Serious Games: Serious Opportunities

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ABSTRACT
Computer and video games are primarily understood as a form of entertainment. Increasingly, however, they are becoming recognized as providing a powerful means for learning, both among educators and the game development community. For example, this year heralded the advent of the inaugural *Serious Games Summit* held during the *Game Developers Conference* in San Jose. The core focus of the summit was to bring together educators and game developers and investigate the current and future landscape of games and learning. This paper explores the notion of games as a means for learning, together with current research and applications of games within education and industry.

Keywords
games, videogames, learning, education, applications

INTRODUCTION
Recently games, particularly digital games such as console-based videogames and computer games, have become recognized as providing rich learning contexts for players (Norman 2001b; Norman 2001a; Prensky 2001; Papert 1998; Stapleton 2003; Gee 2003a; Gee 2003b; Stapleton and Taylor 2002). In turn, this has led to a view of games as educational technologies and, consequently, as having application beyond the realm of entertainment *per se*.

In this paper, I explore two (2) key questions. The first is "what is it about games that make them so good for learning?". As a result of the first, the second explores possible opportunities for the applications of games as learning technologies. It should be recognized that rather than presenting a comprehensive account, this paper aims to provide insight into these areas and promote dialogue and possible collaborations between the game industry, research institutions and market segments.

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SERIOUS GAMES
Last year at the *Australian Game Developers' Conference* (*AGDC*), I presented a paper entitled *Why Videogames are Cool and School Sucks!* (Stapleton 2003). In that paper, I examined the relationship between learning and videogames, and compared the learning from videogames with the typical approaches to learning within school classrooms. The purpose of the paper was to present a case for the recognition and adoption of games as learning technologies, thereby aiding educators in understanding games as a means for providing serious learning opportunities for players. As I have already covered, in some degree of detail, a number of issues related to games as educational technologies, *serious games*, here I will simply provide an overview of some of the more predominant issues. I suggest that those readers seeking more information on games and learning refer to the references provided at the end of this document.

An Overview of Games and Learning
Today's digital computer and videogames are characteristically long, challenging and complex. In order to 'beat' the game and successfully achieve the long-term objective of the game, players typically need to develop a variety strategies and skills. This has led some academics to recognize the videogame playing as "a demarcated learning project"(Papert 1998, p.87). Others, such as Norman (1993), have compared the learning players achieve through the informal context of videogames, to that of the traditional formal context of school.

> *Think of what it takes to learn a game compared to what has to be done in school. To play a game well requires the same kinds of learning, study, understanding, and practice as are required of any educational activity. (Norman 1993, p.32)*

Games, it would seem, provide powerful and meaningful contexts for learning. This view, while relatively new to the academic community, is one the game industry has already been aware of for some time. A major reason for this is the game business' equivalent of natural selection. Game studios are in the business of creating products where success is dependent on the ability of players to learn and overcome the various challenges and obstacles within the game. As Papert (1998) points out, "[i]f their [the game studios] public failed to learn, they would go out of business"(p.87).

Game developers, therefore, are in the business of continually creating complex and entertaining challenges for players; challenges which players must master and learn through the development of skill and strategy in a fun way. Accordingly, game players can also be understood as learners.

Games v. School

With games understood as learning technologies, the question arises as to what's different about the learning when games compared to that typically within schools.

One of the more obvious differences resides with the control afforded to the learner as player. Games are environments specifically designed for players to experience interactively through play. Without the activity of the player there is no game; games are to be *played* by *players*. Consequently, the locus of control resides with the *player* as a learner. Now compare this with the environment that typically dominates many of today's schools. Here, it is the *teacher* who decides what to do next, when to do it, what the primary goal is, and so on. In short "a learner is asked to learn what the instructor thinks [s]he should learn" (Gargarian 1996, p.149). Control and *activity* is primarily afforded to the teacher.

So, simplistically speaking, the locus of control is typically afforded to players in games and teachers in schools. Accordingly, it is predominantly the player, as learner, who directs activity in games and it is predominantly the teacher who directs activity in the classroom. Games, therefore, present a *learner-centered* approach to learning, whereas traditional education presents a *teacher-centered* approach. To use a metaphor, if learning is understood as a journey, a learner-centered approach is where a learner is in charge of driving a vehicle, and a teacher-centered approach is like catching public transport, with the teacher being the driver.

When regarding players as learners, this focus on *activity* simply means that players are involved in a *learning process* whereas teachers are engaged in a *teaching process*. In the former, it is up to *players to construct* for themselves, their own knowledge, whereas in the latter, it is up to *teachers to transfer*, or typically transmit, knowledge from the teacher to the learner. So the two processes of teaching and learning can be regarded as quite different; they are not simply the inverse of each other. Learning can be understood as a process whereby learners active construct knowledge through experience and interaction, whereas teaching, from a traditional viewpoint, can be regarded as process by which teachers disseminate knowledge to learners through transmission

Now, this is not to say that *all* teachers adopt this approach. Einstein, for example, remarked "I never try to teach my students anything. I only try to create an environment in which they can learn." (Einstein in Prensky (2001, p.71)). Einstein's comments reflect a view of teaching and learning in which the learner is the active participant and where, like a good game designer, the role of the teacher is to create an environment that promotes learning through interaction.

The design of serious games—games with a focus on education—is, in my view, about creating environments and opportunities for players to *learn*, rather than creating products that aim to *teach*. It's about creating meaningful experiences and activities for players, rather than a means for 'transmitting' knowledge from the game to the player.

SERIOUS OPPORTUNITIES

The previous section examined, albeit briefly, the question of the learning potential of games provided a justification for employing games as valid contexts for learning. Now, with games understood as educational technologies, we can examine some of the possible applications of 'serious games'.

The Serious Games Landscape

This year's inaugural *Serious Games Summit* at the *Game Developers Conference* (CMP Media 2004) in San Jose participants explored the *serious games landscape*; namely, the various market segments in which games could provide solutions to clients (see Table 1).

Serious Games User Map
▪ K-12 Edutainment*
▪ Higher Education
▪ Health Care
▪ Corporate
▪ Military
▪ Non-Government
▪ Other

Table 1 Representation of the serious games user map

K-12 Edutainment

While the K-12 sector is recognized and understood as a possible market for serious games, presently it is not considered a key focus within the serious games community. This is primarily due to the large number of 'skill-and-drill' 'edutainment' type titles which are typically associated with this market. Initiatives, such as the *Education Arcade's* 'Games in Education Conference' (MIT Comparative Media Studies and Entertainment Software Association 2004) held this year at the *Electronic Entertainment Expo* (*E3*), focused almost exclusively on this sector.

Companies operating within this sector include the *Riverdeep* (Riverdeep Interactive Learning 2004) family of brands that include *Broderbund, The Learning Company, Edmark,* and *Destination Success*, and the *Leapfrog* (LeapFrog Enterprises 2004) series of products.

Higher Education

In terms of the current landscape, the higher education sector appears to offer the greatest potential for the development and implementation of serious games. While working closely with game industry professionals,

there exists the potential for academics to contribute to the development and implementation process. Further, funding opportunities may exist through various research projects. Finally, this sector also has the capability to build products for themselves and, consequently, can be considered excellent potential partners for game industry professionals.

Health Care

Another potential market, and one being strongly pursued in the United States, is that of health care. The *Games for Health* (Sawyer 2004) serious games project recently organized a conference to specifically investigate issues and opportunities within this sector. A variety of applications can be thought of here such as games as a form of motivation and reward for patients undergoing some form of treatment. Games could also be to distract patients during certain procedures such as dental work, for example. And other games may form components of the treatment itself such as in the treatment of phobias, anxiety or physical therapy.

Corporate

The corporate market looms as one of the most lucrative of all market segments. Nonetheless, the segment itself is extremely diverse comprised of a plethora of industries and possible applications. Further, game-based solutions could be a small as an *advergame*—a digital game designed to advertise products and services—for a small retail store, to a complex training simulation to a large multinational company. In short, this market presents some challenges to serious game developers, including the convincing, to varying degrees, of the benefits of game-based solutions to clients.

Military

As longtime avid adopters of gaming for serious purposes, the military are well aware of the potential of serious games. The military invest heavily in the design, development and implementation of serious games primarily for training and recruitment purposes. Further, this investment also allows for crossover opportunities into other market segments.

Non-Government

Another potential market for serious games include non-government organizations. Organizations such as *Greenpeace, Red Cross* and the *Salvation Army*, are all examples of organizations within this sector. A key point for potential game developers made at the *Serious Games Summit* is that an organization being 'not-for-profit' doesn't necessarily mean that it has no budget for serious-game projects.

Other

Finally, there are numerous other markets and applications for game-based solutions. Among others, fields such as game journalism together with politically-based games all form part of this segment. For instance, *Newsgaming.com* (Frasca 2004) is an example of a games design for political purposes.

Case Studies

As a means of developing insight into the various issues related to the design, development and implementation of serious games, I present three (3) case studies. I chose these studies as a means to compare and contrast similarities and differences between various market segments.

The following three case studies are illustrations of game-based solutions in the areas of university physics, firefighter training, and the treatment of phobias. Each of these games was presented at the *Serious Games Summit*.

Case Study 1: Supercharged!

As an example of MIT's *Games-to-Teach* project (MIT Comparative Media Studies and Microsoft Corporation 2001), *Supercharged!* (MIT Comparative Media Studies 2002) is a game developed with the primary aim of promoting learning in physics; specifically electromagnetism, and is an example of a game developed *by* the higher education sector.

The gameplay of *Supercharged!* is for players to use the physics of electromagnetism to charge their spacecraft —a charged particle—and navigate through three-dimensional space to reach a goal. In order to achieve this goal, players would need to understand the relationship between charge and distance by asking questions like "if you're a positive charge and you're moving toward two negatively charged particle, which way would you move?". Players could also place charges within the three dimensional environment as a means to help them navigate towards their eventual goal.

Finally, although not explicitly stated, *Supercharged!* was developed by academic researchers on a "fraction of a normal game budget" (Barnett et al. 2004, p.6)

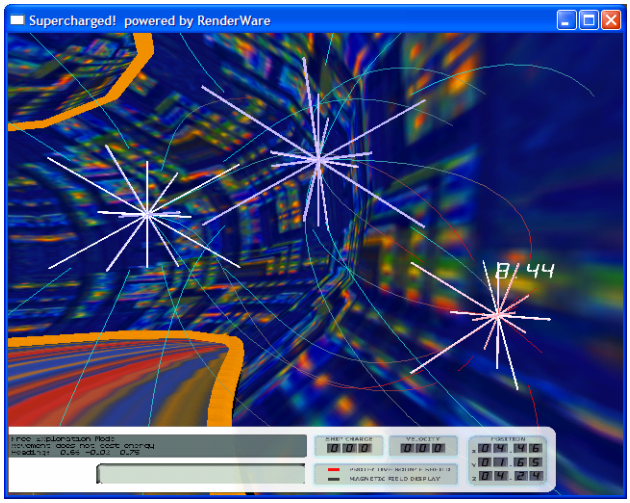

Figure 1 Screenshot of *Supercharged!*[1]

[1] Screenshot sourced from the PowerPoint presentation available at http://www.seriousgames.org/summitslides/kurt_squire.ppt.

Case Study 2: VR Phobias

The purpose of *VR Phobias* (Wiederhold 2004) was part of the treatment for a variety of phobias within patients including fear of driving, fear of the dark, fear of spiders, fear of heights, fear of snakes, claustrophobia and agoraphobia.

Implemented by the *Virtual Reality Medical Center* (2004), both simulations and off-the-shelf videogames are key components of the treatment. For example off-the-shelf games such as *Need for Speed* (Electronic Arts 2004) and *Midtown Madness* (Microsoft Game Studios 2004) are employed as a means to treat patients with a fear of driving.

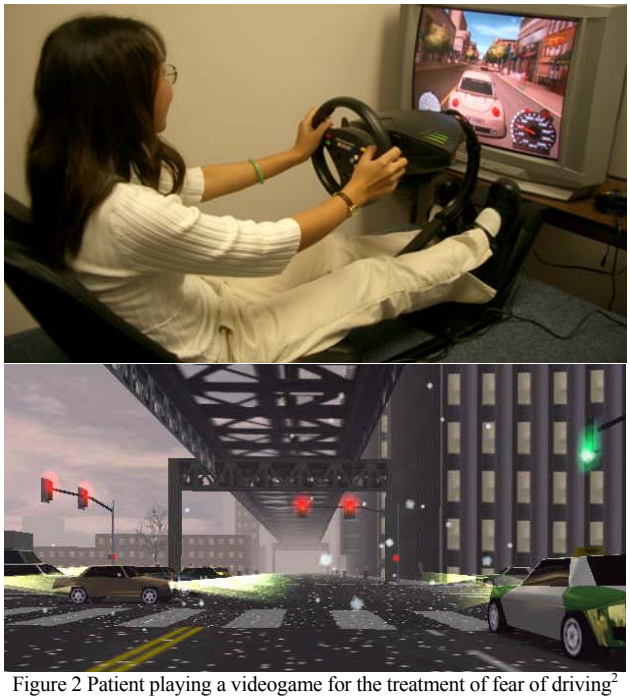

Figure 2 Patient playing a videogame for the treatment of fear of driving[2]

In other cases, off-the-shelf videogames are modified, or *modded*, to enable new content and gameplay. For example, *Unreal Tournament* (Epic Games 2004) was modified as part of the game-based treatment of arachnophobia.

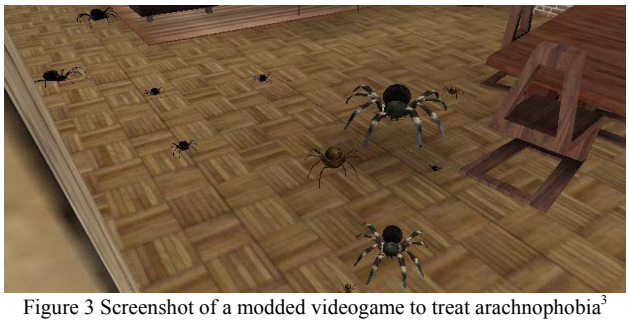

Figure 3 Screenshot of a modded videogame to treat arachnophobia[3]

The games are used as part of clinical interviews with patients being asked what they are thinking, in reference to their phobia, while playing the game. Further, the games have a high success rate (92%) in terms of the treatment of varying phobias with few (4.5%) participants dropping out from therapy (Wiederhold 2004, p.7).

Case Study 3: Biohazard

The final case study presented here is *Biohazard* (Carnegie Mellon Entertainment Technology Center et al. 2004) a training system developed by Carnegie Mellon University for firefighters to act in the wake of terrorist attack.

The game was one component of the training program which also included traditional lecture based learning along with field-based exercises.

In terms of its development, the game itself was a mod of the *Unreal Tournament* engine and was developed using an iterative, spiral model of development with US$150,000 in funding.

The game was implemented via a Local Area Network (LAN) party classroom where several participants would play (and train) with an instructor in a single room. In this way players could talk to each other while performing firefighting activities within the game. Further, the instructor had the ability to create certain events, such as a bomb explosion, and a variety of variables, such as time of day, type and number of victims, wind speed, temperature and so on.

One issue that emerged during implementation of the game was the importance of detail in training simulations, as it seemed that players pay attention to small details, such as the color of the firefighters boots, needed for them players to accept, or "buy into" the game.

Figure 4 Screenshot of *Biohazard*[4]

Comparison and Contrast

While providing only a small sample, I contend that the three case studies do provide enough fertile ground for comparison and contrast. Drawing from the case studies, I have identified a number of issues I believe are worth consideration in relation to the design, development and implementation of serious games. Now while not all

[2] Screenshot sourced from the PowerPoint presentation available at http://www.seriousgames.org/caseblasts/vrphobia.ppt

[3] Screenshot sourced from the PowerPoint presentation available at http://www.seriousgames.org/caseblasts/vrphobia.ppt

[4] Screenshot sourced from the PowerPoint presentation available at http://www.seriousgames.org/caseblasts/Hazmat-small.ppt

issues can be fully explored here, there exists ample opportunity to discuss some of the more prominent ones.

Learning Outcomes

One of the most obvious issues when it comes to serious games is that of *learning outcomes*. The case studies presented games that aimed at promoting *conceptual learning* (*Supercharged!*), *technique, process and skill* (*Biohazard*) and a mixture of both *understanding and technique* (*VR Phobias*). Designers of serious games need to be aware of what *type of learning* the client hopes to achieve by implementing a game-based solution. This issue is paramount because the metrics used to measure successful achievement of the learning outcomes differs significantly between skill-based and concept-based outcomes.

Further, when evaluating solutions to learning challenges, game-based solutions should be considered among a variety of others. In short, the question "is a game-based solution required?" needs to be asked as there may be other more suitable and attractive alternatives.

Implementation

Another key issue is *implementation.* In the case studies, locations of implementation included a traditional middle-school physics classroom, a LAN party classroom, and a clinical practice. Accordingly, the *contexts for implementation* are wide and varied. Further, implementation often comes as part of a broader context of teaching and learning. For example, *Supercharged!* became part of the idle school physics curriculum, *Biohazard* was integrated into a broader sequence of teaching and learning which included traditional lectures and hands-on field training, and *VR Phobias* was part of a broader series of techniques for treating phobias.

In short, it is important for serious game developers to understand that *not all the learning needs to be in-the-box*. This idea is not unfamiliar within the realm of entertainment focused games. Together with playing games, avid gamers read magazines and strategy guides, visit websites and share their knowledge and experiences. Players they learn both with*in* and with*out* the game.

Budgets

Compared to the development of console-based videogames, the budgets for serious games are relatively small. Nevertheless, there are ways of reducing budgets while also delivering quality product such as modding existing game engines and collaborating with others.

Another issue related to budgets is determining the money trail within particular markets and organizations. For example, the infrastructure and flow of money within a small corporation differs significantly from that of a University. These issues need to be recognized to ensure that the game develop knows *where, when* and *how* money is to be transferred during the development cycle.

Collaboration

Collaboration between parties is typical in the development of serous games. Each of the case studies required some form of collaboration. However, the scope for collaboration can vary widely possibly from the game designer working relatively autonomously within their own workplace environment, to them becoming more of a consultant and helping to mediate a project within a team working in an external environment such as a University.

Technology

The significant budget constraints typical of serious game-based projects impose limitations on the designer. Developing tools, content and game-engines from scratch is expensive so it may be more attractive to use existing technologies. For example, using *Renderware* (Criterion Software 2004) as the middleware development platform for *Supercharged!* would significantly reduce costs. Further, both *VR Phobias* and *Biohazard* modded existing game engines, again significantly reducing costs. Clearly, the ability to adopt these approaches, among others, will depend on a number of other factors including the type of game being developed, target platform, access to facilities, personnel expertise and so on.

SUMMARY

Computer and videogames can be regarded as providing authentic, meaningful and powerful contexts for learning. Games provide players, as learners, with deeply satisfying challenges that require the development of skills and strategies in order to achieve the game objective. Further, when contrasted with traditional views of education, games provide a learner-centered rather than teacher-centered approach to education. Understanding games in this way opens the possibility for games to move beyond their primary focus within entertainment and explore the new contexts and markets. Higher education, the health sector, the military, non-government organizations and the corporate sector are all potential clients of game-based solutions. In developing games for these markets developers need to be aware of a number of issues including learning outcomes, implementation, budget constraints, technological factors and collaboration considerations. Addressing issues such as these can be understood as a means to providing new markets and business opportunities for game developers, new research and collaboration opportunities for universities, and new solutions and learning opportunities for clients.

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REFERENCES

1. Barnett, M, Squire, K, Grant, J M & Higginbotham, T 2004, *Electromagnetism Supercharged!*, viewed November 22 2004, http://labweb.education.wisc.edu/room130/PDFs/squire2.pdf.
2. Carnegie Mellon Entertainment Technology Center, Microsoft Corporation & Federation of American Scientists 2004, *Team Hazmat*, viewed 2004, http://www.seriousgames.org/caseblasts/Hazmat-small.ppt.
3. CMP Media 2004, *Game Developers Conference*, viewed 2004, http://www.gdconf.com.
4. Criterion Software 2004, *Renderware*, viewed 2004, http://www.renderware.com.
5. Electronic Arts 2004, *Need for Speed Underground 2*, viewed November 2004, http://www.eagames.com/official/nfs/underground2/us/home.jsp.
6. Epic Games 2004, *Unreal Tournament*, viewed 2004, http://www.unrealtournament.com.
7. Frasca, G 2004, *Newsgaming*, viewed 2004 www.newsgaming.com.
8. Gargarian, G 1996, 'The art of design', in Kafai, Y and Resnick, M (eds), *Constructionism in Practice: Designing, Thinking and Learning in a Digital World*, Lawrence Erlbaum Associates, Mahwah, New Jersey, pp. 125-159.
9. Gee, J P 2003a, *High Score Education: Games, not school, are teaching kids to think*, viewed April 24 2003, http://www.wired.com/wired/archive/11.05/view.html?pg=1.
10. Gee, J P 2003b, *What Video Games Have To Teach Us About Learning And Literacy,* Palgrave Macmillan, New York, NY.
11. LeapFrog Enterprises 2004, *LeapFrog*, viewed 2004 www.leapfrog.com.
12. Microsoft Game Studios 2004, *Midtown Madness*, viewed 2004, http://www.microsoft.com/games/midtown/.
13. MIT Comparative Media Studies 2002, *Supercharged! Electromagnetism Energized*, viewed 2004, http://www.educationarcade.org/gtt/EM/Intro.htm.
14. MIT Comparative Media Studies & Entertainment Software Association 2004, 'The Education Arcade - Games in Education Conference' Electronic Entertainment Expo (E3), Los Angeles Convention Center, May 9-11,
15. MIT Comparative Media Studies & Microsoft Corporation 2001, *Games-to-Teach Project*, viewed October 23 2003, http://cms.mit.edu/games/education/.
16. Norman, D A 1993, *Things that make us smart: defending human attributes in the age of the machine,* Perseus Books, Cambridge, MA.
17. Norman, D A 2001a, *The future of education: Lessons learned from video games and museum exhibits*, viewed August 28 2001, http://www.jnd.org/dn.mss/NorthwesternCommencement.html.
18. Norman, D A 2001b, *Learning from the success of computer games*, viewed August 29 2001, http://www.jnd.org/dn.mss/ComputerGames.html.
19. Papert, S 1998, in *Game Developer Magazine*, pp. 87-88.
20. Prensky, M 2001, *Digital Game-Based Learning,* McGraw-Hill, New York, NY.
21. Riverdeep Interactive Learning 2004, *Riverdeep*, viewed 2004, www.riverdeep.com.
22. Sawyer, B 2004, *Games For Health Project*, viewed November 21 2004, http://www.gamesforhealth.org/.
23. Stapleton, A J 2003, *Why Videogames are Cool & School Sucks!*, http://www.agdc.com.au/03presentations/phpslideshow.php?directory=andrew_stapleton.
24. Stapleton, A J & Taylor, P C 2002, 'Physics and Playstation Too: Learning Physics with Computer Games' Australian Institute of Physics 15th Biennial Congress, Darling Harbour, NSW, July 8-11,
25. Virtual Reality Medical Center 2004, *Virtual Reality Medical Center*, viewed 2004, http://www.vrphobia.com.
26. Wiederhold, B K 2004, *Using Videogames to Treat Mental Health Disorders*, viewed 2004, http://www.seriousgames.org/caseblasts/vrphobia.ppt.