Serious games:
online games for learning

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Serious games, expected to be a US$1.5 billion global market in 2008, are being described by some analysts as the next wave of technology-mediated learning. As organizations intensify their efforts to engage with members of today's workforce, serious games offer a powerful, effective approach to learning and skills development.

This paper looks at serious games and their potential as learning tools. It also asks and answers some of the initial questions that challenge decision-makers, designers, and developers alike:

• Do serious games really promote learning?

• Who uses serious games?

• What do learners think about serious games?

• What can we expect in the near future?

• How do we start a serious game initiative for our organization?

Three distinct groups of stakeholders will have immediate and direct involvement with serious game design and development:

• Game designers who are being asked to include instructional elements within game play and are looking for guidance on how to make those additions

• Learning designers who are interested in adding computer games and simulations to their learning designs

• Line of business decision-makers who are exploring ways to reach an increasingly wired, hyper-connected workforce already accustomed to anytime, anywhere access to ideas, information, and each other

21st century learning experiences need to reflect the lives of 21st century workers. While there is still skepticism that something called a game could be anything more than a leisure activity, serious organizations are getting serious results with serious games.

Adobe®

Online games

While computer games have been around for as long as there have been personal computers,[1] the recent success of websites featuring online games like Habbo Hotel,[2] Sims Online,[3] Second Life,[4] and World of Warcraft[5] seems to have awakened new interest in the power of games to engage. The popularity of these immersive experiences is due entirely to the convergence of virtual worlds, games, social networking, and rich Internet applications (RIAs).

Habbo Hotel *(www.habbo.com)* was developed using Adobe® Director,® and requires only Adobe Shockwave® Player on the client side.

There are a wider range of online games than many people think; they include casual games, serious games (the focus of this paper), and advergames.

1   In 1961, Steve Russell developed a game, Spacewar, to teach himself coding on MIT's first PDP-11.

2   www.habbo.com

3   www.ea.com/official/thesims/thesimsonline/us/nai/index.jsp

4   www.secondlife.com

5   www.worldofwarcraft.com

Casual games

Casual games are purely for entertainment. They may include everything from the solitaire game that is preloaded on every personal computer to downloadable games to hugely complex multiplayer games like Counter-Strike and Halo, and everything in between. Many people, though not all, limit the category to downloadable games, leaving boxed or online games in another category. Casual games are available in many platform formats: PC, game console, and mobile. While learning can and does occur within a casual game, it is a by-product, rather than an intentional outcome of game play.

Pogo *(www.pogo.com)* is a casual game portal owned by Electronic Arts.

Serious games

Serious games[6] are designed with the intention of improving some specific aspect of learning, and players come to serious games with that expectation. Serious games are used in emergency services training, in military training, in corporate education, in health care, and in many other sectors of society. They can also be found at every level of education, at all kinds of schools and universities around the world. Game genre, complexity, and platforms are as varied as those found in casual games. Play, an important contributor to human development, maturation, and learning, is a mandatory ingredient of serious games.

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6 *Serious games also have other names, including immersive learning simulations, digital game-based learning, gaming simulations, and "games you have to play," to name a few. While some distinctions may exist between these, I use "serious game" as the über-term for any kind of online game for learning.*

Drawing from both casual and serious games, advergames use public persuasion techniques to promote a product, brand, cause, or political candidate. Advergames are becoming a popular form of marketing for movie and TV show debuts.

Common game attributes

At a minimum, all online games, learning or otherwise, share a number of traits:

Backstory and story line—Every game has a backstory, or a story upon which it is based, and a story line that it follows, even if inferred. The story line is not the game play itself, but rather the rationale for the game play.

Game mechanics—These handle all the specific functions within a game, including such things as how the game's physical world behaves (for example, the amount of compression a ball has when it bounces, how fast a ball goes before and after it bounces, and so on); in-game weather; and the actions a character takes when given a command (for example, "attack" could mean rushing the opponent, then hitting the opponent with a sword, then kicking hard, then dodging to the right, and so on).

Rules—The corollary to game mechanics are the rules of the game—the constraints in game play that exist on every player's actions and abilities.

Immersive graphical environment—This is the sensory representation of the experience layer of the game, including 2D/3D graphics, sound, and animation. This environment can be static (it resets at the end of each player session) or persistent (it continues to evolve even when a player isn't logged in).

Interactivity—This focuses on the impact a player's actions have on the world and includes issues of persistence and player interaction.

Challenge/competition—This is at the heart of any game. The competition might be against the game, against one's self, or against other players.

Risks and consequences—These must attend every challenge, but they exist in the safe game environment where the consequences of an action or decision do not impact the real world.

Games can have a single player or multiple players; players might need to organize teams before or during play. Because of the "never off" nature of the Internet, multiplayer online games are as likely to have players across the globe in heated battle with each other in real time as they are to have coordinated teams comprised of players from many time zones and speaking different languages. E-mail and chat are used to facilitate the interactions, communications, and logistical coordination among players.
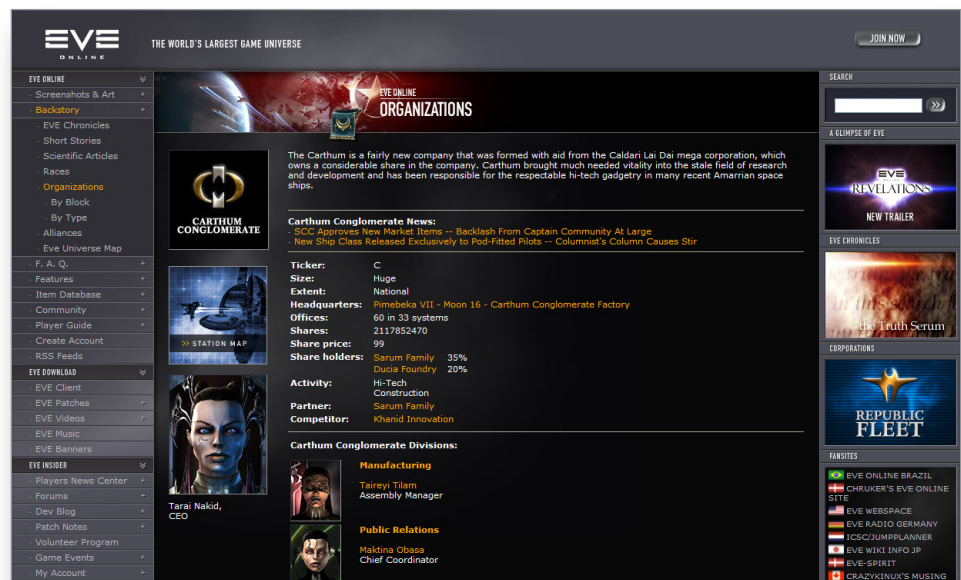
Serious games: where game design meets learning

What sets serious games apart from the rest is the focus on specific and intentional learning outcomes to achieve serious, measurable, sustained changes in performance and behavior. Learning design represents a new, complex area of design for the game world. Learning designers have unique opportunities to make a significant contribution to game design teams by organizing game play to focus on changing, in a predefined way, the beliefs, skills, and/or behaviors of those who play the game, while preserving the entertainment aspects of the game experience.

Do serious games really promote learning?

Games are a form of organized play. Games have a stated goal and rules of play to guide players to that goal. The goal can be fanciful or purposeful. According to Salen and Zimmerman,[7] a game that is well-designed yields "meaningful play," a condition very like learning. They define meaningful play as "what occurs when the relationships between actions and outcomes in a game are both discernable and integrated into the larger context of the game." When game design focuses on learning outcomes, then, while preserving playfulness, serious learning is possible.

There is a growing body of research on the effectiveness of online games as learning tools. Several reviews of the literature have been conducted in recent years. In her just-published review[8] of peer-reviewed material from the last ten years, Mary Jo Dondlinger concludes that "there is widespread consensus that games motivate players to spend time on task mastering the skills a game imparts…[A] number of distinct design elements, such as narrative context, rules, goals, rewards, multisensory cues, and interactivity, seem necessary to stimulate desired learning outcomes."

There are anecdotal data to look to as well. EVE Online,[9] for example, is a subscription-based casual game. Even though it is a casual game, real learning is taking place. Because its story line involves setting up corporations with the goal of dominating the market, EVE "has attracted chief executives, city traders, MBAs, and economists to learn hard financial lessons they can take into the real world," according to FT.com.[10] The recent article goes on to quote an Austin-based software CEO and former EVE player: "Once you have managed a virtual corporation that spans the universe, you can easily manage a real corporation that spans the earth."

At EVE Online *(www.eve-online.com),* players endeavor to control the largest, most powerful company in the universe.

7 Salen, K. and Zimmerman, E.. Rules of Play: Game Design Fundamentals. Cambridge, Mass., and London, England: The MIT Press, 2004.
8   Dondlinger, M.J.. "Educational Video Game Design: A Review of the Literature." J. of Applied Educational Technology 4(1): 21-31, 2007.
9 www.eve-online.com
10 Nittall, C., "Gamers Hone Hypercapitalist Skills Online," FT.com. May 6, 2007.
   www.ft.com/cms/s/0c3c18fe-fc03-11db-93a4-000b5df10621

Who uses serious games?

In 2008, according to futurist and serious game advocate Eliane Alhadeff,[11] US$1.5 billion will be spent on serious games worldwide. Other industry watchers put the billion-dollar target out as far as 2011. No matter which date is correct, recent market trends have been quite positive; PricewaterhouseCoopers[12] pegs the market in the United States for 2007 at approximately US$150 million, with the compound annual growth rates in the double digits for each of the last five years.

Interest in serious games can be found in a wide variety of settings. As recently reported in BusinessWeek:[13] "Companies around the world, including McKinsey & Company, Royal Philips Electronics, and Johnson & Johnson Pharmaceutical Research & Development, are bringing games with 3D computer graphics into the workplace[, and]…using games to recruit new talent, improve communication between managers and their far-flung staff, and train employees and new hires at all levels."

Military and emergency services

Military and emergency services organizations were very early adopters of serious games for training. In fact, the U.S. Department of Defense originally coined the term "serious game" as a more acceptable way to talk about "war games" with Congress and the public.

The value of serious games to this sector is readily apparent. The critical and hazardous nature of the work for which soldiers are trained requires a "virtually real" environment where mistakes are not catastrophic. The highly coordinated and cooperative nature of their work requires a learning environment that builds teams and prepares personnel for highly specific and highly coordinated missions. The U.S. Army is so convinced of the power and effect of serious games that it uses its massively multiplayer online game—one of the five most popular games online today—America's Army,[14] as a recruitment tool.

America's Army *(www.americasarmy.com)* has been successful as both a recruitment and a training tool for the U.S. Army, as well as being one of the most popular online entertainment games.

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11 http://elianealhadeff.blogspot.com/
12 www.pwc.com/extweb/industry.nsf/docid/E7376CAA22C376408525662700504BD4
13 www.businessweek.com/innovate/di_special/20070813thepowerof.htm
14 www.americasarmy.com

Higher education

For many of the same reasons as military organizations, higher education institutions use serious games in a variety of settings—for example to:

- Give psychology students a way to understand various states of mental illness

- Stage a play in the "original" Old Globe Theatre

- Teach hedge fund management

- Accelerate time for science experiments

- Teach Arabic language, culture, and customs

The Learning Lab at The Wharton School *(www.wharton.upenn.edu)* developed Tragedy of the Tuna, a game where students represent a tuna fishing fleet and balance decisions that impact their own group as well as a commonly shared resource.

Games in schools

Younger learners are also being exposed to serious games with great success. England's North West Learning Grid, for example, launched DiDA Delivered, a diploma program in IT skills for secondary students in the U.K. The curriculum includes 4,000 learning objects and 300 serious games. In order to stimulate motivation and engagement of individual students and class groups, the project team created a virtual learning environment that is:

• Learner-centric

• Highly individualized

• Aimed at encouraging exploration of a large body of content

In the wake of the positive response to DiDA Delivered the curriculum has more recently been launched in Australia, New Zealand, and Ascension Island. One of the reasons for DiDA Delivered's popularity is that it enables teachers to develop their own content to add to the learning environment. Using Adobe Flash® software, Diane (Lee) Nolan, DiDA's product manager, developed a series of templates that make content development quick and easy to author. Says Nolan, "serious games are seen as important, but teachers don't know what to do or how to get involved." DiDA Delivered gives teachers a new tool and the means to customize it for their own needs.
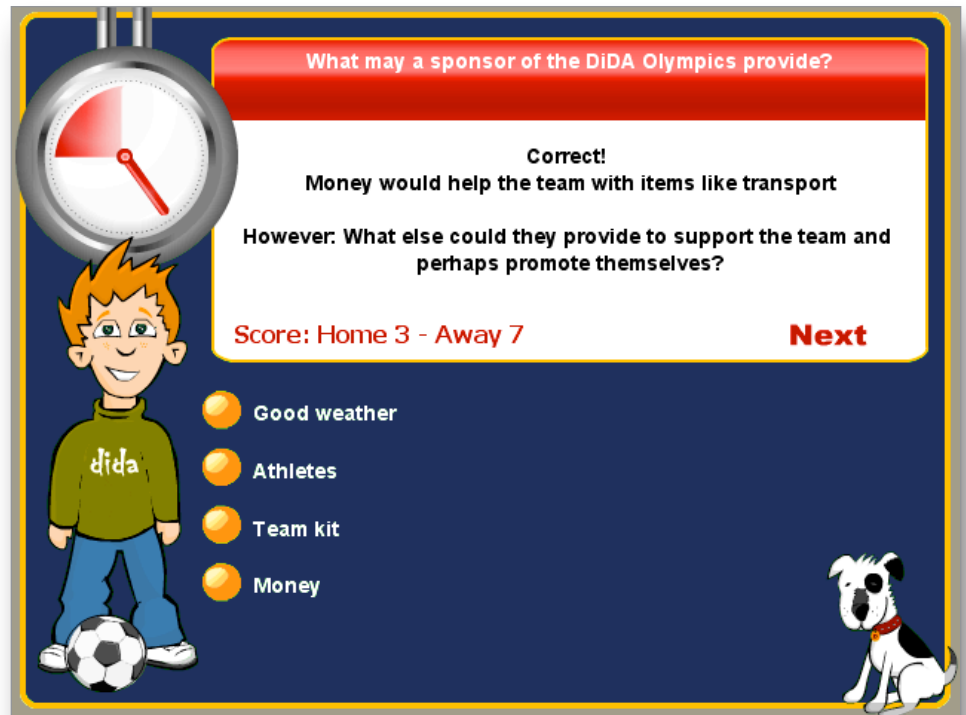
At last count, DiDA Delivered *(www.dida-delivered.org)* included at least 300 serious games, each of which was developed with Adobe Flash.

Forward-thinking companies interested in attracting and retaining younger workers are already integrating serious games into training, performance support, and company community programs. They recognize what Deborah Wince-Smith, president of the Council on Competitiveness, has observed: "Game players have to think strategically about their positioning and analyze opponent strengths and weaknesses. They have to figure out how to achieve goals and execute those plans. They have to manage resources, make lots of decisions, and respond to rapidly changing scenarios."

These characteristics might not immediately come to mind when considering the learning needs of an employee of a fast food restaurant. McDonald's believes otherwise. Today, much of the training of McDonald's in-store personnel is conducted via serious games, including customer service, store operations, and employee supervision.

McDonald's restaurants use serious games to train store personnel, in this case about customer service, thanks to 3Dsolve *(www.3dsolve.com)*, the developer of this program.

Game development skills

In the world of game development, employers are scrambling to find enough talented people to meet their needs and are looking to specialized academic programs for qualified candidates. Full Sail Real World Education, a fully accredited university in Florida, offers a 21-month dual-track Bachelor's degree program: One track covers all general education requirements, while the other track provides all the skills a graduate needs to get a job with a game development company. Full Sail has organized the game track around Adobe Director and Adobe Flash as well as supporting products from Adobe Creative Suite. Its students graduate with a portfolio they have authored in Director ("the premier authoring environment," says Full Sail instructor Steve van Zandt) containing a set of work products they have developed using Flash and Director—along with industry-standard skills that are sought after by employers.
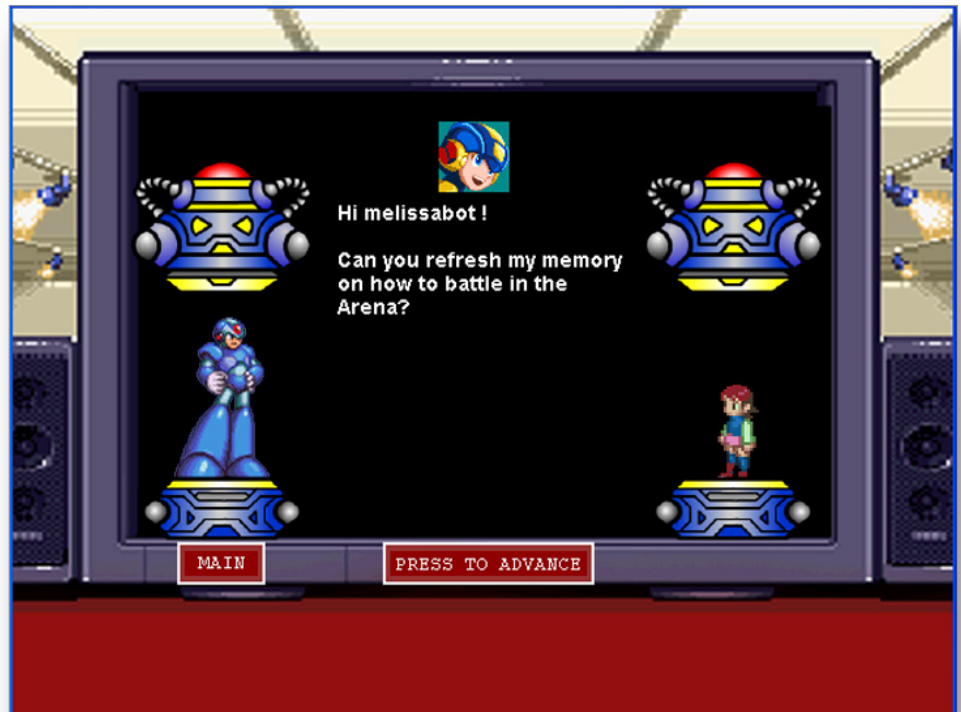
Tim Kindberg developed MegaTim, a game created in Director, while he was a student at Full Sail. His work, from concept to launch, took five weeks to complete after just four weeks of training in Adobe Director.

What is different about today's worker or learner?

According to the Federation of American Scientists "50% of all Americans and 75% of American heads of household play computer and video games….On average, kids aged 8-18 spend about 50 minutes per day playing video games. The average adult male spends 7.6 hours per week playing video games, and the average adult female spends 7.4 hours per week."[15]
Adds Don Thompson, assistant director, Education and Human Resources, National Science Foundation: "Perhaps the most fatal flaw in the education of young people is that we apprentice young people into 19th century science rather than letting them play 21st century scientist."[16]

The import of these data becomes clear when juxtaposed with the learning preferences[17] of digital natives, who prefer:

• Receiving information quickly from multiple multimedia sources

• Parallel processing and multitasking

• Processing pictures, sounds, and video before text

• Random access to hyperlinked multimedia information

• Interacting/networking simultaneously with many others

• Learning "just-in-time"

• Instant gratification and instant rewards

• Learning that is relevant, instantly useful, and fun

The stimuli these learners seek when learning bear a striking similarity to those stimuli present in online games. Since online games, then, provide a stimulating environment that fosters development of critical skills and characteristics, it seems self-evident that serious games provide a natural environment in which to learn the necessary skills for today's work.

What do learners think about serious games?

Learners are ready for designers to catch up to the ways they are already using technology for living and learning. Diane Nolan from the DiDA project admits, "pressure from the learners themselves" was a factor in deciding to incorporate serious games into its curriculum.

Charles Rejonis, director of the Learning Lab at the University of Pennsylvania's Wharton School, sees the value of serious games when he sees students animatedly interacting within and surrounding a simulation: "You can just tell the level of engagement between students in the lab." Alec Lamon, also director of the Learning Lab, believes the way serious games are woven through the curriculum gives Wharton and its students a competitive edge. The numerous awards they've received from Adobe and others give credence to the quality of their designs and the utility and effectiveness of serious games.

"OTIS changed my life!"
—Wharton graduate student (when asked to evaluate Wharton's Online Trading Investment Simulation, OTIS)

15 *"Summit on Educational Games: Harnessing the Power of Video Games for Learning."*
   Washington, D.C. Federation of American Scientist, 2006.
16 *Ibid*
17 *Ian Jukes and Anita Dosaj, The InfoSavvy Group, February 2003, as quoted*
   on www.apple.com/au/education/digitalkids/disconnect/landscape.html.

What can we expect in the near future?

Several emerging trends are likely to accelerate the climb of the serious game market toward mass adoption.

Learning designers are key

First and foremost will be the energy and perspective that learning designers bring to serious game development teams. Their understanding of learn*er* analysis and learn*ing* analysis will infuse already talented development teams with a much needed sensibility.

Learning management system 2.0+

Many corporations and other large institutions have implemented learning management systems (LMSs) as part of their overall enterprise management and record-keeping. LMSs are the interface between learner and content and, as such, act as content gatekeepers for learners. If content is not technically compatible and/or doesn't provide the LMS with the desired statistical input regarding learner activity and progress, institutions must wrestle with how, or even whether, to work around the problem. Since little serious game content satisfies the requirements of LMSs, there will be both a call to rethink the purpose and design of LMSs for the eLearning 2.0 world and beyond, as well as a push to examine the internal activities of a game as a way to monitor learner progress. There will be an equal and louder call for standards that will address these issues.

In part, the concern about LMS/serious game integration stems from the need to assess individuals on their learning and development and incremental progress. This presents two interesting dilemmas:

1. In the "learn by doing" world of serious games, learners are frequently called upon to "do" things that result in the generation of content. In fact, learner-generated content will be recognized as one of the principle design mechanisms for learners to demonstrate mastery of a game's learning objectives. What tools will learners use? What standards will apply? What new learning approaches may or may not result as a function of this technical capability?

2. As discussed earlier, group learning for building and honing team skills and intra-team coordination and effectiveness will be emphasized in serious games. But LMSs focus on individual performance and needs. How do we measure and track group progress? How do we set group goals, break them down into individual objectives, and then roll up in-game activity to support group outcomes and individual measurements? Or will a different form of assessment evolve?

No community? No dice!

As awareness about team learning infuses serious game design, in-game communications capabilities will be crucial. Not only will the typical chat and e-mail functions be the norm, but game blogs, team wikis, and other Web 2.0+ communications technologies will quickly find a home within serious games. These tools, of course, will need to respond to the needs of today's students and workers vis-à-vis device accessibility; recalling the multifaceted attentional needs of the MTV generation, learners will want equal access to serious games on their laptops, PDAs, and phones.

Beyond satisfying learners' affiliative needs, these communications capabilities can promote mentorship opportunities and facilitate access to subject matter experts.

New learning models

Even with the (for many) new focus on "the group," attention to the individual user experience will not diminish. In fact, current personalization techniques—customizable avatars being the most prominent—must be examined for their effectiveness or intrusion into the cohort learning experience. How, for example, does anonymity effect group cohesion during the learning experience? Does it impact in any way the transference of new skills from the game environment to the real world?

Learning designers have long sought to provide performance remediation or support at the optimal moment for learning. As serious games converge with virtual worlds for the enterprise, learning environments will become integrated into the actual work environment. This is likely to have considerable impact on learning designs, as learning designers will need to concern themselves as much, if not more, with organizing and structuring the learning experience as with parsing and presenting learning content.

Haptic computing

A number of technologies are on the horizon that will provide an even more immersive environment than is possible today. Haptic computing, which adds the sense of touch to the simulated or virtual environment, is already being used in medical training and other critical content domains. The recent launch of Nintendo's Wii platform has brought awareness of haptics to the consumer market, opening the door to new learning design and gaming innovations. Moving forward, pricing for haptics input devices will come down to terrestrial levels, enabling designers to use this technology for noncritical content. Most exciting about this technology is the promise of including learners who have been out of our reach previously; by activating the sense of touch, differently abled learners can participate in virtual environments in ways not previously available.

New business models and revenue streams

Several serious game developers have or will be offering commercial (as opposed to custom-designed) solutions to the marketplace. Since casual and advergame developers have a somewhat longer history of testing business strategies, serious game companies will be very attentive to lessons learned by their counterparts.

Currently, a number of casual game developers are addressing a particular annoyance among gamers: each game site has its own address with its own client-side player and its own, separate user login. Recently launched game portals attempt to overcome these problems. In addition, they offer a number of other advantages to the subscriber, such as content rating and referral, and social networking within a community of like-minded users.

Not surprisingly, the need for standards is underscored as the portal developers grapple with game-to-game portable user-generated content and other crossover issues. This issue will not be ignored, as users/gamers/learners grumble and demand seamless portability.

These same developers, whose revenue streams have relied on traditional subscription models heretofore, are currently testing a number of different approaches to more effectively monetize their product in line with new usage patterns. Serious game developers will be paying close attention to the successes and failures of these models as they determine how best to commercialize learning in new ways.

Perhaps the most controversial trend for serious games is the use of in-game advertising or sponsorship. This offers some promising opportunities for serious game developers in seeking new sources of funding and revenue. Will it negatively impact learning, or will it be a nonevent for learners?

Let the games begin

A number of factors contribute to the success of a serious games project from an operational perspective. The following recommendations will help you evaluate your enterprise's readiness for a serious game initiative:

1. Serious game design is a team sport. Your team might include members with some combination of these skills and more: C programming, JavaScript writing, art, instructional design, animation, story writing, and database programming. Few organizations find it easier or more efficient to "go it alone," so finding the right partner to provide the talents and expertise to round out your team is critical.

2. You will need both learning and game design expertise for your project.

3. Game designers and learning designers have each developed distinct workflows. To overcome differences, project teams will want to create:

   a. A plan of record for the project that documents all design and development decisions; this living document should be a resource to the entire team throughout the project

   b. A common project lexicon

   c. A process diagram and that will guide the project team in their work; game designers and learning designers must negotiate a process that reflects the needs of their respective disciplines

Serious games do not exist in a vacuum but are part of a course, curriculum, or larger learning experience. Learning designers must plan for easy and natural integration of a serious game into the overall learning design. Most especially, learning designs must include a plan for learning transference from the game back to the greater learning plan or to the workplace.

Software tools selected for creating serious games should accommodate the skills of both expert and less technical users. Learning designers are typically comfortable in an authoring environment like Adobe Director.

Tools developers themselves should have a deep understanding of game development that is reflected in their tools. Product suites, such as Adobe Creative Suite 3, that focus on streamlining workflow and easy integration of file types can greatly shorten development time.

Tool selection will be of great interest to your organization's IT department as well; some IT departments will shut down a project that uses technologies not already on the "approved" list. To mitigate against any such interruption or derailment, serious games projects are well-advised to select broadly adopted content creation and distribution tools, such as Adobe Flash (97% market penetration), Adobe Acrobat® (89% market penetration), and Adobe Director and Adobe Shockwave Player (56% market penetration and growing).

Conclusion

Serious games are a rapidly growing industry. Military, corporate, education, and health care organizations from around the world are enjoying the positive effects that serious game implementations have had on their organization's learning needs. Learning designers and game designers must collaborate fully for a game to provide the most engaging and effective learning experience. Incorporating aspects of social networking and other Web 2.0+ technologies into serious game design enhances learner-adoption by today's workforce. Developing and deploying a serious game using industry-standard tools, such as those offered by Adobe, will promote sweeping adoption by users.

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