Gaming and the network generation

Nicola Whitton

Education and Social Research Institute

Manchester Metropolitan University

Citation:

Whitton, N. (2008). Gaming and the Network Generation, in S. Wheeler (ed) *Connected Minds, Emerging Cultures: Cybercultures in Online Learning*. Charlotte, NC: Information Age Publishing

Introduction

There is a conception of the modern student, brought up on computers and interactive media, as part of a cognitively different 'generation', who learns in ways that are significantly different from previous generations of learners. It has been argued that computer games, through the provision of immersive interactive environments, have the potential to motivate and engage this new breed of learner (Prensky, 2001; Oblinger, 2004).

This perceived change in the learning needs of the 'Games Generation' (Prensky, 2001) or 'Net Generation' (Oblinger, 2004) coupled with the ongoing growth in use and acceptability of a range of communications technology has precipitated a growing interest in the potential of computer games for learning. In a recent survey, 36% of primary school teachers and 27% of secondary school teachers said that they had used games to teach (Sandford et al, 2006). It is not clear, however, the extent of use of games-based learning in post-school education, or the appropriateness of this method with older learners.

This chapter considers the acceptability of computer game-based learning in the context of university students. It discusses the potential of computer games in relation to theories of learning, examines the conceptions of a cognitively different type of learner and explores the notion that these learners find computer games the ideal environment in which to learn. The chapter then goes on to discuss student game preferences in terms of genre and the types of computer game that may be more appropriate for learning, and aspects of computer game design that may influence student use. The chapter concludes by considering the benefits and challenges of computer games for learning and teaching in tertiary education.

Computer games as constructivist learning environments

This section will argue that certain types of computer game, designed for educational purposes, can provide authentic situated learning experience. The constructivist perspective hypothesises that people learn by constructing their own perspectives about the world, by problem-solving and personal discovery. The design of student-centred online learning environments and interactive, exploratory learning objects has been very much influenced by the constructivist perspective (e.g. Grabinger et al, 1997; Land & Hannafin, 2000). However, students do not always use learning environments in the manner expected (Beasley & Smyth, 2004) and it is the activities that are carried out in a learning environment that support autonomous learning and higher-level thinking skills. By the provision of problem-based contexts with authentic tasks, computer games have the potential to be truly engaging constructivist learning environments.

A constructivist learning environment provides real tasks with 'just-in-time' information and resources to support the completion of activities in an authentic and transferable context. Wilson (1996) describes a constructivist learning environment as:

> a place where learners may work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities. (Wilson, p 5.)

Honebein (1996) describes the pedagogic goals of the design of constructivist learning environments: they should support students to take responsibility for their learning, including the topics they pursue, methods of learning and strategies for problem-solving; provide experience of multiple perspectives and viewpoints; encourage ownership and self-awareness of the learning process; make learning realistic and relevant, based on authentic, real-life activities; make learning a social experience, supported by collaboration and interaction; use multiple modes of representation; and use rich media.

Computer games can provide the opportunity for learners to explore and navigate immersive virtual worlds using rich media, they can create authentic contexts for practising skills that can be transferred to the real world, and they can present a forum and context for problem-solving. Researchers have highlighted that computer games have the facility to create real-life problem-solving experiences. Kiili (2005) argues that "games provide a meaningful framework for offering problems to students. In fact, a game itself is a big problem that is composed of smaller causally linked problems." (Kiili, 2005, p 17), and in a survey of 25 educational 'experts' using game-based learning, de Freitas (2006) found that "broadly the experts interviewed seemed to advocate the use of simulations and games for problem-based learning" (de Freitas, 2006). Gee (2003) argues that playing video games has key learning principles built in and involves learning a new literacy and although games are not

necessarily appropriate for teaching content, they do teach people how to interact in a new domain and learn transferable skills. He says that when we learn new domains we learn to experience things in new ways, gain the potential to join new social groups and prepare for future learning in related domains.

Collaboration and learning from others is fundamental to the constructivist perspective, and multi-user games or collaborative game playing in the same physical space are two ways that facilitate this. Central to the notion of constructivist learning is the idea of students working together, sharing and clarifying ideas and opinions, developing communication skills and learning from one another. Working collaboratively enables students to work to their strengths, develop critical thinking skills and creativity, validate their ideas, and appreciate a range of individual learning styles, skills, preferences and perspectives (McConnell, 2000; Palloff & Pratt, 2005).

Vygotsky's (1978) work in the field of social constructivism is particularly concerned with the collaborative aspects of learning, theorising that learning takes place at a social level first and then at an individual level. His theory of Zones of Proximal Development contends that the zone of proximal development is the difference between what a student can learn working alone, and what he or she can achieve when being supported and guided by a teacher or some other expert. In collaborative gaming, this apprenticeship role is provided by more experienced players supporting and initiating 'newbies' (Steinkulher, 2004). Participating in communities of practice provides a legitimate and ongoing way of learning from others as part of a group through apprenticeship and education in the context of the group norms, processes and identity (Lave & Wenger, 1991). Wenger (2000) describes these communities of practice as "the basic building blocks of a social learning system" (Wenger, p 229). Multi-user computer gaming communities provide a platform for collaboration, support and learning through in-game interactions, out-of-game support sites, observation and provision of 'just-in-time' information (Ducheneaut & Moore, 2005).

The constructivist perspective also puts forward the idea that students learn better by exploring and experiencing authentic contexts for themselves and discovering their own meaning from the experience. The Experiential Learning Cycle (Kolb, 1984) emphasises the importance of active learning, with planning, reflecting and theoretical underpinning. According to this cycle, learning takes place as part of a sequence of steps. Computer game-based learning, provides the interaction and feedback that is crucial to the experiential learning cycle. Computers can facilitate a whole range of types of interaction from basic items that can be clicked, moving backwards or forwards through a linear sequence, to the use of hyperlinked environments and virtual interactive worlds (Sims, 1997). Computer games have the potential to offer sophisticated interaction systems and intrinsic feedback mechanisms. Gee (2003) argues that computer games reflect the experiential learning cycle in that students must examine the virtual environment, reflect on the situation and form a hypothesis about what something in the situation might mean,

and re-probe the virtual world to see what effect it has. While it is true that this cycle maps onto learning within the game world, it does not necessarily provide students with scope for the meta-cognitive processes that are required for them to truly engage with and take responsibility for their own learning when applying their learned knowledge and skills to the real world. It is important to recognise that game-based learning is necessarily part of a larger learning process and should be considered in terms of the other activities and reflection that surround the game and not as a stand-alone activity.

Adult learning theory, or andragogy (Knowles, 1998), argues that the key characteristics of adult learners, as related to their motivations and learning needs, are that: adults need to know why they need to know something before they are willing to invest time and energy in learning it; they have a deep psychological need to be self-directing and to take responsibility for their own learning; they have a wide variety of backgrounds and experience and it can not be assumed that all adult learners come from the same starting point; they become ready to learn something when they need to know it to be able to cope effectively with real-life situations; and they are task-oriented in their learning. They learn things best in the context of using them to do things they want to do. It is important to note, however, that pressure of life and work commitments and limited time to devote to study is becoming more true of younger students also. Adult learning theory has much in common with the constructivist approach in that it advocates learners taking responsibility for their learning, and learning through experience in an authentic context, so it can be argued it is actually of relevance to all learners to varying degrees.

Adult learning theory highlights the fact that motivation to learn is paramount and that learning activities must be purposeful. This brings into question the acceptability of game-based learning with adult learners, who may perceive games as frivolous and a waste of time. Play is perceived by many as only for young children, as not being a respectable thing to do, and as activity that is easy (Rieber, 1996). It is important to ensure that any gaming experience in an educational context is appropriately designed so that it not only meets an educational need in the most effective manner, but is perceived as doing so by the students. The next section discusses student attitudes and perceptions towards computer games in more detail.

Attitudes to games-based learning in Higher Education

Prensky (2001) describes the definite distinction between ‘Games Generation’ learners, or ‘digital natives’ who have grown up with computer games, television, and other media, and use them to learn instinctively; and older learners, for whom interacting with these types of technology has to be done through conscious effort and who exhibit more traditional learning strategies. He argues that the generation of people brought up in a world of computers are cognitively different from previous generations and that this immersion in technology has fundamentally changed the way in which people acquire and assimilate information. He describes ten cognitive

changes in people of the Games Generation associated with a fast pace of learning and ability to process information from multiple channels at a greater speed, but with a need for quick rewards and feedback. He also describes a preference for visual materials and working collaboratively, actively seeking and evaluating information with no distinction between play and learning, and a greater acceptance of games and fantasy contexts for learning, change and new technologies in general.

Two recent UK studies have provided evidence that students may not be as comfortable with technology for learning and new ways of working as may be assumed. In a study into student expectations of Higher Education, IPSOS MORI (2007) investigated ICT provision and found that while the group of potential students were classed as digital natives (e.g. have grown up with technology, see it as a core part of their engagement, see ubiquitous internet as the norm) they don't value the use of technology for its own sake, but instead put a high value on face-to-face teaching and traditional teacher-student interaction. CIBER (2008) found that the assumption that young people who are brought up in the information age are more web-literate than older people is false and although they demonstrate an apparent ease with computers they rely heavily on search engines and lack critical and analytic skills. In fact, the study claims, character traits that are often associated with young web users, such as lack of tolerance of delay in search and navigation, are actually true of all age groups of web users.

Throughout the literature on game-based learning, it is sometimes assumed that a primary reason for using computer games for learning is that they are intrinsically motivating to students (e.g. Alessi & Trollip, 2001; Becker, 2001; Oblinger, 2004). A study was carried out at Napier University in Edinburgh to examine student perceptions of game-based learning, in particular the motivational aspects (Whitton, 2007). This study consisted initially of twelve in-depth interviews with current or ex-students to draw out themes and opinions relating to the potential of game-based learning in Higher Education. There were an equal number of male and female participants, ranging in age from 20–29 to 60+ and containing a mix of game-players and people who did not play games recreationally. These interviews were used to identify areas of interest and a survey was carried out with a larger population (n = 200) to examine student attitudes to computer games for learning. The population used for this study was a group of third-year undergraduate, and Masters-level postgraduate computing students. It was hypothesised that out of any population of students in Higher Education the demographics of computing students matched those most likely to engage with computer games recreationally (i.e. men aged between 20 and 29 (Entertainment Software Association, 2007)), so could be argued to be a group for whom this mode of teaching may be perceived most positively.

The vast majority (98.5%) of this population had played a computer game at some point previously, while 48.5% still played regularly and 38.5% occasionally: this is a group that engages with games in their leisure time and, if the assumptions in the gaming literature are to be believed, would be expected to be motivated by

educational games. The two primary motivations cited for playing computer games were to be able to play with others (social benefits) and for the mental challenge. This provides some evidence that games as constructivist learning environments that support problem-solving may match the types of game that students prefer to play in their leisure times.

In order to consider whether game-based learning would be seen as an acceptable, or even motivational, way to learn in the student group under study, they were asked if they would be positively motivated to learn something with a game, whether they would not be motivated either way, or whether they would find using a game to learn demotivating. Only 62.5% said that they would find computer games for learning positively motivational and previous experience of playing educational games did not significantly affect the level of positive perception. It is interesting to note that even in a group of predominantly male, predominantly young, game playing students, who it might be expected to be more motivated than other groups to learn with computer games, fewer than two-thirds of the students actually said that using a game to learn would be positively motivating.

This research provides evidence that fewer students actually find learning games motivational than might be expected of 'net generation' learners. However, from the initial interviews (many of the participants of which were considerably older) there was a universal feeling that while computer games for learning may not be motivational for their own sake as games, they would be motivational as learning experiences if they were perceived as being an appropriate and effective way to learn and not merely as a gimmick.

While this is clearly a small study, it provides evidence that the reasons for using computer games for learning should not be based on the supposed cognitive needs of one generation, but because they can be effective tools for learning, for all learners. Despite the potential motivational aspects of games not providing a compelling rationale for their use educationally, there are other pedagogic reasons for considering computer game-based learning. A more persuasive argument for using games to learn is based around the changing profile of university students. Changes have taken place in the needs of learners, but this is due to changes in the student population leading to greater diversity of age, background and ability coupled with changes in students' attitudes towards their education, increasingly seeing themselves as 'customers' in the education system, and having greater expectations. Computer games will not suit every learner, or every learning context, but when effectively designed can provide authentic collaborative learning environments, which while not intrinsically motivational to all students, will be seen as an appropriate way to learn if they are the best tool for the job.

Game genre and design characteristics

Two other important aspects that influence the effectiveness of computer games for learning as constructivist environments are the genre of game and the design. Certain types of game may be more appropriate for learning than others, but these may not be those that are typically played by students in their leisure time.

In the Napier University study described in the previous section, students were asked about their gaming habits. There was a wide range of types of games played within this group, including adventures, multi-player games, puzzles, role plays, shooters, simulations, sports, and strategy games. The most favoured genre overall was first-person shooters, which, because of their fast-pace and violent content may be inappropriate for education. So, while the group who took part in the study may show a greater propensity to play games, the types of games favoured are not always suitable for learning in a formal context.

However, adventure games and strategy games were the next two most popular genres. These game types exhibit many of the characteristics of constructivist learning environments such as an authentic experiential context, cognitive puzzlement and problem-based situations. The use of multi-player games among this group was also high, indicating acceptability of a collaborative environment.

A second issue to that of genre is the types of virtual gaming world that are most appropriate for learning. This can be in terms of the number of players (single to multi-player to massively multi-player), the fidelity of the environment (textual to graphical to immersive) and the playing medium (desktop, console, mobile device, real world). A second study was carried out a Napier University to compare the effect of interface design on engagement (Whitton, 2007). Two collaborative online game-based activities with the same learning outcomes were compared: the Time Capsule, a direct online translation of a face-to-face collaborative activity; and the Pharaoh's Tomb, a graphical multi-player adventure game. Both game-based activities were designed to take the same time to complete and with the same set of learning outcomes and supporting materials. Each of the sessions was designed to fit into a one-hour time slot, because this fitted with the timing of lessons at the universities where the trials were undertaken.

The Time Capsule is an interactive group negotiation activity with an explicit goal to agree on items to be placed in a time capsule and clear rules regarding the number of items and their total cost. There are no measured outcomes or scoring, therefore, beyond achieving the goal or not, it is not possible for teams to compare themselves with others, removing the element of competition. The Time Capsule provides a fantasy scenario for the participants but it does not present an immersive world that can be explored as part of that scenario, although it does provide interactivity and feedback to actions.

The Pharaoh's Tomb is a three-dimensional collaborative graphical adventure game that offers a range of challenges based around group problem-solving and has explicit group goals of returning an object to a certain place within the tomb and enabling the whole team to escape, and implicit rules as to what the team members can do (e.g. each player can carry only one object at a time). The Pharaoh's Tomb game is scored, which means that there are measured outcomes (as opposed to simply achieving the goal or not) and teams can compare themselves with other teams, introducing an element of competition. The game is not designed to support inter-group competition because this would be at odds with the collaborative nature of the exercise. It provides a fantasy environment of an Egyptian Pharaoh's tomb that can be navigated and explored; characters can interact with objects and gain feedback from the environment as well as from other players.

The comparative study was undertaken with undergraduate computing and marketing students (n = 112) such that each student was allocated to one of the activities. When a student logged in to the multi-user software engine he or she was automatically allocated to the next available game, which effectively meant that players were allocated to teams at random. Students were asked to complete three questionnaires: background information before the session, engagement after the online element, and self-perceived learning after the debriefing and discussion. This chapter only considers the analysis of the engagement questionnaire (although there was also no significant difference in self-perceived learning).

The responses to each question in the engagement questionnaire were summed to produce an overall engagement score for each individual. To see whether there is a significant difference between the levels of engagement of those students using the Pharaoh's Tomb game and those using the Time Capsule learning activity, non-parametric statistical the Mann–Whitney statistical test was considered to be appropriate (Greene & D'Oliveria, 1993).

There was found to be no significant difference in engagement between the two conditions. However, engagement was hypothesised to be made up of five factors: challenge, control, interest, immersion and purpose, and the questionnaire was developed so that specific questions mapped to each of these factors. It was therefore also possible to use the Mann–Whitney statistical analysis to examine whether there was a significant difference in any of the factors between the two experimental conditions.

There was no significant difference between the level of challenge, interest, immersion and purpose between the two activities. However, there is a significant difference, at the 0.01 level of significance, in perceived control between the two activities, with the Time Capsule activity being rated more highly for control. This is a particularly interesting finding as it provides evidence that, while the Pharaoh's Tomb was designed to provide an environment with many options and objects that could be manipulated, students actually felt a significantly higher level of control

using the Time Capsule application. This could be due to the greater complexity in the interface of the Pharaoh's Tomb, or the fact that the Pharaoh's Tomb required three-dimensional spatial navigation skills, which left a small number of students unable to move around in the environment, whereas the time Capsule did not require the players to master navigation or interact with objects in a virtual environment.

In considering the type of game-based environment that is appropriate for student learning it is important to think about the needs of the teaching situation to ensure that they are met without adding additional cognitive elements (e.g. steep learning curve, complex interface, navigation) that are unnecessary to the learning process.

Challenges of game-based learning in virtual worlds

It is important that educators do not make assumptions about the current generation of students, or take for granted that tools used for entertainment will transfer into appropriate tools for learning. There are several challenges for computer game-based learning in education.

The rationale for using games must be clear to both teacher and students. While some games may support learning, educators must be clear that they are using them for their pedagogic benefits and not simply because of an assumed motivational effect. If this is the case then students will be more likely to perceive the game as being an appropriate and effective way in which to learn. There needs to be an explicit pedagogic rationale and a strong match between gaming outcomes and learning outcomes so that engagement in the game is linked directly to learning from the game. Learning from games needs to be scaffolded to ensure that all aspects of the experiential learning cycle are catered for, and that all student learning styles are taken into account, with activities to encourage reflection, collaboration and application outside of the gaming environment; computer games need to be seen as an element in a learning package rather than a stand-alone activity.

There are problems associated with the design of bespoke education software often involve the amount of money spent on producing it compared to entertainment software, and how this affects the expectations of learners. Jenkins (2002) argues that most educational software is of poor quality, badly edited and unprofessional. It will never be the case, however, that the amounts of money spent on commercial software will be available for education, and it is more important that resources be used to ensure that educational games are well designed in terms of playability and learning. The growing trend towards modifying existing games software for use in education (de Freitas, 2007) may provide one way to address this issue. Whatever method for development is adopted, creation of a complete learning package is timely and expensive, and requires specialist expertise.

It is also important that the use of games does not lead to accidental exclusion, particularly on the basis of extra cognitive load caused by the game design or interface. In particular, spatial ability may limit navigation in three-dimensional

environments. While the studies described in this chapter were carried out with a predominantly male sample, it is also important to consider the perceptions of females as relates to game playing, as these may be very different to those of males. The act of learning to play a game itself is often considered to be part of the experience in entertainment software, however this needs to be kept to a minimum in an educational context (when it does not relate to the learning outcomes). There is also a danger with the use of computer games for learning, as with any educational innovation, that motivation to engage by students is partly due to a novelty effect and as it becomes over-used students cease to be motivated.

As well as student learning through playing games, there are also a number of researchers who believe that students can learn by developing or creating games, as well as simply playing them. Rieber and colleagues (1998) argues that learning by building games can be an at least, if not more, effective way to learn than traditional methods, while Shubik says that "possibly at least as important as playing a game is constructing one" (Shubik, 1989, p 186). Gee (2003) argues that active, critical learning should lead to learners becoming designers, either by physically designing extensions to the game or by cognitively extending the game design and using that to inform their play.

A final issue to highlight is the lack of robust empirical studies into the effectiveness of computer games for learning, particularly in post-school education. Much of the research into game-based learning is anecdotal and small-scale, or does not address issues of educational effectiveness. There is an identified need among policy makers for more robust empirical work to provide a baseline of evidence on how educational games can be used most effectively to teach (de Freitas, 2007). Mitchell and Savill-Smith (2005) conclude that:

the literature base is relatively sparse, findings often conflict in their outcomes, there is a lack of studies regarding educational games use by adolescents, some studies have methodological problems, and longitudinal studies are needed. (Mitchell & Savill-Smith, p 61.)

The author strongly believes that there is a place for computer game-based learning in tertiary education, but that it is certainly not suited to every teacher, student or learning context. It is key to see games as simply another option available to teachers to effectively integrate with other traditional and electronic pedagogic practices. However, when used for its pedagogic aptness, with appropriate scaffolding for learning and reflection, computer game-based learning environments have the potential to provide truly useful, engaging and collaborative educational experiences.

References

Alessi, S. M. and Trollip, S. R. 2001. Multimedia for Learning. Boston: Allyn and Bacon.

Beasley, N. and Smyth, K. (2004) Expected and Actual Student use of an Online Learning Environment: A Critical Analysis. The Electronic Journal of E-learning, 1/2.

Becker, K. (2001) Teaching with games: the minesweeper and asteroids experience. Journal of Computing in Small Colleges, 17 (2), 23–33.

CIBER (2008) Information behaviour of the researcher of the future. Bristol: JISC.

de Freitas, S. I. (2006) Using games and simulations for supporting learning. Learning, Media and Technology, 31 (4), 343–358.

de Freitas, S. (2007) Learning in Immersive Worlds: a Review of Game-based Learning. JISC.

Ducheneaut, N. and Moore, R. J. (2005) More than just 'XP': learning social skills in massively multiplayer online games. Interactive Technology & Smart Education, 2, 89–100.

Entertainment Software Association (2007) Facts and research: game player data. [Available online] http://www.theesa.com/facts/gamer_data.php

Gee, J. P. (2003) What Video Games Have to Teach Us About Learning and Literacy. New York: Palgrave MacMillan.

Grabinger, S., Dunlap, J. and Duffield, J. (1997) Rich environments for active learning. ALT-J: Research in Learning Technology, 5 (2), 5–17.

Greene, J. and D'Oliveria, M. (1993) Learning to Use Statistical Tests in Psychology. Buckingham: Open University Press.

Honebein, P. C. (1996) Seven goals for the design of constructivist learning environments. In Wilson, B. G. (Ed.) Constructivist Learning Environments: Case Studies in Instructional Design. Englewood Cliffs, NJ: Educational Technology Publications.

IPSOS MORI (2007) Student expectations study. Bristol: JISC.

Jenkins, H. (2002) Game theory. Technology Review, March.

Kiili, K. (2005) Digital game-based learning: towards an experiential gaming model. The Internet and Higher Education, 8, 13–24.

Kolb, D. A. (1984) Experiential Learning: Experience as the Source of Learning and Development. New Jersey, NJ: Prentice Hall.

Knowles, M. (1998) The Adult Learner (5th edition). Houston, TX: Butterworth-Heinemann.

Land, S. M. and Hannafin, M. J. (2000) Student-centered learning environments. In Jonassen, D. H. & Land, S. M. (Eds) Theoretical Foundations of Learning Environments. Mahwah, NJ: Lawrence Erlbaum Associates.

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

McConnell, D. (2000) Implementing Computer Supported Cooperative Learning (2nd edition). London: Kogan Page.

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.

Oblinger, D. (2004) The next generation of educational engagement. Journal of Interactive Media in Education, 8. Page numbers?

Palloff, R. M. and Pratt, K. (2005) Collaborating Online: Learning Together in Community. San Francisco, CA: Jossey-Bass.

Prensky, M. (2001) Digital Game-Based Learning. New York: McGraw Hill.

Rieber, L. (1996) Seriously considering play: designing interactive learning environments based on the blending of microworlds, simulations and games. Education and Training Resource & Development, 44, 42–58.

Rieber, L. P., Smith, L. and Noah, D. (1998) The value of serious play. Educational Technology, 38 (6), 29–37.

Sandford, R. and Williamson, B. (2005) Games and Learning. Bristol: Nesta Futurelab.

Shubik, M. (1989) Gaming: Theory and practice, past and future. Simulation and Games, 20 (2), 184–189.

Sims, R. (1997) Interactivity: a forgotten art? Computers in Human Behavior, 13 (2), 157–180.

Steinkuehler, C. A. (2004) Learning in massively multiplayer online games. In Proceedings of the 6th International Conference on Learning Sciences, Santa Monica, California.

Vygotsky, L. (1978) Mind in Society: The Development of Higher Psychological Functions. Cambridge: Harvard University Press.

Wenger, E. (2000) Communities of practice and social learning systems. Organization, 7 (2), 225–256.

Wilson, B. G. (1996) What is a constructivist learning environment? In Wilson, B. G. (Ed) Constructivist Learning Environments: Case Studies in Instructional Design. Englewood Cliffs, NJ: Educational Technology Publications.

Whitton, N. (2007) An Investigation into the Potential of Collaborative Computer Game-Based Learning in Higher Education. PhD Thesis. Available at: www.playthinklearn.net Retrieved 10 March, 2008.