
The potential of a game based learning approach to improve learner outcomes

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Abstract

Whilst some critics may argue that games have no place in the classroom, in this article I argue that student achievement can benefit from building on the technology skill of the young people, allowing them to address real-life challenges within the safety of the virtual worlds of games. The young people of today play video games for entertainment and relaxation, and they are skillful at manipulating the virtual worlds that they inhabit during the games. Examples from classroom research illustrate how the use of video games in teaching and learning has the potential to change the way that we teach and improve the learning outcomes for the students by enabling them to experience real life examples. Teachers can harness these experiences and interests to engage and motivate students by taking advantage of the dynamic and interactive features of these digital games, thus enabling engagement in learning activities. This article highlights some of the issues and challenges facing teachers considering the use of game based learning in their classroom.

Introduction

The society and culture of young people today is awash with technology – young people have access to all means of devices that they can use to access information anytime, anywhere. The computer and other digital technologies are having an effect upon the
world that we live in; they influence how we work, learn, spend our money, entertain ourselves, and how we communicate (Pivec, 2007). Therefore, it is only to be expected that these technologies will filter into the way that we teach and the way our students learn at school. A strong message is being sent out to teachers by the media, government, and students that technology has a place in the schools of today and tomorrow. The vision statement from the New Zealand Curriculum document gives a direction for learning that “Young people will be confident, connected, actively involved, lifelong learners” (Ministry of Education, 2007).

Many schools are having difficulty in engaging secondary students in meaningful learning environments. The 21st century learners are demanding a pedagogy that meets their needs (Jukes, 2009). The learners that are coming into school now and in the future are different from learners of the past. Teachers need to reconsider the effectiveness of teaching methodologies that were embedded in their learning practices that were ordered and linear, in order to meet the students “big picture” learning goals. Teachers need to create and offer new curriculum contexts that connect with, engage, and motivate the digital natives that they are now facing in the classroom.

The characteristics of those students who appear to show a preference for learning through games and play are those young people who are used to receiving information at high speed - the digital natives; they appear to have the ability to multi-task or parallel process (Prensky, 2001). They have a preference for visual graphics before text and they prefer random access to information. Networking and sharing information in a collaborative manner appeals to them—they appear to thrive on instant gratification and need frequent rewards to keep them motivated.

As not all learners respond well to traditional “talk and chalk” or “tell and test” styles of teaching, teachers and schools are finding that they have to change or adapt not only the content they teach but also the way they teach that content. Since 2001, several prominent researchers have debated the potential of using digital games as a learning tool in the classroom (Egenfeldt-Nielson 2004; Gee, 2001; Prensky, 2001, 2006; Rieber, Tzeng, & Tribble, 2004). Research by Groff, Howells, and Cranmer (2010) suggests
that a game based approach allows teachers an excellent opportunity to engage students in meaningful learning activities that can have a wide range of educational benefits. Teachers are starting to recognise that the learning principles that are embodied in computer and video games reflect some of the best theories of learning, but as yet these games are underutilised as an educational resource.

Computer, video games, and digital games have been defined as interactive multimedia tools with dynamic elements that are under the control of the user (Rieber et al., 2004). Two different categories of instructional video games have been described:

- Exploratory programmes or simulations encourage students to explore particular domains of knowledge and to learn through discovery, and
- Tutor/drill-and-practice programmes provide information, demonstrate concepts, and provide opportunities for practice.

Some commercially off-the-shelf games are able to present the learners with rich, immersive environments, simulations, and experiences that are not just about learning facts, repetitive skills, or drills, but enable the development of skills such as problem solving, decision making, and strategic planning. In some of the more popular games that students engage with, the students can create their own virtual world within the game environment, including their own avatar or representation of themselves. In many cases they are also able to develop their social skills through on-line real time interaction, and while they will have to engage in the social rules of the on-line community, they are in control of the technology. Other games that can be found on numerous free websites such as Learningforkids.com can provide learners with one-to-one interaction and feedback on specific subject areas such as learning vocabulary for ESL students. There are other games (e.g., Poverty is Not a Game - PING) that enable players to participate in global communities with a common interest, and as a result develop the social skills of effective communication and collaboration within those communities. Finally, there are also the types of games more traditionally used for learning. These involve drill and practise for learning specific skills (e.g., Mavis Beacon Typing and Maths Blaster). In this article I will argue that both types of programs are useful teaching tools when used appropriately. The key to success for teachers and their
students is to match the type of program with the learning goal. Tutor/drill-and-practice programs can be highly effective for developing and practising computational skills, but these types of programs can be ineffective when teaching students entirely new material. Additionally, younger students, who have not yet acquired sufficient background knowledge of the topic or self-managed learning behaviours, find it difficult to use the more complex simulations. However, older students can reap substantial learning benefits using such programs, particularly with respect to acquiring deep, conceptual understanding of complex topics (McFarlane, Sparrowhawk, & Heald, 2002). Ulicsak and Cranmer (2010) reported that in the UK, 79% of the 737 students aged between five and 15 they surveyed played computer games at home several times a week, while McGonigal (2010) has stated that 3 billion hours a week are spent on playing video games worldwide. This illustrates how games have become an important part of their digital culture, and suggests that a game-based approach may resonate with today’s learners.

Prensky (2001) argues that the designers of entertainment video games have a great appreciation of how to create engaging and motivating learning environments, and that the education world would do well to consider how this could be exploited in order to enhance the teaching and learning experiences of the digital generation. This idea of using games for learning has been expanded upon in 2006 by Learning and Teaching Scotland. The Consolarium, a game-based learning centre within Learning and Teaching Scotland was established to explore the range of gaming technologies available that would inform and influence curriculum development (Groff, Howells, & Cranmer, 2010).

By using video games we are able to create new and powerful ways of learning in our classrooms. These types of games are very popular with young people, and the development of the technology means that they are now much more than a “toy”. Over the last few years these games have also become more and more sophisticated both in design and content. Like books and movies, they can be used in anti-social ways, and they can be a simplification of reality; and current games often incorporate—or are at least based on—violent and sometimes misogynistic themes. While unrestricted
recreational video gaming may have deleterious effects on academic achievement and aggressive behaviour, educational video games can present a powerful tool for increasing student learning. In some cases, educational video games provide no additional benefit beyond traditional instructional methods, but in other cases educational video games produce impressively large benefits. The following sections will explore the different ways that teachers are using games within the classroom, and the potential benefits of these. This will be followed by an exploration of the issues that need considered when using games in the classroom.

**Benefits of using games in classrooms**

*Virtual worlds*

The first step to understanding how video games can transform education is changing the widely shared perspective amongst educators and parents that games are “mere entertainment”. Games have become more than a compelling toy for both children and adults and more a route to computer literacy; they are important because they let people participate in “new worlds”. Video games let players think, talk, and participate; they also let players take on roles otherwise inaccessible to them. These rich virtual worlds are what make games such powerful contexts for learning and training for real world employment. Simulations have been used by airline pilots, defence force, and the medical profession to practise basic skills in a safe environment for many years now.

The virtual worlds of games are rich contexts for learning because they make it possible for players to experiment with new and powerful identities. In the various web sites devoted to the game *Civilization*, for example, players organise themselves around a shared goal of developing expertise in the game and the skills, habits, and understandings that are required. If we look at the development of gaming communities, we see that part of the power of games for learning is the way they develop shared values.

Games bring together ways of knowing, ways of doing, ways of being, and ways of caring: the need for effective social practices, powerful identities, and shared values that
make someone an expert. The expertise might be of a modern soldier in *Full Spectrum Warrior*, a zoo operator in *Zoo Tycoon*, a rock star in *Guitar Hero*, or a world leader in *Civilization III*.

Another example of how games can support learning is by enabling students to experience some of the concepts that have in the past been difficult to access. For example, the law of gravity is no longer something understood solely through an equation; students can gain virtual experience walking on worlds with smaller mass than the Earth, or plan manned space flights that require understanding the changing effects of gravitational forces in different parts of the solar system. In virtual worlds, learners experience the concrete realities that words and symbols describe. Through such experiences, across multiple contexts, learners can understand complex concepts without losing the connection between abstract ideas and the real problems they can be used to solve. In other words, the virtual worlds of games are powerful because they make it possible to develop understanding through participation.

Kinzie and Joseph (2008) carried out a survey on middle school children to discover their game playing preferences. The explorative mode of play was the most appealing for all students, but particularly for girls. The games that were used here usually involved a series of challenges or quests within an overarching scenario. They can include teacher devised web quests through to more advanced tasks found in commercial adventure games such as the *Carmen Santiago* games.

Akpan and Andre (2000), in a study of 81 seventh grade students, found that using simulations was a popular option for some schools. They investigated the use of a simulated frog dissection, before or instead of an actual dissection, and this resulted in significantly better understanding of the anatomy than the dissection alone or use of the simulation after the dissection. Similarly, Maloney (2005) found that with high school girls, a simulation of a dissection was a viable alternative to actual dissection. Further support for the value of exploration in a simulation environment comes from a study by Ronen and Eliahu (2000). Students that were given the option of exploring an interactive simulation of electrical circuits demonstrated better knowledge of these
circuits and demonstrated increased confidence in their skills than those who did not have this option. Many science experiments are carried out through simulations, where there is no risk of injury to the participants but all aspects of the experiment can be covered.

**Motivation**

Becta (2001) found that students are motivated by video games because they “use technology to represent reality or embody fantasy” (p. 1). The students are motivated to win and are challenged to move to the next level. They receive instant feedback on their decisions and actions and are then ready to move on to the next level of challenge. With traditional classroom practice students do not always get the feedback on their progress immediately and may be unable to proceed to the next level until the teacher has prepared the work for them. Mitchell and Savill-Smith (2004) have identified twelve factors that combine to make video games motivating and engaging. These factors include fun, play, rules, goals, interaction, outcomes and feedback, adaptive, winning, conflict or challenge, problem solving and representation or a story. When these aspects are included in a game, students are motivated to continue to “play” and learn.

A study by Ke (2008) found that games were more motivating than pencil and paper activities in learning mathematics, although no significant difference was noted in learning outcomes. The students were motivated to work at the task with greater intensity when presented through the medium of a game. Although this is new a new concept, many reluctant learners of mathematics became more engaged when linked to the playing and scoring in a game of darts. In contrast to this study, Papastergiou (2009) noted differences in both motivation and conceptual learning when a game based approach was used by the teachers. Tüzün, Yilmaz-Soylu, Karakus, Inal, & Kizilkaya (2009), in their research with fifth grade students, showed an increased intrinsic motivation and less concern about grades when studying geography using a game format when compared to their traditional classroom. Additionally, their performance in geography improved significantly after using the game. Papastergiou (2009) analysed the effect of a game format on learning in a computer science classroom. He assigned
groups of high school students to either a gaming or non-gaming class. It was found that there were three types of learning supported by the games based approach. Learning was stimulated by the content of the game, the improvement of skills required to play the game, and the learning of new skills from the game. The motivation and concentration of the game group also demonstrated an improvement.

Other important issues to consider are that game based learning can provide a safe environment for students that are motivated to take risks and accept challenges that would not be possible in the real world.

**Collaboration**

Although the stereotype of the gamer is a lone teenager seated in front of a computer screen in a bedroom, game play is a thoroughly social phenomenon. The clearest examples are the massive multiplayer online games: games where thousands of players are simultaneously online at any given time, participating in virtual worlds with their own economies, political systems, and cultures, for example, Second Life. Video games bring players together, competitively and cooperatively, into the virtual world of the game and the social community of game players. In response to the criticism that video game play is socially isolating, there is evidence to show that video game play is social. Almost 60% of frequent gamers play with friends. Thirty-three percent play with siblings and 25% play with spouses or parents. Even games designed for single players are often played socially, with one person giving advice to another holding a joystick. A growing number of games are designed for multiple players—for either cooperative play in the same space or online play with distributed players.

Other types of games that students found engaging were those creative games were they could be involved in building or designing their own games, or building equipment for use within a game. This included activities such as creating an avatar or character for use in *World of Warcraft* or the building of the race car before entering the race. It was also found that although students showed a preference for using games and simulations, they also required guidance in order to maximise their learning.
New ways of thinking

In schools, students largely work alone with school-sanctioned materials; avid gamers seek out news sites, read and write FAQs, participate in discussion forums, and most importantly, become critical consumers of information. Classroom work rarely has an impact outside of the classroom; its only real audience is the teacher. Game players, in contrast, develop reputations in online communities, cultivate audiences as writers through discussion forums, and occasionally even take up careers as professional gamers, traders of online commodities, or game modders and designers. The virtual worlds of games are powerful, in other words, because playing games means developing a set of effective social practices. Gee (2003) describes game players as active problem solvers who do not see mistakes as errors, but as opportunities for improvement. Players search for newer, better solutions to problems and challenges, he says, and they are encouraged to constantly form and test hypotheses. This research points to a fundamentally different model of how and what players learn from participating in games.

Issues to consider when using games in the classroom

In order for game-based learning projects to be successful, sound pedagogy is required by the teacher. Some of the commercial video games have been produced in the absence of any coherent theory of learning or underlying body of research, purely in the vein of entertainment. It requires special skills on behalf of the teacher to use this type of game as a learning experience. In addition, not all video games are appropriate for classroom use (Shaffer, Squire, Halverson, & Gee, 2005). The following sections explore issues that must be considered when deciding how best to use games in the classroom.

Provide guidance

In their review of research on computer simulations and learning, de Jong and van Joolingen (1998) found the need for instructional support including hints, suggestions, and just-in-time background knowledge, to be a consistent finding. Rieber et al. (2004) have conducted a series of studies of a computer game designed to simulate the
relationship between velocity and acceleration. They found that although students were successful with the game, they needed guidance in the form of explanations and feedback during the game in order to explicitly describe the principles involved. However, in one study they found that with a carefully structured simulation, a tutorial in advance was unnecessary. In a pilot study of eighth grade students, Zydney (2005) found that students benefited from scaffolding for organisation and higher-order thinking that were built into a multimedia learning environment on pollution.

However, the availability of support within the software is not always sufficient—students may not access such support if left to themselves. Students playing games are likely to ask their friends for help or search the internet before consulting the in game help pages. In a study by Lajoie, Lavigne, Guerrera, and Munsie (2001), high school biology students used a hospital simulation programme as a part of their studies. Students worked in one of three groups: one with a teacher providing guidance, one with an older student serving as a coach, and one working independently without the aid of a teacher or coach but with the availability of an online consultant. Students again used their peers as the first point of reference when they had a problem.

**Appropriate level**

Games also need to provide various opportunities for students to interact in particular ways in order to clarify and extend their learning. The students need to be faced with achievable but challenging activities. Habgood, Ainsworth, and Benford (2005) reviewed research on fantasy worlds and learning in digital games and noted that well-designed, highly engaging games incorporate achievable challenges. The research of Habgood et al. (2005) also highlighted the importance of the level of challenge in a game being proportional to a student’s skill level. Rieber (2005) noted that with complex games and simulations, students may benefit from starting with a subset of skills and adding additional skills as the earlier ones are mastered. In contrast, however, de Jong, Martin, Zamarro, Exquembre, Swaak and van Joollingen (1999), using a physics simulation, found no difference between students who were initially given a subset of skills and those who had the entire simulation available to them from the start.
Both of these studies used college students as subjects; younger students might be more likely to benefit from this levelled presentation of a simulation or game.

**Time to reflect**

One surprising finding from research by Rieber and Noah (1997, cited in Rieber, 2005) is that a game might negatively affect learning. In a velocity-acceleration game, students who used the game scored lower on a post-test of physics concepts than students who did not have the game. The researchers hypothesised that the game element took precedence for the students, and that although users became proficient at the game, they were not explicitly aware of the underlying principles that they were applying because they did not reflect on them. When the researchers engaged the students in conversation about the game’s relationship to physics, the students were able to make connections to the principles. Other work by Rieber et al. (2004) supports the need for students to provide explanations of the concepts and principles that the game or simulation is designed to represent. Some students find it difficult to explain the concepts that they have developed through the playing of the game.

**Gender stereotypes**

Gender can present a challenge to the teacher when considering using games for learning in the classroom. The video game market has been predominantly male. However, the percentage of women playing serious multi player online games has steadily increased over the past decade. Women now slightly outnumber men playing web-based games. Spurred on by the belief that games were an important gateway into other kinds of digital literacy, game designers made efforts in the mid-90s to build games that appealed to girls. More recent games such as *The Sims* have been huge crossover successes that have attracted many women who have never played games before. Given the historic imbalance in the game market (and among people working inside the game industry), the presence of sexist stereotyping in games is hardly surprising. Yet it is also important to note that female game characters are often portrayed as powerful and independent. In his book *Killing Monsters*, Jones (2002) argues that young girls often build upon these representations of strong women warriors.
as a means of building up their self confidence in confronting challenges in their everyday lives.

**Perception of games**

Unfortunately, a large gap exists between the public's perception of video games and what the research actually shows. The critics, often parents and teachers with no empirical evidence, suggest that the lessons people learn from playing video games as they currently exist are not always desirable. Alongside those people who support the use of video games in the classroom are these critics; the use of computer games in education has generally been received with degrees of scepticism. For example, it has been suggested that video games encourage violence, and promote social isolation, they have led to an epidemic of youth violence, they cause obesity, and they can inhibit cognitive development.

To counter this argument, researchers have found that people serving time for violent crimes typically consume *less media* before committing their crimes than the average person in the general population. It is true that young offenders who have committed the recent school shootings in America have also been game players. But American young people in general are more likely to be gamers—90% of boys and 40% of girls play video games. According to a 2001 U.S. Surgeon General's report, the strongest risk factors for school shootings centred on mental stability and the quality of home life, not media exposure. The moral panic over violent video games is doubly harmful. It has led adult authorities to be more suspicious and hostile to many young people who already feel cut off from the system. It also misdirects energy away from eliminating the actual causes of youth violence and allows problems to continue to fester.

Some studies found a correlation, not a causal relationship, between violent video games and youth aggression which means the research could simply show that aggressive people like aggressive entertainment. But no research has found that video games are a primary factor or that violent video game play could turn an otherwise normal person into a killer. Former military psychologist and moral reformer Grossman (2000) argues that because the military uses games in training (including, he claims,
training soldiers to shoot and kill), the generation of young people who play such games is similarly being brutalised and conditioned to be aggressive in their everyday social interactions.

Grossman's (2000) model only works if we remove training and education from a meaningful cultural context. We also have to make the assumption that the learners have no conscious goals, that they show no resistance to what they are being taught, and that they unwittingly apply what they learn in a fantasy environment to real world spaces. A growing body of research does suggest that games can enhance learning. The military uses games as part of a specific curriculum, with clearly defined goals, in a context where students actively want to learn and have a need for the information being transmitted. There are consequences for not mastering those skills. From personal experience I acknowledge that the UK Navy also uses simulation to provide helicopter pilots with virtual experience of rescue situations as well as simulated engine failure, both a dangerous and expensive issue to be attempted in real life! There are driving simulations for F1 drivers, learner drivers, and commercial pilot training that are all better delivered through video games.

**Concluding thoughts**

There is a lot being learned in games. But for some educators it is hard to see the educational potential in games. Research by Becker and Jacobsen (2005, cited in Becker, 2007) involved surveying Canadian teachers to find out if they would be interested in using games in the classroom. Just over 50% were willing to try this, but the response depended upon the definition of the word “game”. There was a greater response from the teachers when “interactive simulation” was used instead of the word game. Clark (2003, cited in Mitchell and Savill-Smith, 2004) suggests that there are a number of risk factors that can have a negative impact on learning through games. Clark suggested that the learning outcomes may not be in agreement with the game objectives, the game can distract the student from learning as they may focus on scoring and winning, there may be gender differences in the appeal of the game, and they may not provide sufficient
challenge to the learner. But video games can also be about so much more. Even the harshest critics agree that we can learn something from playing video games.

While the integration of game based learning in the classroom may seem daunting at first, the benefits soon become clear. These benefits can include motivating the learners to succeed and to continually improve, to foster self-esteem, self-determination, and enhance self-image. Games can facilitate collaborative learning thereby implicitly developing learners’ ability to observe, question, hypothesise, and test. They can be employed to facilitate the skill of meta-cognitive reflection, develop complex problem-solving skills whilst making school an exciting place to be. The opportunity exists to be exposed to a wide variety of curriculum areas through the use of video and computer games.

The question that remains is how can we use the power of video games as a constructive force in our classrooms? The important consideration in the design of the learning environments is one that builds on the educational properties of the game, but deeply grounds them within a contemporary learning theory that also embodies the technological developments. The current literature (e.g., references) on game-based learning has shown that computer and video games can be a valuable part of an educational curriculum if they are used in the right circumstances. They need to be sufficiently challenging in order to engage students. The level of challenge should be flexible, changing as students become more proficient with the task. While many games and simulations incorporate features to guide and support students, teachers should monitor students’ use of these materials to make sure the structure and rules of the game do not take priority over learning. In addition, Mitchell and Savill-Smith (2004) suggests that games are most powerful for learning when they are personally meaningful, experiential, social, and epistemological all at the same time.

While not attempting to dismiss concerns, there are many games that do not follow the stereotypical view of a computer game and these games can be used to engage, motivate, and extend learners. This framework requires the active involvement of the children in the construction of their own meaning, understanding, and developing skill set. Inherent
and fundamental to social constructivism is the idea that we must also appreciate that the learner does not operate in a theoretical vacuum but within a complex and dynamic social framework. The tremendous popularity of video games means they have enormous potential as learning tools that capture students’ attention and fire their imaginations. However, harnessing that potential requires careful attention to design features and appropriate training for teachers. The understanding of links between video games and learning is still very much at a nascent stage, both with regards to game design and effective delivery. As video games in education are gaining attention, it becomes more and more critical to understand why and how these games can affect students, teachers, and their learning. Teachers need to look to the tools that their students are utilising outside of the classroom and begin to use these tools to support their learners within the classroom, and if games are the tools that student engage with then teachers need to make room in their toolbox for a 21st century tool.

References


