Computer Games as Educational and Management Tools:

Uses and Approaches

Maria Manuela Cruz-Cunha
Polytechnic Institute of Cávado and Ave, Portugal

Vitor Hugo Costa Carvalho
Polytechnic Institute of Cávado and Ave, Portugal

Paula Cristina Almeida Tavares
Polytechnic Institute of Cávado and Ave, Portugal

Information Science REFERENCE

Senior Editorial Director: Kristin Klinger
Director of Book Publications: Julia Mosemann
Editorial Director: Lindsay Johnston
Acquisitions Editor: Erika Carter
Production Editor: Sean Woznicki
Typesetters: Mike Brehm, Keith Glazewski, Natalie Pronio, Jennifer Romanchak, Milan Vracarich Jr.
Print Coordinator: Jamie Snavely
Cover Design: Nick Newcomer

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com/reference

Library of Congress Cataloging-in-Publication Data

Computer games as educational and management tools: uses and approaches / Maria Manuela Cruz-Cunha, Vitor Hugo Carvalho, and Paula Tavares, editors.
p. cm.
Includes bibliographical references and index.
Summary: "This book considers the many uses of games and simulations, focusing specifically on their use in organizational and educational settings and providing perspectives on gaming for distance learning, gaming for rehabilitation, business simulators, and motivational games, this publication explores new and emerging trends in this ever-evolving area of research"-- Provided by publisher.
ISBN 978-1-60960-569-8 (hardcover) -- ISBN 978-1-60960-570-4 (ebook) 1. Management games. 2. Management--Simulation methods. 3. Organization--Simulation methods. 4. Computer simulation. I. Cruz-Cunha, Maria Manuela, 1964- II. Carvalho, Vitor Hugo, 1979- III. Tavares, Paula, 1973-
HD30.26.C66 2011
658.3'124--dc22

2011012251

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Chapter 5
Games and Simulations in Distance Learning: The AIDLET Model

José Bidarra
Universidade Aberta, Portugal

Meagan Rothschild
University of Wisconsin, USA

Kurt Squire
University of Wisconsin, USA

ABSTRACT

This chapter discusses the selection and potential use of electronic games and simulations in distance learning supported by an operational model called AIDLET. After analyzing the different approaches to the use of games and simulations in education, and discussing their benefits and shortcomings, a framework was developed to facilitate the selection, repurposing, design and implementation of games and simulations, with focus on the practical aspects of the processes used in Open and Distance Learning (ODL). Whereas traditional learning is based on knowledge memorization and the completion of carefully graded assignments, today, games, simulations and virtual environments turn out to be safe platforms for trial and error experimentation, i.e. learning by doing/playing. New instructional models may require that rich interactive processes of communication are supported, that assignments are structured as game-like projects, and that a culture of interaction, collaboration, and enablement drives learning and personal development. In this context, the AIDLET model was set out and verified against a taxonomy representing the main categories and genres of games to meet the requirements of distance education teachers, instructional designers and decision-makers.

INTRODUCTION

The current model of pedagogy in conventional schools and universities is essentially teacher focused and one-way communication. It is set against evidence that shows how students learn more by collaborating with their teacher and with each other in the context of educational narratives (Pachler & Daly, 2009). Furthermore, evidence indicates that a new model of education is emerging, one that is student-centered, networked, customized and col-

DOI: 10.4018/978-1-60960-569-8.ch005

laborative, leading to the creation of mechanisms through which infusion experiences and other rich learning contexts may support activity in novel situations (Shaffer, 2004). In addition, it is now recognized that student emotional expressions are a part of the learning process and also an essential component of basic education, a fact that continues to be a minor concern in schools and higher education. There is a growing body of evidence from the neurosciences and the cognitive sciences that recognizes the importance of emotions in cognitive processes and memory operations. The Portuguese born neuroscientist António Damásio developed a theory of emotion that has evolved from his first book, *Descartes' Error: Emotion, Reason and the Human Brain* (1994), which explains how feelings are entangled in the cogitations of the brain and the circumstances of the body. In his second book, *The Feeling of What Happens: Body and Emotion in the Making of Consciousness* (1999), Damásio further explores the role of emotion. He attempts to connect the neurology of emotion to the neurology of consciousness and extends this to the existence of a sense of self. Essentially, Damásio states that mind and body are inseparable and integrated via mutually interactive biochemical and neural components, such as the endocrine, immune, and autonomic neural constituents, which produce chemical and electrical transmitters.

As a rule, freedom of choice, challenge, participation, transparency, integrity, collaboration, fun, speed, and innovation must be a part of students' learning experiences. Playing games may be an important part of learning as this generation's game-playing experiences are more widespread than the game-playing experiences of previous generations. No doubt technology is transforming the ways we learn today but the most widely accepted theories and models behind learning are still valid. For instance, the pedagogical framework for implementing new software tools, games and simulations in the context of Open and Distance Learning (ODL) can be developed by drawing on concepts from: constructivism (Bruner, 1966; Piaget, 1973), social constructivism (Vygotsky, 1978), situated cognition (Brown, Collins, & Duguid, 1989; Barab & Kirschner, 2001), and communities of practice (Wenger et al., 2002). Social constructivism in the Vygostkyan way provides a series of principles that may be accomplished during the development of educational activities. The Piagetan notion of constructivism is at the core and it basically means that students modify their current knowledge schemes to integrate new information and acquire new knowledge when in contact with teachers, peers and the surrounding environment. In addition, learning activities must be situated in authentic settings and in a context that is meaningful to each individual student, and may increase in effectiveness when students are part of community that shares values and contributes to a common objective. Constructivism, situated learning, and the establishment of communities of practice constitute a robust theoretical framework for knowledge acquisition based on the notion that learning occurs in the context of activities that typically involve a problem or task, other persons, and an environment or shared culture.

A recent Educause Center for Applied Research (ECAR) survey of undergraduate technology used in the United States reports that 82.2% of undergraduates own a computer, with 80.5% owning a laptop. Web-enabled or smart phones are owned by 66.1% of undergraduate students, though not all use the features due to cost. Over 85% of students surveyed report using network resources for activities such as accessing social networking sites, playing online multiuser computer games, or accessing virtual worlds (Salaway & Caruso, 2008). Video game use has become a more diverse and popular form of entertainment than it was a decade ago. Games are not just for children, as nearly half (49%) of players are between the ages of 18 and 49. The gender divide in gamers has also greatly narrowed, with males making up 57% of online game players, and women at 43% (ESA, 2008). With the emergence of greater variety in

game style and genre, the market is embracing a diverse range of player motivations. The numbers found in the ESA surveys will continue to shift as the games industry evolves in inclusivity.

The interest in gaming for educational purposes has also increased over the last decade, with researchers identifying key pedagogical features that make good video games inherently strong learning tools. What underlies the allure of games? As educational game researcher James Gee (2003) asks how do good game designers manage to get new players to learn their long, complex, and difficult games. A well-designed game entices players into the "reality" of the game world and keeps them there until the goals of the game have been met (Salen & Zimmerman, 2004). Gee points out that incorporating appropriate challenges that are "doable," and other widely accepted effective learning principles that are supported by research in cognitive science, are in fact a large part of what makes good video games motivating and entertaining (Gee, 2004).

James Gee (2007) has narrowed down the list of pedagogical strengths to thirteen principles that link good games to good learning, emphasizing the areas of learning empowerment, problem solving, and understanding. High-quality games cycle players through new content, encouraging the player to try different ways of learning and thinking (Gee, 2003). A well-designed game doesn't distinguish between learning and playing, rather, players refine and add to their skill sets as the game progresses (Gee, 2004). When a player is successful in-game, the game expertise is linked to 'expert' behaviors such as self-monitoring, pattern recognition, high-level problem recognition and solving, principled decision-making, qualitative thinking, and superior use of both short and long term memory (VanDeventer & White, 2002).

Popular video games like *World of Warcraft* emphasize cooperation and leadership rather than individual competition for the highest score (typical of arcade games, for example). These video games reward creative problem solving, multitasking, collaboration, experimentation, and stimulate the creation of models (Steinkuehler, 2004). The instant feedback and risk-free environment invite exploration and experimentation, stimulating curiosity, discovery learning and perseverance (Kirriemuir, 2002). Learning how to learn becomes an essential skill and the speed and dexterity developed playing video games becomes an added-value. Social skills are also important: to be a guild master in a game like *World of Warcraft*, a player needs to be able to create a vision, recruit and inspire people, and organize the group's strategy. And while the game industry has recognized and embraced such learning fundamentals, weaving them into design to increase value to the player, educational institutions have yet to fully recognize and integrate these models.

From another standpoint, the methodology of Open and Distance Learning (ODL) is now widely based on the e-learning model, a technology-based model that has emerged as a serious contender to help support the learning needs of individuals in this day and age. According to Klopfer (2008), "e-learning itself can mean many things to many people and at its core simply means electronically supported learning, which can be online, on desktop PCs, or even on mobile devices (though the latter is sometimes referred to as *m-learning*). In practice e-learning often means delivery of information and content to learners through online hypertext, accompanied by images, audio, and video. But e-learning can mean much more, as evidenced by the recent surge of interest in using video games to teach everything from basic math skills for young learners to advanced communication skills for adults." (p. 8). For students, the major motivation for enrolling in distance education is not the technology or the network access capability, but the freedom that allows students to move through a course of studies at a time and pace of their choice (Anderson, 2008). Today, improvements in the processing power of mobile computers combined with networked media applications provide a tremendous opportunity for

novel approaches to online learning that go well beyond the use of Learning Management Systems (LMS). Relevant examples are Personal Learning Environments (PLE) that enable individuals to access, aggregate, configure and manipulate digital artifacts in the context of ongoing learning experiences. The power of these new virtual learning environments lies in creating (hyper)spaces that give users a sense of learning by doing, or, in the case of games, learning by playing.

There is reason to believe that learner-driven demand and anticipated boost in effectiveness will facilitate an increasing uptake of serious games in the short term, even if simulations have a longer association of its use to support education and training – namely in applications for business, health, and military training. In any scenario, institutions and educators will need extra support when selecting, repurposing and using games or simulations in their practice, often trying to overcome factors such as time pressure, lack of experience, shortage of resources, etc. In many cases off-the-shelf games can be successfully introduced into educational processes, always a good decision as the creation of high quality educational games has a prohibitive cost. Therefore the access to tools and frameworks that may help in the process will benefit the stakeholders in any ODL organization. For instance, US military have considered the use of a framework for the use of Massive Multiplayer Online Gaming in Military Training and Education (Bonk & Dennen, 2005). In another case, a framework for evaluating games- and simulation-based education in general has been proposed by De Freitas & Oliver (2006) indicating the main pedagogical requirements. In a similar approach, a study by Moreno-Ger et al. (2008) proposes a set of educational game design guidelines, namely: choosing an appropriate genre, adding assessment and adaptation to the design and integration with an online environment. But we were not able to find yet a comprehensive framework for the selection, repurposing, design and implementation of games and simulations in ODL courses, so this became our main goal.

In the next section we start by analyzing the potential for the use of games and simulations in distance education, and by discussing their benefits and shortcomings in this context. Next we introduce the AIDLET framework for the selection, repurposing, design and implementation of games and simulations, concentrating on the practical aspects of the processes involved. Finally, we verify the AIDLET model against a taxonomy representing the main categories and genres of games, attempting to meet the requirements of distance education teachers, instructional designers and decision-makers.

THE POTENTIAL OF GAMES IN ODL

It has been established that Open and Distance Learning (ODL) institutions hold great potential for the instruction of a broad and diversified range of learners. It has also been established that well-designed interactive media tools such as games, simulations, and virtual environments may provide learners with relevant and engaging paths to content mastery. The next step is to bring the two together. But overcoming the technology gap between learners and institutions is just one aspect of the problem. Traditional ODL pedagogy has to be reformulated, not just accommodating the latest technology but also enabling rich social interaction, enhancing group work and communication within educational settings. Many educational researchers today would define learning as a multidimensional construct of learning skills and cognitive learning results, for instance, procedural, normative and strategic knowledge, and attitude (Pivec & Dziabenko, 2004). Academic and life success require not just the accumulation of facts and conceptual understandings, but also attitudes, dispositions, and values that are aligned with those of science. Learning is, from this perspective, about building up knowledge, skills, beliefs

and attitudes that together, form an identity as someone who is a capable consumer, and perhaps even producer of scientific knowledge. Some have even speculated that this "identity-level" is a good way for educators to think about transfer. Perhaps if students experience the development of identities as competent performers in science, acquiring knowledge, skills, and beliefs congruent with those valued by various scientific communities, they will take on these practices outside of formal school contexts. So, in line with the use of new digital media, a current tendency in education acknowledges the emergence of new learning experiences that games may turn out and seeks to understand their consequences for how we think, act, play, and learn (Shaffer et al., 2005).

Convergence of Learning Modes

In the last decade the classroom mode and the distance learning mode have been converging, in part due to the success of many e-learning experiences, based on the progress in information and communication technologies and their permeating all learning environments in most developed countries. Using computers and accessing the Web in schools and universities, taking advantage of quality learning products in digital format, linking institutions with broadband connections, using Web 2.0 networking applications, all create favorable conditions for increasing student autonomy and learning effectiveness (Moore & Anderson, 2003). But this also creates a shift in teacher's profiles and roles: the ability to virtually experience events in shared spaces determines that they become mediators between students and the information provided by a variety of sources, rather than being the exclusive owners of knowledge to be transmitted.

Globally, the implications of this re-conception of education, as a mobile and flexible exchange of ideas in a broad context, are profound. It goes beyond the traditional view of instruction as the transmission or construction of knowledge within the constraints set by a curriculum, to replace it with an ongoing process of learning through continual exploration and negotiation. As Don Tapscott (2008) puts it: "Educators should take note. The current model of pedagogy is teacher focused, one-way, one size fits all. It isolates the student in the learning process. Many *Net Geners* learn more by collaborating—both with their teacher and with each other. They'll respond to the new model of education that's beginning to surface—student-focused and multiway, which is customized and collaborative." (p. 108). We would just add that learning in this way is in fact pervasive or ubiquitous education. This means that education is available 24 hours a day, 7 days a week, anywhere, and anytime. Pervasive learning is also a social process that connects learners to communities of devices, people, and society so that students can construct relevant and meaningful learning experiences, author specific content (text, images, audio, video), in locations and at times that they find meaningful and relevant.

So, for the most part, distance learning has become a way of life for students wherever they are. For the institutions this is good news, as for the first time in history we have educational technologies that cost nothing to governments and schools: smartphones and mobile computers (most students have one), networking software (freely available, e.g., Facebook, Twitter, Skype), learning applications (increasingly available, often for free e.g., Apple Store) and open educational resources (freely available, e.g., MIT – OCW, Stanford). On top of this, there are many other free tools available for personal learning environments, such as collaborative tools (e.g., blogs, wikis, authoring software), immersive environments (e.g., virtual worlds like Second Life), media production and distribution tools, and so on. There is an old adage of distance education research that states: 'It is not technologies with inherent pedagogical qualities that are successful in distance education, but technologies that are generally available to citizens' (Dias et al., 2008).

I this context we argue that the transformation of ODL curriculum and instruction processes must be based on the new digital media capabilities and its patterns of use by students, namely through interactive and rich content embedded in game-like learning experiences. For this to take place we also propose the integration of games and simulations with the existing e-learning standards and platforms used for online education. Ideally, these educational games should be able to coexist in environments that follow the learning objects model and have elevated pedagogical value (Moreno-Ger et al., 2008).

Learning Attributes of Games

But what is the real potential for the integration of games and simulations in distance education? What are the expected benefits and shortcomings in this specific learning context? It may be important to note that not all games do all things. Certain game styles and formats may lend themselves better to different sorts of players and objectives. For example, there are different player experiences in single vs. multiplayer games, but no one is superior for learning per se. It depends on what the specific learning goals and player behaviors are. Also, much like other entertainment industries, games are experiencing genre shifts as developers take specific traits from multiple game styles to achieve desired systems and play experiences. It is for these reasons that the attributes and styles cannot be put nicely in "boxes", or fit a precise matrix for that matter. There is considerable overlap.

The goal of the AIDLET model is to provide a planning framework for development and inclusion of game environments for learning, taking into account familiar attributes of commonly referred to game subtypes. Let's start first by identifying the broader categories of games referenced in educational game studies:

Edutainment Games

These are games that usually combine education and entertainment in a package that highlights intended educational outcomes targeted at specific groups of learner, very often targeted as youth and children's games. Most edutainment games currently in the market are not supported by empirical learning evidence and thus it's difficult to integrate them in an effective educational program.

Serious Games

These are games with many of the characteristics of entertainment games but with intended educational outcomes targeted at specific groups of learners. The "serious" adjective is generally applied to refer to products used by industries like defense, education, scientific exploration, health care, management, city planning, engineering, religion, and politics. Put simply, these are games with a serious purpose; the games may include First Person Shooters (FPS), Role-playing Games (RPG), Real Time Strategy (RTS) games, and Massively Multiplayer Online Games (also called MMOG or simply MMO). In most cases, these are the games that will better integrate with the ODL workflow.

Location Aware Games

This rather new designation usually refers to virtual experiences played out in real world spaces. This last aspect makes the difference and identifies the genre more specifically. In general, contextualized clues can only be discovered via real world spaces with the aid of GPS devices that are becoming common amongst students these days. Unfortunately, even with the advantage of involving students in authentic real world tasks, participation in groups, and frequent interaction and feedback, these games are difficult to integrate in an ODL workflow because e-learning students are far away and dispersed geographically.

Global Reach Games

Also a recent phenomenon, exampled by games such as *World of Warcraft* or *Everquest*. The term covers any video game capable of supporting hundreds or thousands of players simultaneously. These by inevitability are played on the Internet and feature at least one persistent world. In the case of *Second Life*, which is not a game per se, we can consider the existence of a virtual world with a game-like society of users. Many types of games can be set up in a virtual world and take full advantage of a 3D environment with its realistic interaction modes.

In an effort to identify more distinctive learning attributes of games we must take a look at the design specificity and comparative merits of games' categories and genres. In many cases they extend and overlap to create mixed categories/ genres. The potential for integration in a typical ODL workflow is discussed.

Traditional and Casual Games

Chess, solitaire, and card games, whether traditional or game specific, are examples of such games. Other casual games are commonly deployed online, and offer movement in 2D or 3D space with obstacles to overcome. Timing is sometimes critical, with heavy reliance on motor skills, memory, and planning. Themes may vary from games that expand concepts, such as the food chain, set matching, etc. to card games aimed at teaching math, animal, and plant species. Other games in this genre have shown potential for involving math and physics, for example, games such as *World of Goo* and *Crayon Physics*. Because these games were not developed specifically for education, the behaviors are not mapped directly to learning objectives. However, the player behaviors do support the kinds of scientific thinking practices that educational game environments tend to foster. Potential in this genre exists for games that support systems engineering and computing concepts. The *Flash* technology can be used to easily produce cards or other digital artifacts for ODL.

Shooting /Action

These games can include First Person Shooters (FPS) or other fighting games. The game scenarios may exist within a broader narrative framework, and are presented from a first person perspective. In shooter games, players typically aim and fire at moving objects to destroy them. This involves the development of fast hand to eye coordination and may be important in training areas associated with the police or military. In most cases the player operates virtual mechanical devices and has to accomplish some objective (e. g. drive a vehicle, fire a weapon or use a tool). Shooter and fighting games may be played solo, or designed for team collaboration. Military strategy games in these genres may also include cultural learning objectives, using local cues to engage with others in-game to accomplish missions. These games can be used in ODL as a drill-and-practice component of a course, for example, in engineering, sports, or military training. Team development objectives can also be met through multi-player modes.

Adventure Games

The adventures or quests offer a series of challenges usually within a detailed framework. Most adventure games do not rely on speed or "twitch" play for success. A classic example in this genre is the interactive fiction game *Myst*. The tasks in the game may be relevant to the curriculum and the learning process, often in terms of motivation, as in the case of Sid Meyer's *Civilization*, a widely popular and researched game that involves geography, history, and politics (also falling within the strategy genre). There is definitely room for the deployment of this kind of games in distance education.

Role-Playing Games

A Role-Playing Game (RPG) is a game in which the participants assume the roles of fictional characters. Drawing from original RPGs like *Dungeons and Dragons*, players inhabit a role with status and responsibility within a shared context, and in which the context is defined by a set of rules. The educational function of RPGs may be extensive. Players in educational RPGs may establish the actions of their characters (e.g., lawyers or politicians) based on their characterization, and the actions succeed or fail according to a formal system of rules and guidelines. This may be interesting for many ODL courses requiring students to learn those kinds of skills and the related tacit knowledge. This is also very useful for learners to practice behaviors in an environment that provides clear consequences based on the context and rules of the game world.

Strategy Games

Sometimes called Real Time Strategy (RTS) games, this genre of video games emphasizes skillful thinking and planning to achieve a goal. They involve strategic, tactical, and sometimes logistical challenges. There are many good examples of this type of games, in the areas of history, economy, management, ecology, society, etc. Typically these games involve multiple challenges and are aimed at developing problem-based skills. Some very popular and successful titles are: *Civilization* and *Age of Empires*. These are very expensive games to design and produce but some of the themes and inherent characteristics of those commercially available may be interesting for specific ODL courses.

Simulation Games

For a game to be considered a simulation game, as opposed to a pure simulation or a virtual world, a game system must exist in which the player has a role and specific objectives. In simulation games, the player operates a model or simulation that behaves according to a programmed set of rules. Many simulation games focus on some element of realism, thus forcing players to understand and remember complex principles and relations and progress by trial-and-error. These often very expensive games can teach anything, from flying a plane up in the sky to steering a submarine deep in the ocean. Typical examples are *Flight Simulator* and *Train Simulator*. Another is *SimCity*, a popular mainstream title that has been used for educational purposes. Social simulation games are also a large component in the simulation genre, with Will Wright's *The Sims* the most widely recognized title. Another recent (and free) simulation game for Business Project Management training is *INNOV8*, developed by IBM a few years ago and now reaching version 2 (IBM, 2009). These kinds of simulation games are often suitable for online cooperative work and thus very apt for integration in ODL.

Modeling Games

Modeling is often a component of the game rather than the game in itself, and usually is tied with other types of games (action, strategy, simulation, programming, etc.). For example, some car racing titles involve creating a track or building the car before you can race it. This genre is also linked with programming games, as learners may create the models before they are able to program them. Examples include robots, cars, bikes, machines, factories, companies, electronic devices, etc.

Programming Games

A programming game is basically a computer game where the player has no direct influence on the course of the game. Instead, a computer program or scripts are written in some domain-specific programming language in order to control the actions of the characters, often robots, tanks or

bacteria, which seek to destroy each other. Many programming games are considered environments full of digital organisms, related to artificial life simulations. Games that enable users to build microworlds have been created at the MIT *MediaLab*, and extensive research has been published on this (e.g., programming of Lego robots and Logo projects). The potential for use in ODL is great and technology is often freely available.

Massively Multiplayer Online Games

A Massively Multiplayer Online Game (also called MMOG or simply MMO) is a game capable of supporting hundreds or thousands of players simultaneously. The most accomplished and famous MMO is *World of Warcraft*, with many millions of players all over the world, but in education this is a hard choice to make due to enormous technological demands (software, servers, technical support, etc.). Nevertheless, there are a few multiplayer games with educational intentions, in one example (MEGG - http://www.cybertrain.info/megg.html) there is capability to build an online multiplayer educational game on any theme, with menus, text, graphics and multiple choice quiz banks.

Virtual Worlds

Virtual worlds are one of the newer developments on the Internet, with *Second Life* being the most well known. The unique qualities of 3D virtual worlds can provide opportunities for rich sensory immersive experiences, with authentic contexts and activities for experiential learning, simulation and role-play, including the creation of complex environments and scenarios. Hundreds of university systems around the world use the *Second Life Grid*™ as a lively part of their educational programs. Many of the previous types of games can be set up in a virtual world and take full advantage of a 3D environment and its realistic interaction modes. One recent example is *SLOODLE Game Show*, an open source game for *Second Life* (http://www.youtube.com/watch?v=SRVVrAp_64U)

Layered Reality Games

These games are representative of a new set of experiences that consists of roughly three different categories of games: Augmented Reality Games, Hybrid Reality Games, and Alternate Reality Games, mostly involving active engagement, participation in groups, frequent interaction and feedback, and connections to real world contexts via GPS. This last aspect makes the difference and identifies the genre more specifically but implies that these games are more difficult to integrate in the ODL workflow.

In general, research shows that learning through games is possible by immersing players in relevant experiences, by modeling expert problem solving, by providing guidelines to solve a problem, and by structuring problems so that the player builds on previous knowledge, which are all features of powerful and well designed learning environments (Bransford et al., 2000; Gee, 2003). On a less positive note, according to Huntington (2006), there are obvious barriers to the development or adoption of educational games in general. For instance:

- High development costs in an uncertain market makes investment in educational gaming innovations too risky for the commercial video game producers and even the educational materials industries.
- Change in institutions comes slowly in terms of adopting any new innovations and as do making the necessary organization and instructions changes that allow use of new learning technologies.
- There is unwillingness on the part of institutions to give up textbooks in order to purchase educational gaming products.

- The specific educational values that are tied to established standards have not been proven through in-depth research.
- Some parents and teachers have very negative attitudes about the use of videogames in the classroom.
- Games are especially good at teaching higher order skills, which are not typically assessed in standard examinations.
- Access to computers is sometimes so low that it can't play a mainstream role in student learning (the case of many developing countries).

But the application of games in education requires more than just their availability and adequacy, a new educational perspective is needed. Squire (2008) suggests the following scenario: envisage for a second that you are a teacher or instructional designer, charged with developing an advanced science course, covering a few hundred new terms, facts and concepts. How would you go about designing materials that handles these concepts? What kinds of experiences would you want learners to have? How would you pace them and how would you know if they truly mastered what you needed them to learn? These questions, which may seem traditionally the domain of instructional technologists, are also relevant for video game designers. As games get longer and more complex, designers devise ways to "teach the player" to see and act in particular ways. Whereas educational technologists ask if education can happen at a distance, gamers show you that it already does, as game designers and distributed game communities help them become better players. Part of what is interesting about contemporary video games is how experiences are ordered so that players are "taught" the game through the careful construction of levels, missions, and interactions. Few, if any, of the so called "serious games" or even research prototypes that have been made, to the best of our knowledge, take advantage of most of these design principles.

How is assessment defined? In games that are designed for learning play behaviors are mapped to the specific actions that relate to the learning goals. Other design considerations that promote attainment of educational goals include deciding how pass and fail states map to desired player performance. Games' environments designed for specific learning goals may also include threshold points in-game, much like educational threshold concepts are gatekeepers for understanding future content, game threshold points can be designed to scaffold player skill and require player mastery of certain behaviors before progressing in the game world. Games also provide opportunities for learning from feedback loops. As players are evaluated on their performance, feedback loops help guide player behavior towards desired outcomes. In this way, the development of the game system will support player progress in both micro and macro objectives. Assessment instruments may include capture logs of player performance in situ, recordings of student performance, and discourse analyses of students' work in game play. Other documents emerging from the game (including students' writing, illustrations, or digital representations) can be analyzed to identify how their thinking is (and is not) affected by the game experience.

THE AIDLET MODEL

In a more pragmatic way, considering the current educational context, to attain high quality learning results based on constantly connected, highly interactive, and fully mobile media environments, the right teachers, materials, methods, and games have to be found. But this may be a rather costly and challenging proposition for many ODL organizations as it involves: investment in new information and communication technology (mildly expensive), faculty and tutor re-training (time and capital intensive), development of engaging digital materials (games and simulations

may be expensive), review of internal processes (habits are difficult to change) and, last but not least, establishment of a credible and high quality brand name (as online learning is often regarded as a kind of lower-grade education, not to mention games-based learning). However, even with the adoption of new digital media, games and simulations, we must accept the fact that not all knowledge can be acquired through distance learning. In some cases it is not suitable for acquiring all the necessary skills, for example in:

- health sciences, especially surgery and hospital practice;
- experimental sciences, which require laboratory practice;
- applied psychology, involving direct interpersonal experience;
- court training in law, about oratory and argumentation.

A way to overcome this difficulty is to separate theoretical content from the corresponding practical component. The former may be taught in distance learning mode, and, to a certain extent, practice may be supported by VR applications, simulations and games representing real situations (Bidarra & Cardoso, 2007). On that note, Starr (1994) argues that simulations – the process of setting up scenarios and exploring under what conditions they might work – are at the core of business, government and science. For many years researchers have studied the uses of simulations in education and established that well-designed simulations will develop in the student a profound, flexible, spontaneous, kinesthetic understanding of the subject matter (Gibson et al., 2007, Issenberg, 2006, Teodoro, 2004, Kezunovic et al., 2004). Squire & Giovanetto (2008) argue that when considering the higher education of gaming, a core intellectual feature of a twenty-first-century educational system should include inroads into participation in cultures of simulation. In fact, students who learn by means of simulations can improvise better in real world contexts. They can handle unexpected situations with ease and knowledge learnt is not structured around a set of norms or processes but developed from intrinsic personal experience. This is the kind of knowledge students retain for a long time. Unquestionably, today video games are the individual's primary exposure to this important way of thinking. And in the probable scenario that games/simulations may not be developed or cannot be applied, online learning can be made more game-like (Gee, 2003) in an attempt to change the inflexible and prescriptive models in use today.

Dealing with the Issues

Based on our observations and on data collected we consolidated a clear-cut framework to assist ODL teachers, instructional designers and managers in making the right decisions about the adoption and use of educational games and simulations. But for a framework or toolkit to be effective, no matter how simple or practical it is, a particular learning context has to be defined. Previous research by De Freitas & Oliver (2006), on the kinds of questions facing tutors when thinking of introducing games- and simulation-based learning into their practice, relied on some interesting questions:

Which game or simulation to select for the specific learning context?
Which pedagogic approaches to use to support learning outcomes and activities?
What is the validity of using the chosen game or simulation?

So, trying to answer those questions, our research started by exploring real world practices and went on identifying the main concepts and activities that defined those practices, in the belief that a certain way of thinking and doing could be derived and applied to new situations. For instance, the traditional classroom environment, where an instructor can guide the activity of the

students, is very different from the online educational environment in which specific game genres have to be identified and suitable frameworks set (Moreno-Ger et al., 2008). So, in the case of ODL we were confronted with the existence of three main groups of requirements: the definition of an approach closely linked to educational content specifications, the repurposing of existing game/simulation titles or the design and development of specific games/simulations, and the integration of games/simulations in the ODL workflow.

The framework we propose builds on these requirements and is rooted in research previously conducted into conventional teaching/learning with games (Prensky, Gee, Gibson, Jenkins, Squire, etc.), all sharing essential features such as students, teachers, and resources; but in this model we had to go beyond that by explicitly addressing the requirements imposed by the typical context of Distance Education. A relation may be established with the ACTIONS model (Bates, 1995, 2000), a media selection and evaluation framework often used in ODL studies. 'ACTIONS' is the acronym for seven main criteria that Bates proposes for selecting a specific learning technology, namely: access, cost, teaching and learning implications, interaction, organizational issues, novelty and speed. In this model he uses a pragmatic approach to the effective costs of technologies, and relates these to other important features that are relevant for decision-makers. The fundamental principle is still valid today: educational technologies are not good or bad, it's the way they are used that dictates the success or failure of a project. The same can be said of the application of games and simulations in ODL.

Applying the Model

The chief benefit of using a conceptual model for instructional design is that common pitfalls can be avoided. So, our purpose is twofold: (1) to help distance education teachers and instructional designers in the implementation of game- and simulation- based learning, and (2) to support ODL organizations and decision-makers in the process of choosing the right tools and methodologies. Of course, an overall educational strategy must be in place, indicating the materials and learning objectives (content), the ways to choose, validate, organize, and present content (curriculum & instruction), the individual attention offered to each student (tutoring), the grading and confirmation of a level of competency (assessment), and the creation of peer groups that both make learning more effective and engaging (learning community).

The framework we propose tries to beat the shortcomings of other models, not specifically tailored for the use of games in distance education, by introducing a six-dimensional model with the acronym 'AIDLET', addressing issues related to availability and cost, interaction and communication capabilities, distance education workflow integration, learning design potential, engagement and ease of play, thematic value and adequacy (summarized in Table 1).

The six steps provide main criteria for consideration, certainly not intended as prescriptive, allowing for practitioners to be more critical about how they implant games and simulations into their courses. With this basis, teachers, designers and decision-makers may develop their own metrics for introducing games and simulations in specific educational programs. The key-aspects of the model may be described as follows:

Availability and Cost

The widespread use of games as entertainment is a known fact but it doesn't mean that games in general are effective for learning purposes. Some games can be selected and used to assist the learning process and others have to be designed from scratch to support a specific course. The first decision is whether to consider the repurposing of an existing title or the development of a new one. There are basically three options: buy an "off-the-shelf" title, contract with a development

Table 1. The AIDLET Model for selection and implementation of games in ODL

AIDLET Model	Questions
Availability and cost	Is there an adequate game for the organization and for the learners? What is the cost? If the available version is not suitable, can it be modified? The game or simulation has to be developed from scratch? At what cost? What is the unit cost per student?
Interaction and communication capabilities	The game is state-of-the art in terms of concept, interface and design? Is it Web 2.0 ready? The interaction and communication features are adequate for learning?
Distance education workflow integration	Does it integrate with ODL practice and workflow? What kinds of connections can be made to other ODL tools and media?
Learning design potential	What kinds of learning are supported? What instructional approaches are possible within the constraints of the game/simulation? What other technologies can be integrated in supporting teaching and learning?
Engagement and ease of play	Are the game characteristics engaging and user-friendy? Is it accessible to teachers and students less experienced in games? How long does it take to master the basics of the game?
Thematic value and adequacy	Can the game content be used without any side effects? Are the themes appropriate? What social skills does the game develop? Are these congruent with cultural, societal and organizational values?

firm or get in-house production. The costs are very different and tend to increase from the first to the latter. There is no stable and robust model to use here as it all depends on the instructional design to be used and the budget on hand. For instance, learning history with Sid Meyer's *Civilization* is quite inexpensive, because the title is widely available at affordable prices, while developing a game for a new course on telecommunications surely has a prohibitive price.

Interaction and Communication Capabilities

Games and simulations are by definition very interactive yet not all of them support useful educational interaction that leads to effective learning. Furthermore, the *quantity* of interaction that is possible with a system does not guarantee the *quality* of the interaction in terms of attaining learning goals. A sense of security and progress is important and depends on broad agreement both on the ends to be pursued and on the means to achieve them. The design of the interaction is vital to the success of the game/simulation as these are initial requirements that make or break the deal. A poorly made design will never be used by students no matter the amount of research and development that was spent in the project. Also the essential Web 2.0 features of current applications are important to enable connection with other people and resources not only for support, as is usually the case to tackle technical problems, but to achieve a strong motivation and a multiplying effect that facilitates learning. The current boom in social networking is a solid indicator of this requirement.

Distance Education Workflow Integration

Learning with the new digital tools really implies much more than just using intensively a given set of applications: it comprises all the human factors and qualified work involved in conceiving appropriate learning materials, devising a sound pedagogical strategy, providing each student with efficient support, assessing individual progress, grading students, and certifying their final results. So many questions arise: how games and simu-

lations integrate with the usual ODL workflow? How do we monitor student's activity? What if the students do not visit all the areas in the game/simulation? What if they wander around wasting time? How much time and effort is necessary to accomplish all the tasks? How do we assess the students? Etc. Of course, there is no ready answer to these questions; the idea is to figure out the answers specific to each project before going any further.

Learning Design Potential

The best way to see the instructional benefits of games and simulations is to evaluate how they are used in education. For example, evaluating the performance of titles in the so-called "Serious Games" genre, namely, investigating the kinds of learning that may be supported, the instructional strategies that are possible within each game constraints, the e-learning platforms and technologies that are compatible. Only when students feel comfortable with the online environment and the technology provided will they be able to study and contribute. On the other hand, excessive involvement with games and simulations may damage the interaction with other course content and the interaction with people, and this certainly needs to be monitored closely. Another pragmatic way is to consider typical game-based learning scenarios to be developed, where synchronous or asynchronous online communications may be used:

Synchronous Scenarios

- Training of dialogue and articulation
- Leading and conducting meetings
- Courtroom conferencing and interaction
- Business conferencing and interaction
- Collaborative design in architecture
- Health professional interaction practice
- Surgery and operation theater practice

Asynchronous Scenarios

- Dynamic learning activities (e.g., driving a vehicle, operating a machine)
- Active exploratory learning (e.g., archeology, history, CSI, detective work)
- Goal oriented brainstorming (e.g., advertising, marketing)
- Policy decision making (e.g., business, government, orgs)
- Business decision making (e.g., marketing, sales, operational)
- Process management (e.g., commerce, industry, communications)
- Strategic planning (e.g., business, government, orgs)
- Case study (e.g., business, sociology, health, ICT)
- Experiential activities (e.g., laboratory, field trip)
- Debating relevant issues (e.g., policy, business, academia)
- Science modeling (e.g., chemistry, engineering)
- Reporting, expressing and communicating (e.g., business, health, science)
- Multimedia communications design
- Web communications design
- Scientific investigation
- Computer programming
- Information systems design
- Computer graphics design
- Computer games design
- Language laboratory
- Cultural events management
- Sports strategy and tactics

Engagement and Ease of Play

This aspect usually becomes apparent only after students start playing a game or interacting with a simulation, when participants become excited and joyful about the program. An ideal situation would be to have a prototype to try out, as is

the norm in many commercial games and TV programs. Here, as well as in television contests, there must be a challenge that the player can understand and may be able to succeed at by using his or her knowledge, intelligence, and dexterity. To be engaging an educational game or simulation must be composed of purposeful, goal-oriented, rule-based activities that the players perceive as fun. This means that we must be aware of any signs of either cognitive overload or excessive dispersion of attention in the players that may impair learning activities. At the end of the day, designers and instructors have to ask if the amount of potential learning is justified by the amount of work and time to implement the game. And must be willing to admit that often it is not!

Thematic Value and Adequacy

These are perhaps the most subjective of all the factors in the model: what is "valuable" and what is "adequate". But these are important criteria because we have to consider information that is relevant to a specific culture, society, group or organization. Many games and simulations will not be suitable for adoption because of issues related to religion, politics or race, for example. On the other hand, many games and simulations were developed to engage players in a very respectful game play, for instance, *World Without Oil* or *Food Force* (World Food Program), but may not be suitable for the specific learning goals set out in the curriculum. Furthermore, some games and simulations may be too restrictive and prevent students from developing their own meanings, interpretations and critical views. This also means inquiring what instructional activities can be created to maximally address weaknesses of the game (e.g., missing, misleading or inaccurate content). Other essential aspects to evaluate are the topics breadth or depth, and the types of strategies that are promoted by game (e.g., trial and error, problem-based, etc.).

Discussion and Recommendations

To test our conceptual framework we analyzed many off-the-shelf games in an attempt to assess its potential for selection, repurposing and implementation in ODL. Following the AIDLET model, we made use of a scoreboard to evaluate the sensible application of typical examples representing the main categories and genres of games (summarized in table 2).

Popular games may range from shooting games to casual games, from role-playing games to family entertainment games. However, our findings concerning the potential of games in ODL show that simulations, strategy (RTS) and role-playing games (RPG) are the genres that may support good quality learning according to the AIDLET framework. This is in line with the ESA report (2008) that indicates strategy (33.9%) and role-playing (18.8%) games as best selling games sold for play on computer systems. Success titles of these categories include *SimCity, The Sims, Civilization, Age of Empires, Final Fantasy* and *Warcraft*. Many of these games are supported by high quality simulations and have been used for educational purposes. Furthermore, some of them are responsible for engaging large groups of remotely located users, leading to the expansion of educational projects in many organizations, sometimes using multiplayer online role-play gaming approaches as a means for engaging and retaining large remotely located learner groups (De Freitas & Griffiths, 2007). On a less positive note, we are aware that games are not for all topics, learners, or environments; games are effective only if matched to content, learning styles, digital literacy and educational context, also, they may be expensive to integrate and implement. In addition, not all games are alike as they have diverse underlying strengths and strategies.

The field of game-based learning is changing so fast that it is hard to keep up with all the research. As a result, there is an opportunity for new research and researchers to focus on the

Table 2. Assessment of typical examples representing the main categories and genres of games.

Sim or Game	Availability & Cost	Interaction	Distance Edu	Learning Design	Engagement	Thematic Value
Traditional	Good	Average	Average	Average	Average	Average
Action	Average	Good	Average	Average	Good	Average
Adventure	Poor	Good	Average	Average	Good	Average
RPG	Average	Good	Good	Good	Good	Good
RTS	Average	Good	Good	Good	Good	Good
Simulation	Average	Good	Good	Good	Average	Good
Modeling	Average	Good	Average	Average	Average	Average
Programming	Good	Good	Good	Average	Good	Good
MMO	Poor	Good	Poor	Average	Good	Poor
Virtual World	Average	Good	Good	Average	Average	Average
AugRG	Poor	Average	Poor	Average	Average	Average
HibRG	Poor	Average	Poor	Average	Average	Average
AltRG	Poor	Average	Poor	Average	Average	Average

Poor = hard choice (may be expensive, difficult to integrate, cover themes not appropriate, etc.)
Average = compromise (a good choice in some cases, may be partially used, depends on instructional design, etc.)
Good = safe choice (already tested, easily available, low cost, most themes appropriate, etc.)

kinds of questions that will sustain a move toward a full-grown scientific field. If we don't blend academic requirements with game initiatives and experiences there is the risk of all these efforts becoming a fad. Concurrently, due to the fact that comparatively few games are in use in ODL and the mainstream research tends to cover generally standard tertiary education and training, there is a vital need for empirical research on the specific application of games in ODL.

CONCLUSION

This chapter started with a review of the values underpinning new digital media, games and simulations in today's education. We chose to focus on how these are enacted in social practices supported by contemporary digital habits, and how they may be present in ODL, but at this point in time we were not able to demonstrate how distance education was significantly transformed through the deployment of this technology or indeed by any other means. In fact, while paying attention to how technological artifacts are enacted in society we were simply able to identify familiar patterns of interaction and communication that are of value to Distance Education. Games are often heralded as one remedy for the failure of conventional education but our interpretation of the research data would be to see them in terms of the influence of a popular new media form. The implications for understanding the relationship between games and learning therefore are that games need not be defined as an essential instrument or a type of content but as contemporary human creations whose forms and meanings are strategic for education. In this regard, ODL establishments need to adopt these innovative modes of learning in order to make a difference in academic development and deal with new learning styles. Also, contemporary organizations need employees proficient in effective communication, teamwork, project management, and other soft skills such as responsibility, creativity, entrepreneurship, corporate culture, etc. Simulation- or Game-based learning may be

the right answer to those needs, particularly if supported by appropriate e-learning methodologies. In this context, the role of the instructor is a critical (if somewhat overlooked) component in the deployment of instructional games, as are other learner support strategies such as helpdesk or online mentoring. The task ahead is certainly a difficult one but we think the AIDLET model may help teachers and instructional designers make better decisions regarding the application of game-based learning in their particular topics. We believe this is a great time for ODL stakeholders to take on the challenge of adopting new digital media, serious games and interactive simulations.

ACKNOWLEDGMENT

The *Fundação para a Ciência e a Tecnologia* (grant SFRH/BSAB/833/2008), and the *Games, Learning and Society* research group at the University of Wisconsin in Madison.

REFERENCES

Anderson, T. (2008). Teaching in an online learning context. In Anderson, T. (Ed.), *Theory and practice of online learning* (2nd ed., pp. 343–366). Athabasca University.

Barab, S. A., & Kirshner, D. (2001). Methodologies for capturing learner practices occurring as part of dynamic learning environments. *Journal of the Learning Sciences*, *10*(1-2), 5–16. doi:10.1207/S15327809JLS10-1-2_2

Bates, A. (1995). *Technology, open learning and distance education*. London: Routledge.

Bates, A. (2000). *Managing technological change: Strategies for college and university leaders*. San Francisco: Jossey-Bass.

Bidarra, J., & Cardoso, V. (2007). *The emergence of the exciting new Web 3.0 and the future of open educational resources*. Paper presented at the EADTU 2007 Conference, Lisbon, November 8-9, 2007.

Bonk, C., & Dennen, V. (2005). *Massive multiplayer online gaming: A research framework for military training and education advanced distributed learning initiative*, Office of the Under Secretary of Defense (Personnel & Readiness), Readiness and Training, 4000 Defense Pentagon, Washington, DC.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How people learn: Brain, mind, experience, and school committee on developments in the science of learning*. Washington, DC: National Academy Press.

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher*, *18*, 32–42.

Bruner, J. S. (1966). *Toward a theory of instruction*. Cambridge, MA: Belknap Press of Harvard University.

Damásio, A. (1994). *Descartes' error: Emotion, reason, and the human brain*. New York: Avon Books.

Damásio, A. (1999). *The feeling of what happens: Body and emotion in the making of consciousness*. New York: Harcourt.

De Freitas, S., & Griffiths, M. (2007). Online gaming as an educational tool in learning and training. *British Journal of Educational Technology*, *38*(3), 535–537. doi:10.1111/j.1467-8535.2007.00720.x

De Freitas, S., & Oliver, M. (2006). How can exploratory learning with games and simulations within the curriculum be most effectively evaluated? *Computers & Education*, *46*(3), 249–264. doi:10.1016/j.compedu.2005.11.007

Dias, A., Keegan, D., Kismihok, G., Mileva, N., & Rekkedal, T. (2008). *Achievements of mLearning today*. Report of European Union project 227828-CP-1-2006-1-IE-MINERVA-M.

ESA – Entertainment Software Association. (2008). *Demographics of entertainment software users.* Retrieved March 14, 2009 from http://www.theesa.com/ facts/index.asp

Gee, J. P. (2003). *What video games have to teach us about learning and literacy*. New York: Palgrave Macmillan.

Gee, J. P. (2004). *Situated language and learning: A critique of traditional schooling*. New York: Routledge.

Gee, J. P. (2007). *Good video games + good learning: Collected essays on video games, learning and literacy*. New York: Peter Lang.

Gibson, D., Aldrich, C., & Prensky, M. (2007). *Games and simulations in online learning: Research and development frameworks*. Hershey, PA: IGI Global.

Huntington, B. A. (2006). *Barriers to the development of educational games*. Report of the Summit on Educational Games: Harnessing the Power of Video Games for Learning. Washington, DC: Federation of American Scientists. Retrieved March 12, 2009 from http://www.fas.org/ gamesummit/

Issenberg, S. B. (2006). The scope of simulation-based healthcare education. *Simulation in Healthcare: The Journal of the Society for Simulation in Healthcare*, *1*(4), 203–208. doi:10.1097/01.SIH.0000246607.36504.5a

Kezunovic, M., Abur, A., Garng Huang Bose, A., & Tomsovic, K. (2004). The role of digital modeling and simulation in power engineering education. *IEEE Transactions on Power Systems*, *19*(1), 64–72. doi:10.1109/TPWRS.2003.821002

Kirriemur, J., & McFarlane, A. (2004). *Literature review in games and learning. NESTA Futurelab Series*. Bristol: NESTA Futurelab.

Klopfer, E. (2008). *Augmented learning*. Cambridge, MA: The MIT Press.

Moore, M. G., & Anderson, W. G. (2003). *Handbook of distance education*. Mahwah, N.J.: L. Erlbaum Associates.

Moreno-Ger, P., Burgos, D., Martínez-Ortiz, I., Sierra, J. L., & Fernández-Manjón, B. (2008). Educational game design for online education. *Computers in Human Behavior*, *24*(6), 2530–2540. doi:10.1016/j.chb.2008.03.012

Pachler, N., & Daly, C. (2009). Narrative and learning with Web 2.0 technologies: towards a research agenda. *Journal of Computer Assisted Learning*, *25*(1), 6–18. doi:10.1111/j.1365-2729.2008.00303.x

Piaget, J. (1973). *To understand is to invent: The future of education*. New York: Grossman Publishers.

Pivec, M., & Dziabenko, O. (2004). Game-based learning in universities and lifelong learning: "UniGame: social skills and knowledge training" game concept. *Journal of Universal Computer Science*, *10*(1), 14–26.

Salaway, G., & Caruso, J. B. (2008). *The ECAR study of undergraduate students and information technology, 2008* (Research Study, vol. 8). Boulder, CO: EDUCAUSE Center for Applied Research. Retrieved May 19, 2009 from http://www.educause.edu/ecar

Salen, K., & Zimmerman, E. (2004). *Rules of play: Game design fundamentals*. Cambridge, MA: MIT Press.

Shaffer, D. W. (2004). When computer-supported collaboration means computer-supported competition: Professional mediation as a model for collaborative learning. *Journal of Interactive Learning Research*, *15*(2), 101–115.

Shaffer, D. W., Squire, K., Halverson, R., & Gee, J. P. (2005). *Video games and the future of learning* WCER Working Paper No. 2005-4. Retrieved May 17, 2009 from http://www.wcer.wisc.edu /publications/workingPapers/ Working_Paper_No_2005_4.pdf

Squire, K. (2008). Educating the fighter: Buttonmashing, seeing, being. In Davidson, A. (Ed.), *Beyond fun: Serious games and media*. Pittsburgh, PA: ETC Press.

Squire, K., & Giovanetto, L. (2008). The higher education of gaming. *E-Learning and Digital Media, 5*(1). Retrieved September 6, 2009 from http://www.wwwords.co.uk/ ELEA

Starr, P. (1994). Seductions of Sim policy as a simulation game. *The American Prospect, 5*(17). Retrieved May 10, 2010 from: http://www.prospect.org/ cs/articles?article= seductions_of_sim

Steinkuehler, C. (2004). Learning in massively multiplayer online games. In *Proceedings of the 6th International Conference on Learning Sciences* (pp. 521-528). June 22-26, Santa Monica, CA.

Tapscott, D. (2008). *Grown up digital: How the net generation is changing the world*. New York: McGraw Hill.

Teodoro, V. D. (2004). Playing newtonian games with Modellus. *Physics Education, IOP – Electronic Journals, 39*(5), 421-428.

VanDeventer, S., & White, J. (2002). Expert behavior in children's video game play. *Simulation & Gaming*, *33*(1), 28–48. doi:10.1177/1046878102033001002

Vygotsky, L. S., & Cole, M. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wenger, E., McDermott, R., & Snyder, W. M. (2002). *Cultivating communities of practice: A guide to managing knowledge*. Boston, MA: Harvard Business School Press.