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Gaming towards academic and physical success

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Abstract

This review addresses the potential of serious video games and the benefits that serious video games can have on a student academically as well as physically. Serious video games require strategic thinking, problem solving, planning and decision making. Serious video games enable learners to experience ~eal world situations without the real-life consequences. Exergaming provides potential for combining gaming and exercise, this type of video game has tremendous upside. This review of research.investigates how video games can be used to engage learners and help students learn. Research is needed to determine which features of games and simulation~ are important for learning and how best to design these games.

GAMING TOWARDS ACADEMIC AND PHYSICAL SUCCESS

A Graduate Review

Submitted to the

Division of Instructional Technology

Department of Curriculum and Instruction

In Partial Fulfillment

Of the Requirements for the Degree

Master of Arts

UNIVERSITY OF NORTHERN IOWA

by

Eric Burt

August, 2008

This Review by: Eric Burt

Titled: Gaming Towards Academic and Physical Success

has been approved as meeting the research requirement for the

Degree of Master of Arts.

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ABSTRACT

This review addresses the potential of serious video games and the benefits that serious video games can have on a student academically as well as physically. Serious video games require strategic thinking, problem solving, planning and decision making. Serious video games enable learners to experience real world situations without the real-life consequences. Exergaming provides potential for combining gaming and exercise, this type of video game has tremendous upside. This review of research investigates how video games can be used to engage learners and help students learn. Research is needed to determine which features of games and simulations are important for learning and how best to design these games.

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INTRODUCTION

The dismissal bell rings and kids hurry off to their homes. Doors slam, gaming consoles are powered on and new worlds are explored; this is not the exception, this is the norm. In the annual video game report card, Walsh, Gentile, Walsh and Bennett (2006) stated that children, ages 8 to 18, spend more time (44.5 hours per week) in front of computer, television, and game screens than they spend on any other activity in their lives except sleeping. Engagement in video games is often viewed as a negative but what if that same amount of screen time was used to learn? How can educators use the power of serious video gaming to help children learn? More importantly how can this information be used to convince educators of the benefits of serious video gaming?

What is serious video gaming? Serious video gaming usually refers to games used for training, simulation, or education that are designed to run computers or video game consoles. According to Corti (2006) serious video gaming "…is all about leveraging the power of computer games to captivate and engage end-users for a specific purpose, such as to develop new knowledge and skills" (p. 1). Prensky (2006) states that the serious (video) game initiative was in place long before the term serious game was being used. This initiative was started, "…to increase the use of simulation and gaming in public policy debates" (p. 13). Susi, Johannesson, and Backlund (2007) define serious video gaming as a game that is used for something other than entertainment. During this paper the reviewer will be using the terms serious games, serious video games, and video games synonymously.

There are several well-designed serious video games that capture students' attention while teaching content such as *Hungry Red Planet* (www.hungryredplanet.com), *FreeDive* (www.breakawaygames.com), and *S.M.A.R.T BrainGames* (www.braingames.com). The

Federation of American Scientists (FAS) (2006) hosted a summit on educational games and produced a report entitled *Harnessing the Power of Video Games for Learning*. The FAS found that when serious video games are interactive they can lead to deeper learning with a highly engaging learning experience. The FAS (2006) went on to say that serious video games contain many of the same characteristics that are required for quality learning such as: (a) clearly stated goals, (b) repetition until mastery, (c) player's progress is monitored and adjusted for the individual player, and (d) scaffolding and motivation are used to stay on task.

Serious video games are being used daily in classrooms. *Immune Attack* and *Multi Casualty Incident Responder* (www.fas.org) are serious video games created by the Federation of American Scientists (2006). *Immune Attack* is a three-dimensional game that provides scientifically accurate simulations of the immune system, with imagery designed by medical illustrators. The game features conferencing and auto-tutoring technology meant to personalize the gaming and learning experience with content-rich sessions. It also contains a built-in assessment feature, through which users must answer questions to move on to the next level. Players navigate a nanobot, a very small robot which is the size of a cell, through 3-D blood vessels and connective tissue in an attempt to save an ailing patient by retraining her non-functional immune cells. *MCI (Multi Casualty Incident) Responder* is a video game that is designed to help fire service personnel shorten the time of critical decision-making.

The United States Department of Health and Human Services (2007) wrote that Americans should accumulate at least 30 minutes (adults) or 60 minutes (children) of moderate physical activity per day for most days of the week. More may be needed to prevent weight gain, to lose weight, or to maintain weight loss. In their report on video games, Walsh et al. (2006) suggested that the lack of physical activity that comes with all of

those stationary hours in front of the screen is a large contributor to the obesity problem. In fact, children who use a lot of media have a lower activity level that is linked to a higher rate of obesity. What is disturbing is the amount of time children are spending in front of the screen. The Kaiser Family Foundation (2005) also noted that the link between obesity and media use has become increasingly clear with each new study. Children, ages 8 to 18, spend more time (44.5 hours per week) in front of computer, television, and game screens than they spend on any other activity in their lives except sleeping.

This literature review is important because it is intended to build a foundation in using video games to engage students in learning and ultimately involve them in computer-directed activities that can fight obesity. This review will search for answers for the following three research questions:

1. Can educators use video games to engage learners and help students learn?

2. Can video games help to fight obesity?

3. Can serious video games be designed to train students to enter the global workforce?

METHODOLOGY

The resources used for this literature review on serious video games were plentiful.

Sources for identifying and locating sources through online databases included: The

University of Northern Iowa Panther Prowler, WilsonWeb Education Full Text, EBSCOhost

databases, Google Scholar, and ERIC. The University of Northern Iowa Rod Library staff

was helpful in locating scanned copies of articles via interlibrary loan. The descriptors/

keywords used in the research of this topic included: Serious Games, Video Games,

Simulations, Physical Education, Education, Critical Thinking, Internet, and Teaching

Methods.

The resources were analyzed based upon relevance to the subject of using video

games in the classroom. This included a review of each article's abstract, introduction, and

conclusions before tagging an article for further evaluation. Each article was read for

constructing general ideas and concepts. Resource selection criteria included preference for

articles written for peer-reviewed journals and investigation of author and purpose of writing

the article. Non peer-reviewed journal articles and websites were reviewed to generate search

terms and possible topics related to research questions. Internet searches were also completed

to investigate definitions for terms, concepts, and further descriptions of programs discussed.

ANALYSIS AND DISCUSSION

Serious Video Games

To Do or To Know

Is it better for a student to compile information or apply knowledge? Are students prepared for life if they can recite facts about a subject or is it more important for them to be able to apply this information? Shaffer (2006) describes John Dewey's beliefs on learning and how they are applicable to video games, "The process of moving from interest to understanding is learning by doing – or, to be more precise, learning by trying to do something, making mistakes, and then figuring out how to fix them" (p. 124). Serious video games enable students to learn to apply knowledge through games such as *SimCity*, *America's Army* and *CivIII*.

How can educators use serious video games as a teaching tool? Whelchel (2007) describes various "… methods by which history games can be used to not only teach historical concepts but also instruct students how to critically evaluate and deconstruct historical representations found in popular culture" (20th para.). Whelchel explains that games such as *CivIII* require players to manage resources, research new technologies, build and maintain cities, establish relationships with others in the gaming world, choose governments, create and maintain armed forces, and recognize the importance of geographical features in the development of their society. The goal of *CivIII* is to achieve world domination, either through force, diplomacy, or the cultural and material wealth of your society. Prensky (2006) writes that clever game designers such as Sid Meier (*CivIII*), "…build learning into their games explicitly, through artificial intelligence and feedback" (p. 184).

Whelchel (2007) found that instructors must use the resources available; both the technology and the time. To use technology and time together most effectively he suggests the following projects to incorporate historical video games:

1. Hands-on History

Overview: This project centers on using these games as primary tools in teaching historical concepts. Students will use the games to learn about the importance of geography in historical development, technological diffusion, the impact of trade, economics, and resource availability and expenditure, the contingent nature of historical development, the complex interplay between various political, economic, and military systems, and the relationship between choices made during play and their ultimate outcomes.

2. Pet Civilization

Overview: This approach involves students assuming the role of one of the civilizations in the game and comparing their civilization against the actual historical development of the polity in question. This project employs a two-pronged methodology. First, the students will be asked to compare the attributes of their chosen group to their actual historical traits. They will also be asked to compare the historical progression of their group with their own progression in the game world. The first section teaches the students to detect potential biases and inaccuracies, while the second encourages them to recognize the contingent nature of history and show that if different choices were made in the past, they could have had a significant impact on the way history progressed.

3. Deconstruction Fun

Overview: The last project involves students focusing on the deconstruction of

civilization builders as artifacts from their own culture. As such, it is more

appropriate for higher level students such as history undergraduates, although as an

optional project it may make a good choice for World Civilization courses as well. By

the end of the project, students should be able to recognize that media is informed by

cultural constructions and biases and they should be careful to accept what they see in

such products as the truth. (p. 7)

Serious video games can immerse students into virtual worlds where they can make

real-world-type decisions without real-world consequences. Susi et al. (2007) describe

America's Army (www.americasarmy.com) which is a very successful game. *America's*

Army was launched in 2002 and has been downloaded over 17 million times. *America's*

Army has a community of 4 million registered players. Prensky (2006) describes *America's*

Army as a learning tool designed to teach kids about Army life. The United States Army has

invested 16 million dollars in *America's Army* and the game has been a recruiting success.

America's Army has helped the Army to recruit soldiers at 15% of the cost of other recruiting

programs (Michael & Chen, 2006). This serious video game allows players to participate in

simulated real-world battle scenarios in real time with other players. These scenarios can be

learned through the repetition of playing the game. The battle scenarios challenge the learner

and will encourage the player to try again after learning from their failure. The soldier (or

player) can try various solutions to the battle scenario and learn that there is more than one

correct solution. Grossman (2005) lists, "Another benefit (for the Army) of this particular

game is that its target audience has found it to be a major source of information and

knowledge about the Army; it is reported that 30% of Americans between the ages 16 to 24

claim to have learned some of what they know about the Army from this game" (p. 1).

DeMaria (2007) describes how context is used and how it relates to video games and

motivation, "Context is often used in video games to provide motivation and, in some cases

justification. If the character you play is motivated entirely by selfishness and greed, you will

most likely play a game from that perspective" (p. 96). This context is where the meaning of

the action changes. Context is used by designers as a tool to provide a player the motivation

and deepen the player's involvement. DeMaria described how each choice a player makes in

a video game could determine the story that the character lives. These choices, options that

the designers create, will determine what the player will take or learn from the game. This

provides endless possibilities and allows video games to involve players in almost any kind

of situation or activity.

Multiplayer Learning

America's Army is a multiplayer game that allows players to learn from one another

within the game itself. Being a multiplayer game, *America's Army* also encourages

collaboration, problem solving, and social interaction (FAS, 2006). Serious video games such

as this one facilitate learning from the game and from other players. Gee (2007) writes about

this collaboration,

> But video-game players can be part of a powerful network, if they so desire and know
>
> how. Their own ineptness need not stop them. There is knowledge they can use, if
>
> they know how to leverage it, stored in other people and in various tools and
>
> technologies. (p. 200)

This type of collaboration is very similar to learning from a group science experiment. The class will form into groups and work collaboratively through a project while using their problem solving skills.

The game *World of Warcraft* allows players to interact with a wide variety of unique characters while playing the game from many different and distinct viewpoints. Gee (2005) describes the benefits of video games,

> In multiplayer games like *World of Warcraft,* players form teams in which each
> player contributes a different set of skills. Each player must master a specialty, since a
> Mage plays differently than a Warrior, but the players must understand each other's
> specializations well enough to coordinate with one another. Thus, the knowledge
> needed to play the games is distributed among a set of real people and their smart
> tools, much as in a modern science lab or high-tech workplace. (p. 3)

Gee also describes how games such as *World of Warcraft* nurture higher-order thinking skills. Real-world skills such as how a player's actions might affect his/her future actions and the actions of his/her opponents.

Social Aspects

Video games are social by nature. One of the earliest games ever created was *Pong*. *Pong* was a video game based on the sport, ping pong. Although this was not the first video game, it was the first video game to capture the attention of the United States. *Pong* was also the first gaming console to gain popularity in the home. Pong was a simple game that required the player to hit a ball across the screen, trying to make the opponent miss. Both the arcade and home version were two player games. Online gaming has changed the way kids play games. There is no need to gather at an individual's house to play a game now. A player

can sit in the comfort of her/his own home while playing a game with others from all over the world, literally. Shaffer (2006) felt that online video games bring people together, enabling them to chat and socialize while playing a game or become friends in real life. Game discussions can encourage sportsmanship and give players a voice to share their opinions and ideas.

Educators and parents are often misinformed when they state that video games hinder social interaction. When properly used, the opposite can be said. A serious video game can stimulate students to share and support each other. This double loop learning is very powerful. Palloff and Pratt (1999) described double loop learning as, "The learning process, then, involves self-reflection on the knowledge acquired about the course, about how learning occurs electronically, about how the technology itself, and about how the user has been transformed by their new-found relationships with the machine, the software, the learning process, and the other participants" (p. 62). Students learn the content of the game while learning cooperation and social interaction skills.

Online Gaming

Because *America's Army* is an online game it can reduce biases from others toward a player's race, gender and physical ability. Players cannot physically see who they are playing with or against. Palloff and Pratt (1999) addressed the issue of culture and gender discrimination in their text, "Connections are made through the sharing of ideas and thoughts. How people look or what their cultural, ethnic, or social background is become irrelevant factors in this medium, which has been referred to as the great equalizer" (p. 15). In the game, *World of Warcraft,* players have the ability to play as one of eight different races with unique racial traits, nine playable classes and thirteen professions to fit the

player's style. To succeed in *World of Warcraft* a player must learn about the different classes of characters while thinking about how these differences will help the player accomplish his/her goals. Each choice in the player creation process has consequences. A player may also create multiple characters.

Access

To make serious video gaming even more appealing, the user does not have to wait for training; the simulation is student-centered and can be played at any time and anywhere. A web-based game may be played if there is a connection to the web. This connection is a given throughout the world today through wireless technology. Students are connected to the web through their cell phones, PDAs, laptops and desktops. This allows a student to play or learn from his/her cell phone while waiting in the dentist's office or lying in bed. Prensky (2006) states that the U.S. does not appreciate the potential of cell phones the way the rest of the world does: "…and in some groups – such as students in parts of Japan, Korea, Europe, and the Philippines – cell phone penetration is over 100 percent, which means that individuals own and use two or more of these devices" (p. 129). Cell phone prices are dropping and their mobility is a powerful tool for users. The school day does not apply to serious video gaming. Prensky (2006) describes how cell phone owners can download mp3 podcasts and listen to class lectures or other educational audio files. Another use would be for educators to use the text messaging feature to give pop quizzes or poll students.

Engagement

Video games can engage students in learning. Rosas (2003) writes, ''Computer games offer teachers enormous resources they can use to make their subject matter come alive for their students, motivating learning, offering rich and compelling problems,

modeling the scientific process and the engineering context and enabling more sophisticated assessment mechanisms'' (p. 74). Why would schools incorporate serious video games? If an instructor asks a student if he/she wants to learn about WWII through lecture or book they may arouse some interest. If that same instructor asks students if they would like to play a game to learn about WWII there will be more genuine excitement. The more complex a video game is the more engaging it is to the student. Prensky (2005) describes the benefits of complex games over mini-games,

> Unlike mini-games, complex games are not trivial, and are not limited to one small topic or skill. Complex games are deep – the time kids spend playing a complex game (on average about 40 hours) is the same as they spend in class in an entire course in school. Complex games have the potential to teach, and teach well. They are big enough to include and teach entire bodies of material, and even entire courses. (p. 11)

If students are engaged playing a complex video game, they will replay the game several times, learning different ways to complete a task. Gee (2007) wrote,

> ...learners are not always overtly aware of the fact that they are 'learning,' how much they are learning, or how difficult it is. Learners are embedded in a domain where, even when they are learning, they are still in the domain, still a member of the team, still actually playing the game, even if only as a newbie. (p. 124)

Because these learners are engaged, they will spend more time playing the game and they will learn the material faster. Gee (2007) offers that students are comfortable with video games; if educators can motivate students to learn through video games, the student will come away feeling better about the learning experience.

Video games are not motivating for every student. In a 2005 study involving middle school geography students, Squire (2005) found that students were not immediately motivated. He wrote that students often asked, "What is the purpose of this" (p. 2). Squire stated that 25% of students in the study said that the game was too hard and complicated. Another 25% of the students loved playing the game and described it as a perfect way to learn history. Although Squire does not think that video games are the magic cure for education he does believe that,

> As schools go online, we have tremendous opportunities for rethinking the culture of our classrooms. E-learning educators are wise to look toward games as models of next-generation learning environments. They long have been best models of engaging activity and, more recently, excellent examples of learning environments. (p. 8)

Playing video games does not appeal to all students and different reactions and responses from students should be anticipated by educators.

Video game engagement has also been found to benefit students with Attention-Deficit/Hyperactivity Disorder (ADHD). Houghton, Milner, West, Douglas, Lawrence, Whiting, Tannock, and Durkin, (2004) studied the effects of *Crash Bandicoot I* on 49 unmedicated boys clinically diagnosed with ADHD and 49 non-ADHD boys. Their study found that,

> Academically, computer games offer teachers, clinicians and parents increased opportunities to assist children with ADHD to maximize their learning potential. Allowing these children to successfully deploy executive functions might increase concentration, reduce unwanted hyperactive-impulse and inattentive behaviors, and hence increase the quantity and quality of academic work produced. (p. 32)

The performances of these students show that video games can be powerful learning tools.

Assessment of Student Engagement

Observation and interviews are tools that can also be used to determine students' engagement. Kadakia (2005) conducted action research using seventh grade language arts students that focused on how student engagement is affected by a curriculum that incorporates popular culture. Kadakia decided to engage students by using video games in the curriculum. A seventh grade student stated, "I thought that using the video game in class was a great idea. It was interesting and I paid attention. It is much more interesting than listening to you tell us stuff and reading stuff" (p. 29). The game *Morrowind* was used to introduce choices and consequences in a language arts classroom. *Morrowind* is a role-playing game where each player creates a fantasy character and explores an open-ended world.

> Each day, many students entered class asking if we were going to use the game again. Almost every student moved up closer to the screen. Two white male students in particular got the prime seats every day, which was different from their usual hang in the back attitude. (p. 31)

Morrowind successfully brought up moral issues and raised the engagement level in the study. The instructor observed more students, as well as a greater variety of students, volunteering. The instructor also observed body language that implied that the students were actively paying attention (Kadakia, 2005).

Problem Solving

Players learn from their decisions while playing serious video games. They have control in their own learning. Serious video games require players to strategize, problem

solve, plan and execute, and adapt to rapid change. These are the same skills they will need in the workplace. In the game, *Zoo Tycoon,* players own and run a zoo. Players may play in first-person mode, just like a guest at a zoo, or they can care for the animals playing in zookeeper mode. Players can build exhibits, buy animals, and deal with the visitors. The player learns about the habitats of the animals while solving complex problems. In the newest version of the game, *Zoo Tycoon 2: Extinct Animals*, players are able to lead a paleontology dig to search for fossils, assemble the finds and then take them to the research lab to bring the animals to life. Players will then populate the zoo while researching and curing diseases that may harm the animals. Shaffer (2006) describes the benefits of serious video games in general, "Games like these are fun, but their value is in letting children live in worlds that they are curious about, or afraid of, or want desperately to be able to try out" (p. 24). Serious video games like *Zoo Tycoon 2: Extinct Animals* force the student to solve complex problems using real-life decision making skills without the real-life consequences.

Issues

There are many roadblocks that have been created to discourage serious video game use in the classroom as a learning media. DeMaria (2007) wrote,

At best, the term video game inspires thoughts of triviality and childish obsessions. At worst, video games are attacked in politics and billed in the media as violent, antisocial, corrupting, and dangerous to our youth. Public discourse dwells almost exclusively on the negative, misbehaving side. (p. 1)

Video games have been portrayed negatively for years in the media. Games such as *Grand Theft Auto, Mortal Kombat,* and *Resident Evil* have been criticized by the media as being too

violent. The media has manipulated this issue for years. Gee (2005) argues against this stereotype,

> Violent crime in the U.S. has gone down dramatically during the same period that game playing has dramatically increased. More importantly, the overwhelming majority of normal kids who see some violent movies and play some violent games, but receive the usual, societal counter messages, do not and will not act violently in public or private. (p. 21)

Collier, Liddell, and Liddell (2008) write that the demographics of video game players is changing, "...there are more adults between the ages of 18 and 49 playing video games than adolescents" (p. 1). They indicate that the increased popularity of video games in this demographic has motivated video game makers toward creating more mature games that involve extensive violence, nudity and drug use. "A Federal Trade Commission (2004) study found that 69% of 13- and 16-year-olds who were unaccompanied by a parent were allowed to purchase a mature game intended for people ages 17 and older" (p. 1). All of this attention has prompted the creation of the Entertainment Software Rating Board or ESRB. This organization creates and enforces ratings that determine a game's content and suitability. This rating is displayed on the software boxes for the consumer and the retailer.

Another issue posed by the media is video game addiction. DeMaria (2007) addressed this issue,

> Many game players are probably paying a price for their game-playing experience. They are certainly losing out on opportunities to do something other than play a game. Likewise, people all over the world are paying a price for watching television instead of reading a great novel or spending time volunteering at the local hospital.

Even reading a great novel involves a loss of other options. Life is always about

trade-offs, and playing a video game is another choice people make. (p. 29)

A video game habit is a symptom of other problems that must be addressed by the individual

with the problem. People can be addicted to many different things such as cigarettes and

alcohol or even something as innocent as the game of golf. Orzack (1999) describes some of

the individuals that she was treating for video game addiction,

They are so bright that they are bored with school and what is presented, or they are

disturbed with something that is going on in their lives. They are so bright that they

neglect homework because it's not worth it. (p. 23)

Video game players may isolate themselves from their family by playing video games.

Parents that focus on the video game as the problem instead of as a symptom to the problem

will do nothing to find the real challenge (DeMaria, 2007).

Many educators, administrators and parents view serious video games as a form of

entertainment. Rosas (2003) states,

However, the incorporation of games through computer technology still creates

resistance. This resistance is based on (1) teachers' perceptions of games as merely

entertaining and not as useful instructional tools, (2) teachers' lack of knowledge and

skills with respect to computer assisted instruction, and (3) insufficient developments

of effective educational hardware and software. (p. 72)

When used correctly, video games can enhance the learning of students.

In a research report on the benefits of females playing action video games Feng

(2007) reports,

Superior spatial ability is related to employment in engineering and science, and

females, who typically score lower than males on tests of spatial skills, are

underrepresented in these fields, with worldwide participation rates as low as one in

five. Given that our first experiment and others have shown that particular cognitive

capacities are associated with educational and career choices, training with

appropriately designed action video games could play a significant role as a part of a

larger strategy designed to interest women in science and engineering careers. Non-

video-game players in our study realized large gains after only 10 hours of training;

we can only imagine the benefits that might be realized after weeks, months, or even

years of action-video-gaming experience. (p. 854)

This research report provides data supporting the benefits of serious video gaming, and also

provides data that shows that males play action video games and video games in general,

more frequently than females. Females clearly benefited from just ten hours of training.

Given that superior spatial skills are important in the mathematical and engineering sciences;

these findings have practical implications for attracting men and women to these fields.

A different issue that must be addressed is the possibility of physical and mental

problems that are associated with incorrect posture and constant focus on a screen. Palloff

and Pratt (1999) describe these issues well, "…physical problems that can be experienced as

the technology is used extensively, such as carpal tunnel syndrome, back problems,

headaches, and so forth. Psychologically, students and faculty can become addicted to

technology" (p. 7). How can educators address these issues? Healy (1999) outlines several

ways to combat some of these health issues.

- Eliminate sources of light and glare. Be alert for direct glare from sunlight and lighting fixtures directed at the user's eyes and indirect glare due to any type of reflection on the video screen.

- Teach children to take frequent "eye breaks" – totaling about fifteen minutes off for every hour of computer use. In addition, have them take a ten-second break for every ten minutes.

- Staring can strain the eyes. Remind children to blink frequently.

- Encourage children to use good posture when working at the computer, sitting straight on a well-fitting chair and resting wrists on the desk.

- Workstations in schools should be adjustable for different-size children. (p. 116-119)

DeMaria (2007) describes the physical risk factors from video games. Eye strain and repetitive motion injuries are serious side effects of video games. Breaks should be taken by players at half-hour or hourly intervals to do some simple stretches for the fingers, wrists, shoulders and neck. Other recommendations would be for the gamer to look away from the screen at intervals and to pay attention to joint pain and headaches. DeMaria also suggests that video game players should play relaxed, easing tension on the hands, back, neck and arms. The majority of these physical risks come from being stationary in front of a screen; exergaming combats many of the stereotypes associated with gamers leading sedentary lifestyles.

Video Games and Physical Education

Sedentary Lifestyles

There was a time when playing meant climbing a tree, kicking or throwing a ball, playing tag or riding a bike. Today playing means sitting in front of a screen, either television or computer, and the only things moving are the thumbs of millions of children. The only time children ride their bikes is when they need to get from a screen at their house to a screen at a friend's house. As recently as 2005, Dowshen stated that in a year, the average child spends 900 hours in school and 1,023 hours in front of a television.

The Center for Disease Control and Prevention (2008), addresses the serious issue of childhood obesity,

> Overweight is a serious health concern for children and adolescents. Data from two NHANES surveys (1976–1980 and 2003–2004) show that the prevalence of overweight is increasing: for children aged 2–5 years, prevalence increased from 5.0% to 13.9%; for those aged 6–11 years, prevalence increased from 6.5% to 18.8%; and for those aged 12–19 years, prevalence increased from 5.0% to 17.4%. (p. 1)

The cause of this obesity can be attributed to many factors including an unhealthy diet and poor exercise habits. Both of these factors are formed at an early age. Parents do not seem to understand the health risks that are associated with childhood obesity and often feel that a child's size is inherited or that the child will grow out of the extra weight. The United States Department of Health and Human Services (2007) states that overweight adolescents have a 70% chance of becoming overweight or obese adults. This increases to 80% if one or more parents are overweight or obese.

A report by the United States Department of Health and Human Services (2007) reports that every 32 seconds someone dies of heart disease in the United States. It is vital that youth are educated on how to lead a healthy lifestyle. Physical education programs are being trimmed from school budgets at an alarming rate. While being worried about No Child Left Behind, the nation's educators have forgotten about the crucial role that physical education plays in school systems. These physical education programs can be a great resource for children. Physical education class is often the only source of activity for children these days. With so many children living in urban environments, they just do not have access to a yard or playground to give them a place to be active.

Physical education is the ideal place to discuss goal setting and proper weight loss. Goal setting is a constant in video games. In video games the player constantly strives to reach a goal, master the content, and move on to a higher level of difficulty. Prensky (2006) explains that video games consist of goals that players really want to achieve. The goals should be a combination of short-term, medium-term and long-term. Prensky also writes that, "Making sure the player's goals are clear and compelling is a major piece of game design, and one that also helps their learning" (p. 60). This is no different than weight loss. Losing weight can often seem discouraging if there is no plan in place. Green and Reese (2006) stated that setting weight loss goals should be small so that the child does not become overwhelmed or discouraged. A weight loss rate of two to four pounds per month could be a target goal. Goal setting can serve as the motivating factor in maintaining a positive attitude and increasing a child's self-confidence.

Green (2006) found that quite often, the obese child experiences frustration in physical activities, is ridiculed by his or her peers, chosen last for teams, and thus, establishes

a negative attitude toward physical education and school in general. This can develop into a vicious cycle that leads to more inactivity. As students struggle in physical education, their views become more and more negative. As their views become more and more negative, they exercise less and less. Green (2006) discovered that the social environment has a powerful impact on eating behavior and physical activity habits, particularly when these activities occur primarily in social settings such as family dinners, group outings, school lunches, recess and recreational times. Obese children need help to cope with these difficult situations. As youth become more sedentary, obesity takes its toll on society in general. The United States Department of Health and Human Services (2007) states that the economic cost of obesity in the United States was about $117 billion in 2000.

Exergaming

Running, aerobics, weight lifting and yoga are what come to mind when most people think about physical fitness. Video games probably would not even make the list. In fact, Brown (2006) found that the association of electronic game use with obesity was significant; with nearly a two-fold increased risk for obesity by hour per day spent playing electronic games. Most people associate video games with a sedentary lifestyle, picturing gamers locked away in a dark room playing violent and aggressive games while staring at a screen. That association disintegrated with the arrival of exergaming. Standage (2007) states that exergaming combines video games with physical exercise. The interface controllers allow users to play games using full-body movements. Players might exert pressure on a padded metal bar rather than pushing buttons on a plastic controller. They might stand in front of a screen and wear a belt equipped with motion sensors, controlling on-screen action with real-world movements. Romero (2006) describes how these motion sensors work,

At the heart of the controller technology are tiny accelerometers. Inside these chips, silicon springs anchor a silicon wafer to the rigid controller. As you wave the controller through the air at an attacking enemy, the wafer presses onto the springs, just as you are pressed against the seat of a car when you stomp on the gas pedal. The faster the controller accelerates, the more the wafer moves relative to the rest of the chip. The accelerometer monitors the position of the wafer by measuring capacitance, or the ability to store electric charge, in different directions. When you move the controller forward in a punch, the capacitance increases at the back of the wafer and decreases at the front. Using capacitance to measure how far and in what direction the wafer moves, the system translates your real-life movements into the perfect jab to your opponent's face. (p. 1)

Some controllers contain motion detectors that detect movement that might correspond with the movement of a tennis racquet, golf club or bowling ball.

Riding a bike or running on a treadmill for an hour can be a thoroughly boring experience for a lot of children. These same children will play video games for hours on end. The idea of turning this non-active time into a time of exercise and movement is a huge step toward combating childhood obesity. Video game makers have taken notice and have started developing video games that get children on their feet and off of their bottoms.

Video games like *Dance Dance Revolution (DDR)* are helping children become more fit. Borja (2006) described how the dance game works. A player stands on a vinyl or metal-based pad with four arrows pointing up, down, right, and left. When the game begins, the music starts and colored arrows scroll up from the bottom of the television screen. When the colored arrows pass over a set of transparent arrows in the middle of the screen, usually to

the beat of the song, a player must step on the corresponding arrow on the dance pad. In a two-minute span, a child could take anywhere from 80 to 200 steps while playing *DDR*. Whether society likes it or not, video games have been a constant in our lives since 1958 when, according to Kudler (n.d.), Willy Higinbotham invented the first video game, a table tennis-like game played on an oscilloscope. Today, the state of West Virginia has put the Xbox video console, along with copies of *DDR* into all of its 765 public schools (Toppo, 2007). Not long ago it would have seemed outrageous to bring a video game system into a public school. In fact, in some schools it may be grounds for suspension. Today physical and health education teachers are encouraging it. The West Virginia study on *DDR* required children ages 7-12 to play the game at home for at least 30 minutes, five days a week, for 12 weeks. Researchers registered their weight, blood pressure, body mass index (BMI) and other measures and found that overweight kids showed improved overall health (Toppo).

In a report on *DDR* (Edwards, 2006), a physical education student, Catherine Carte, stated that

'Gym was "horrible, absolutely horrible," says Carte, who now supplements traditional physical exercise by working up a sweat moving to *Dance Dance Revolution*. "I was like, O.K.; I'll see what it's about before I start hating it. But I really liked it."' (p. 1)

Teachers are equipping their students with heart rate monitors and pedometers to track data. Brown (2006) writes that *Dance Dance Revolution Ultramix 3* for the Microsoft XBox tells players how many calories they burn per dance session. The game also comes with a 30-day trial membership to the 24-Hour Fitness gym franchises.

The video game fitness craze is a great way to build excitement toward exercise but video games should supplement physical activity, not replace it. Children should still participate in running, walking, aerobics, and team sports. Exergaming could be the nudge that some children need to start being more active. The American Medical Association (2007) recommends no more than one to two hours of screen time per day, including time spent on video games, television, videos/DVDs, and computer use. However, data shows that

- Forty-two percent of children play video games for at least one hour per day, with 22 percent reporting they play for two or more. This is on top of the three hours a day the average child spends in front of the television.

- Fifteen percent of children state they feel they spend too much time playing video games. Interestingly, 26 percent say they play too little, suggesting what a large role games now play in young people's lives.

- One in ten (9 percent) admit they play so much that it sometimes hurts their homework. This finding is particularly surprising because third-, fourth- and fifth-graders do not typically have a lot of homework.

- Over half (55 percent) say they sometimes try to stop playing video games so much. Children who play video games in their bedrooms play five hours more per week than children who do not play in their bedrooms. (Walsh et al, 2006, p.5)

The Nintendo Wii is a relatively new technology when it comes to exergaming. The Wii targets players of all ages and comes with a sports package that forces the user to get involved with the game. These games, bundled with the Wii console, include tennis, baseball, golf, bowling and boxing. Standage (2007) states that the Wii does away with button pushing and instead incorporates physical movements directly into the gameplay

using the Wii's motion-sensitive wireless controllers. Holding a controller in each hand, players throw punches into the air to control the on-screen action. Similarly, the Wii's tennis, bowling, golf and baseball games require players to act out the physical movements involved in each of those sports, though they do not require as much physical exertion as the boxing game.

Serious Video Gaming for Global Training

Global Workforce

Are educators preparing the youth for the global workforce that they will be entering? Shaffer (2006) argues,

> Simple math and reading skills, will, at best, get you a low-level service job, because standardized skills are not what they once were. Young people today need more. Young people need much more. Even the capacity to learn new things quickly and well, important though it is, is not enough. (p. 1)

He describes the crisis in education, "Young people in the United States today are being prepared – in school and at home – for standardized jobs in a world that will, very soon, punish those who can't innovate" (p. 3). This type of preparation is leaving the children of the United States behind the rest of the world.

The Federation of American Scientists (2006) states,

> 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. (p. 16)

We are teaching students who have grown up with video games. Prensky (2006) describes the future,

> Our kids know, instinctively, that in an age when knowledge and the power of technology will have increased millions or even billions of times in their lifetimes, the skills they will need in the future are not the skills of the past, i.e., the ones they are being taught in school. (p. 31)

Students live in a world where it comes naturally to communicate with a cell phone through voice and text messaging. These students have no problem listening to an iPod, watching television, instant messaging on their computer and doing homework - all at the same time! Technology is a part of their daily lives.

The Future of Game Design

What is a game? A game is just an organized form of play. Games have rules that players must follow, and the players all have a set goal. If game design focuses on the learner with serious outcomes, serious gaming can take place. The future of serious video games in the classroom hinges on the ability of video game designers to create a fun meaningful game. Video games have become successful because they are designed to engage players. Dicky (2005) offers,

> Looking at various aspects of game design is likely to yield information about the development of educational games, an investigation of popular games is also likely to yield information about design that would inform the field of instructional design for both traditional educational media and interactive learning environments. (p. 71)

As children grow up, they play a variety of games such as *Monopoly* and *Chutes and Ladders*. Many adults continue to play games such as *Solitaire* and *Sodoku*. Prensky (2005)

describes these types of games as mini-games. Mini-games take no more than one hour to complete and are used as a way to pass time or entertain. Prensky writes,

> My strong sense is that if educators and designers focus on the complex (and not the
> mini) games for education, and if parents, teachers and educators really come to
> understand what complex games are capable of and why the kids love them so much
> (which they can do best by talking to, listening to, and even playing the games with
> their kids) a great many of today's resistant adults will come around and embrace
> "complex" games, in their many forms, as a key educational tool for today's students
> and for kids in the future. (p. 12)

Why do students want to learn? There are many factors that influence a student's internal and external motivation to learn. Shaffer (2006) argues that students learn by trying to accomplish some goal in the face of obstacles. If a student stumbles on an obstacle the student will try and figure out what they know, what they need to know, and then work their way past that obstacle.

Because good video games are excellent learning environments, a good video game can be designed to combat one of the most common arguments made against them. Poor social skills are commonly blamed on a student being isolated from his/her peers due to excessive screen time. DeMaria (2007) believes that video games could be designed to teach social skills,

> A well-designed video game is an excellent teaching tool, and a well-designed game
> will teach regardless of whether the designer intended to teach or the player intends to
> learn. I would love to see games that teach social skills useful for some subpopulation

of children and adolescents who don't know how to treat others and how to interact.

(p. 20)

The very nature of many video games encourages social skills. Players learn collaboration skills by regularly sharing ideas on message boards and chat rooms. Players frequently play games with others in real time, either on the same team or as opponents online. Social skills are developed through the communication that must happen to advance in the game.

Video games are a way that designers can present real life situations where specific skills can be learned and practiced. DeMaria (2007) describes a video game that places players in a life-or-death situation. This situation requires the player to power up a machine to save the lives of others. The player will not learn anything about electricity if the solution is as easy as flipping a switch. Instead he describes a scenario where the designer forces the player to find the tools, trace the current, splice the wire etc. A failure will cause the player to explore the many variables and learn why the power is not working. A failure could also lead to the virtual player being electrocuted. Dying in the real world is not a realistic way for a student to learn. Although the death of a player in a virtual world is not really life-threatening it will cause the player to learn from the event if they would like to have success in the game.

So, how do educators start incorporating serious video games into the curriculum? Rosas (2003) provides the following, ''(Computer) games offer teachers enormous resources they can use to make their subject matter come alive for their students, motivating learning, offering rich and compelling problems, modeling the scientific process and the engineering context and enabling more sophisticated assessment mechanisms'' (p. 74). Serious video games are a resource for learning if they are designed correctly. A video game designer is

measured by the success of the games that he/she creates; this success is measured by video game sales. The future of serious video games lies in the hands of video game designers.

CONCLUSIONS AND RECOMMENDATIONS

Technology is a part of students' everyday lives. It seems as if every other student walking down the hallway has ear buds dangling from his/her ears, while tapping a text message on the phone while talking to friends. Prensky (2006) describes students today,

Notice that kids' attention spans are not short for everything. They're not short for games, for example, or for music, or for anything else that actually interests the Digital Natives. As a result of their formative experiences with digital objects, though, Digital Natives do crave interactivity – they expect an immediate response to their each and every action. Traditional schooling, as we've discussed, provides very little of this. (p. 36)

Teachers are potentially fighting a losing battle if they refuse to change and implement technology into their curriculum. This technology can help us become better educators and help engage students in learning. Serious video games can grab a student's attention and hold it for an extended period of time.

Alhadeff (2007) estimates that $1.5 billion dollars will be spent on serious video games worldwide in 2008. The development of serious video games will continue to rise as interest grows. The military and medical fields have been using serious video games for training for quite some time. This is the perfect environment for serious video games. If a player makes a mistake in battle or on the operating table, it could cost someone's life. A mistake made in a video game is a learning experience that could save a life.

The design of a good serious video game is not by chance, it uses a formula for success. Players learn from serious video games consciously or subconsciously. Video game design and educational design have been two totally separate entities. Today's students are a

part of the video game generation. They have grown up playing video games. Where else can students immerse themselves into a zookeeper's world, facing the same real-life problems while learning the skills to deal with these problems in a realistic way? What are the consequences if one of the animals dies from a mistake made by the zookeeper? There are none, at least no real-life consequences. This is a learning experience that enables students to learn, take risks and try things that they otherwise may never be able to experience. This is the student's game. Personalized learning is taking place. The game will get harder and harder as the student achieves goals and sets new ones. Serious video games such as *Zoo Tycoon* encourage inquiry and questions. The players will not just learn information; they will actually be able to apply it in real-life settings.

There is no denying that the sedentary lifestyle that today's children are leading can put them on a crash course with obesity. The Department of Health and Human Services (2007) has found that overweight adolescents have a 70% chance of becoming overweight or obese adults. The fact that children spend more time per year in front of a screen than they do in the classroom is reason enough to cause alarm. In 2005, Dowshen found that the average child spends 900 hours in school while spending 1,023 hours in front of a television each year. Lack of attention to this alarming situation can put the health of children at risk. Something must change if society is going to help today's generation of children.

With so many children living in urban settings, the physical space for exercise is at a premium. Children can not just go out their backdoors and play like they could in the past. Parents are concerned for the safety of their children, so they are restricted to the house. This lifestyle discourages physical activity and encourages a sedentary way of life. Video game designers are addressing this problem by combining gaming with exercise. Through video

games like *Dance Dance Revolution* and gaming systems like the *Nintendo Wii*, children are playing games while getting a workout. Video games cannot replace traditional exercise, but their use is a step in the right direction. Most children do not want to run laps or do jumping jacks but playing a video game is a whole different story. Standage (2007) found that exergaming can have a major impact on energy expenditure, making it a potential option for obesity prevention and treatment. Michael and Chen (2006) offer that video game playing can have a number of benefits, such as improved hand-eye coordination, improved ability to multitask, and the ability to work in a team using minimal communication.

As educators implement serious video games into the curriculum students will learn higher-order skills as well as practical skills. Games such as *Multi Casualty Incident Responder* give students practice for high performance situations. Players have the opportunity to learn and apply rarely used skills while developing expertise. Prensky (2005) describes this type of game as a complex game. These games include enough information to keep students engaged for forty or more hours and are so in depth that an entire course can be covered using the game.

Students need to have the skills to succeed in the workplace. Today's workplace has changed. According to the Federation of American Scientists (2006) students are living in a global workplace and they will need to be able to think strategically, analyze problems, plan and execute ideas and maybe most importantly adapt to change. FAS also stated that video games offer many of the same things that good learning requires such as goals, projects that can be practiced until mastered, monitoring of progress while adjustments are made, motivation to stay on task, and personalized learning.

There are many serious video games that can help students learn. Interested in ancient

history? *CivIII* will meet their need. There is *Multi Casualty Incident Responder* for those interested in the medical field. These games will positively impact students today.

More research is needed to determine which features of games and simulations are important for learning and why, and how best to design these systems to deliver positive learning outcomes. Research is needed on how to best assess the knowledge and skills learners acquire from games, and on understanding the barriers to the adoption of learning innovations in education institutions (Federation of American Scientists, 2006).

Research is needed to determine which features of games and simulations are important for learning and how best to design these games. The reviewer recommends that the Department of Education partner with the video game industry and develop educational games. This action would bring educators and game designers together. Groups such as the United States Army that have successfully implemented serious video games should be brought on board to work with educators. The games that are developed should be available for home video game consoles as well as the personal computer.

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