

Serious Fun – The Role of Digital Games in Learning and Education¹

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Abstract

As the power and sophistication of digital and video has grown exponentially over recent years, researchers in many fields have become increasingly aware of the powerful potential of digital games in a wide range of learning and educational applications. Digital games can engender levels of engagement, motivation, application and skill in players that are the envy of traditional trainers and educators. This paper examines the qualities that give digital games this great potential, and will review current developments in the field of digital game-based learning (DGBL). Sample case studies from a wide range of subject domains are also examined and reviewed.

1 Introduction

The worldwide video games industry has grown vigorously in recent years to become a major global industrial sector, with a recent forecast projecting a global value for the games industry in 2009 of the order of \$47 billion dollars [DTC Intelligence, 2008]. Whilst the main purpose of the vast majority of the games sold will be for entertainment, there is a lot of ongoing interest and research in academia and industry into the use of video games for non-entertainment purposes, particularly in the areas of education and training. Researchers are especially interested in the high levels of motivation and engagement engendered

by computer games amongst players of all ages, but particularly amongst children and teenagers.

In this paper, I will review how video and computer games are being applied as primary or complementary instructional tools over a wide variety of subject domains, and I will examine the claims being made about how games-based learning can be dramatically more effective than other, more conventional modes of learning. I will review some case studies of how game-based learning has been applied to teach often difficult, complex or tedious subject matter and how effective these applications have been, and I will look at some of the difficulties and challenges posed by the implementation of game-based learning. Finally, I will examine some cases of where the engaging and immersive qualities of video games so prized by some researchers could have potentially dangerous or anti-social consequences.

2 Engagement, Motivation and Fun

Much of the interest in game-based learning stems from the insight that motivation is of central importance to learning [Garris et al., 2003]. Games generate very high levels of motivation amongst game players, promoting extended periods of sustained, concentrated application to the solving of the challenges of the game. J.P. Gee describes watching his six-year-old grandson play “*Pimkin*”, a game for the Nintendo GameCube, in which the child had to

¹ This paper reflects on topics and ideas raised in the lecture “Exploring Games” given by Dr. Aphra Kerr on 2nd February, 2008.

"...lead a multi-colored army of little Pimkin to fight, build, grow more Pimkin, and explore a strange landscape, all the while solving multiple problems to discover and get to the locations of the spaceships missing parts." [Gee, 2004]

Moreover, Gee's grandson applied the high levels of concentration required to accomplish these relatively complex tasks over several hours. Such levels of sustained concentration and application to any task are normally very difficult for a child of six years of age, so whatever it is in games that achieves this level of engagement is clearly of interest to educators and educational researchers.

Marc Prensky explores at length the enormous potential of digital games in learning in his book "Digital Game-Based Learning" [Prensky, 2001a], which he describes as a "manifesto" for the adoption of game-based learning techniques in the fields of learning and education. Prensky maintains that most conventional training and education today is deadly boring, including (indeed, especially) on-line training. He argues that learning can and must be fun, and proclaims that a "21st century learning revolution" is underway in which learning

"will finally throw off the shackles of pain and suffering which have accompanied it for so long."

Prensky defines "fun" in this context as meaning "enjoyable" or "pleasurable", as opposed to "amusing" or "frivolous", and emphasises that making the learning experience fun will mean that the trainee remains engaged even if the subject matter is hard. It is lack of engagement and boredom that are the main barriers to effective learning, rather than difficulty; indeed, Seymour Papert points out that games are often fun *because* they are hard, and he argues that

"the reason most kids don't like school is not that the work is too hard, but that it is utterly boring...The fact is that kids prefer things that are hard, as long as they are also interesting." [Papert, 1998]

In discussing the relationship between fun, games and play, Prensky lists the reasons why games are so engaging. He defines twelve separate characteristics of games, including fun, play, rules, goals, feedback, problem solving, challenge, interaction and narrative, all of which serve to promote enjoyment, pleasure, involvement, motivation, learning, creativity and identification, combining to create a powerful and effective learning experience. The "safe to fail" environment created in the virtual worlds of digital games also promotes experimentation and learning from mistakes.

While Prensky's promotion of digital game-based learning is enthusiastic and sometimes even evangelical, Sara de Freitas gives a more sober assessment of the potential of digital games in learning [de Freitas, 2006]. While she acknowledges the key roles of motivation and engagement in effective learning, she points to a number of practical challenges faced in the creation and implementation of game-based learning, ranging from the need to strike "a correct balance between delightful play and fulfilling specified learning outcomes", to practical concerns such as difficulties relating to accessing suitably configured equipment in schools. She also highlights the lack of empirical evidence supporting the effectiveness of game-based learning and the need for better understanding as to how to deploy game-based learning in practice. De Freitas makes a number of practical recommendations for the promotion of game-based learning, including incorporating games into established pedagogic practice, better support materials and training for teachers and tutors, and more research into the effectiveness of game-based learning.

3 Case Studies

In this section I review a number of case studies of digital game-based learning and training applications.

3.1 Business Training – "The Business Game"

"The Business Game" is a role-playing game developed by PIXELearning [PIXELearning, 2008]. It is designed to simulate a modern business, is aimed at a

teenaged audience and is designed to be taught in a classroom setting, satisfying the business education requirements of the UK's National Curriculum. In "The Business Game", the game player gets to run a manufacturing company, and main goal of the game is to develop and bring a product to market that potential customers will want, and to sell the product at a price and in sufficient volumes to return as much profit as possible. Players get to practice such business activities as market research, product selection and pricing, selecting a suitable sales channel, trading, budgetary/financial control, and production planning. Feedback is provided to the players in the form of financial performance reports in which players can see how much net profit they have made, and as the game is intended to be played in a classroom setting, the teacher will be on hand to help students interpret the results.

Feedback quoted on the PIXELearning web site indicates that "The Business Game" achieves a high degree of engagement amongst the students who have played it, due to the immersive nature of the game, in which the player gets to practice all the principle activities involved in managing a business. Learning is facilitated through the feedback provided at the end of the game cycle, and motivation is boosted by the fact that game is typically played competitively by multiple teams of students in a classroom setting, with each team vying to outdo their competitors and make as much profit as possible. "The Business Game" offers a wide range of product and marketing strategies and possible outcomes, allowing students to learn from unsuccessful as well as successful outcomes.



Figure 1 - Production Selection in "The Business Game"

3.2 Financial Training – "In\$ider"

"In\$ider" [Prensky, 2001c] is a game developed by PriceWaterhouseCoopers for training auditors and accountants in the intricacies of financial derivatives trading in financial markets. Financial derivatives can be extremely complex, and so makes for very difficult and complex training course subject matter. "In\$ider" is a game that aimed to overcome the difficulty and tedium of the subject by offering a high level of engagement through the use of a rich story line, plenty of interesting challenges and characters, and urgency through with "something at stake". A strong, soap-opera style narrative line revolving around the various characters runs through the game to help keep players engaged, and a "hook" is built in at the end of each CD to entice players to progress to the next one.

The success of "In\$ider", with over 20,000 copies in print, thousands of accountants and auditors trained and high degree of uptake all over the world both within PwC and externally demonstrates that even complex and highly technical material can be taught effectively using a well constructed game. However, the game's designer, Paula Young, tells of the challenges faced by the development team of incorporating the complex subject matter into the story line. Moreover, the "In\$ider" case study cost \$3,000,000 to develop, and this and many of the other case studies in Marc Prensky's book demonstrate the significant expense and effort required to develop and roll out a successful training game.



Figure 2 - The "In\$ider" Financial Derivatives Trading Game

3.3 Educational – “Nanoquest”

“Nanoquest” [Brabazon and Gorman, 2006] is a 3D online game which aims to allow 13-15 year olds explore the atomic-scale world and to get them interested in nano-technology and science generally. The plot involves the player being shrunk to nanoscale size, where they can see and manipulate atoms and molecules. In order to escape from this nano-world, the player has to explore and navigate through it, accomplishing various tasks such as constructing a “nano-car” by collecting buckey-balls and nano-tubes, fixing a malfunctioning quantum CPU, etc., all the while avoiding hazards such as charged molecules that can slow the player down. Completing these tasks allows the player to become familiar with the strange and intriguing properties of the nano-scale world, learning about charged particles, quantum worm-holes, and the capabilities of nano-machines while having fun playing the “Nanoquest” game.

The mission-based platforming and collection mode of the game plot will be familiar to the game’s target audience, and so the game is easy to learn. “Nanoquest” is likely to be the first opportunity that most players (not just young teenagers) will have to visualise and become familiar with the atomic-scale world, and is certainly much more engaging than most text books on this topic.



Figure 3 - Nanoquest

3.4 Military – “Joint Force Employment”

The US military have been avid users of simulators and games-based learning products for many years, and have dozens of DGBL programs ongoing. Just one of these is the “Joint Force Employment” training game [Moore, 2000], designed to train the commanding staff of each of the three branches of the US military how to mount joint missions involving all three forces, acting as an integrated military unit. The “Joint Force Employment” game features full action, immersive, realistic war scenarios similar to commercial war games such as “Real War” and “Warcraft II”, all of which allow Joint Force commanders to learn the tactics and techniques of integrated military operations in a highly realistic and immersive fashion.



Figure 4 - Joint Force Employment

3.5 The Risks of Socially Undesirable DGBL

We need to be aware that the very efficiency of game-based learning and the high levels of immersion and engagement it engenders may also have undesirable consequences if the roles and behaviours learned in the game are of a violent, dangerous or anti-social nature. Given the recent upsurge in road deaths in Ireland, particularly amongst young males, games such as "Need for Speed", where the goal of the game is to race souped-up cars around urban settings as fast as possible, raise the possibility that the "safe to fail" environment provided by such games is actually a dangerous delusion, encouraging gamers to assume that the only consequences of a real-life car crash will be having to go back to the start of the current game level, rather than the ultimate "game-over" event that is all too often the reality.

Of even greater concern are games such as the controversial game "Manhunt", an especially disturbing example of a hyper-violent role-play game, in which the player is required to execute opponents in as cruel and violent a manner as possible, and in which the violence is presented in horrifically graphic details, including scenes of decapitation, castration, evisceration carried out with a wide variety of weapons. In a report on it's reasons for the classification of "Manhunt" as "objectionable", the New Zealand Office of Film Classification & Literature stated that

"The game is constructed so that the player must choose to enact the most brutal and graphic forms of violence and cruelty in order to progress through it to the bonus levels... To succeed in this game, a player, regardless of age or maturity, must learn over an extended period of time to acquiesce in, tolerate, or even enjoy, the violence he or she inflicts." [The Office of Film & Literature Classification, 2003]

If immersive games are not only producing intense learning experiences but actually changing the way the player's mind works, as Marc Prensky claims [Prensky, 2001b], then the potential impact of hyper-violent games such as "Manhunt" on players must be of profound concern to society; further research in this area is urgently required.

4 Conclusions

Anyone who has watched the concentration, application and skill that children and teenagers apply to mastering modern video games (and anyone who has played these games!) will readily appreciate the enormous potential of digital game-based learning in facilitating engaging and effective learning, and this subjective insight is readily borne out by the academic research outlined in this paper. More research needs to be done into the evidence for the effectiveness of digital game-based learning, the principles and techniques required to create good quality DGBL experiences, and the practical measures required to integrate DGBL into mainstream education. Further work should also be undertaken to validate the existence of the negative learning aspects of immersive games suggested above. It seems likely, however, that the impact of digital game-based learning will be overwhelmingly positive, and will play an ever greater role in all aspects of training and education.

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