through an interactive whiteboard and walking his students through the first-person 'landscapes' of the game, whilst narrating and setting tasks for the students. Each student records their own reflections, good examples of writing from the game and phrases from other students into their journals. These short extracts inform their own written and spoken language. In addition the class reads extracts from *the Hobbit* by J.R.R. Tolkien, comparing the visual and written language metaphors between the textual and game-based worlds. Tim Rylands has developed an effective method for integrating the game-space into his teaching and his method includes developing 'realia' - or supporting materials - to enrich the experience, thus he has developed maps of area explored and even a manual for looking after plants discovered. But importantly the work and activities within the classroom sessions make learning engaging.

While this technique has been used for supporting literacy, Rylands has also used the game to teach music, art and citizenship to his students. Rylands is in the process of developing dedicated software (funded by the DfES) to create both a teacher interface with guidelines on how to teach with the game and a pupil's interface allowing learners to write alongside games and allowing them to create their own music. The project *Myst Alive* will be developed in 2007 and released for tutors. Level Four literacy attainment for the school has risen from 75% in 2000 to 93% in 2004, and for boys attainment is now 100% as compared with a national average that has remained at 70% between 2000 and 2004.


Figure CS1: Screen shot from Myst

## Mini case study 2: *Teaching physics with games in schools*

*Supercharged!* is a game for teaching high-level conceptual physics (Barnett *et al*., 2004; Jenkins *et al*., 2004). The game allows learners to pilot a spaceship around a three dimensional environment by using the electric charge of the spaceship and charged particles within the space. Learners plan their trajectory through each level by tracing the field lines that come from the charged objects. Through this game learners develop a more practical understanding of how charged particles behave. Barnett and colleagues found that students who participated in a module that used *Supercharged!* performed better than pupils who had learned physics through hands-on experiments, demonstrations and watching simulations (2004, quoted in Squire, 2006):

**The most dramatic results, in fact, came from students who were unsuccessful in school, suggesting that game-based formats may make complex science thinking accessible to a broader range of students (Squire, 2006: 21).**

This finding was supported in recent user studies where students using *Krucible*, a physics simulation tool (de Freitas *et al*., 2006) found learning more complex physics easier to comprehend through visualisation techniques.

Figure CS2: Screen shot from Supercharged

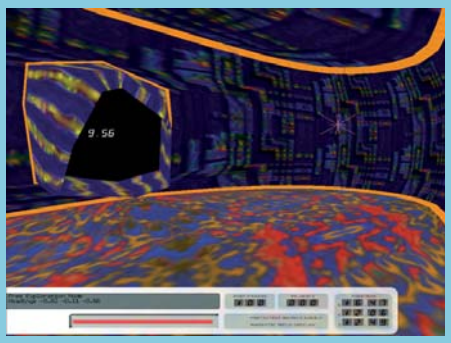


Figure CS3: Screen shot from Supercharged!

## Key points for effective practice

- **The use of game-based learning can change not just what is learnt but also significantly how we learn, for this reason it is important to consider all the possible implications of adopting game-based learning in your practice (e.g. context of use, duration of study periods, technical support, community of practitioners, etc.). See call out box on Key point for implementation of game-based learning.**

- **Games may be used as metaphors as well as literally in practice, seek out examples from practice before implementing these in your practice, and ensure that all the stakeholders are onside.**

## Case Study 2: Racing Academy: Learners as engineers, mechanics and drivers[3]

### Background

Some independent research centres are exploring the educational potential of games to support learners. An example of these is the Futurelab, which has been piloting games such as: *Savannah and Racing Academy* primarily in schools, but more recently in colleges and universities. The focus of their recent exploration has been to evaluate the usefulness of COTS games, and their work has revealed that 31.5% of primary and secondary teachers in schools are already using COTS games in their practice and almost 60% of them would consider using games in the future. Recent survey work with the JISC has revealed that while in FE/HE 5% are using games and 10% are using simulations, a percentage closer to 70% of experts polled would consider using games in the future.

#### Mini case study 3: *Outdoor games for schools*

*Savannah*, a mobile game that introduces young learners to natural history concepts. The game designed at the Futurelab with the BBC National History Unit is designed to enable young children to role play the life of lions in the open savannah. The game allows for a connection to be made between the physical space of the savannah and the virtual hub connected via PDAs over a network connection. The project uses GPS systems to map out the physical space and information is relayed back to the central hub at base camp. This game has interesting implications for learning in that it integrates role play in a physical space with additional prompts such as video footage and discussion to reinforce learning. This project was complex technically to set up and may be difficult to replicate in most school contexts without substantial technical support. It does however reveal how games can be used to cross between physical and virtual spaces however the project also revealed how important learning design around the game is for reinforcing learning.

Figure CS4: Savannah being played by students. Source: Futurelab.

One game-based learning project that aims to address educational challenges of the 21st century through a game, the *Racing Academy* project, uses the metaphor of learners as engineers, mechanics and drivers.

The *Racing Academy* game has been developed by Lateral Visions with Futurelab to support learning communities in the field of engineering and science. The game - a racing car physics simulation - is based upon advanced mathematical techniques and has so far been trialled with GCSE students (Sandford and Williamson, 2004) and undergraduate mechanical engineering students (Turner *et al.*, 2004).

[3] **For more details, see:** http://www.futurelab.org.uk/download/projects/racing_academy.php


Figure 5: Racing Academy: game interface

## The challenge

The main challenge to be addressed by the project centres upon testing whether such a game can adequately support a community of practice centred upon developing a deeper understanding of physics.

## The solution

In the first phase of the project *Racing Academy* will be integrated more fully into the science and engineering curriculum, through design workshops, the second phase of the project will focus upon the evaluation of the use of the game in practice. The evaluation is being undertaken at the University of Bath, Department of Mechanical Engineering, Barnfield Further Education College and Penwith Further Education College.

The main aims of the project are to ascertain whether Racing Academy can support communities of practice based around serious or educational discussion and debate of real physics principles. Although Futurelab and the main partners would like to use the game as a Massively Multiplayer Online Game (MMOG), currently the prototype has been tested in single player mode in classroom/computer room settings with limits imposed on face-to-face communications, using message-board facilities to test and capture the level at which communities of practice are learning from, and sharing in, reflections upon learning. The Futurelab evaluation conducted in 2004 however did not conclusively show that the message boards were indicating learning: 'no deeper exploration of the underlying principles was observed' (Sandford and Williamson, 2004: 24).

Current studies are aiming to evaluate the educational context in order to produce lesson plans, tutor and learner notes and support. This may facilitate better results based upon the provision of specific learning support, such as the use of supporting documentation, lesson plans, supporting resources, face-to-face discussion sessions and collaborative working. The game includes computer-controlled drivers with their own functional car control artificial intelligence (AI), 'capable of driving cars with real physics' (Turner *et al.*, 2004, p.432). The game is being used to support learning about the underlying forces at work in motor engineering and the learners can manipulate over 1,000 parameters including the car tyres, gear ratios using performance testing, racing and use of telemetry outputs.

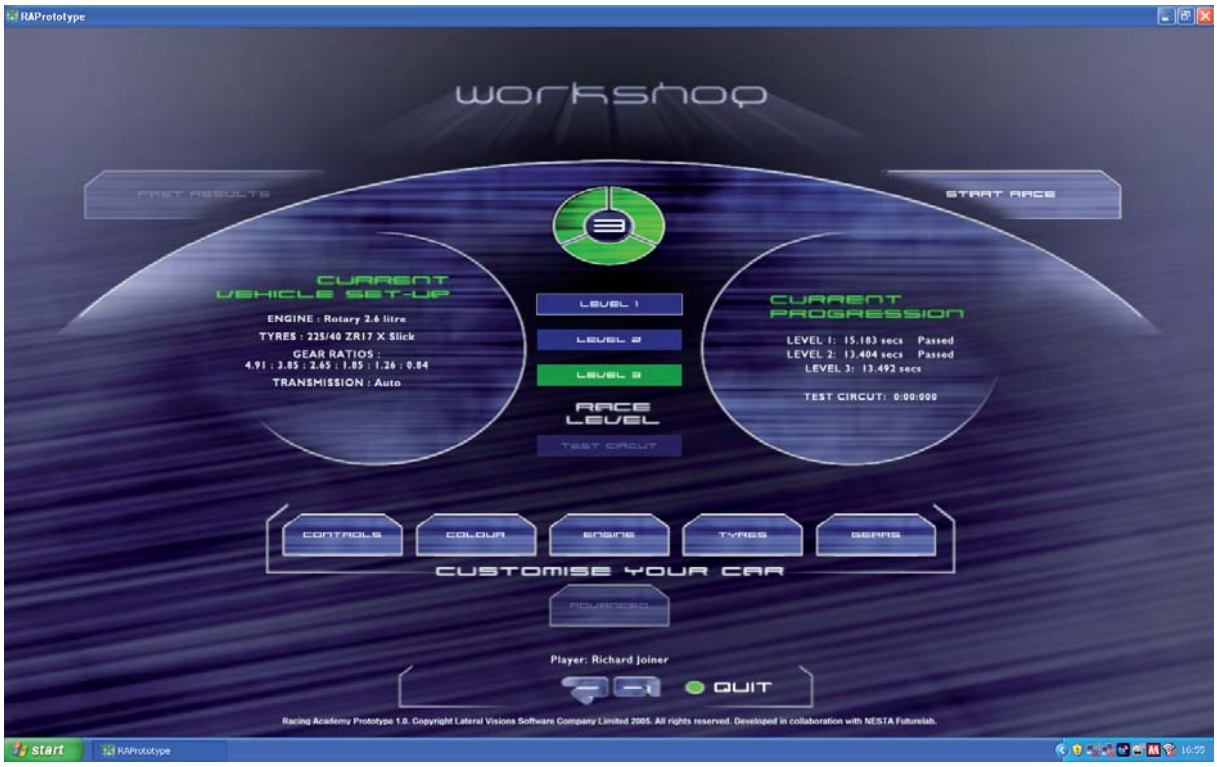



Figure 6: Racing Academy dashboard

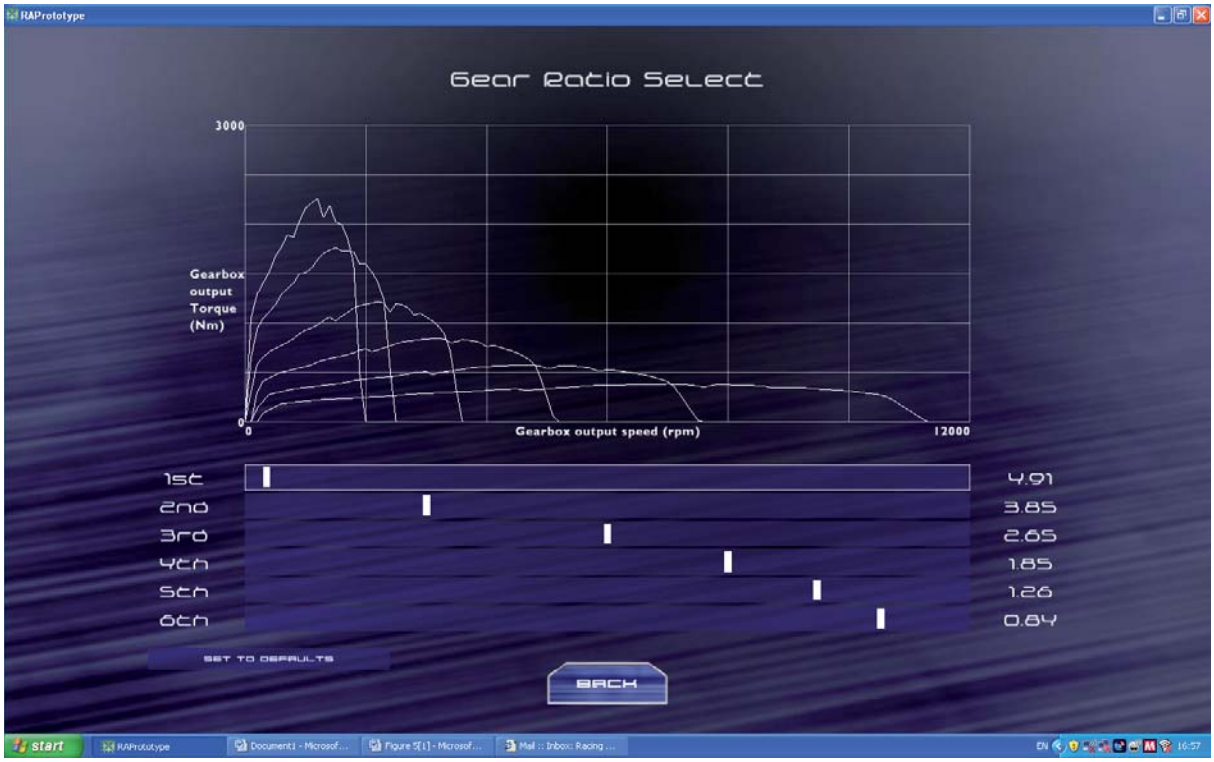



Figure 7: Gear differentials in Racing Academy

As with other game-based learning, the assessment of the 'success' of the game is largely through completion of tasks or levels, individual and group scores are worked out on the basis of race speed times. Wider opportunities for self- and peer- assessment also might be incorporated into the game. The game operates giving the learner increasing access to changing the parameters of the game, as they progress the access increases to more complex parameters and telemetry (e.g. gear ratios), which allows them to control more aspects of the design of

their vehicles. This elaboration theory approach supplements the Lave and Wenger (1991) communities of practice approach whereby learning is situated into specific contexts of practice:

> Knowing is the act of participation in complex social learning systems. Competence in a community is contingent upon one's access to and appropriate use of the community's shared repertoire of communal resources, including language, routines, sensibilities, tools, artefacts, stories, and styles (Joiner and Owen, 2006: 4).

Joiner and Owen argue that computer games are in Gee's words, 'little learning engines', in this way games are social learning systems with 'affinity groups' that centre upon particular game genres. They would like to support this approach through online communications in this project, based upon real physics principles, and where individual students that start as legitimate peripheral participants on the edge of the social system through time become expert members of the system.

| Key points for effective practice |
| --- |
| ■ **Game-based learning may have benefits for learning in groups through social software tools; ensure that these are well tested before using them with learners.** |
| ■ **Ensure that there is an alignment between learning objective, game, activities and assessment in order to support the most effective learning outcomes with game-based learning** |

## Case Study 3: Games for Enterprise Planning at the Business School at the University of Glamorgan[4]

### Background

There is still much that we do not know about how we learn from these 'immersive worlds', but the reinforcement of practiced tasks and activities has been found to accelerate learning (Delanghe, 2001). In addition they have been found to be particularly effective for the rehearsal of task-based activities (elaboration theory), as well as supporting discovery or *exploratory learning* (learning through exploring open-ended environments) approaches where more unbounded experiences can be supported. This makes serious games and simulations particularly adept at supporting both associative and cognitive learning approaches (Mayes and de Freitas, 2006) and recent games developed by the US military (e.g. *America's Army*) allow for both these approaches as well as showing the potential of situative approaches - where learning through communities of practice can be supported effectively. These examples remind us of the potential of immersive worlds to facilitate learning with a number of different cognate approaches: learning as behaviour, learning as knowledge construction and learning as social interaction.

The commercial sector has been quick to use these immersive learning tools and after military and medical training, business training has been one of the more popular areas for supporting the use of simulation-style applications. This has led to uptake of other new applications to support learning, not least business *games*.

Business training is an area that has taken up simulations widely to produce multiple training scenarios for the generic skill sets that business leaders and managers require to support them in the transition from trainee to professional - much as Lave and Wenger describe the movement from legitimate peripheral participant to full participation (1991). Many such simulation tools exist: *Virtual Leader* is one example of this, alongside other professional development games developed by commercial companies. One example of this is Cisco, who has developed several training games as part of their Cisco training suite of materials, for example they have developed *Wireless Explorer* which is an immersive game that allows networking professionals to practice their knowledge of wireless networks in an outer-space style challenge. Learners participate through their capacity to ensure that the amicable space aliens stay in wireless communication

[4] **For more details, see:** http://e-st.glam.ac.uk/simulationgames/GameSim_1.htm

during their deep-space missions. Assessment of the individual and team performance is scored against site survey strategies, deployment of networks and network maintenance.

## The challenge

Following in this tradition, a team at the University of Glamorgan wanted to develop a simulation game engine which could be used to support teaching and learning in a number of different contexts.

## The solution

The team decided to develop the features of a games engine while creating a simulation game for teaching students on the Enterprise Planning module of their Business Studies undergraduate degree programme.

The game has been introduced specifically to meet the challenge of engaging, motivating and retaining learners on the course, and has been developed using Flash software within an object-oriented framework (generated using an XML manifest for web-enablement). It utilizes an animation style 3D visual interface with different avatars (characters in the role play, see call out box on avatars), who ask questions and provide answers for questions selected by the learner. The learner can also collect objects and give these to other game characters. These interactions generate consequences and it is within this model of simple rules that rich and meaningful learning interactions can occur. The software was purposefully developed for use within the University virtual learning environment to aid the transferability of use of the application between different schools.

### Avatars

**An avatar is an interactive representation of a human figure in a games-based or three-dimensional interactive graphical environment. The term was made popular by Neal Stephenson in his novel 'Snow Crash'. For example a person may be represented in a virtual meeting or the tutor in a distance learning context may be represented by their avatar dealing with students. Usually an avatar will have human characteristics, including speech and facial expressions.**

The purpose of the simulation game is to be used as a tool for unlocking 'discussion and creative thinking' (Lynch, 2006: 25) within seminar sessions. The main aim of the project, funded from University development funding, was 'to create a reusable, web-based simulation game engine' for supporting teaching and learning across the University (Lynch, 2006: 25).


Figure 8: Screen shot from the Business game at University of Glamorgan.
Source: Martin Lynch

The game engine, originally designed for use in Business Studies, has since been used to create a virtual ward for use in the School of Care Sciences where paediatric nursing students practice admitting and then treating a child suffering from fever.

The project raises interesting questions about how best to integrate games within traditional learning contexts (see Figure 9) as part of formal face-to-face taught components. The team have adapted an approach to embedding the game as outlined by Garris *et al.* (2002). See Figure 10, here a three-stage model offers inputs including instructional content and game characteristics which lead to processes which combine user judgements and behaviour with immediate system feedback. The emphasis is upon end learning outcomes reinforced by debriefing.

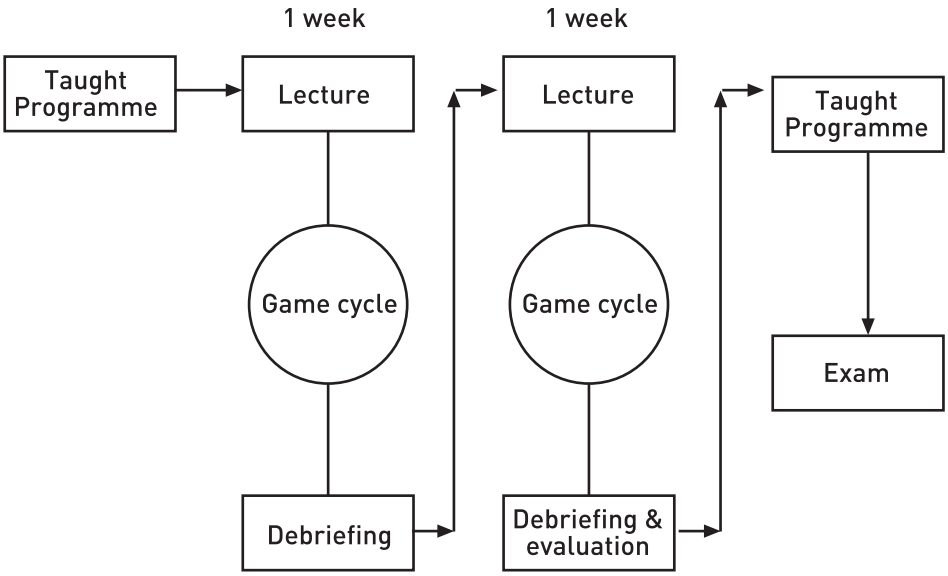



Figure 9: How the game was embedded into the course

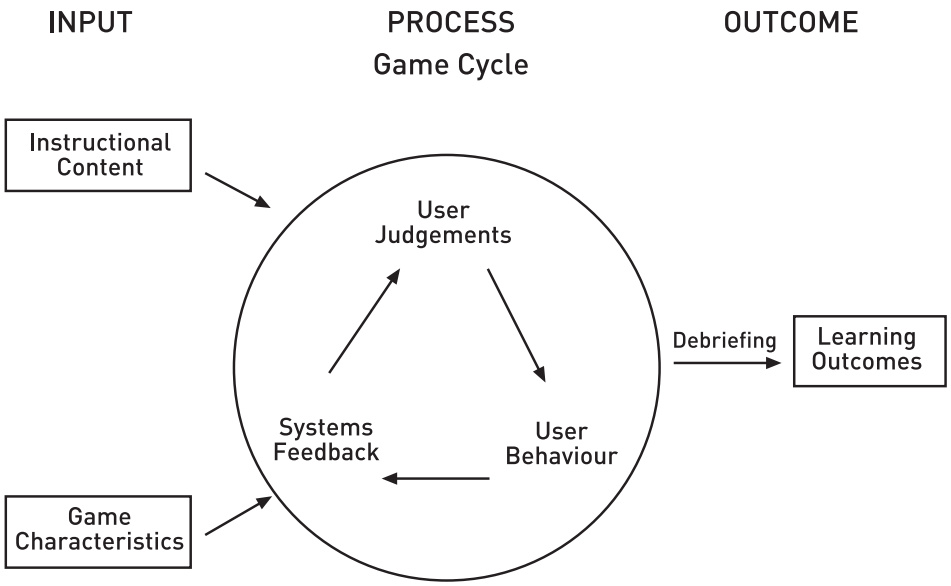



Figure 10: Input-Process-Outcome Game Model
Source: Adapted from Garris, R., Ahlers, R., Driskell, J., 2002

In terms of situating the game into learning practice, Lynch and Tunstall (2006a, b) give an emphasis to the importance of debriefing (or post-exercise reflection). This is well described in the literature around the effective use of simulations (e.g. Crookall, 1995; Petranek, 2000). In order for learning outcomes to be achieved it is necessary with simulations (and games) to reinforce learning that has taken place through meta-reflection and post exercise consideration. This may be done through replaying the simulation, discussion, and dedicated activities that aim to highlight key aspects of the learning. Without this learners may not reinforce the learning process and gains made may be lost. The reason why this is particularly important for role play activities is because a relationship needs to be made between activities occurring in the game world and the learners' relationship with the real world. This process allows the learner to make sense of how the tasks and activities enacted in the immersive world may take on relevance (or a connection) with tasks and activities to be performed in the real or lived world.

| Key points for effective practice |
| --- |
| ■ **Ensure that game-based learning activities are fully integrated with face-to-face learning otherwise learning will not be as effective.** |
| ■ **Provide opportunities for reflection upon learning with games through dialogue and discussion.** |

## 3.2: Games and simulations as microworlds

Many games and simulations are operating upon the notion that learning is based upon discovery and exploration, experimentation and play. One approach to this, has been to view games and simulations as 'microworlds', that is worlds created with objects and artefacts to allow learners to explore a given imaginary or mock-realistic domain or environment in an open-ended way. This approach to learning has been demonstrated to be effective and powerful, and recent research and examples from practice highlight wide potential for games not only for professional development, but also in a range of other learning contexts. Again this approach relies upon the use of role play and narrative to allow learners to suspend their belief and learn through problem solving and team working.

## Case Study 4: UniGame: Social skills and knowledge training: Games for lifelong learners[5]

### Background

Lifelong learning is becoming an increasingly large market, as more and more learners seek to upgrade skills for the fast changing employment market, change careers through retraining and support widening interests and opportunities for learning informally. The internet is creating more opportunities for learning with others from abroad, as well as supporting new chances for learning collaboratively whilst based in different locations. To support these learning opportunities and broaden life experiences, e-learning and now game-based learning are providing new tools with which to support these learner groups.

### The challenge

One of the challenges with learning with remotely located groups is a need to create engaging immersive and interactive opportunities for digital interactions and transactions to take place. Game-based learning offered in different disciplinary areas to remotely located groups of learners would allow for these kinds of learning opportunities. Developing learning experiences that allow learners to inhabit identities within microworlds are complex to design. They need to be immersive, and enable learners to become characters within the microworld,

[5] **For more details, see:** http://www.unigame.net/

allowing for 'perceptions, actions, conversation [and] modes of expression' that allow the learner to participate in social practice (Squire, 2006: 22).

## The solution

One example of this approach is *Unigame: Social skills and knowledge training*, an adaptive online game that can be used by tutors in universities and for lifelong learners to support varied subject areas as defined by the tutor (Dziabenko *et al.*, 2003; Pivec *et al.*, 2003; Pivec and Dziabenko, 2004). The UniGame was developed within the EU Socrates / Minerva project, where five partners (from Austria, Greece, Italy, Sweden and UK) were involved. The *Unigame* developers' aim is to provide a generalised framework to allow every tutor to apply game-based learning with their learners. The approach aims 'to foster participation in problem-solving, effective communication, teamwork, project management as well as soft skills such as responsibility, creativity, micro-entrepreneurship and corporate culture' (Unigame, 2006).

Based upon constructivist and collaborative learning approaches, the game is web-based allowing for its use by remote learner groups, although it is primarily used as part of face-to-face learning activities. Most of the game's parameters can be adapted and tailored to the tutor's activity plan. The *Unigame* team have developed guidelines for tutors to support these kinds of activities (Pivec and Sfiri, 2004; see also Unigame 2006).

Each game uses a specific topic moderated by the tutor, and the tutor plays the role of facilitator during game play, coordinating discussion and deciding upon outcomes of the discussion. Used in this way, the players form four teams each with up to eleven players; the multiplayer game can be used with up to 44 players (in 4 teams). The play time of the game can take from several days to a few weeks to play, depending upon the complexity of the subject under consideration, the skills of the learners and the number of players (Pivec and Sfiri, 2004).

The aim for each player is to comprehend their role within the team and engage in discussion about a specified topic area. Through this general discussion the goal is to reach general consensus with the other teams. Peer assessment is through chip allocation, whereby points (chips) are allocated to teams that come to a group consensus. The team that accumulates the most points wins the game.

> The players gain knowledge over this subject by searching for information and using it in the discussions that follow with other teams' members. The game's platform offers several means for communication to its users. Users are able to communicate with each other by using private or public forums, both text and voice chat modules and virtual meetings, which are enhanced by audio/video interaction, a shared whiteboard and a presentation table, where users are able to create an online presentation (Dziabenko *et al.*, 2003: 2).

During the game play learners are training their social skills, working collaboratively to find and share information and to develop their argumentation strategies and understanding of the subject area. Different communicational means, such as discussion forums, text and chat, as well as video conferencing, are used within play groups and with the wider game teams. These are available to support collaboration and are accessible through the project web site (Unigame, 2006).

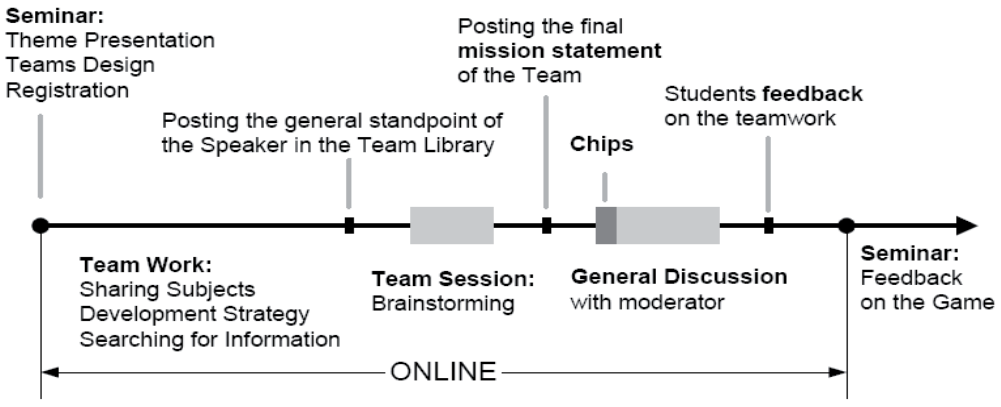



Figure 11: Blended learning approach taken to using game-based learning with Unigame. Source: Unigame.

The game is often used in sessions using a blended learning approach that includes five main elements:

1. Introductory seminar, where the tutor introduces the topic area with the learners and learners register on the system.
2. Team work and team preparation, includes teams forming online (e.g. 'Government', Environmental groups', 'Industry'), personalised roles also are selected within each team (e.g. Minister, Chief Executive Officer). Each team has a team leader, and each subject has a team speaker. The team space includes forum, video conferencing facilities, a library, member list and dynamic profile. All the work is collated in a Subject Standpoint – a document that collates the teams' position. A final mission statement is produced. This document is the main basis for the General Discussion between the different teams.
3. Point allocation, points are allocated to each subject indicating priorities. This is done in a 30 minute session.
4. The General discussion takes place in the video conference, and the different subjects are debated. White board and text chat facilities further support communications between the remote teams. The moderator coordinates debate and signals when general consensus has been made. The team with the most points over the discussion wins the game.
5. Student feedback is given and discussion about the game may take place in the virtual or face-to-face seminar debriefing. When the tutor is satisfied with the level of feedback given the game is finished (see *Figure 11*).

Based upon *Unigame* the University of Edinburgh-developed ***Oaklands Game*** provides a role play based upon the discussion about the decision whether to implement a particular approach using information technology: Manufacturing Resource Planning (MRPII), in a medium-sized firm: Oakland Furniture. The participants each take on the roles of board members and of an external consultant. The game utilizes a range of social software and web-based tools to deliver a generic solution to the challenge of engaging remotely located learners, and may be particularly useful for supporting distance and remote lifelong learner groups where discussion-based learning and the development of social skills is a primary aim.


Figure 12: Screen shot from Oaklands game

## Mini case study 4: *Games for supporting student finance-planning*

A set of games specially designed to support students grappling with their finances have been developed by Uniaid, a student's charity. They have commissioned several games including: *All About U* and *Student Survivor*. These Flash-based web games focus upon supporting students, providing help with planning student finances. The games are being used by school and college students, and are available over the Web.

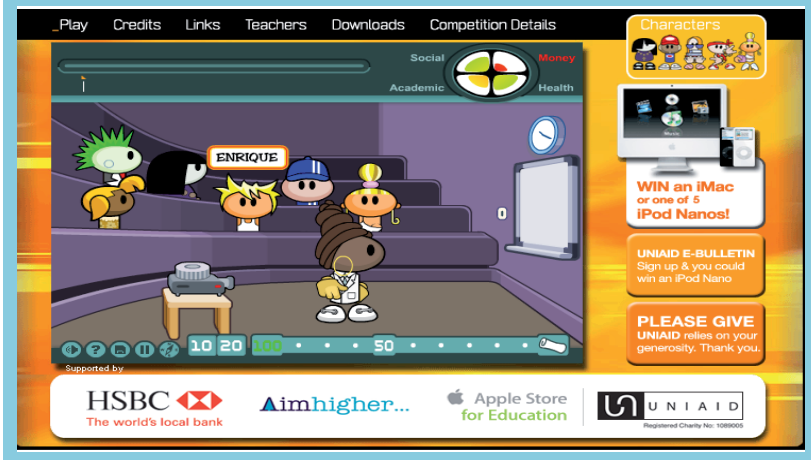



Figure CS5: Student survivor. Source: Uniaid.

The game adopts a more generic approach to game-based learning that is based upon the creation of new scenarios. Using an approach which utilizes a generic shell (in Flash or Java) is becoming more popular. These can be tailored for different teaching subjects and topic areas. For example, University of Sheffield Hallam is starting work this year which aims to develop 15 reusable Flash shells allowing for re-purposing according to different discipline and topic areas (A. Middleton, email communications, 3rd August, 2006).

| Key points for effective practice |
| --- |
| ■ **Introduce a feedback loop into learning activities to ensure that the game-based learning remains relevant and effective in learning practice.** |
| ■ **Align assessment with game-based learning activities to ensure that it is effective.** |

## Case Study 5: Neverwinter Nights: Role play in microworlds[6]

### Background

Games are being used effectively to teach key and basic skills (de Freitas *et al.*, 2006). Examples of this trend in the UK include the use of Ufl Learndirect's *Max Trax* to support numeracy basic skills; and the Learning and Skills Development Agency's (now Learning Skills Network) *Key Skills Trainer*, for supporting key skills to Level 2, both are used primarily for adult learners (de Freitas *et al.*, 2006), as well as Flash-based *Skillswise* games developed by the BBC.

[6] **For more details, see:** http://nwn.bioware.com/ and http://www.educationarcade.org/revolution

## The challenge

According to one of the West Nottingham Curriculum Team Leaders, one of the reasons that games have been used to support key and basic skills is because students are often not very engaged with the subject area and lack motivation to complete the portfolio course work (Galloway, 2006). Games therefore have been deployed to re-engage and re-motivate learners in this field of learning.

## The solution

Continuing in this tradition of using games to support basic and key skills, tutors at West Nottinghamshire College have been using an immersive commercial-off-the-shelf (COTS) game called *Neverwinter Nights*, which has been modified to teach FE students Key Skills (Level 1: Application of Number and Communication). See *Figure 13: Screen shot from Neverwinter Nights*.


Figure 13: Screen shot from Neverwinter Nights

*Neverwinter Nights* is an interactive and immersive adventure-style game set in the mythical worlds with Barbarians and Wizards. The *Neverwinter Nights* game, developed by Bioware for Atari, has been modified [see Call out box on Modding] to include dedicated learning resources for key skills learners, as well as providing supplementary functionality for reflection during game play, including a journal facility that can be used for making notes. While instances of COTS games being used effectively have not been widely supported in studies; developers have modified the *Neverwinter Nights* game - to include dedicated learning resources and activities.

### Modifying games software

**Modding is a slang term for modifying software or hardware. Modding is when software or hardware is modified in order to perform a function that was not originally intended. In the games context, mods are created 'user modifications' of leisure games and can offer new content for an existing game or 'total conversion' mods that change the game significantly. An example of this is *Revolution*, which completely transforms the original Neverwinter Nights software.**

This assessment prompted the college team to integrate learning activities into the *Neverwinter Nights* game, to improve the motivation of learners and keep them engaged to ensure completion of the course and course work. To create the modified game, the commercial developers worked with West Nottinghamshire College. The Further Education College has since won the Association of Colleges Becta Beacon Award (2004/5) for the effective use of information learning technology to enhance teaching and learning support, and the game has been used successfully since 2002 with 1,500 students at West Nottinghamshire College completing the course to date. The game is currently being used in 30 other colleges in the UK, using the software, which is licensed for 750GBP per

site, and the team continues to provide support for the wider community through technical support, a dedicated telephone helpline and demonstrations of the game.

Notably, the impact upon course completion and grades of key skills in the college has increased from 30% to 100% in the college between 2001 and 2006, and the students have found the game-based learning approach to be far more engaging that the original text version. Learner comments taken from the beta testing phase (Oldham, 2003) included:

> *Pretty cool game. I played at home in my spare time*
>
> *Neverwinter Nights gets you interested*
>
> *Fun I like it*
>
> *Prefer Neverwinter Nights over text based learning*

Additionally, ***Neverwinter Nights*** has been used in other higher education contexts; for example at the University of Alberta in Canada (Gouglas ***et al***. 2006). The ***Neverwinter Nights*** title has also been modified and used for educational purposes in the USA, where the interface has been significantly changed to facilitate teaching of American Revolution history. The modified game: ***Revolution*** was developed by the MIT-University of Wisconsin Education Arcade initiative, led by the project director Henry Jenkins and with a design and development team led by Philip Tan (Education Arcade, 2006). The initial design document was written by Matt Weise with additional inputs from Kurt Squire.

Russell Francis (based at Oxford University) and MIT researchers have undertaken studies to assess the effectiveness of usage of the re-titled ***Revolution*** for school learners (Francis, 2006a; b). Francis's efforts were focussed on developing a scheme of work around the game and exploring how best it might be used as an educational tool in the classroom. The study focused upon a series of workshops held at MIT in the spring of 2005, here ***Revolution*** was used with groups of home-schooled students and a high-school history class. The study aimed to explore the educational potential of virtual role as a new medium for supporting learning and teaching about social aspects of history. (See Figures 14: screen shot from ***Revolution***).


Figure 14: Screen shot from *Revolution*

The study focused upon story telling as the basis for experiential learning [see call out box on Experiential learning]:

> Story-telling has played an important role in humanities education since the advent of formal schooling. Stories are fictional constructs. However, stories based on historical events or stories that explore real world social issues allow learners to step out of the immediacy of the present and imagine what it might be like to be someone else who may have lived at a different time, place or under different social-historical circumstances (Francis, 2006: 2).

## Experiential learning

**Experiential learning is a model of learning developed by David Kolb, in 1984. His model is developed from the learning cycle developed by Kurt Lewin (a Gestalt psychologist - 1890-1947). The experiential cycle suggests that there are four stages of adult learning: concrete experience, reflection, abstract conceptualisation and active experimentation. Kolb also built on the work of John Dewey and Jean Piaget and the constructivist notions that learning builds upon meaning construction.**

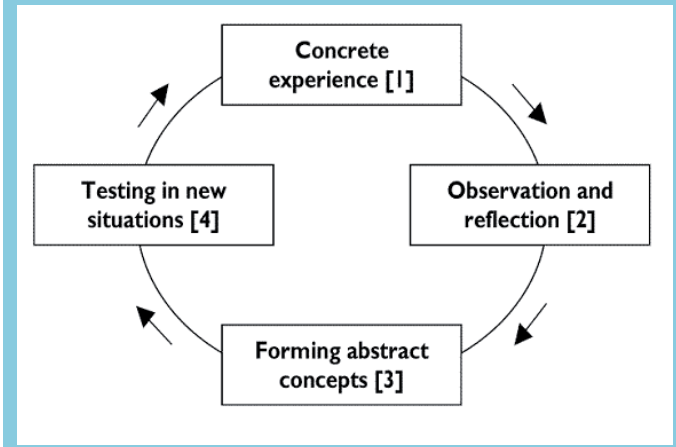



Figure A1: The experiential learning cycle. Source: Kolb, 1984.

One of the main differences between traditional story-telling and game-based story-telling is what Murray refers to as the 'push against the boundaries of linear narrative' (Murray, 1997). In this way, in game-based narrative, linearity is exchanged for multiple potential narrative routes, and the player becomes an 'active agent who constructs their own narrative path' (Francis, 2006:2). Player choice in terms of narrative path becomes a more empowering aspect of the process of play in these narrative based environments. In this way, player autonomy was found to be a significant motivator for learners (see also Sandford *et al.*, 2006). Alongside more choice of narrative line taken, in the *Revolution* study the issue of identification of the learner with the historical figures depicted as 'avatars' is also significant [see call out box on Avatars]. The choice of character taken similarly allows the learner to reconstruct a view of history from the character's point of view, thereby reflecting upon the social historical figure (e.g. slave) and their view and experience of the social reality presented. Evidence of these experiences can be viewed in the machinima diaries produced by the students about their experiences (Education Arcade, 2006).

Role play is a critical aspect of many games, particularly adventure or 'God games', these games still retain the goal orientation, but rely upon the identification of the player with the character - avatar - who represents them within the game-world or 'micro-world'. In learning contexts role plays are used regularly and provide an excellent support for collaborative learning approaches where learners may, for example, take on another role as an interviewer perhaps, or key role in history, enacting an interview or an episode in history.

Designing role plays allows students to empathize and reflect upon situations from real life or past history and so interrogate its significance in a more direct and meaningful way. Francis surmises that: 'students develop a holistic understanding of the simulated social system absorbing information from multiple modes (visual, textual, symbolic interactions) generated through interaction with virtual objects and people' (Francis, 2006:17). But also that 'knowledge of the simulated social system is constructed iteratively as players test out and revise particular hypotheses in situated practice' (Francis, 2006:17).

One games design research team regards role play as central to game play, and has defined an eight-step process for designing role plays for learning:

1. Identify the potential activity as a role play simulation
2. Articulate the learning objectives
3. Identify the major stakeholders and different stakeholder perspectives involved in the activity

4. Create the scenario and identify learning opportunities in the scenario for different stakeholders
5. Select appropriate stakeholders to become playing roles
6. Identify the meeting places
7. Design the learning episodes, which have learning goals and tasks in line with the overall learning objectives
8. Identify resources for each of the playing roles (Joanneum and Edinburgh, 2002: 18).

This approach could easily mirror the serious games development process (de Freitas and Jarvis, 2006) and if games are to be effective, role play games need to adapt to players' 'disposition, real world identity and willingness to identify with a specific role' (Francis, 2006: 17). However Francis also cautions us that when using game-based approaches that 'there is a danger that much of the knowledge acquired through situated role play might remain tacit' (Francis, 2006: 17), and therefore the process of meta-cognition through dialogue, group work and reflective practice is central, and needs to be clearly supported by the tutor through activities and discussion.

| Key points for effective practice |
| --- |
| ■ Design role plays to allow students to empathise and reflect upon situations from real life, this will support learner motivation and allow learners to transfer learning from a learning context to a real life context more readily |
| ■ Develop realistic scenarios to allow transfer of learning from rehearsal to real life contexts |

## Case Study 6: Legal practice in Ardcalloch at the Glasgow Graduate School of Law[7]

## Background

The military have been using simulations to support effective training since the earliest days of computing, and as such have been on the cutting edge of technological and social changes. They have been using the latest equipment and training approaches to accelerate learning and to reduce the high costs associated with conventional training methods. The military have been pioneering and using computer based training and synthetic environments for decades and while scientific studies have been few - the continued use and development of these approaches provide some evidence in itself of the success of these methods to train military forces. The US military in particular has identified the power of games and has been quick to develop some of the most engaging examples of serious games for multi-players. Particular examples of this trend are *Full Spectrum Command*, *Full Spectrum Warrior* and *America's Army* (de Freitas *et al.* 2006; Li, 2004).

While simulations have a long history of use with the professions such as legal, medical and military, and business training, uptake in other educational areas has been slower. While it is not definitive that this is because of the vocational dimension and effectiveness of simulations in those particular contexts, there is a clear link between effective use of simulations and vocational practices. However in a climate where greater relevance of work-based learning is being heralded as important both for learners (and their orientation into work) and industry (and their requirements for specific skill-sets) this area of educational practice may well become more widespread, particularly as the use and application of ICT becomes cheaper to deploy and the skills of tutors through CPD develop to match these innovative uses.

The use of microworlds therefore has potential for learning in many vocational contexts, particularly the scope for developing scenario-based learning opportunities, supporting social interactions and learning transactions. Role play and character identification are two components that make learning in microworlds effective. Another aspect of the process is well illustrated by a simulation that has been developed at the University of Strathclyde.

[7] **For more details, see:** http://www.ardcalloch.ggsl.strath.ac.uk/introduction/

## Mini case study 5: *America's Army: a serious online game*

**America's Army was developed for the US Army by the Moves Institute, and while it is now the largest online gaming community with 7.3 million current users (M. Zyda, email correspondence 27th June 2006), its quality and popularity underline the fact that this is one of the first serious games to be developed and used widely (even beyond its intended audience). The popularity of the game has led others to follow suit, but its blend of training and entertainment has set a high standard for subsequent serious games applications to follow. One of the interesting aspects of America's Army is the range of the kinds of skills gained and improved by using these games and simulations. These may include: decision making, part-task practice such as hand-eye coordination, logistics training, leadership, complex problem solving, team-based strategic thinking, management skills (e.g. planning, communications, self-reliance), as well as the drill-and-practice tasking (e.g. relevant legal guidance, arms training and military strategy). Another example of this approach that focuses upon drill-and-practice tasks, the US Navy Recruiting Command has developed Strike and Retrieve - an online game-based on shooting skills and aimed at young adults, ages 17 to 24.**

### The challenge

The main challenge for colleagues at the Glasgow Graduate School of Law at the University of Strathclyde was how to best utilize ICT to aid law students to make a smoother transition from academic study of the law into vocational legal practice.

### The solution

The Diploma in Legal Practice offered at the Glasgow Graduate School of Law (GGSL), University of Strathclyde, is a vocationally orientated postgraduate course. The course aims to introduce learners who have completed their undergraduate studies in Law to the knowledge, skills, attitudes and values required to become advocates and solicitors in Scotland. The course is mandated by the Law Society of Scotland, and involves eight compulsory subject areas and one option subject choice. Following the course students then enter a two-year traineeship, on successful completion of which they are deemed 'fit and proper' to enter the legal profession.

To support their students, Paul Maharg, Karen Barton and colleagues at the GGSL developed a blended learning solution evolving a traditional lecture- and tutorial-based course with academic examinations into a highly interactive and practice-based set of activities supported by online collaborative assessments. The main focus of the Diploma is the fictional west coast Scottish provincial town of *Ardcalloch*.

The virtual town of *Ardcalloch* includes businesses (including virtual law firms), institutions and citizens – in short, the 'realia' of local urban life. The town - accessed via the University intranet - allows learners to take up the role of legal practitioners operating in *Ardcalloch*, supported by databases of legal documents and templates, forums for discussion with tutors (who, being practitioners, double in their roles within a transaction), email communications with other firms and supervisors, and activity and personal logs. In addition to these resources, learners can also access video course lectures, multimedia, online drafting tools, notes, documents and assignments through this means. Tutor-practitioners, in seminars as well as through online support and communications, support the learners throughout the simulated transactions

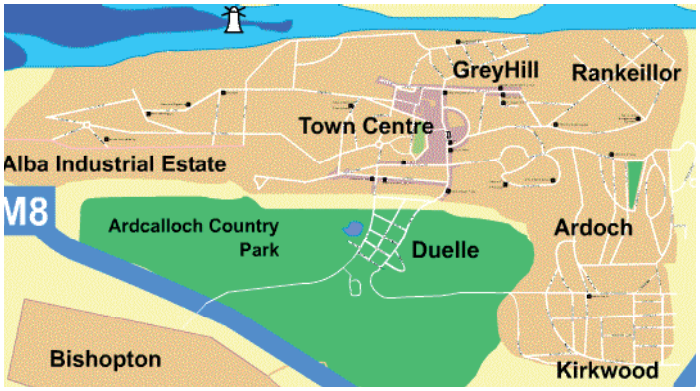



Figure 15: Map of Ardcalloch


Figure 16: Ardcalloch Directory of local businesses.

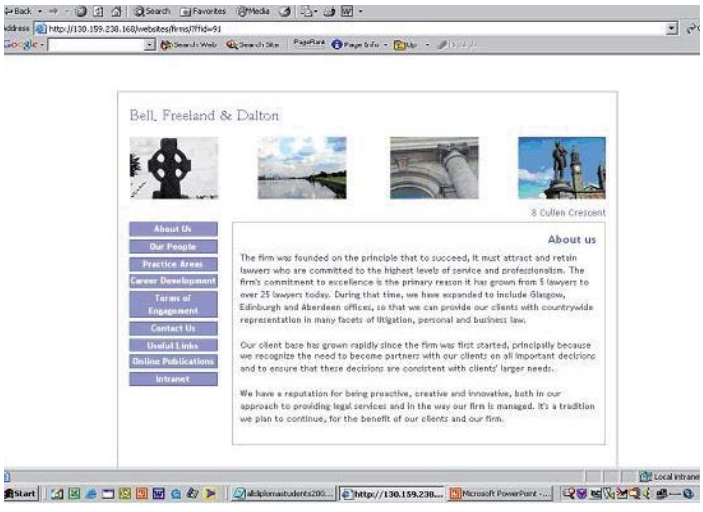



Figure 17: Web site for a 'virtual' legal firm in Ardcalloch.

According to the designers of the course (Barton and Maharg, 2006; Maharg, 2006), the simulation depends upon three main factors:

- Design of learning outcomes and activities,
- Type of simulation field (e.g. bounded or open), and,
- Organization of communities of practice supporting the simulated activities.

The type of simulation used depends upon the learning outcomes desired and the type of transaction that is the focus of the simulation. Thus certain transactions are fairly linear – winding up the estate of a deceased client, for instance - and produce a 'bounded field' of simulation that rely upon more 'specific and precise' outcomes (Barton and Maharg, 2006). Other transactions are more flexible and less well-structured. This 'open field' of practice does not require specified learning outcomes but rather specifically wide-ranging activities and bodies of evidence in the form of a transaction file. It is noteworthy that both types of simulated activities warrant assessment, the type of assessment being real-world based and consistent with legal practice outcomes such as winning an adversarial case, following correct procedures, managing risk, and being aware of ethical and client-centred practice. In this way, Barton argues that it is the 'realia' – that is the choice of which items learners will want use, the 'virtual objects' - that lends authenticity to the activities, allowing the learners to have a more realistic set of experiences (Couture, 2004).

Barton and Maharg suggest a notion of the 'depth of field' as a way of assisting designers of complex simulations, this 'depth of field' (similar to the photographer or cinematographer's use) and similar to the notion of *diegesis* (that is the internal space within of the game, see: de Freitas and Oliver, 2006) allows designers to place 'realia' and objects within the simulation to allow learners to have a freer opportunity to explore the simulation. This includes intended objects as well as incidental ones. As in the notion of diegesis, the realism of this allows the learner to become more immersed within the space, a factor that is non-dependent upon the fidelity or verisimilitude of the simulation – that is the realism of the look of the space, but more dependent upon the realism of the experiences within the space.

The organization of the user communities in *Ardcalloch* is supported by the realism and immersive nature of the activities *per se*. This allows and facilitates an identity change through role play from the undergraduate student to the legal practitioner – as we saw in the study on *Revolution* where the student 'became' the slave of the 18th century. This process of change is critical in this course, which is organized to provide a bridge between academic study and vocational practice (Barton and Westwood, 2006). The simulation allows the learner to make these changes in a safe and controllable environment, without adversely affecting any real world clients. The identity formation that takes place in the learner allows a 'scaffolded' approach on the part of the tutors and designers who are able 'to enable learners to work within the problems and issues that arise when professional identity is first formed' (Barton and Maharg, 2006). That is, scaffolding for learning assists learners in constructing more complex thinking tools for learning (Hogan and Pressley, 1997).

This course indicates that the use of simulations can not only inform the process of learning but can also provide a clear structure for how simulations can be used effectively to support identity change and professional development within a formal educational setting. The link from academic endeavour to vocational practice has been well conceived in this exemplar. The exemplar also demonstrates that effective use of immersive worlds needs to be carefully planned into group activities and social interactions, through scaffolded learning, discussion and reflection.

| **Key points for effective practice** |
| --- |
| ■ **Place aspects of learning carefully within immersive environments to allow the learner control over when and how they engage with them.** |
| ■ **Consider the level of immersion as part of the learning design to ensure that learning is most effective** |

## 3.3: Games as tools - for rehearsing and skills therapy

Games are increasingly being used to support improving specific skills or part tasks. This approach borrows from simulation trainers and in particular from associative learning approaches with an emphasis upon simple skills, repetition of tasks, and progressively more difficult activities (elaboration theory). There are many examples of this approach to game-based learning (e.g. *Max Trax*, *Key Skills Trainer*), and while it is popular, its use is most effective with specified skills, in contrast to microworlds where more open ended experimentation works well, these games are more limited in scope, but may be easier to test and use in practice, because they are more targeted and require less ICT skills on the part of the tutor and learner. *Skillswise* and *Webwise* are other examples of these kinds of games, which are often developed in Flash and can often be accessed directly over the web. Use is generally with Flash Media Player, which can be downloaded relatively easily from the internet. Ease of access and use are making these games relatively popular, but they cannot be modified and are limited in application.

The impact of games in health care and for therapy is beginning to have a significant impact, for example being used for pain relief for burns victims while being treated (*SnowWorld*, University of Washington). Educational games are also being used for therapeutic purposes, some of which are based upon 'life challenges' that is where human interactions are used to rehearse life skills. An example of this approach are the microworlds within *Second Life* being created to allow learners with Asberger's Syndrome to act out activities of daily life such as social interaction, budgeting and shopping in order to practice skills, and for those with Schizophrenia to introduce them to challenges that they may face in a safe environment.

The London Knowledge Lab a collaborative venture between the UK Institute of Education and Birkbeck College has worked on a range of different game-based learning projects including the: PACCIT-funded *Making games* project and more recently the *Serious Games: Engaging Training Solutions* project part-funded by the UK Department of Trade and Industry and partly by the commercial partners Vega Group PLC and TruSim (Division of Blitz Games) the project involving academic partners aims to develop dedicated training applications to support specific business needs, for example one demonstrator will aim to train medical staff in infection control (de Freitas and Jarvis, 2006). While the *Making Games* project evaluated how learners with literacy challenges were supported through the use of game-based learning (Pelletier, 2005b) see Figure 18; the *Serious Games* project aims to explore the development of generic frameworks and tools to inform serious games design and produce empirical data to interrogate assertions that targeted user groups can be best supported by dedicated games for learning (de Freitas and Jarvis, 2006).


Figure 18: Screen shot from Making Games Project.

Figure 19: Screen shot from the Institute of Creative Techologies-developed Post-Traumatic Stress Trainer

Much of the literature surrounding simulations highlight the importance of feedback, and in particular immediate feedback, as a particular strength of the form. The immediate feedback can allow learners to alter their performance more quickly often leading to accelerated learning times (Delanghe, 2001). These games are sometimes referred to as drill-and-practice games, as they often rely upon repetition, and associative approaches to training (Gagne) and often the activities will become increasingly difficult. Marketed as a cognitive assistive tool, the *Brain Trainer* is a game-based upon the cognitive research of Michael Merzenich, a neuroscientist and cofounder of Posit Science in San Francisco, and is being used with Octogenarians to reverse cognitive

aging (Singer, 2006). Another similar game is *Dr Kawashima's Brain Training: How Old Is Your Brain?* combining arithmetic, puzzles, sudoku and other quizzes, completed at speed, and which over time can reduce your 'brain age' to 21. The game is offered on Nintendo DS handhelds.

The University of Southern California's Institute for Creative Technologies (ICT) also has been funded through the US Army to develop immersive learning spaces for therapeutic purposes. One example of their work includes the Virtual Reality (VR) Assessment and Treatment of Combat-Related Post-Traumatic Stress Disorder (PTSD) project, which had developed an immersive virtual environment application for the treating Iraq War veterans with PTSD, see figure 19.

## Mini case study 6: *Emergency control training*

Games are increasingly being used by Government agencies to support training for emergency services. *Hazmat: Hotzone* is one example of this trend. The training programme, developed by the Entertainment Technology Centre based at Carnegie-Mellon University in Pittsburgh, was produced in conjunction with the New York City Fire Department. The game world is used to create an instructional aid for training fire-fighting teams in how to operate in major emergencies such as chemical spills or bioterrorism.

Founded upon collaboration between government, industry and academia to design and use interoperable distributing learning systems (Wisher and Fletcher, 2004), the US Department of Defense (DoD) set up the Academic Advanced Distributed Learning (ADL) Co-Lab at the University of Wisconsin-Madison. The ADL initiative aims 'to examine methods for learning management systems to link simulations and online games as a means to enrich learning environments and enhance learning outcomes' (Bonk and Dennen, 2005:11). The ADL Co-Lab has undertaken some pioneering research and development work in the field of simulations and games for training (Squire, 2003; Steinkuehler, 2004; in press; Gee, 2003). One example of this work is the game *Outbreak Quest*, developed in 2004 as a collaborative effort between the Centers for Disease Control and Prevention (CDC) and the ADL Co-Lab. It involved the development of a prototype simulation of one partial scenario incorporating the activities and events building up to detecting a potential outbreak of disease in a local or state health department (Martinez-Gallagher and Norton, 2004).

*Outbreak Quest*, the developers argue is similar to the game *Myst*. However, while in *Myst* players use analysis and logic to solve puzzles, in *Outbreak Quest*, players use investigative decision making skills to solve puzzles and continue the game narrative. In *Outbreak Quest* the dialogues and interactions with other characters are central to the training application (See Figures D6/7). The developers' argue that the adventure game genre fits the activity of the epidemiologist as the investigation of how diseases spread relies upon the investigator building an accurate narrative (Martinez-Gallagher and Norton, 2004: 5).


Figure CS6: Screen shot from Outbreak Quest


Figure CS7: Screen shot from Outbreak Quest

Another recent example of the trend, is *Pulse!!* - The Virtual Clinical Learning Lab - is a virtual training environment designed to support a range of the training needs nurses and medical professionals require. The Department of the Navy's Office of Naval Research is funding the immersive virtual learning space, being developed by BreakAway Ltd, for the Texas AandM University-Corpus Christi. The aim of *Pulse!!* is to provide an environment in which civilian and military medical professionals can practice their clinical skills aiding response mechanisms for large-scale incidents. Virtual patients, using artificial intelligence (AI) will respond in lifelike ways to environmental changes and medical techniques and skills used by the trainees. The system may be used by new

trainees or for established professionals to update training.

The concept of using a *game as an interface to a suite of training content* and individual and group activities is a recent one, and in part emerges from the success of online games such as *America's Army* to engage and retain the interests of trainees from around the world to complete all stages of the game. In addition, socio-technological developments such as: increasing processing power, better infrastructure for networking computers, developments in software and the emergence of online communities have allowed for more opportunities for using high fidelity interactive systems in a range of different contexts. It may be envisaged that these and other developments, such as mobile wireless capabilities and pervasive gaming, may also become part of a more synthesized set of interfaces allowing for more complex information sets to be presented to groups of learners, part of a more general trend towards the convergence of technologies – or rather integration of different technologies and forms. It is clear that the military will continue to utilize this and other approaches to support more immersive and realistic training environments, perhaps even using the game as an overarching interface for channelling more complex training scenarios.

## Case Study 7: *Second Life*: Living in a metaverse[8]

### Background

Developed by Cory Ondrejka and colleagues at the Linden Lab, the *Second Life* metaverse was launched in 2003. Since then it has become a popular online world with over 1 million residents and a GDP (gross domestic product) value of $64 million.

Inspired by Neil Stephenson's novel *Snowcrash* (1994) and its 'Metaverse' idea, the environment supports the building and development of an online world and its virtual real estate developed by users can be bought and sold online (Ondrejka, 2004; 2006).

> While other science fiction had described immersive online games and virtual spaces, Stephenson was the first to describe an online environment that was a real place to its users, one where they interacted using the real world as a metaphor and were entertained, socialized and conducted business (Ondrejka, 2004: 2).

The metaverse has 700 central processing units (CPUs), resulting in 44km$^2$ of space being simulated. Users can populate their real estate with objects, clothes and artefacts that they create and own, but can also share and sell. Interestingly, the demographics of users of *Second Life* show an equal gender split, and when regularly polled the users are also equally split when asked if *Second Life* is a game. One notable aspect of the online world is that creation takes place real-time with the world, not using separate programmes, this 'encourages teams to work together on larger scale projects and creates the strong interpersonal bonds that are critical to online world success' (Ondrejka, 2004: 10). Notably, over 95% of the objects in *Second Life* are user created. The commitment of users is evidenced by the amount of time users are spending in the online world, with 25% of users spending more than 30 hours per week (Ondrejka, 2004).

Perhaps most intriguingly *Second Life* is a direct product of academic collaboration, notably the decision to allow residents to create their own objects was a result of an academic roundtable (Lessig, 2003).

> Linden Lab's development of *Second Life* provides an inside look at academic collaboration because academic feedback has been critical to several important decisions during *Second Life's* development cycle (Ondrejka, 2006: 113).

### The challenge

*Second Life* provides an immersive space for supporting user communities and their varied activities, including events and seminars. Whilst the vast majority of activity there is commercial and leisure orientated, a range of communities have been developing in *Second Life* meeting a wide range of educational and therapeutic challenges. A major challenge has been how to engage and create cohesion within these user communities.

### The solution

One example of a learning application for therapeutic purposes within *Second Life* is *Virtual Hallucinations*, this demonstration allows users to develop a better understanding of how a sufferer of schizophrenia experiences the world.

[8] For more details, see: http://secondlife.com/

It includes simulations of visual and auditory hallucinations, based upon accounts from real-world sufferers.

An example of a community within *Second Life* using the therapy model is *Brigadoon* – this is an island that provides its 12 members, who have autism or Asperger's Syndrome, with an environment within which they can interact with one another and learn to communicate in different ways. The metaverse which includes live chat facilities, as well as other supports for community members (using blogs and messaging) provides the opportunity for individuals to practice social skills in a safe and risk free context. Community members find this a more comfortable training context – less threatening than direct face-to-face contact. One user commented:

> It's easier engaging in conversation on *Brigadoon* than in the real world. And *Brigadoon* enables mobility; I spend much time in a wheelchair because of progressive spinal disease. I can participate in activities that I'd otherwise mourn (Salman, 2006).

Another example of the therapeutic use of the world is *Live2Give* which provides a similar environment this time supporting a community of severely physically disabled people with opportunities for improved opportunities for communications, interactions and expression.

The educational uses of *Second Life* are notable as well. *Campus: Second Life* is an initiative to support schools, colleges and universities to utilize the game-environment to teach different subjects. Early projects have included areas of study such as the Media Studies Department at Vassar College (Poughkeepsie, NY), Trinity University, the University of Buffalo, the Department of Design and Industry at San Francisco State University and the School of Architecture, University of Texas, Austin (see Figure 20). Anne Beamish, Assistant Professor in the School of Architecture, University of Texas, Austin commented:

> My students set out to investigate the early development of the resident community within *Second Life*... They became residents of the *Second Life* world, contributing their different skills and testing the limits of the system. They worked together in real time and addressed a variety of issues, including economic structure, social architecture, building density, and traffic patterns. *Second Life* gave my students a laboratory for testing their ideas that just isn't readily available anywhere else (Linden Lab, 2004).

Figure 20: Screen shot from Campus: *Second Life*

These communities are operating in new and often creative ways to support a range of learning processes that are usually not curriculum based. Despite this, the communities are developing interesting experiences that are broadly informing development and communications that extend their current competencies and skills. Further research is being undertaken in *Second Life* and it is hoped that the metaverse will open up new opportunities for underserved learners as well as informing the development of formal immersive learning experiences. Learning in the context of immersive worlds is beginning to have more wide ranging uses and applications beyond learning basic skills, and as *Second Life* communities demonstrate, interactions within and between groups are opening up new opportunities for learning beyond the classroom confines (physically and conceptually). This does present real challenges for learning with games and immersively, and opens up new opportunities for innovating practitioners to create new approaches and spaces for learning.

| Key points for effective practice |
| --- |
| ■ **Learning through exploration is one of the strengths of game-based learning, allowing learners and learner groups time and scope for exploring environments freely** |
| ■ **Learning can be undertaken in quite different settings and with different groups, some learners may welcome learning through games, but others may prefer other modes. Offer a choice to learners who find learning in game-based contexts problematic** |

## 3.4: Summary of key points and findings arising from case studies

These case studies have revealed a wide range of applications for learning in immersive worlds. This section highlights the key points for effective practice and key findings emerging for future debate and development.

### Key points for effective practice

Key points for effective practice arising from the case studies include the following:

- The use of game-based learning can change not just what is learnt but also significantly how we learn, for this reason it is important to consider all the possible implications of adopting game-based learning in your practice such as context of use, duration of study periods, technical support, community of practitioners. See call out box on Key point for implementation of game-based learning.
- Games may be used as metaphors as well as literally in practice, seek out examples from practice before implementing these in your practice, and ensure that all the stakeholders are onside.
- Game-based learning may have benefits for learning in groups through social software tools; ensure that these are well tested before using them with learners.
- Ensure that there is an alignment between learning objective, game, activities and assessment in order to support the most effective learning outcomes with game-based learning.
- Ensure that game-based learning activities are fully integrated with face-to-face learning, otherwise learning will not be as effective.
- Provide opportunities for reflection upon learning with games through dialogue and discussion.
- Introduce a feedback loop into learning activities to ensure that the game-based learning remains relevant and effective in learning practice.
- Align assessment with game-based learning activities to ensure that it is effective.
- Design role plays to allow students to empathise and reflect upon situations from real life, this will support learner motivation and allow learners to transfer learning from a learning context to a real life context more readily.

- Develop realistic scenarios to allow transfer of learning from rehearsal to real life contexts.
- Place aspects of learning carefully within immersive environments to allow the learner control over when and how they engage with it.
- Consider the level of immersion as part of the learning design to ensure that learning is most effective.
- Learning through exploration is one of the strengths of game-based learning, allowing learners and learner groups time and scope for exploring environments freely.
- Learning can be undertaken in quite different settings and with different groups, some learners may welcome learning through games, but others may prefer other modes. Offer a choice to learners who find learning in game-based contexts problematic.

## Key findings from practice

We have observed specific themes and issues emerging from these case studies of practice, as follows.

- There has been a dominant perception of gaming as a leisure pursuit with no pedagogic value. The perception of gaming as a learning tool for post-16 education is changing and Games Design and Game theory courses are being introduced in HE/FE contexts leading to more critical approaches to game play.
- Prensky (2001) and others (e.g. Stone, 2004) argue that games and their uptake and use is often tied to conversancy with new technologies. This creates generational perspectives to gaming e.g. digital natives vs. digital immigrants, where digital natives can use and switch between different technologies fluently.
- Differing definitions of immersive learning abound and create problems when discussing the subject of educational or serious games. There is a need for educational games to appropriate their own terminologies (as different from those used in leisure gaming contexts), although this may create greater confusion when researchers and games developers attempt to work together.
- Game-based learning is often experience-based or exploratory, and therefore relies upon experiential, problem-based or exploratory learning approaches.
- Role play and identification with virtual avatars are central to learning in immersive worlds, but learners need choice over characters adopted (Francis, 2006a).
- Game-spaces are highly immersive and can be collaborative.
- Immersive worlds have been used to support different modes of learning, e.g. as metaphors and as microworlds, as tools for the rehearsal of skills, and for therapeutic purposes.
- While in the past immersive worlds have been used to support primarily professional development and training requirements in large numbers (due to high costs), today the approach is being adopted in schools and colleges, universities are also using this form of learning (esp. in business training) for smaller numbers of learners.
- The design of game spaces and the use of games spaces are becoming closer as gamers start to modify games engines and use software development toolkits to add features and functions.
- Convergent forms of gaming are becoming more widespread, e.g. TV/games, mobile/games etc.

In particular, game-based learning and the use of simulations are giving the opportunity for learners to role play, to identify with others, to use games for therapy, to rehearse skills, to explore in open-ended spaces, to learn in groups and to develop higher cognitive skills. The last section of the report summarises some of the possible trends for using game-based and simulation-based learning in the future.

# Part four: Future trends

The range of opportunities for learning in immersive worlds can be daunting in the potential scope of possibilities, as well as in the possible applications. However, game-based learning offers considerable potential for reaching non-traditional learners, as well as empowering learners to create their own content and work collaboratively with others to solve problems. This section will aim to provide an overview of selected trends arising that may have implications upon how games and simulations may be used in the future to support these kinds of holistic and collaborative learning experiences.

## 4.1: Use of serious games applications

Computer and console games are increasingly being used as part of leisure time activities. Currently 52 per cent of UK households have internet access and there are 20.8 million consoles and handhelds in UK homes. Over the last ten years, more than 335 million leisure software titles have been sold (Office of National Statistics/Screen Digest/Chart-Track, 2006). This explosion of leisure gaming has brought with it a deeper consideration of the use of games (and simulations) to support learning in pre- and post-16 education.

As noted above, the change in perceptions about gaming has prompted a more generic and critical approach to using games to be considered by the research community as a whole. This is evidenced by a greater willingness for games developers and educationalists to begin to form networks in order to explore ways to develop the most effective game-based learning (e.g. Serious Games Alliance, conferences on serious games, work by Futurelab, London Knowledge Lab, and subject of numerous special issues e.g. Computers and Education; Learning, Media Technology). This 'serious games movement' is bringing together academics, games developers and instructional designers to crack the problem of how to create effective serious games applications. The identification of a large new market has encouraged developers to begin to seek out academics, and the learning potential of proprietary games has allowed academics and practitioners to want to work with developers to ensure that products and tools meet the requirements of the learners (ELSPA, 2006).

The research has highlighted a gap between games developers and learners and tutors, curriculum designers and educators. This gap is partly attributable to a disconnect between the aims and objectives of leisure games design and the aims and objectives of learning and educational design. So the serious games movement attempts to overcome or lessen this disconnect in order to crack the challenge of how to make enjoyable and yet effective use of games in training and learning contexts. Towards this end, the movement has supported collaborations between educators, industry partners and government organisations with new research and development initiatives and pilots taking place. Attempts are being made to overcome this gap, but as the drivers of leisure games are generally financial, until a more unified market is suggested, development companies are unwilling to invest the substantial amounts of money associated with games development for education. Modifying existing games is seen as one solution to this, but serious games partners have a more pragmatic approach and see the value in developing, dedicated rather than modified, tools for purpose.

The implications for education may be in terms of the numbers of proprietary games for education that become available over the next five to ten years. Should serious games prove successful and if business models are shown to be successful then we may see more dedicated games for education become more widely available.

## 4.2: The authoring and development of immersive worlds

Although currently the authoring and developing of immersive game-based learning environments is in its infancy, the wider games development community have been modifying existing games software for years. The practice of modifying software while previously the preserve of computer scientists and programmers, has become increasingly open to those with lower programming skills with the emergence of software development kits, which are easier to use and are often available for free over the internet.

The trend of modding, as discussed earlier in this report, presents new questions about self-authoring and the production of immersive and interactive learning spaces to support specific user communities. However, it is unclear exactly what this trend will offer in term of applicability to the education sector, or whether it will become a central tool to support reflection upon learning, however what is assured is that this approach, although relatively recent, does have the interest of the academic community, across different disciplines. As a wider trend to support some of the rhetoric surrounding personalizing learning, learner authored content may provide for a completely novel approach to learning through exploration, investing the learner with a sense of empowerment that may also work well with underserved learners (de Freitas *et al.*, 2006).

Other authoring tools are becoming available to support experiential or exploratory styles of learning, one example of this trend is Game Maker - a drag-and-drop tool created by Mark Overmars in Utrecht University - the software has since been used as a teaching tool for both game design and for teaching elementary programming principles. The work of Jake Hapgood explores students' game authoring tools in schools contexts (Hapgood, 2006). Another approach are 'animated narrative vignettes'. Here teachers may develop the animated narrative vignettes to present to their class or to support online training. Students might also create them in experiential learning exercises. The computer animations encourage critical thinking and may also be used as assessment tools. These are primarily used to facilitate role plays, discussion and problem-solving. One example of this is the Clover tool (Bailey et al., 2006), used by school teachers in the US with students who have been bullied. Mini games can also be used for learning, that is taking a smaller segment of a larger - perhaps commercial game - for learning purposes.

The implications for education are demonstrated as a range of tools that can be used easily by tutors to support their innovations with game-based learning and the use of narrative and scenario-based learning opportunities.

## 4.3: Online gaming

The use of online games for collaborative game play in leisure time contexts (e.g. *Everquest* and *World of Warcraft*) has increased dramatically over the last five to ten years with the growth of usage of the internet. The phenomenon has led to over 4 million users of *Everquest* worldwide and 6 million users of *World of Warcraft*. Another online game that uses more of a training component, the *America's Army* game developed by the US Army Moves Institute, currently has over 7 million registered users. Alongside these games are large numbers of fanzine sites where users can 'chat' and share strategy and game 'cheats'.

Multiplayer games have become the subject of anthropological study and cultural investigation (Herz, 2001; Carr *et al*., 2006), not least because of the complex levels of social interactions that have emerged. For example, the emergence of multiplayer games has promoted the development of self-organised combat clans, resulting from the beta version of *Quake*, these clans however have persisted for years:

> There are thousands of them. The smallest have five members; the largest have hundreds and have developed their own politics, hierarchies, and systems of governance. They are essentially tribal – each has a name... Although the clan network may seem anarchic because it is fiercely competitive and has no centralised authority... it is a highly cooperative system... largely because the players that comprise them, have a clear sense of shared goals (Herz, 2001:183-184).

The growth of online gaming has been swift and widespread (Steinkuehler, 2004; Griffiths *et al.*, 2003; Yee, 2006), and work has demonstrated how these may have uses in education and training contexts (e.g. Squire, 2003). Particular potential strengths of this approach for educational purposes may include: greater access to wide global communities of learners; the ability to create excellent group-based support opportunities and structures; and, potential to support links between learners of different skills levels and ages. While this area is relatively under-researched due to its recent emergence, early indications show that educators are already beginning to integrate this format within tertiary education settings (e.g. Ebner and Holzinger, 2005).

The longevity of players on these games has also been studied, Yee (2003) found that players were playing on the online multiplayer game *Ultima Online* for as long as 28.1 months; *Everquest* was played for as long as 22.7 months, indicating the power of this form for engaging large groups of player for significant periods of time.

Online gaming may have significant implications for education; particularly notable may be the support mechanisms around large online communities of learning. Using the game-based approaches may lead to new innovations not only around how students are taught but also in terms of the *modus operandi* of learning and teaching.

## 4.4: New forms of gaming

The widespread uptake of games in leisure-based and informal learning contexts has been noted above; this is rapidly changing both the expectations and requirements of a new generation of formal learners. In parallel, an innovative global collaborative culture (based upon online communities) is providing an environment in which social and technological developments can be transmitted and taken up by 'viral' and web-based communities. This environment is leading to plurality of developments that are supporting greater opportunities for media to crossover (converge), thereby creating new hybrid media forms. These crossovers are not always predictable, but recent examples have shown how games can be deployed in different media contexts (e.g. as games within games - machimina, as games within television programmes) and with new ICT forms of communication (e.g. mobile games). See call out box on machinima. Overall this diversity and diversification of games, modes of gaming and

crossover with other media, has implications for how learning may take place that is in more seamless and immersive ways. It is envisaged that these trends will continue, delivering new forms and therefore new applications, with opportunities for reaching different (e.g. underserved) learner groups and communities.

### Machinima

Machinima is a portmanteau of machine cinema or machine animation. Machinima are films created using of computer-generated imagery (CGI) rendering using real-time, interactive (game) 3D engines, unlike CGI used in cinema which uses high-end and complex 3D animation software.

Currently, more than 40 million Britons own mobile phones (BBC, 2006). The ubiquity of mobiles phones is leading to more mobile gaming applications. In particular recent research projects (e.g. European Union-funded *Mobilearn* and *MLearn* projects) are using this mode of delivery for supporting skills needs (e.g. literacy and numeracy). However while these studies have shown that mobile gaming can be used to engage students, desired learning outcomes are not always effectively demonstrated (Attewell and Savill-Smith, 2004).

The use of mobile - and pervasive gaming - is also relatively recent (Bjork *et al*., 2002). Some academic pilots have tried to evaluate these games, one leisure game using a soap-opera style game: *Supafly* in Sweden (Jegers and Wiberg, 2006) explored three aspects of pervasive gaming: mobile place-independent game play; integration between the physical and the virtual worlds; and, social interaction between players. Interestingly the study found that the game was not used on the move but either at home or work, the link between virtual and real life also was not clear to the player, players also stayed within established social groups rather than making new friendships. Several other game-based learning applications using mobile and portable devices are being piloted. As well as *Savannah*, which used mobile devices to map virtual spaces onto real spaces, other mobile games, such as *Urban Tapestries* and *MobileGame* aim to map real spaces onto the virtual. The *Urban Tapestries* project allows users to author their own virtual annotations of physical locations through use of pdas and mobile phones; the project allows collective memory of spaces to develop organically over time. The *MobileGame* developed as part of the European Union-funded *Mobilearn* project allows participants to 'experience immersion in a mixed reality environment' (Schwabe and Goth, 2005: 192). The game is used for orientation days at a university, and the 'rally' involved small teams of 2-4 people. The rally is structured as a competitive and cooperative game, where each team tries to catch another team. the approach centres upon the strength of gaming as a collaborative and team building activity – or set of activities, although not strictly a learning game *per se*.

Following from the mixed reality approach, the emergence of 'street gaming' or 'social gaming' where individuals play games in often urban spaces are games 'experiences' which are proliferating. An example of this trend is highlighted by a Cooperative game play experiment undertaken at the University of Southern California, which included a 3-day workshop and play day (Fullerton, 2005) led by Bernie DeKoven (DeKoven, 2002). Another form, of street or social gaming is 'Big Game', which crosses over into Alternate Reality games; these games are usually large-scale multiplayer games that blend electronic and virtual elements with real-world presence (Ruberg, 2006)

The explosion in the use of games is reflected by a range of different modes of gaming, using dedicated games consoles, using the PC for single player gaming, using PCs and consoles for internet and online (MMORPG) gaming, mobile gaming etc. Alternate Reality Games are games that are cross-media and that blur the line between the game space (diegesis) and the real world experience. A well-know example of this is the *Majestic* game that used telephone calls to the player to blur the game space with the real world experience, similar to the David Fincher directed film *The Game* (Szulborski, 2005). While this narrative-driven format has not led to any specific training or learning projects, the potential of the approach means that it could be applied effectively within learning contexts.

These convergent forms of gaming rely upon using multiple media channels and sources, and parallel developments in social software (e.g. blogging, wikis and social shared spaces such as *MySpace*) support wider opportunities for collaborative activities (e.g. Stead *et al*., 2006). Other approaches are blending augmented reality interfaces with games (e.g. *ARQuake*, *EyeToy*).

These convergent forms of games and immersive interactions may have quite profound implications for how we learn in the future, but in overview seem to imply a more general move towards more holistic and reality-based learning experiences rather than a sequencing of learning 'chunks' or pieces.

The following table summarises some of these key trends and selected implications for the education sector.

| Key trends | Selected implications for education sector (e.g. usage patterns) |
|---|---|
| Widespread use of games technologies and serious games movement | ■ Wider use of games technologies in the home is increasing the interest of use of games in educational contexts, this is leading to increasing use of games particularly in schools and colleges, but also in universities<br>■ The serious games movement is a trend towards designing and analysing the use of games (and simulations) for supporting formal educational objectives and outcomes. The movement aims to meet the significant challenge of bringing together games designers and educationalists to ensure fun, motivation and educational value. |
| Authoring and development of immersive worlds (e.g. development of content creation tools) | ■ Through modifying existing games applications for educational purposes there is great potential for learning with games. This approach may have implications upon instructional / constructional learning design, as well as changing the traditional role of the tutor towards one of facilitator, collaborator, producer or author. The approach of self-authored content may also promote greater opportunities for team and cross-disciplinary teaching. |
| Growth of online gaming and online gaming communities | ■ The growth of online gaming and their communities may have uses for formal education, producing greater support for learning outside of formal learning contexts, and providing support for distance, lifelong and distributed learning groups.<br>■ This trend may also produce more seamless learning experiences – lessening the hard lines between learning at work, home and formal learning institutions. Learning that follows from online experiences may place a greater emphasis upon team learning, collaborative learning and forming and maintaining dedicated learning communities of practice. |
| New forms of gaming (e.g. mobile games) and convergent forms of gaming emerging (e.g. social and alternate reality gaming) | ■ The emergence of the wide use of mobile and pervasive gaming also has implications for learning in formal contexts. However there are significant challenges as well, learning with mobile games may lead to a need for more complex lesson crafting to exploit non-location specific learning opportunities.<br>■ Mobile learning also may require significant technical support (not local necessarily), more CPD and training opportunities. However mobile learning may also provide new opportunities for learning in groups and across wider spaces (e.g. cross-institutionally).<br>■ The emergence of social and alternate reality games indicates a general trend of crossover technologies. These new forms may have uses for learning formally, however would involve significant knowledge on the part of the tutor, and would require creative approaches to lesson planning and assessment.<br>These areas of gaming are rather more on the cutting edge of developments and may take some time to become part of the dominant game-based approaches.<br>■ The use of social software is supporting more opportunities for collaborative learning (e.g. in co-located and distributed learning groups)<br>■ Creative learning may be stimulated by game play. In this way, games may be used as a resource for learning rather than as a mode for teaching learners |

Table 5: Table of selected trends

# Part five: Conclusions

According to this review of the literature and case studies from practice, there is clearly a substantial *potential* for learning with games and simulations. However, while the research to support the effectiveness of simulations is considerable, recent studies of using leisure games in learning contexts have found challenges with using games and simulations effectively in practice, particularly in terms of setting and assessing specified learning objectives. The use of both leisure (commercial-off-the-shelf) games and proprietary games need to be embedded in practice effectively and in accordance with sound pedagogic principles and design. In either case, there is clearly a need for more rigorous baseline studies that can quantify how much and in which ways games and simulations are currently being used most effectively to support learning. In addition there is a need for guidelines, case studies and exemplars from current practice to inform and improve the quality of delivery of games-based learning across the sector and to support better future planning and resource allocation.

While the area is made complex by the range of activity taking place, the need to develop more critical approaches to games study and development in the post-16 educational sphere is certain, and is evidenced by Games Studies degree programmes being launched in colleges and universities and its development as an academic field of study. One of the benefits emerging from an increasing interest and synthesis of the field of study is the parallel development of the serious games movement, which aims to explore how developers and educationalists can work with users to produce dedicated games applications for learning and training. A departure from current practice where games development companies are generally focused upon the larger and more homogeneous leisure market, in the future industry and their exploration of the education market may be supported through additional funding opportunities and investment.

Although formal education currently presents a segmented market, and therefore does not have so much appeal for their investment beyond research development at present, in time and with more global learning communities this market may become more attractive to them, and may foster more enduring collaborations with educationalists and learners. Further work needs to be done to bring the development and education communities closer together, to build shared vocabularies and expectations, as well as to inform new learning designs to support learning experiences. However, due to the fast changing nature of the innovations, the cost-implications and the staff training requirements, the impact upon education might be significant in terms, such as learning systems development, learner modelling, personalization capabilities, distributed learning infrastructure and technical support as well as more directly in terms of the role of the tutor, the pedagogic design used, the range of learning materials offered as well as learner control, accreditation and assessment models.

The wider debate about e-learning and its importance for underpinning learning of the future has been considered extensively through consultation with stakeholders (DfES, 2005), over the last few years in the UK. Reflecting these approaches, the policy direction for the use and application of games technologies to support learning has been rather more piecemeal, led more by bottom-up initiatives and research-related funding opportunities than coordinated central policy development. Like e-learning in general the development of this potential will rely upon a closer alignment between policy, institutional practice and learning processes, and to facilitate this it may be beneficial to have a lead from the policy development level. However in practice this is not always the case, leaving practitioners and learners to generate exemplars of practice from which policy objectives then can be reached, and as the spread of examples from practice may suggest, uptake of game-based learning in particular is rather more learner-driven in practice.

However not all the innovations needed to embed gaming applications will be learner driven, implying, as has been noted in the report, a need for greater flexibility not least in terms of learning session durations, assessment modes and accreditation. This change, as noted with e-learning in general, may well require greater coordination between curricula and policy development with stakeholders, and has implications affecting the design, development and application of media-based learning as a whole. To achieve the ambitions that game-based learning implies in short requires collaboration, inter-working and constructive change (policy, organisational and pedagogic) – and this needs to be undertaken in the spirit of collaboration but with a full awareness of what clear benefits and outcomes for learners may be attained. While we have some 'early adopter' models of practice in evidence, more research and action research would benefit the wider community of practitioners who are seeking to use these new approaches to innovate their own practice.

Notably, the potential for educators to become involved in the development of learning content associated with these new games formats at this stage is substantial, and may be further encouraged using participatory development methodologies to ensure that tutors and learners have a greater say in dedicated content

developed for games usage, to ensure compliance with sound pedagogic design principles and alignment with learning outcomes and assessment. Thus, development in this sector will, it is envisaged, follow many of the general trends of e-learning uptake – and is subject to many of the same challenges that may include:

- early adopter model of uptake,
- innovation in pockets,
- need for infrastructural and tutor support,
- gradual development,
- need for better links between policy, institutional change and the requirements of the learner,
- need for substantial investment to keep up with technical developments.

Development will also rely upon the central requirement of continuing professional development for tutors, in some cases the use of tutor-practitioners and greater collaboration between stakeholders for developing sharable and personalized content.

To conclude: the rapidly changing landscape of games and simulation development is bringing new potential for learning in immersive worlds using multiple media. Moreover, the speed of uptake in leisure contexts and the expectations of younger learners in particular have deep implications upon how game-based learning will be used in practice. With a greater emphasis upon learning experiences, game-based learning may provide significant challenges to our institutions and teaching strategies, however, it may also provide new opportunities for reconsidering how we learn and for supporting the development of new immersive spaces where learners may produce their own materials, share learning experiences and practice skills for the 'real-world'. This may give an indication of the kinds of forms that may have an influence upon how we learn over the next few years, as the 'digital natives' who may be more interested in active 'street gaming' than watching television become the teachers, managers and policy makers of 2020.

| Main Conclusion | Brief description |
|---|---|
| Games need to be embedded into practice to ensure effective learning | Use of both leisure (commercial-off-the-shelf) games and proprietary games need to be embedded in practice effectively and in accordance with sound pedagogic principles and design |
| More research needed to provide empirical evidence for how game-based learning can be used most effectively | Need for more rigorous baseline studies that can quantify how much and in which ways games and simulations are currently being used most effectively to support learning |
| More effective supporting materials needed to support practitioners wishing to use game-based learning approaches | There is a need for guidelines, case studies and exemplars from current practice to inform and improve the quality of delivery of games-based learning across the sector and to support better future planning and resource allocation |
| New developments including the serious games movement are informing the development of games for learning | New developments such as the serious games movement are facilitating collaborations between academic, industrial and government agencies seeking to develop proprietary learning games. Although further work still needs to be done to bring the development and education communities closer together, to build shared vocabularies and expectations, as well as to inform new learning designs to support learning experiences. |
| Great potential for tutors and practitioners to become involved with games development for learning | The potential for educators to become involved in the development of learning content associated with these new games formats at this stage is substantial, and may be further encouraged using participatory development methodologies to ensure that tutors and learners have a greater say in dedicated content developed for games usage, to ensure compliance with sound pedagogic design principles and alignment with learning outcomes and assessment. |
| Potential for learners to become more empowered with game-based learning | There are new opportunities with game-based learning for reconsidering how we learn and for supporting the development of new immersive spaces where learners may produce their own materials, share learning experiences and practice skills for the 'real-world'. |

Table 6: Table of Conclusions

# References

ALDRICH, C. (2004). Simulations and the future of learning. San Francisco. CA. John Wiley and Sons.

ALDRICH, C. (2005). Learning by doing. San Francisco. CA. Pfeiffer

AMORY, A., NAICKER, K., VINCENT, J. and ADAMS, C. (1999). The use of computer games as an educational tool: identification of appropriate game types and game elements. British Journal of Educational Technology, 30(4): 311.

ARISTOTLE (2004). Nichomachean Ethics. London. Penguin Books.

ATTEWELL, J. and SAVILL-SMITH, C. (Eds.) (2004). Learning with mobile devices: research and development. London Learning and Skills Development Agency.

BAILEY, B.P., TETTEGAH, S.Y. BRADLEY, T.J. (2006, in press). Clover: Connecting Technology and Character Education Using Personally-Constructed Animated Vignettes. Interacting with Computers.

BARAB, S., THOMAS, M. DODGE, T., CARTEAUX, R. and TUZUN, H. (2005). Making learning fun: Quest Atlantis, a game without guns. Educational Technology Research and Development, 53(1): 86-107.

BARNETT, M., SQUIRE, K., HIGGENBOTHAM, T. and GRANT, J. (2004). Electromagnetism Supercharged! Proceedings of the 2004 International Conference of the Learning Sciences. Los Angeles. UCAL Press.

BARTON, K. AND MAHARG, P. (2006) E-simulations in the wild: interdisciplinary research, design and implementation. In Aldrich, C., Gibson, D., Prensky, M. (eds), Games and Simulations in Online Learning: Research and Development Frameworks, Information Science Publishing.

BARTON, K. AND WESTWOOD, F. (2006) From student to trainee practitioner - a study of team working as a learning experience. Web Journal of Current Legal Issues, special edition on legal education, 3. Last retrieved online on 16th October 2006 at http://webjcli.ncl.ac.uk/2006/issue3/barton-westwood3.html.

BEAL, S.A. and CHRIST, R.E. (2004). Training effectiveness evaluation in the Full Spectrum Command game (Technical report No. 1140). Alexandria, VA. US Army Research Institute for Behavioral and Social Sciences.

BEE, F. and BEE, R. (2003). Learning needs analysis and evaluation. London. Chartered Institute for Personnel Development.

BEETHAM, H. and SHARPE, R. (2006) Rethinking pedagogy in the digital age. London. Routledge.

BEGG, M., ELLAWAY, R., DEWHURST, D. & MACLEOD, H. (2006). Virtual patients: consideration of narrative and game play. M. Burmester, D. Gerhard and F. Thissen (Eds) Digital Game Based Learning: Proceedings of the 4th International Symposium for Information Design. Universitatverlag Karlsruhe.

BELANICH, J., SIBLEY, D.E. and ORVICH, K.L. (2004). Instructional characteristics and motivational features of a PC-based game. (Research report No. 1822). Alexandria, VA. US Army Research Institute for Behavioral and Social Sciences.

BIGGS, J. (1999). Teaching for Quality Learning at University. Buckingham. Society for research in Higher Education. Open University Press. Last retrieved online on 31st July 2006 at: http://www.dmu.ac.uk/~jamesa/learning/solo.htm.

BJORK,S., HOLOPAINEN, J., LJUNGSTRAND, P. and MANDRYK, R. (2002). Ubiquitous Games. Personal and Ubiquitous Computing 6: 358-361.

BONK, C.J. and DENNEN, V.P. (2005). Massive Multiplayer online gaming: a research framework for miiltary training and education. Madison. Wisconsin. Advanced Distributed Learning. Last retrieved online on 9th August 2006 at: http://www.strategicleader.us/ExperientalLearningPapers/GameReport_Bonk_final.pdf.

BOUD, D. and FELETTI, G. (Eds.) (1991).The Challenge of Problem Based Learning. New York: St. Martin's Press.

BUCKINGHAM, D. (2003). Media Education: Literacy, Learning and Contemporary Culture. Cambridge. Polity Press.

BYERS, J. A. (1998). Biological effects of locomotor play: getting into shape or something more specific? In M. Bekoff and J. A. Byers (eds). Animal Play. Evolutionary cooperative and ecological perspectives. Cambridge. Cambridge University Press.

CALLOIS, R. (1961). Man, play and games. New York. The Free Press.

CARR, D., BURN, A., BUCKINGHAM, D., SCHOTT, G. (2006). Videogames: text, narrative, play, Cambridge. Polity Press.

CHUMBLEY, J. and GRIFFITHS, M. (2006). Affect and the Computer Game Player: The Effect of Gender, Personality, and Game Reinforcement Structure on Affective Responses to Computer Game play. CyberPsychology and Behavior, 9(3): 308-316.

COLEMAN, J. (1971). Learning through games. In E. Avedon and B. Sutton-Smith (Eds). The study of games. New York and London. John Wiley, pp. 322-329.

COUTURE, M. (2004). Realism in the design process and credibility of a simulation-based virtual laboratory. Journal of Computer Assisted Learning, 20(1): 40-49.

CROOKALL, D. (1995). Debriefing: The key to learning from simulations/games. Thousand Oaks. California. Sage Publications.

CSIKSZENTMIHALYI, M. (1992). Flow. The psychology of happiness. London. Rider.

DARKEN, R. P., MCDOWELL, P. and MURPHY, C. (2005). Open Source Game Engines: Disruptive technologies in training and education. Paper presented at the Interservice/Industry Training, Simulation and Education Conference.

DE FREITAS, S. (2006a). Using games and simulations for supporting learning. (eds). C. Martin and L. Murray. Learning, Media and Technology. Special Issue on Gaming.

DE FREITAS, S. (2006b). JISC e-Learning and Pedagogy Experts Group Meeting: Games for Learning session. A Summary Report. Last retrieved online 31st July 2006 at: http://www.jisc.ac.uk/uploaded_documents/Summary_report.pdf.

DE FREITAS, S. and JARVIS, S. (2006). A Framework for developing serious games to meet learner needs. To be presented at the Interservice/Industry Training, Simulation and Education Conference. Florida. December.

DE FREITAS, S. and OLIVER, M. (2006) How can exploratory learning with games and simulations within the curriculum be most effectively evaluated? Computers and Education Special Issue on Gaming. 46 (2006) 249-264.

DE FREITAS, S., SAVILL-SMITH, C. and ATTEWELL, J. (2006). Educational games and simulations: Case Studies from Adult Learning Practice. London. Learning and Skills Research Centre.

DEKOVEN, B. (2002). The well-played game. Lincoln, NE. Writers Club Press.

DELANGHE, F. (2001). Validating small arms simulation. Military training and simulation news 6:31-34.

DEPARTMENT FOR EDUCATION AND SKILLS. (2005) Harnessing technology: Transforming learning and children's services. London.

DICKEY, M. D. (2003). An investigation of computer games strategies for engaged learning. Paper presented at the annual meeting of the American Educational Research Association. Chicago, IL.

DICKEY, M. D. (2005). Engaging by design: how engagement strategies in popular computer and video games can inform instructional design. Education Training Research and Development, 53(2): 67-83.

DICKEY, M. D. (2006). Game design narrative for learning: appropriating adventure game design narrative devices and techniques for the design of interactive learning environments. Educational Technology Research and Development, 54(3): 245-263.

DRUIN, A. (2002). The Role of Children in the Design of New Technology. Behaviour and Information Technology, 21(1) 1-25.

DZIABENKO, O., PIVEC, M., BOURAS, C., IGGLESIS, V., KAPOULAS, V. AND MISEDAKIS, I. (2003). A web-based game for supporting game-based learning, In Proceedings of 4th annual European GAME-ON Conference (GAME-ON 2003), London, United Kingdom, November 19-21: 111-118.

EBNER, M. and HOLZINGER, A. (2005) Successful implementation of user-centred game-based learning in higher education: an example from civil engineering. Computers and Education.

EDELMAN, G. (1992). Bright air, brilliant fire. On the matter of the mind. London. Penguin.

EDUCATION ARCADE. (2006). Revolution web page. Last retrieved online 12th October 2006 at: http://www.educationarcade.org/revolution.

EGENELDT-NIELSEN, S. (2005). Beyond Edutainment: Exploring the educational potential of computer games. Doctoral Thesis, IT-University of Copenhagen. Denmark. Last retrieved 30th May 2006 at: http://www.itu.dk/people/sen/egenfeldt.pdf.

FACER, K. (2004). Why do we think it is worth talking about computer games and learning in the same breath? Last accessed 13th July 2004. URL: http://www.futurelab.ac.uk/research/discuss/02discuss01.htm.

FACER, K. JOINER, R. STANTON, D. REID, J. HULL, R. and KIRK, D. (2004). Savannah: mobile gaming and learning? Journal of Computer-Assisted Learning, 20: 399-409.

FRANCIS, R. (2006a). Towards a pedagogy for game-based learning. Paper presented at JISC Online conference: Innovating with e-Learning 2006. 30th March. Available in Innovating e-Learning Practice - The proceedings of the JISC Online Conference: Innovating e-Learning 2006. Cheltenham. Direct Learn Services Ltd. Last retrieved online at: www.jisc.ac.uk/elp_conference06.html.

FRANCIS, R. (2006b). Revolution: Learning about history through situated role play in a virtual environment. Paper presented at the American Educational Research Association Conference, San Francisco.

FULLERTON, T. (2005). The play's the thing: Practicing play as community foundation and design technique. Proceedings of DiGRA 2005 Conference.

GALLOWAY, J. (2006). A great balancing act. Times Educational Supplement. April.

GARRIS, R., AHLERS, R. and DRISKELL, J. (2002). Games, motivation and learning: a research and practice model. Simulation and Gaming, 33: 441-467.

GEE, J. P. (2003). What videogames have to teach us about learning and literacy. New York: Palgrave Macmillan.

GOUGLAS, S., SINCLAIR, S., ELLEFSON, O. and SHARPLIN, S. (2006). Neverwinter Nights in Alberta: Conceptions of narrativity through fantasy role-playing games in a graduate classroom. Innovate 2(3). Last accessed 27th July 2006. URL: www.innovateonline.info.

GREEN, C.S. AND BAVELIER, D. (2003) Action video game modifies visual selective attention. Nature, 423(6939): 534-537.

GREENO, J.G., COLLINS, A.M. and RESNICK, L. (1996) Cognition and Learning. In D.C. Berliner and R.C. Calfee (Eds) Handbook of Educational Psychology, NY: Simon and Schuster Macmillan.

GRIFFITHS, M. (1999). Violent video games and aggression: a review of the literature. Aggression and Violent Behaviour, 4(2): 203-212.

GRIFFITHS, M. (2002). The educational benefits of videogaming. Education and Health, 20(3): 47-51.

GRIFFITHS, M., DAVIES, M and CHAPPELL, D. (2003). Breaking the stereotype: The case of online gaming. CyberPsychology and Behaviour, 6(1): 81-91.

GUHA, M. L., DRUIN, A., CHIPMAN, G., FAILS, J., SIMMS, S., and FARBER, A. (2004). Mixing Ideas: A new technique for working with young children as design partners. In Proceedings of Interaction Design and Children (IDC'2004). College Park, MD, pp. 35-42.

HAPGOOD, J. (2006). Compulsory Game Development for Everyone: Gamasutra Education. Last retrieved online on 24th October 2006 at: http://www.gamasutra.com/features/20060807/habgood_01.shtml.

HEPPELL, S. (2006). Personalisation of Assessment: Issues. Discussion paper presented at Department for Education and Skills, Personalized content workshop on 13th February 2006.

HERZ, J. C. (2001). Gaming the system; what higher education can learn from multiplayer online worlds. Educause, Publications from the Forum for the Futureof Higher Education. Last accessed 7th August 2006. URL: http://www.educause.edu/ir/library/pdf/ffpiu019.pdf.

HOGAN, K. and PRESSLEY, M. (Eds). (1997) Scaffolding Student Learning: Instructional Approaches and Issues. Cambridge, MA. Brookline Books.

HOLMBOE, K. and JOHNSON, M. (2005). Educating executive attention. Proceedings of the National Academy of Sciences, 102(41): 14479–14480.

HUIZINGA, J. (1980). Homo Ludens: A study of the play element in culture. London. Routledge and Kegan.

JARVIS, S., TREGUNNA, B. and DE FREITAS, S. (2006). Presentation to SG-ETS research project team at the London Knowledge Lab, 1st August.

JEGERS, K. and WIBERG, M. (2006). Pervasive gaming in the everyday world. Pervasive Computing, January-March 2006.

JENKINS, H., SQUIRE, K. and TAN, P. (2004). You can't bring that game to school! Designing Supercharged! In B. Laurel (Ed.) Design research. Cambridge, Massachusetts. MIT Press.

JOANNEUM and EDINBURGH UNIVERSITY (2002). UNIGAME: Game-based learning in universities and lifelong learning: Deliverable 1.2. Last retrieved online 15th August 2006 at: http://www.unigame.net/html/case_studies/D2.pdf.

JOINER, R. and OWEN, M. (2006). The large-scale implementation of Racing Academy in Further and Higher education. Proposal to JISC.

JONES, S. (2003). Let the Games Begin: Gaming Technology and Entertainment Among College Students. Pew Internet and American Life report. Last accessed 28th July 2006. URL: http://www.pewinternet.org/pdfs/PIP_College_Gaming_Reporta.pdf.

JUUL, J. (2003). The game, the player, the world: Looking for a heart of gameness. M. Copier and J. Raessens (eds). Proceedings of Level-Up: Digital games research conference. Utrecht. University of Utrecht: 30-45.

KIILI, K. (2005). Digital game-based learning: Towards an experiential gaming model. The Internet and higher education, 8(1): 13-24.

KIRRIEMUIR, J. and MCFARLANE, A. (2004) Literature review in games and learning. Futurelab report. Bristol. Futurelab

KOLB, D. A. (1984). Experiential Learning. Englewood Cliffs.

LAVE, J. and WENGER, E. (1991). Situated learning: Legitimate peripheral participation. New York and Cambridge. Cambridge University Press.

LEEMKUIL, H. DE JONG, T. and OOTES, S. (2000). Review of educational use of games and simulations. EU-Project Number IST-1999-13078. KITS Consortium. Last retrieved online on 31st July 2006 at: http://kits.edte.utwente.nl/documents/D1.pdf.

LESSIG, L. (2003). Creators in Second Life. Retrieved 20th October 2006 at: http://lessig.org/blog/archives/001577.shtml.

LI, Z. (2004) The Potential of America's Army the Video Game as Civilian-Military Public Sphere. Massachusetts Institute of Technology PhD Thesis. Last retrieved online on 31st July 2006 at: http://www.gamasutra.com/education/theses/20040725/ZLITHESIS.pdf.

LINDEN LAB. (2004). Second Life Officially Opens Digital World to College Students for Exploration and Study of Design and Social Communities. Press release issued: 20 September 2004. URL: http://lindenlab.com/press/releases/04_09_20.

LYNCH, M. (2006). LTO Innovation Grant 2005-2006 – Simulation game environment for learning. Final Report. University of Glamorgan.

LYNCH M. AND TUNSTALL R. (2006a). Developing Simulation Case Studies for Higher Education. In:ISAGA 2006 Reality and Game & Game and Reality. Proceedings of the 37th annual Conference of the International Simulation and Gaming Association (ISAGA); 2006 July 3-7; St Petersburg, Russia: 331-332.

LYNCH M. AND TUNSTALL R. (2006b). When Worlds Collide - Creative Partnerships in Higher Education. In: ISAGA 2006 Reality and Game & Game and Reality. Proceedings of the 37th annual Conference of the International Simulation and Gaming Association (ISAGA); 2006 July 3-7; St Petersburg, Russia: 333-334.

MAGNUSSEN, R. (2005). Learning games as a platform for simulated science practice. Proceedings of the Digital Games Research Association 2005 Conference.

MAHARG, P. (2006) On the edge: ICT and the transformation of professional legal learning. Last retrieved online on 31st July 2006 at: http://webjcli.ncl.ac.uk/2006/issue3/maharg3.html.

MARTINEZ-GALLAGHER, M. and NORTON, D. (2004) Outbreak Quest: A 90-day Game Development Initiative. Wisconsin. ADL Co-Lab, University of Wisconsin-Madison. See: http://www.academiccolab.org/resources/documents/OutbreakQuest.pdf. Last accessed 27th July 2006.

MAYES, T. and DE FREITAS, S. (2004). Review of e-learning theories, frameworks and models. JISC e- learning models study report. London. The Joint Information Systems Committee. Last retrieved online on 31st July 2006 at http://www.jisc.ac.uk/elp_outcomes.html.

MAYES, T. and DE FREITAS, S. (2006). Learning and e-learning: the role of theory. In H. Beetham and R. Sharpe (Eds), Rethinking Pedagogy in the Digital Age. London. Routledge.

McFARLANE, A., SPARROWHAWK, A. AND HEALD, Y. (2002) The role of games in education, A research report to the DfES. Last retrieved online 31st July 2006 at: http://www.teem.org.uk.

MICHAEL, D. and CHEN, S. (2006). Serious games: games that educate, train and inform. Boston, MA. Thomson Course Technology.

MINSKY, M. and PAPERT, S. (1971). Progress report on Artificial Intelligence.

MITCHELL, A. and SAVILL-SMITH, C. (2005). The use of computer and video games for learning. A review of the literature. London. Learning and Skills Development Agency.

MOIZER, J., LEAN, J. and SMITH, G. (2006). Modes of learning in the use of a computer-based business simulation game. International Journal of Learning Technology, 2 (1): 49 – 61.

MOSS, M. (2005). Personalized learning: A failure to collaborate? In S. de Freitas and C. Yapp (eds). Personalizing learning in the 21st Century. Stafford. Network Continuum Press.

MOULDER, S. (2004). Fun with purpose. Presentation made to the Serious Games Summit. San Jose. CA. March.

MURRAY, J. H. (1997). Hamlet on the holodeck: the future of narrative in cyberspace. New York. Free Press.

NATIONAL ADVISORY COMMITTEE ON CREATIVE AND CULTURAL EDUCATION. (1999). All our futures: creativity, culture and education. London.NEW LONDON GROUP (1996). A Pedagogy of Multiliteracies: Designing Social Futures. Harvard Educational Review, 66(1): 60-92.

NIEBORG, D. B. (2004). Who put the mod in commodification? A descriptive analysis of the First Person Shooter mod culture. Last retrieved online, 15th August 2006 at: http://www.gamespace.nl/content/commodificationnieborg2004.pdf.

OBLINGER AND OBLINGER (2005). Educating the Net Generation. Educause. Last retrieved online, 31st July 2006 at: http://www.educause.edu/content.asp?PAGE_ID=5989andbhcp=1

OLDHAM, N. (2003). Neverwinter Nights: Learning Environment. (Unpublished supporting materials). West Nottinghamshire College.

ONDREJKA, C. (2004). Escaping the gilded cage. Retrieved October 19, 2006, from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=538362.

ONDREJKA, C. (2006). Finding common ground in new worlds. Games and Culture, 1(1): 111-115.

O'NEIL, H. F., WAINESS, R. and BAKER, E. L. (2005). Classification of learning outcomes: evidence from the computer games literature. Curriculum Journal, 16(4): 455 – 474.

PIVEC, M and SFIRI, A. How to implement a game in an educational context. In Pivec, M., Koubek, C. and Dondi, C. (eds.) (2004). Guidelines for game-based learning. Pabst Science Publishers.

PETRANEK, C. F. (2000). Written debriefing: the next vital step in learning with simulations. Simulation and Gaming, 31(1): 108-118.

PAPERT, S. (1981). Mindstorms. Children, computers and powerful ideas. New York and London. Harvester Wheatsheaf.

PAPERT, S. (1998). Does easy do it? Games Developer. June. Last retrieved online on 16th October 2006 at http://www.papert.org/articles/Doeseasydoit.html.

PELLETIER, C. (2005a) 'The uses of literacy in studying computer games: comparing students' oral and visual representation of games', English Teaching: Practice and Critique, 4(1), pp. 40-59.

PELLETIER, C. (2005b) 'Studying games in school: a framework for media education', refereed paper published by the Digital Games Research Association, available here: http://www.gamesconference.org/digra2005/viewabstract.php?id=190.

PELLETIER, C. (2005c) Reconfiguring interactivity, agency and pleasure in the education and somputer games debate – using Zizek's concept of interpassivity to analyse educational play. E-learning 2(4): 317-326.

PETERS, V. A. M. and VISSERS, G. A. N. (2004). A Simple Classification Model for Debriefing Simulation Games. Simulation and Gaming, 35(1): 70-84 (2004).

PIVEC, M. and DZIABENKO, O. (2004). Game-Based Learning in Universities and Lifelong Learning: UniGame: Social Skills and Knowledge Training. Game Concept. Vol 10 (1): 4-16.

PIVEC, M., DZIABENKO, O. and SCHINNERL, I. (2003). Aspects of Game-Based Learning. I-KNOW 03, the Third International Conference on Knowledge Management, 2-4-July, 2003, Graz, Austria.

PRENSKY, M. (2001). Digital Game-based Learning. New York and London: McGraw-Hill.

PRENSKY, M. (2006). Don't bother me mom, I'm learning. St. Paul, MN. Paragon House.

ROBINSON, K. (2001). Out of our minds. Learning to be creative. Oxford. Capstone Publishing.

ROYAL SOCIETY OF ARTS. (1999). Opening Minds: education for the 21st century. London.

RUBERG, B. (2006). Big reality: A chat with 'Big Game' designer Frank Lantz. Gamasutra, August 10th. Last retrieved online on 16th August 2006 at: http://gamasutra.com/features/20060810/ruberg_01.shtml.

RUEDA, M. R., ROTHBART, M. K., MCCANDLISS, B. D., SACCOMANNO, L. and POSNER, M. L. (2005). Training, maturation, and genetic influences on the development of executive attention. Proceedings of the National Academy of Sciences, 102(41): 14931-14939.

SALEN, K. and ZIMMERMAN, E. (2004). Rules of play. Cambridge, Massachusetts. MIT Press.

SALMAN, S. (2006). Autism community forges virtual haven. The Guardian. March 8.

SANDFORD, R. (2006). Teaching with Games. Paper presented at JISC Online conference: Innovating with e-Learning 2006. 30th March. Available in Innovating e-Learning Practice - The proceedings of the JISC Online Conference: Innovating e-Learning 2006. Cheltenham. Direct Learn Services Ltd. Last retrieved online at: www.jisc.ac.uk/elp_conference06.html.

SANDFORD, R., and ULICSAK, M., FACER, K. and RUDD, T. (2006) Teaching with Games: Using commercial off-the-shelf computer games in formal education. Bristol. Futurelab.

SANDFORD, R. and WILLIAMSON, B. (2004). Racing Academy: Learning Research Report. Bristol: Nesta Futurelab.

SCHWABE, G. and GOTH, C. (2005). Navigating and interacting indoors with a mobile learning game. IEEE International Workshop on Wireless and Mobile Technologies in Education (WMTE'05): 192-199.

SINGER, E. (2006). Brain Trainer: How to conquer cognitive decline, one game at a time. Technology Review (March/April).

STEAD, G., ANDERSON, P., SHARPE, B., CYCH, L. and PHILPOTT, M. (2006). Emerging technologies for learning. Becta ICT Research. Coventry. British Educational and Communications Technology Agency. Last retrieved online, 21st August 2006 at: http://www.becta.org.uk/corporate/publications/documents/Emerging_Technologies_Accessibility.pdf.

STEADMAN, R. H., COATES, W. C., HUANG, Y.M., MATEVOSIAN, R., LARMON, B. R., MCCULLOUGH, L. and ARIEL, D. (2006). Simulation-based training is superior to problem-based learning for the acquisition of critical assessment and management skills. Critical Care Medicine. 34(1):151-157

STEINKUEHLER, C. (2004) Learning in Massively Multiplayer Online Games. In Y. B. Kafai, W. A. Sandoval, N. Enyedy, A. S. Nixon, and F. Herrera (Eds.), Proceedings of the Sixth International Conference of the Learning Sciences (pp. 521–528). Mahwah, NJ: Erlbaum. Last retrieved 28th July 2006 at http://website.education.wisc.edu/steinkuehler/papers/SteinkuehlerICLS2004.pdf.

STEINKUEHLER, C. (in press). Cognition and literacy in massively multiplayer online games. In D. Leu, J. Coiro, C. Lankshear, and K. Knobel (Eds.), Handbook of Research on New Literacies. Mahwah NJ: Erlbaum.

STEPHENSON, N. (1994). Snowcrash. London. Penguin.

STONE, R.S. (2003). Whatever Happened to Virtual Reality? Equipment, Training and Support News (Special ITEC 2003 Edition). April: 43-47. Last retrieved 9th August 2006 at http://www.ets-news.com/third.php?id=249.

STONE, R.S. (2006) Serious Games – Some Illustrative Examples. Defence Management Journal. April.

SQUIRE, K. (2003). Video games in education. International Journal of Intelligent Simulations and Gaming, 2(1): 49-62

SQUIRE, K. (2005). Replaying history: Learning world history through playing Civilization III. Doctoral Thesis. University of Indiana. USA. Last retrieved 30th May 2006 at: URL: website.education.wisc.edu/kdsquire/REPLAYING_HISTORY.doc.

SQUIRE. K. (2006). From content to context: digital games as designed experiences. Educational Researcher (In review).

SUITS, B. (1978). The Grasshopper. Toronto. University of Toronto.

SUTTON-SMITH, B. (1997). The ambiguity of play. Cambridge, Massachusetts and London. Harvard University Press.

SZULBORSKI, D. (2005). This is not a game: A guide to alternate reality gaming. New Fiction Publishing.

THOUGHTLINK. (2001, November). Key drivers for C2 performance: data mining SCUDHunt experiment data. Vienna, VA. Thoughtlink, Inc.

THOUGHTLINK. (2002, October). Meta-analysis of team performance accuracy and shared situational awareness in SCUDHunt experiments. Vienna, VA. Thoughtlink, Inc.

TRONDSEN, E. (2005). The Business of Digital Game-Based Learning. SRI Consulting Business Intelligence.

TURNER, J., GAVIN, C. AND OWEN, M. (2004). Racing Academy. Physics Education, 39(5): 429-433.

UNIGAME (2006). Unigame: Game-based learning in universities and lifelong learning web page and game. Last retrieved online 12th October 2006 at: http://www.unigame.net and http://unigame.fh-joanneum.at).

VAN ECK, R. (2006). Digital Game-Based Learning: It's not just the digital natives who are restless. Educause, March/April.

VEEN, W. (2006). '2020 Visions Wim Veen's projections'. Paper presented at Online Educa in Berlin 2005.Last retrieved on 16th March 2006 at: http://www.global-learning.de/g-learn/downloads/veen_visions2020.pdf.

VEEN, W. and VRAKKING, B. (2006). Homo Zappiens: Reshaping learning in the digital age. London. Network Continuum Press.

WENGER, E. (1998). Communities of Practice. Learning, Meaning and Identity. Cambridge. Cambridge University Press.

WILLIAMSON, B. and SANDFORD, R. (2005). Games and learning: A handbook from Futurelab. Bristol: Futurelab. Retrieved online, 31st July 2006 at: http://www.futurelab.org.uk/research/handbooks/03_01.htm.

WISHER, R.A and FLETCHER, J.D. (2004). The case for advanced distributed learning. Information and Security, 14:17-25.

WITTGENSTEIN, L. (1972). The blue and brown books: Preliminary studies for the 'Philosophical Investigations'. Oxford. Basil Blackwell.

YAPP, C. (2005). Workforce reform and personalized learning. In S. de Freitas and C. Yapp (eds). Personalizing learning in the 21st Century. Stafford. Network Continuum Press.

YEE, N. (2003). Learning leadership skills. The Daedalus Project. Retrieved online, 27th July 2006 at: http://nickyee.com/daedalus/archives/000338.php.

YEE, N. (2006). The Psychology of Massively Multi-user Online Role-Playing Games: Motivations, emotional investment, relationships and problematic usage. In R. Schroeder and A Axelsson (Eds.), Avatars at Work and Play: Collaboration and interaction in shared virtual environments: 187-207. London. Springer-Verlag.

# Appendix A: List of those consulted for the report

Thanks to the following people who have been consulted during the writing this report.

Graeme Atherton (Aim Higher)

Roger Bennett (ELSPA)

Diane Carr (London Knowledge Lab)

Patsy Cummins (NIACE)

Tim Dumbleton (Becta)

Russell Francis (University of Oxford)

Josephine Fraser (Association of Colleges/Nilta)

Lizbeth Goodman (University of East London)

Mark Griffiths (University of Nottingham Trent)

Jake Hapgood (University of Nottingham)

Stephen Heppell (Heppell Consulting)

Paul Hollins (CETIS)

Carol Howard (Oaklands College)

Steve Jarvis (Vega Group)

Richard Joiner (University of Bath)

JISC e-Learning and Pedagogy Experts Group

Ken Kahn (London Knowledge Lab)

John Kirriemuir (Silversprite)

Alistair Lomax (Uniaid)

Martin Lynch (University of Glamorgan)

Paul Maharg (University of Strathclyde)

Andrew Middleton (University of Sheffield Hallam)

Nigel Oldham (West Nottinghamshire College)

Martin Owen (Futurelab)

Caroline Pelletier (London Knowledge Lab)

Leonie Ramondt (Ultralab)

Tim Rylands (Chew Magna School)

Sally Anne Saull (Association of Colleges/Nilta)

Richard Sandford (Futurelab)

Ben Sawyer (Digital Mill)

Mike Sharples (University of Nottingham)

Richard Smithies (Blitz Games)

Kurt Squire (University of Wisconsin-Madison)

Robert Stone (University of Birmingham)

David Swift (British Army)

Bryan Tregunna (Vega Group)

David White (TALL, University of Oxford)

Morwenna Vernon (Cornwall Adult Education Service)

# Appendix B: Glossary of terms

| Term used | Description |
|---|---|
| Avatars | An avatar is an interactive representation of a human figure in a games-based or three-dimensional interactive graphical environment. |
| Educational games | Games for learning are often imaginary (e.g. fantasy) interactive and immersive environments in which role play, skills rehearsal and other learning (e.g. collaborative or problem-based) may take place individually or in teams. |
| Exploratory learning | Learning through exploring environments, realia, lived and virtual experiences with tutorial and peer-based support. This notion of learning is based upon the notion that learning patterns can be helpfully transferred to dissimilar situations through meta-reflection. Unlike Kolb's experimental learning this process is not always circular (although it may be), and does not rely upon lived experience. Rather the approach acknowledge the cognitive process that help individuals to use their imagination and creativity to draw out lessons from interactions as well as extracting meaning from data. This process can be complicated and happen on different levels of understanding. That is learning can be supported through different media, and through multimedia, interactions and textual engagement. |
| Four-dimensional framework | The four dimensional framework developed by de Freitas and Oliver (2006) is designed to aid tutors selecting and using games in their practice. The framework includes: context, learner specification, pedagogy used and representation as four key aspects for selecting the correct game for use in learning practice. |
| Game consoles | A game console is an electronic machine for playing dedicated video games. Game consoles may need a separate output device e.g. television or a PC monitor. The main input device is a games controller, e.g. hand controller, joystick. |
| Game engines | Each computer, video game or interactive application with synchronous graphics has a game engine. The game engine is the central software component, providing the underlying technologies. The engine greatly simplifies the task of games development, and often allows the game to be used on different platforms, e.g. different game consoles and PC operating systems. |
| Immersive worlds | Immersive worlds is a term used in this report to mean simulations, games and other interactive, often 3D virtual spaces, or crossover spaces (e.g. between virtual and real). |
| Machinima | The ability of players to make films within virtual games. |

| | |
|---|---|
| Microworlds | These are worlds created with objects and artefacts to allow learners to explore a given imaginary or mock realistic domain or environment in an open-ended way. |
| Modding | Modding or modifying software in order to allow use in a different context or for different ends to that originally intended, or to further develop the software. Popular game mods include *Neverwinter Nights*. |
| Massively Multiplayer Online Games (MMOGs) | Multiplayer online games such as *Everquest* and *America's Army* use the web to support online game play communities with up to 7 million players, these games are engaging and have led to new forms of digital activity and new groups of avid internet users. |
| Massively Multiplayer Online Role play Games (MMORGs) | A subset of MMOGs, role play games include players taking on the identity or identities of avatars in the game. These games for leisure are very popular and include game clans which work together and the use of social software for supporting communications. |
| Pervasive gaming | Pervasive gaming uses mobile phones and other handheld devices and electronic media such as PDAs, faxes and the internet to allow users to play the game in different locations and at different times – so the game is always available to the player. |
| Serious games | Serious games are so-called because they integrate gaming elements with learning or training objectives. The name also refers to a movement of researchers and developers who are working towards developing games specifically aimed at educational audiences. |
| Simulations | Simulations are non-linear synthetic training environments that allow learners to rehearse different scenarios, tasks, problems or activities in advance of real life interactions or to update skills. |

# Appendix C: Useful Selected Links and Resources

This section provides a short selection of useful links and resources for practitioners considering the use of game-based learning in their practice.

**Useful Links:**

DiGRA, the Digital Games Research Association, is for academics and professionals who research digital games. Retrieved online, 25th September 2006 at: http://www.digra.org/.

The Education Arcade is a MIT-University of Wisconsin Partnership committed to research and development projects that drive innovation in educational computer and video games. Retrieved online, 25th September 2006 at: http://www.educationarcade.org/.

Game Learning. A web site developed by Jake Hapgood to support a community of practice of teachers using games in their practice. Retrieved online, 25th September 2006 at: http://www.gamelearning.net/

Gamasutra Education. A web site with up-to-date information on what is going on with gaming for learning. Retrieved online, 25th September 2006 at: http://www.gamasutra.com/education/

Game Research. A web site dedicated for games research with useful links and information. Retrieved online, 26th September 2006 at: http://www.game-research.com/default.asp.

Game Studies. A cross-disciplinary journal dedicated to games research. Retrieved online, 26th September 2006 at: http://www.gamestudies.org/.

**Selected resources for practitioners:**

DE FREITAS, S., SAVILL-SMITH, C. and ATTEWELL, J. (2006). Educational games and simulations: Case Studies from Adult Learning Practice. London. Learning and Skills Research Centre.

EGENELDT-NIELSEN, S. (2005). Beyond Edutainment: Exploring the educational potential of computer games. Doctoral Thesis, IT-University of Copenhagen. Denmark. Last retrieved 30th May 2006 at: http://www.itu.dk/people/sen/egenfeldt.pdf.

ENTERTAINMENT AND LEISURE SOFTWARE PUBLISHERS ASSOCIATION. (2006). Unlimited Learning: Computer and video games in the learning landscape. London. Entertainment and Leisure Software Publishers Association

GEE, J. P. (2003). What videogames have to teach us about learning and literacy. New York: Palgrave Macmillan.

MITCHELL, A. and SAVILL-SMITH, C. (2005). The use of computer and video games for learning. A review of the literature. London. Learning and Skills Development Agency.

SALEN, K. and ZIMMERMAN, E. (2004). Rules of play. Cambridge, Massachusetts. MIT Press.

SANDFORD, R., and ULICSAK, M., FACER, K. and RUDD, T. (2006) Teaching with Games: Using commercial off-the-shelf computer games in formal education. Bristol. Futurelab.

WILLIAMSON, B. and SANDFORD, R. (2005). Games and learning: A handbook from Futurelab. Bristol: Futurelab. Retrieved online, 31st July 2006 at: http://www.futurelab.org.uk/research/handbooks/03_01.htm.

# Appendix D: Web links from the report

This list provides links to some of the games and simulations featured in the report.

| Game/Simulation Title | URL |
|---|---|
| All About U | www.allaboutu.org.uk/ |
| America's Army | www.americasarmy.com/ |
| Ardcalloch | www.ardcalloch.ggsl.strath.ac.uk/introduction/ |
| ARQuake | http://wearables.unisa.edu.au/projects/ARQuake/www/ |
| Ben's game | www.makewish.org/site/pp.asp?c=bdJLITMAE&b=81924 |
| Big Game | www.thebiggame.org/ |
| Brain Trainer | www.brain-trainer.com/ |
| Brigadoon | http://braintalk.blogs.com/brigadoon/2005/01/about_brigadoon.html |
| Business Game | www.btplc.com/Societyandenvironment/Businessgame/index.htm |
| Campus: Second Life | http://secondlife.com/education |
| Civilisation III | www.civ3.com/ |
| Dr Kawashima's Brain Training: How Old Is Your Brain? | www.braintraining.com.au/ |
| Environmental Detectives | http://education.mit.edu/ar/ed.html |
| Everquest | http://eqplayers.station.sony.com/index.vm |
| EyeToy | www.eyetoy.com/shared/locale.asp?returnURL=/index.asp |
| Far Cry | www.farcry-thegame.com/uk/home.php |
| Full Spectrum Command | www.ict.usc.edu/content/view/56/108/ |
| Full Spectrum Warrior | www.fullspectrumwarrior.com/gm_faq.php |
| Grangeton | www.grangeton.com/ |
| Hazmat: Hotzone | www.etc.cmu.edu/projects/hazmat_2005/screenshots.php?page=0 |
| Homicide | www.homicidethegame.com/ |
| Key skills trainer | www.keyskills4u.com/ |
| Knights of Honor | www.knights-of-honor.net/ |
| Live2Give | http://secondlife.com/ |
| Majestic | http://en.wikipedia.org/wiki/Majestic |
| Max Trax | http://catalogue.learndirect.co.uk/courses/100216BS001/ |
| Myst | www.riven.com/myst_home.html |
| Neverwinter Nights | http://nwn.bioware.com/ |
| Oaklands Game | www.unigame.net/html/project_game.html |
| Outbreak Quest | www.academiccolab.org/resources/documents/OutbreakQuest.pdf |
| Pulse!!! | www.sp.tamucc.edu/pulse/index.shtml |
| Quake 4 | www.quake4game.com/ |
| Racing Academy | www.futurelab.org.uk/download/projects/racing_academy.php |
| Re-Mission | www.re-mission.net/ |
| Revolution | www.educationarcade.org/revolution |
| Roller Coaster Tycoon 3 | www.atari.com/rollercoastertycoon/ |
| Savannah | www.futurelab.org.uk/showcase/savannah/index.htm |
| ScudHunt | www.scudhunt.com/ |
| Second Life | http://secondlife.com/ |
| Sim City | http://simcity.ea.com/ |
| Sims 2 | http://thesims2.ea.com/ |
| Skillswise | www.bbc.co.uk/skillswise/ |
| SnowWorld | www.hitl.washington.edu/projects/vrpain/ |
| Strike and Retrieve | www.mofunzone.com/download_games/nte_strike_and_retrieve.shtml |
| Student Survivor | www.studentsurvivor.org.uk/2/ |

| | |
|---|---|
| Supafly | http://ieeexplore.ieee.org/iel5/7756/33539/01593575.pdf?isnumber=&arnumber=1593575 |
| Supercharged! | www.educationarcade.org/supercharged |
| Theme Hospital | http://compsimgames.about.com/od/themehospital/ |
| Ultima Online | www.uo.com/ |
| Unigame | www.unigame.net/ |
| Urban Tapestries | http://urbantapestries.net/weblog/ |
| Virtual Hallucinations | http://secondlife.com/ |
| Virtual Leader | www.simulearn.net/leadershiptraining.html |
| Webwise | www.bbc.co.uk/webwise/ |
| Wireless Explorer | http://newsroom.cisco.com/dlls/2005/prod_081605b.html |
| World of Warcraft | www.worldofwarcraft.com/ |
| **Project** | |
| Making Games | www.childrenyouthandmediacentre.co.uk/projects.asp?Completed=no&TableName=Overview&RowID=6&ResearchProjectsID=35 |
| Mlearning project | www.m-learning.org/ |
| Mobilearn | www.mobilearn.org/ |
| Serious Games- Engaging Training Solutions | www.londonknowledgelab.ac.uk/graphics/projectsheets/sg.doc |
| Virtual Reality (VR) Assessment and Treatment of Combat-Related Post-Traumatic Stress Disorder (PTSD) project | www.ict.usc.edu/content/view/31/84/ |
| **Technology/Tool** | |
| Game Maker | http://www.gamemaker.nl/ |
| Magic Wall | http://www.cs.umd.edu/hcil/kiddesign/ |
| StoryRooms | http://www.cs.umd.edu/hcil/kiddesign/storyrooms.shtml |
| | |
| **Website** | |
| MySpace | http://www.myspace.com |