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Computer games are usually associated with images of first-person shooters, grotesque monsters, awesome explosions and intense battle scenes. Children, teens, and adults spend many hours losing themselves in these exciting immersive environments. The virtual worlds come complete with 3D graphics, cinema-quality soundtracks, epic plots, and realistic characters. Ongoing technological advancements in computer animation, simulations, and artificial intelligence continue to improve the way game programs engage the player.

Even though computer games are a popular pastime, their value is often underestimated. Most people simply enjoy playing the games without analyzing them, while some consider gaming to be a complete waste of time. However, when computer games are examined from an educational point of view, research indicates that games do much more than develop eye-hand coordination. Actually, many academic benefits can be gained from playing games. Computer games are suitable for improving literacy skills, exploring history and social studies, and learning math and science concepts. Business and social skills are also practiced during the use of computer games. By focusing more effort on making educational games, the electronic game industry can play a positive role in helping people to succeed in school, work, and life.

Computer games are an excellent way to motivate students academically by making learning fun. I've been playing computer games since the age of five, so I know from personal experience that computer games can stimulate interest in learning about a subject. Dmitri Williams, assistant professor of speech communication at the University of Illinois, agrees: "When you strip away all the explosions, blood, magic coins,

princesses and castles, video games are problem-solving tasks – puzzles. There’s some irony in the fact that kids are bored at school but rush home to solve these games where they learn math and history” [Glazer, p. 939-940]. This shows that without students being aware of it, learning can take place in a less structured manner.

The 1990s were the Golden Age of edutainment software designed to be educational as well as entertaining. As a child, I played computer games like *Math Blaster*, *Number Maze*, and the *Jump Start* series. You can still find many of these classic learning games on store shelves. Today, however, educators look down upon such games because of their extrinsic reward structure (equivalent to collecting gold stars rather than self-motivation to learn), lack of integrated learning experience, and gameplay based on rote drill-and-practice in which there is “not really any connection between the arcade games and the math questions” [Egenfeldt-Nielsen, p. 2-3]. The sugar-coated children’s edutainment titles have been superseded by serious games and simulations used for education, training, and experiential learning.

Research over the past decade has demonstrated the value that computer games have as an instructional tool [Clark]. As mentioned in the *Journal of STEM Education* (Vol. 10 No. 1), some recognized benefits of games include skills such as:

- Problem solving
- Decision making
- Strategic planning
- Analytical thinking
- Creativity
- Self-direction
- Adaptation to change
- Rapid learning
- Interpersonal communication
- Team building

In 2006, The Federation of American Scientists declared that computer games can redefine education. The results of their study can be found in a 52-page report, which concludes: “People acquire new knowledge and complex skills from game play, suggesting gaming could help address one of the nation’s most pressing needs – strengthening our system of education and preparing workers for 21st century jobs”

[*Summit*, p. 3]. Computer games with educational content are well-suited for the more interactive learning style preferred by today's students.

Literacy isn't just about reading and writing anymore. Computer games can be classified as literacy activities. They come in genres just like books – science fiction, fantasy, mythology, history, etc. Many games have onscreen text to read, and players must often master a specialized game vocabulary. James Paul Gee, Ph.D., author of *What Video Games Have to Teach Us About Learning and Literacy*, states: “Research suggests that people really know what words mean only when they can hook them to the sorts of actions, images, or dialogues to which they apply” [Glazer, p. 953]. Simply put, words are more meaningful when accompanied by pictures and sound. Moreover, game players are independently motivated to utilize information literacy techniques when they perform research by consulting manuals or seeking game-related information from other gamers and websites.

Computer games not only promote literacy and interactivity, but also encourage exploration and creative thinking. Looking at the world in a variety of ways can be an advantage in learning about history and developing social studies skills. For example, in the games *Civilization* and *Age of Empires*, players see how history unfolds from 4,000 B.C. to the present. They actively take part in building cities, trading items, gathering natural resources, and waging war. Children come across words like “monarchy” and “monotheism,” and they learn what can cause a civilization to survive or fail. When my brothers and I were playing *Return to Castle Wolfenstein*, we started reading World War II history books and learning about Nazis, the Gestapo, military uniforms and weapons. Consequently, what would ordinarily be considered a non-educational computer game turned into an impromptu unit study on World War II.

Perhaps not surprisingly, the biggest computer game success stories involve math and science. Computer games not only motivate kids to learn about these subjects, but also teach basic methods of inquiry such as forming hypotheses and testing models in a simulated environment. Will Wright, creator of *The Sims*, *SimCity*, and more than a dozen other games, explains “it’s the essence of the scientific method. Through trial and error, players build a model of the underlying game based on empirical evidence collected through play. As the players refine this model, they begin to master the game world” [Wright, p. 111]. This type of thinking is required for many games such as *Logical Journey of the Zoombinis*, which teaches advanced math concepts. Likewise, *Garry’s Mod* is a physics sandbox that allows players to design, build, and experiment. Additionally, a game called *CellCraft* turns cellular biology into a real-time strategy game.

Game-based learning actually has an advantage over traditional textbooks and lectures in that it allows for simultaneous teaching and assessment, while also evaluating the user’s knowledge over time [Caron]. But is there any scientific evidence to prove that computer games really do help students learn? Over the past ten years, researchers at the University of Rochester have been studying different ways to get people to learn better and faster. Based on some results released in September 2010, Dr. Daphne Bavelier, Professor of Brain and Cognitive Sciences, stated: “People who play these action games make informed, better decisions than those who don’t. These games keep you on your toes, provide you with a lot of different tasks, while making you maintain long and short term goals” [Perna]. Most importantly, the benefits gained from playing computer games can be successfully adapted to education.

Subject areas in which specific content can be targeted and objectives clearly defined are more likely to show the beneficial results of gaming. At the same time, the

physically realistic and immersive virtual worlds of computer games can complement any educational setting. Kurt D. Squire, an assistant professor of educational communications and technology at the University of Wisconsin-Madison, says: “In the 1990s, educators invested millions of [National Science Foundation] money seeking to build these kinds of environments—now we have them ‘for free’ and with a much higher level of fidelity” [Ash, p. 8]. The best part is that educators don’t have to develop their own game engines.

Game companies have already built in the best learning features. These include:

- Customizable skill levels.
- Levels start out easy and gradually get more challenging.
- Continual progress monitoring and feedback.
- Appeals to multiple learning styles (visual, auditory, kinesthetic).
- Active participation.
- Non-threatening environment.
- Sense of achievement.
- Real-world relevance.
- Lots of practice.

Educators have a choice of either staying with the status quo of boring lectures, textbooks and worksheets, or updating the curriculum in a way that excites students to learn through computer games. The games wouldn’t be a substitute for teachers or textbooks, but would be an effective learning supplement.

Some people question the feasibility of computer games in a classroom setting, but integrating computer games into the curriculum is both workable and practical. According to the Entertainment Software Association, many schools across the country are already using the popular *Dance Dance Revolution* and *Wii Fit* games as a regular part of their physical education programs [“Video Games”]. The same can be accomplished with academics. Marjee Chmiel, director of digital media for The JASON Project’s award winning online science curriculum, thinks it’s worth it: “As we are starting to really gather a rich library of games, the most exciting thing for me has been to

work with and talk to teachers using these games in schools.... Kids get excited and talk about the content of what they are learning to other students, teachers, and parents.... They went home and tried to find more information... That is precisely what I think we all imagine when we talk about developing the habits of a life-long learner....I've never seen a textbook motivate students to do that" [Alhadeff]. In this way, computer games can be a valuable learning resource.

A large but often overlooked population that would be well-suited to game-based learning is the homeschool community. Homeschoolers are open to trying innovative educational options. Computer games are ideally suited to self-study, expanding learning opportunities by allowing students to explore different areas of interest and manage their own progress. Marjee Chmiel adds: "The other piece that has been promising is the extent to which games allow themselves to be areas where students with certain learning disabilities can really thrive. Some students need their own private, little universe to learn, explore, make mistakes, or try new things. When you've got a variety of visual and audio cues helping you learn something, the content is just that much more accessible and students are imbued with this new confidence. We saw some really wonderful instances of this during our pilot testing" [Alhadeff]. Thus, another positive benefit of computer games is that they encourage self-education while building self-confidence.

So far the research shows that computer games aren't a childish waste of time. But some people still object that these games are too addictive and contain bad influences. It should be pointed out that the computer gamers of today aren't the socially isolated computer nerds of yesterday. Contrary to the stereotype, playing computer games can be a social activity in and of itself. Kurt D. Squire observed that "kids are putting together their own teams and are responsible for managing their own learning. This type

of disposition is what I and many others believe is the real ‘walk-away’ for education: an orientation toward learning that is proactive” [Ash, p. 8]. Too much of anything isn’t healthy, but when used wisely and in moderation, combined with reading and other activities, computer games contribute to a well-balanced person. To combat bad influences, it’s important for teachers and parents to set time limits and guidelines for choosing appropriate games, which underscores the need for a combination of self-directed and mentored education.

There are additional advantages to computer games besides learning school subjects. Computer games help develop workplace skills while allowing players to think, talk, and act in roles otherwise inaccessible to them. They are challenged to step into different identities that prepare them for future careers and leadership. The well-known *SimCity* has been used to train urban planners. *America’s Army* is a game that teaches military skills in simulated combat scenarios. Computer games can even help develop social skills. For example, *Tactical Language Trainer* uses simulations to teach foreign language and communication in a cultural context – this includes nonverbal gestures and eye contact – which affect how the simulated characters respond to the learner. Meanwhile, social barriers are breaking down as online games enable players to interact with people of different ages, ethnic groups, social backgrounds, and cultures around the world.

The 2006 study by the Federation of American Scientists states that while the audience is obviously there, the gaming industry has been reluctant to pour dollars into research and development because educational titles don’t make much money. Fast-forward five years, and one can see that the prognosis is changing. In February 2011, *The Horizon Report* predicted that game-based learning would become a reality by 2014 [“Two to Three Years”]. On April 27, 2011, the Bill & Melinda Gates Foundation

legitimized the role of computer games in education by pledging \$20 million to support the development of cutting-edge game-based learning tools [Cook]. The concept of game-based learning has already made considerable progress since James Gee first began to describe the impact of game play on cognitive development in 2003 [Gee]. Many educational computer games are currently available to purchase, freely download, or play online.*

The electronic game industry needs to look seriously at the enormous potential for games in education. Computer games help students think critically, learn cause and effect, process visual information, and develop their sense of spatial orientation. Not only do computer games have educational value, but they also teach skills that employers seek such as analytical thinking, team building, multitasking, and problem solving. Students of all ages can benefit from playing computer games. Far-sighted game developers will take advantage of this timely opportunity to collaborate with educators. Computer games open up a whole new dimension for learning, and show great promise as a key element in the 21st-century educational philosophy.

*Accompanying this written report is a companion website describing many educational computer games that are currently available. See: <http://games.xboltz.net>

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