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Digital gaming as a learning tool : a literature review

Seth Weylin Vickers
University of Northern Iowa

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Abstract

This review of literature focuses on the uses of digital gaming within learning environments. Using academic journal articles, the author reviews the advantages and disadvantages of using digital games, ways instructors are using digital games, the uses of educational as well as recreational digital games, considerations for implementing digital games, and an overview on the importance of digital security. The benefits include increased motivation, collaboration, and the increased opportunity of a learner potentially entering the flow experience. The disadvantages include health risks as well as some learners' negative attitudes towards digital gaming. The author recommends instructors to consider using digital games as a learning tool, but also warns them to carefully consider any digital gaming intervention; otherwise maximum learning potential may not be achieved. In closing, the author mentions the ever-evolving realm of digital gaming and concludes that more research is needed as a means of staying informed.

Digital Gaming as a Learning Tool:

A Literature Review

A Graduate Review

Submitted to the

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Master of Arts

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by

Seth Weylin Vickers

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Leigh E. Zeitz

5/11/12

Date Approved

Graduate Faculty Reader

Ping Gao

5/12/12

Date Approved

Graduate Faculty Reader

Jill M. Uhlenberg

5-14-12

Date Approved

Head, Department of Curriculum and Instruction

Abstract

This review of literature focuses on the uses of digital gaming within learning environments. Using academic journal articles, the author reviews the advantages and disadvantages of using digital games, ways instructors are using digital games, the uses of educational as well as recreational digital games, considerations for implementing digital games, and an overview on the importance of digital security. The benefits include increased motivation, collaboration, and the increased opportunity of a learner potentially entering the *flow experience*. The disadvantages include health risks as well as some learners' negative attitudes towards digital gaming. The author recommends instructors to consider using digital games as a learning tool, but also warns them to carefully consider any digital gaming intervention; otherwise maximum learning potential may not be achieved. In closing, the author mentions the ever-evolving realm of digital gaming and concludes that more research is needed as a means of staying informed.

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Introduction

The year was 1990. It was near the end of the final round, both prizefighters were tired and relying on their instincts. One, a champion defending the belt he had won so long ago, battled the other, the challenger, a very young and naïve man on the verge of something great. The champion threw an uppercut worthy of the history books. The challenger dodged it just in time and before the champion could recover, hit him with a series of his own punches. One two, one two. Stunned, the champion fell with an enormous thud to the ground. The ref with three harmonic blips declared the bout over with a "T.K.O". The young challenger could hardly believe his eyes. He did it. He really did it. At the ripe age of ten, this young and somewhat average student of the world was able to defeat Mike Tyson in what would become a crowning achievement for years to come. Elementary school had tormented our new champion with an atmosphere devoid of authentic motivation. Far away from any classroom after years of studying and practice for this one perfect moment, our young challenger had conquered the Nintendo video game and thus had his epic moment of learning.

Over twenty years later, digital gaming in the classroom has become a prevalent part of learning. In many situations, teachers have found great benefits to the motivational characteristics digital gaming can offer. "Games provide complex environments in which content, skills, and attitudes play an important role during the game" (Gros, 2007, p. 26). According to Walsh (2010), digital games have become a multibillion-dollar industry. Hwang and Wu (2012) report the research on digital gaming within educational settings has increased significantly in the past ten years.

The purpose of this review is to provide an overview of the research on digital gaming

as an educational tool. Digital gaming has faced scrutiny throughout the years. Not everyone shares the idea that an entertaining game can actually help an instructor lead students in reaching various learning goals. "Parents and teachers typically loathe video gaming and go to great lengths trying to curb it rather than cultivate it" (Steinkuehler, 2010, p. 62). Not fully understanding the effects digital gaming can have on a learner can lead to misconceptions about gaming. Becker (2007) reported the majority of teachers who use games do so only as a reward for doing traditional work within the classroom environment. This review of literature will lead to a greater understanding by exploring the notion that digital games can be used as an enhancement within learning experiences. The findings can be used to make educated decisions in matters of using digital games in learning environments. This review of literature will seek to answer the following questions:

1. What are some of the qualities within digital gaming that can lead to potential beneficial learning outcomes?

2. What are the effects of digital gaming as a learning tool?

3. What considerations should an instructor have when choosing to implement digital gaming?

4. Why and how should instructors ensure their learners are using a secure digital gaming environment when using internet-based digital games?

Methodology

The reviewer identified sources for this review of literature by using Business Source Elite (EBSCO), Web of Science (ISI), and Education Resources Information Center (ERIC) through the University of Northern Iowa Panther Prowler located on the Rod library website. Google Scholar was also used to identify resources. These databases were chosen for their vast libraries of the subject matter. Keywords and descriptor used were, *digital games, digital games + comparison study, digital games + learning, videogames, gaming, education, Second Life, videogames + military, computing security, viruses, virtual worlds, role play gaming, videogames + obesity, videogame + health risks, gaming security, Wii, PlayStation, Xbox, learner motivation, videogame + classroom, digital games + outcomes,* and *video gaming.*

The reviewer initially selected the articles based on the following:

- The article had to be tagged to the keywords and descriptors.
- The abstract of the article had to offer insight to the questions posed within the introduction of this review.
- The article could not be more than ten years old.

The reviewer then checked for reliability of the article by ensuring at least one of the following: the article had to come from a scholarly journal, and or the authors of the article had to be credible within the subject matter of the article. The reviewer checked this by running the authors' names through Panther Prowler and Google Scholar. The author had to have some work within a scholarly journal and that work had to be related to the subject matter or the article was omitted from inclusion. The reviewer chose resources for inclusion within this article by determining the depth of insight the article

had pertaining to the topic of this paper. Articles that included hard factual results as research were given first priority.

Analysis and Discussion

Digital games can be great tools for educators from all disciplines. Charles, Charles, McNeill, Bustard, and Black (2011) report digital games give informative and timely feedback, which are also important ingredients to a student's learning experience. Digital games have many properties that can attract their players' attention. "When kids play video games, they want to perfect their skills, advance to the next level, and become a master. It's the kind of focus that many of us would love to see in our classrooms" (Adams, 2011, p. 64). The benefits of digital gaming are plentiful. "Soldiers, surgeons, students, athletes and hospital patients are amongst those who are finding that the right video games, in the right context, can make you smarter, faster and even stronger" (Drummond, 2008, p. 20). With great focus, students are able to achieve learning outcomes that could otherwise be unreachable.

Qualities

The decision to play a digital game and to continue playing can be described as the player's motivation. Players become intensely motivated to play digital games for a variety of reasons. Hoffman and Nadelson (2010) conducted a study on motivational factors for people who use digital games for more than five hours a week. The researchers indentified 189 digital gamers from all walks of life. Individuals were selected based on the prerequisite of playing digital games for more than five hours a week. Through participant self reporting and interviews, the researchers were able to determine some of the factors leading to the motivational characteristics of digital gamers. "Analysis revealed three main reasons; escapism and fun, social connectivity, and the achievement of task-related goals through control" (p. 257). Digital gamers were influenced by the idea of making friends and either

playing with or against those friends. A social gaming environment can also lead to giving credence to accomplishment within the game. Wanting to best their opponents or their own personal scores motivates some players. Instructors can use these motivating factors to help learners reach their goals. Conversely, in an interview, Jane McGonigal (2011) reported about the misconception of digital gaming being a form of escapism, adding that recreational digital gaming is actually a form of positive stress that gamers release on themselves, which can be construed as motivation. Since this stress is positive, gamers are much more likely to deal with the inherent conflict within a digital gaming realm in a positive way, making the gamers more likely to be creative, optimistic, and more likely to collaborate with others.

Flow experience. A good reason for using digital games within an educational setting is the chance of the learner becoming fully immersed within the game and thereby becoming fully immersed in the learning. Csikszentmihalyi (1997) argued when people are happy and completely occupied within a task, a higher level of learning called *flow experience* can occur. People are motivated to be in the *flow experience* because it elicits satisfaction. Educators should prioritize environments that are conducive to the *flow experience* because the learner's satisfaction leads to greater learning. Feng (2011) developed a series of principles to help foster the integration of digital gaming within learning environments, thus creating a greater potential for the *flow experience*.

1) Analyze learners, 2) set clear teaching objectives and select appropriate gaming materials, 3) design teaching instructions according to teaching objectives and game content, 4) consider teaching as the primary goal and use games as supplementary tools, 5) make good use of the characteristics of computer games, 6) place students at

the center of the process and help them enjoy studying, and 7) periodically assess students' learning, to improve teaching. (p. 1330)

According to Jin (2011), the *flow experience* is the main reason instructors should consider using digital gaming within their teaching. Jinn conducted three studies involving 105 undergraduate students as participants. The participants were given a pre-intervention survey, played a specific game for a set amount of time, and filled out an online survey. Each participant followed this structure for three games in total. Jinn found newer, more sophisticated games that require movement, such as those available on the Nintendo Wii, can elicit a much greater *flow experience* from their users. It is important for instructors to use some sort of process for the inclusion of digital games within a learning environment. Any digital game that helps a student learn can be considered beneficial. By carefully choosing which digital game to use for which situation, an instructor can optimize the *flow experience* to ensure maximum benefits for the learner.

Minimal risk. Research suggests the digital realm can provide gamers an opportunity to play within an environment that has minimal risk. Typically when a gamer fails to attain a goal within a game, the repercussion is far less than if the same situation had played itself out in the physical world. In the previously mentioned study, Hoffman and Nadelson (2010) found *minimal risks* to be a significant motivating factor for people who describe themselves as gamers. While the attainment of a goal within a digital game can be a positive experience for gamers, the negative side of not reaching a goal is muted in comparison to the failure of anything in the real world. Gamers are less concerned about failing within the digital realm and through a much less stressful environment become more motivated to succeed within that realm.

Multitasking. Multitasking is required for many digital games. Research has suggested multitasking skills of gamers can increase from the act of digital gaming. According to Gros (2007), complex games may require gamers to keep track of multiple aspects of the game at any given time. These particular games lead to multitasking benefits for those who are able to master them. Gros conducted a study using undergraduate college students who were asked to watch two separate events carried out at the same time on two locations of a television screen. The events were created to elicit specific responses from the students. The researchers studied the response times of the students. The participants who were indentified through self reporting as skilled gamers had faster response times with complex mathematical story problems than novices. The act of consistently having to multitask made it quicker and easier for these learners to multitask in other non-gaming situations.

Time spent. According to Patriarca, Di Giuseppe, Albano, Marinelli, and Angelillo (2009), adolescents spend on the average over one hour and a half playing videogames daily. Many educators have realized the importance of digital gaming and have started to incorporate digital games into their lesson plans. As a society, the overwhelming majority of learners take part in some form of digital gaming. Levine (2011) reported that according to industry research, over 90% of school-aged children take part in digital gaming. Learners are accustomed to using digital games on a regular basis. As such, they are prepared and motivated to experiment and learn in the digital realm. "Videogames are useful instruments for learning specific strategies and for acquiring knowledge; they also develop the learning that is characteristic of the culture of the information society, and this learning is likely to have long-term consequences" (Gros, 2007, p. 28). Based on over twenty years of research

within digital gaming, Griffiths (2010) claims the benefits of digital gaming are plentiful and include the ability to raise a player's self esteem. Some instructors are understanding and taking advantage of the fact that learners are living in an informational age where digital gaming is a prevalent part of our society.

      Recreational. Studies have been conducted to further understand the significance of recreational digital gaming and its correlation to learning. Digital gaming as a recreational activity has helped students become better learners. Thirunarayanan, Vilchez, Abreu, Ledesma, and Lopez (2010) conducted a study where 203 college students from an urban university were given a survey concerning the effects of digital gaming. The researchers found most learners thought digital gaming improved their ability to memorize information as well as the ability to think of more than one solution to a problem. The study also found an overwhelming number of male participants felt digital gaming helped them become more effective at leading group activities. The positive impact digital gaming has on the participants works not only in learning environments, but also outside of them.

Beneficial Outcomes

      Teachers can use existing interests to help their students become more successful. As previously discussed, Levine (2011) reported over 90% of school-aged children take part in digital gaming. For example, Steinkuehler (2010) studied a student who throughout school had consistently, when given predetermined text, scored three grades below his class average in literacy. The student was an avid gamer, constantly using his free time to play *Call of Duty*. When the student was given the chance to choose his own reading material, he chose a book he perceived to help improve his recreational digital gaming skills, a book on World War 2. The student was able to successfully read and be tested on a book that was four

grades above his class average. The motivation for the student having a small chance to improve his gaming skills played a large role in improving the student's literacy as the student was able to jump seven grade levels within his literacy testing. Instructors need to realize the power of digital gaming and use it to motivate learners.

Cognitive disorders. Digital games are being used to help war veterans with war related injuries. Lehrman (2012) reports on the use of video games as a form of therapy for soldiers returning with cognitive disorders. Veterans are using simple memory-based digital games as a means to exercise their minds. Lehrman suggests a major positive outcome for using this type of treatment is the participants are willing to continue their treatment at home. "The allure of gamification seems clear: to make education or therapy fun" (2012, p. 12).

Virtual worlds. The art of story telling has also benefited from digital gaming. By using virtual worlds, authors are able to create and share their stories in ways that were never before realized. Xu, Park, and Baek (2011) performed a comparison study on two groups of participant learners. The first group was asked to create a story for the virtual world Second Life while the second group created an offline story using Movie Maker. The researchers found statistically significant improvements in self-efficacy and flow for the group that created their stories within the digital realm of Second Life. It was concluded through observational analysis the Second Life group was more motivated and engaged than the Movie Maker group.

Digital stories are a form of communication and as they are created, students apply critical thinking skills while selecting the appropriate media to convey the story's message to the audience. It provides the student with a learning environment to apply

> communication skills, work collaboratively, and think critically while addressing
>
> content and technology standards. (p. 189)

The collaborative digital environment provided the learners a context they could not find in the physical world, thus creating an optimal environment for positive learner outcomes. In a separate case study, Walsh (2010) reported the benefits of students who traditionally struggled with print-based literacy when they were given a digital games-based intervention. These students were not only playing games in a learning environment, but also actually designing them. The case study involved seventh grade English classes. The participating English teacher began a unit where the culminating project would have the students create a design for a game that would be shared using PowerPoint. The students were taken to *Game On*, a museum exhibit on digital gaming. While at the exhibit, they took extensive field notes in anticipation of creating their own games. When the students returned, they began working on story lines and game play as well as other attributes that are needed to create a digital game. Finally, the students created PowerPoint presentations to share their respective digital game designs. Walsh found significant gains in standardized testing scores, as well as unprecedented engagement in literacy, attributing the positive results to the motivational characteristics that gaming could provide the learners.

Second Life has also been effectively used to create simulations for the purposes of training. Mahon, Bryant, Brown, and Kim (2010) conducted a study where they used Second Life to create a virtual environment where 20 undergraduate preservice teachers would have the chance to deal with disciplinary issues. The teachers were placed in a controlled Second Life classroom full of artificially intelligent avatars or bots where a test was to take place. During the test the preservice teachers were confronted with various problems from the

preprogrammed avatars. The avatars were programmed to follow a specific role. For example, one would try to talk to his friend while another came unprepared for class. This allowed the researchers to give all of the preservice teachers a nearly identical experience. After the simulation was over, the teachers were given a survey to rate the effectiveness of the instruction. Overall the preservice teachers found the experience to be positive and a unique way to deliver instruction. These findings show Second Life can be used to create safe virtual environments in which the learners can find themselves in situations that they may later face in reality.

Computational skills. Research suggests computation skills can be enhanced through the use of digital games. In a comparison study, Miller and Robertson (2010) found the intervention of using a digital game in a classroom environment led to both speed and accuracy of computation skills improvements. The researchers studied a twenty-minute-a-day intervention in which one group of students played a digital game titled *Dr. Kawashima's Brain Training* while a control group received traditional instruction. They then used a pre and posttest to compare findings between the two groups. "Both showed significant gains in number of correct answers in the test. However, the gains for the intervention group were more than twice those of the control group" (p. 248). This study was able to show when digital gaming is incorporated in a manner suitable for effective learning, significant outcomes can occur. The instructors were able to more than double the computation skills of the learners by merely using a digital game as an instructional tool.

Single Display Groupware. Another possibility of using digital gaming as a learning tool is the idea of using Single Display Gaming (SDG). According to Infante, Weitz, Reyes, Nussbaum, and Gomez et al. (2008), SDG occurs when multiple

gamers use the same screen to play a digital game, but each user has a different control. SDG is used most often within console digital gaming as the majority of multiplayer games, where both players are gaming at the same time, require the players to share a common television screen. Collaboration can occur at a much higher level as the gamers are constantly seeing what their peers are doing. Being in close contact allows the gamers to communicate to each other without having to use any in-game communications or other communication related technology. Infante et al. were able to effectively use a role-playing game within a kindergarten setting by incorporating SDG. The students had to work together to conquer various tasks and were able to do so mainly because they were physically within close quarters to one another and could communicate as well as help each other find solutions to various problems. The quests required to complete when playing digital role playing games motivate participants and promote teamwork (Susaeta, Jimenez, Nussbaum, Gajardo, & Andreu, 2010). By physically placing learners near one another, single display groupware can help an instructor foster a collaborative environment where the learners are not only learning from the instructor, but also from their peers.

Social Disorders. The social aspect of digital gaming can be beneficial in clinical disciplines as well. Hadley (2011) reported on multiple studies where the benefits of digital gaming were based on pro-social behavior. Virtual reality software was shown to elicit emotional responses for patients facing heavy drug addictions, post traumatic stress disorder, as well as Asperger's. In all instances patients were given environments that were challenging to their specific disorder. The patients were able to become more comfortable within these environments, which helped them later be successful in similar real world

environments. The virtual reality environments helped the clinicians create a more believable atmosphere than traditional therapies.

> Clinicians attempting to re-create these scenes in their offices are at a disadvantage in that other important contextual cues are absent. For example, although clinicians may be able to recreate an accurate verbal exchange in a restaurant, they are not able to conjure the rich contextual details, such as the sound of the other patrons, doors opening and closing, and the presence of tables and chairs that need to be navigated. (p. 6)

The virtual environments within the digital games were able to help participants deal with the social realities of life by emulating these stressful situations within a controlled environment.

Science. Science teachers have also noted the positive social impact games can have on learners. "Students interact socially with video games at two levels: 1) interacting with other students as they play the game or after the game and 2) interacting with virtual characters within the game" (Jaipal & Figg, 2009, p. 120). According to Jaipal and Figg (2009), these characteristics of digital gaming were beneficial to students learning science. The researchers used the game *Nano Legends* as an instructional strategy to teach eighth graders life science. Although the participating teachers overwhelmingly felt the content in the game was too focused on one particular area of life science, the researchers found the social aspect of the game fueled the eighth graders' learning. Through interviews of the participating students, they were able to find the social aspect of the game motivated the students at a greater level than their usual traditional instruction. The students were more apt to socialize and help one another within the digital game realm than within the confines of

more traditional instruction. This greater level of socialization helped the students achieve the learning goals set in place by the instructors.

Gross motor. Most traditional digital games require little amounts of gross motor movement. Players typically sit in a chair and exercise their thumbs. Not all digital gaming require the user to stay in a somewhat sedentary isolated position where the only movement is pressing buttons. Sparks, Coughlin, and Chase (2011) report the Nintendo Wii, Microsoft Xbox 360: Kinect, and the Sony Playstation 3 all have games that require gross motor movement. All three consoles use camera-based technology to trace the physical movements of either a control or the movements of the actual gamer. This requires the gamer to move around. In comparison to older platforms, these systems have games that require players to constantly move. According to Maliszewski (2011), the Wii console can be used to enhance physical education in elementary school settings. She found the children were motivated by Wii games such as *Just Dance* and were constantly attempting to beat their own high scores. This led to higher engagement by the participants. The children were also more interested in using the Wii system than traditional games such as *Blockus* or checkers. Realizing its impact, the instructors from all disciplines in the school began to use the Wii with positive results. The social studies teacher used the characters on the Wii fit to start a discussion on gender stereotyping. Jin (2011) found the Wii to enhance the *flow experience* for players by enhancing the role of the physical presence involved within the game. Instructors can use the overwhelming popularity of home digital gaming systems to enhance their lessons.

According to Danforth (2011), librarians across the United States have noticed the health benefits gross motor digital gaming can offer and have begun to add games to their inventory. Some of librarians have even started to organize weekly social gatherings where

participants can come and play the Wii competitively or cooperatively with their peers. The librarians have also used these games to supplement instruction for continuing educational learning environments.

> For national gaming week 2011, Rowan County Public Library, Morehead KY, presented *Eat and Play the Healthy Way at the Rowan County Public Library*. The program supported computer and board games. Then the library launched a four-week Thursday series on healthy snacks and activities, including *Zumba* dance. This setting was ideal to overlap fitness games on consoles as part of the bigger event. (p. 60)

The Wii has all the benefits of more traditional gaming while adding the benefit of physical activity. This cutting edge technology not only leads to greater motivation by the learners, but also can lead to healthier gaming.

The Wii has also proven to be an effective tool within a medical learning environment. Bokhari, Bollman-McGregor, Kahol, Smith, and Feinstein (2010) performed a controlled study where 14 surgical residents were assigned to play *Marble Mania* on the Nintendo Wii. The researchers chose *Marble Mania* because it was relatively inexpensive and they hypothesized it would help the surgeons hone the fine motor skills required to perform surgery using laparoscopic equipment. A control group comprised of seven surgeons was given absolutely no intervening help. Each participant in the experimental group played and completed all fifty levels of the game, once with their dominant hand, and twice with their recessive hand. Both groups were later given an electrocautery task. The surgeons who had experimented with *Marble Mania* had fewer errors and showed improvement with fine motor ambidexterity movement. The participants found it to be a novel approach that they were

assigned homework in the form of playing a videogame that ultimately led to significant positive outcomes. In an unrelated study, Drummond (2008) reported the usage of more traditional digital gaming also led to positive results with surgeons. Surgeons who played games such as Silent Scope made 37% fewer errors and were twenty seven percent quicker when tested on surgical related tasks.

As previously stated, the *flow experience* is beneficial to all learners. Jinn (2011) conducted a study on twenty Wii games to determine the varying levels of flow they could generate in a learner. The 105 undergraduate student participants were asked to play and rate the games based on a rubric characterized by phenomena that can lead to the *flow experience*. Jinn was careful to mention that the games should be challenging, but not so much that the learner becomes disengaged. Three genres emerged from the study, medical simulation, driving, and avatar based. *Trauma Center*, *Need for Speed*, and *Godfather* were selected as the best at eliciting the flow experience for these chosen genres. *Trauma Center* was chosen based on the realism it offered, as it was most engaging for participants to feel as if they were really doctors doing everything they could to help their patients. *Need for Speed* proved to be a great mix of skill and challenge. The participants felt their ability to level up was closely in line with the skills needed to succeed at the next challenge. *Godfather* elicited empathy and self presence which Jinn correlates as important indicators of the *flow experience*. This research found many games on the Wii system could be utilized to elicit the *flow experience*.

Negative Outcomes

Instructors should consider the negative impacts as they decide on the usage of digital gaming to support an educational environment. According to Jaipal and Figg (2009), even

though digital gaming can motivate and foster collaboration among learners, it does so in an environment that can never fully replicate the physical world. Digital gaming takes place within a virtual world created by the designers and as such it is subjected to the biases of those designers. Jaipal and Figg also found some learners will base their game play more on the manipulation of the artificial rules present in the game rather than the spirit of those rules.

Health. As with the majority of activities, too much digital gaming can have a negative impact on a person's health. Even Jane McGonigal, a major proponent of digital gaming states, "Research suggests there's a hard-and-fast limit on how long you can spend playing games that's good for you, and that's 21 hours per week. I want to be clear about it: if you spend 30 or more hours a week, you start to get the negative impacts" (2011, p. 57). Sparks and Coughlin (2011) describe various digital gaming injuries, while pointing out the majority of these injuries are from acute overuse. The researchers claim the first medically related report of these injuries came in 1987 when the medical community started using the term *Nintendinitus* to describe injuries related to using the Nintendo controller for extended periods of time. With the advent of new console technology came differing ailments. Some gamers using the Nintendo Wii have found negative effects as well. "An epidemiologic review of the National Electronic Injury Surveillance System found that in the Wii's first year, 67% of the musculoskeletal injuries reported (29% were defined as sprains and strains and 38% as overuse injuries) involved the use of the Wii to play simulated sports" (p. 405). Sparks and Coughlin also mention that the term Wii-itis is commonly used to describe injuries that involve gross bodily movement during digital game play. The act of continually using the same bodily movements has shown to cause some gamers health related issues.

Instructors should be aware of these risks when using digital gaming within a learning environment.

With the majority of digital gaming requiring little bodily movement, research has shown a link between obesity and excessive digital gaming. Bener, Al-Mahdi, Ali, Al-Nufal, Vachhani, and Tewfik et al. (2011) confirmed a positive association with digital gaming and obesity, as well as low vision. The researchers used a random sample of school-aged children. Using a body fat analysis, they classified the children into three categories: normal, overweight, and obese. The participants were asked to log their hours of time spent using a television, which included the use of video games. The researchers found a direct correlation with time spent doing sedentary activities and obesity. They then used vision-testing results to study a correlation of sedentary activity and low vision. Once again the researchers were able to prove the more the participants took part in these activities, the greater their chance for having vision related problems. The researchers also noticed the more the participants used videogames, the less amount of sleep they were able to get, possibly leading to a greater chance for health related issues.

Lack of interest. Aside from health related concerns with digital gaming, some researchers are warning digital gaming may not be an effective learning tool for all learners. According to Orvis, Moore, Belanich, Murphy, and Horn (2010), only forty percent of young adults take part in the act of digital gaming on a regular basis.

There is a common belief that young adults have grown up in a digital generation, with information technology and videogames around them their whole life. Accordingly, such individuals are comfortable with using games for training. This research examined whether such assumptions are accurate with respect to U.S. Army

soldiers. Our findings suggest that the assumption that every young adult is a gamer (or even that they have experience playing videogames) is erroneous and, in fact, may be detrimental when it comes to using games for instructional purposes. (p. 155)

The researchers warn instructors about making assumptions that everyone will be motivated and engaged within the realm of digital gaming. Instructors should make every attempt to know their learners and make decisions on the inclusion of digital gaming accordingly. Gros (2007) is quick to point out, video games should not be considered stand alone solutions to educational problems.

Addiction. According to *Brown University Child & Adolescent Behavior Letter* (AMA does not endorse video game addition, 2007), although as of 2007 the American Medical Association does not recognize video game addiction as an actual disorder, physiologists have found it to be a problem. According to Griffiths (2010), addiction is mostly about the user consistently receiving rewards and reinforcements with characteristics of salience, mood modification, tolerance, withdrawal symptoms, conflict, and relapse.

Salience – This occurs when video game play becomes the most important activity in the person's life and dominates their thinking (pre-occupations and cognitive distortions), feelings (cravings) and behavior (deterioration of socialized behavior). For instance, even if the person is not actually playing on a video game they will be thinking about the next time that they will be. *Mood modification* – This refers to the subjective experiences that people report as a consequence of engaging in video game play and can be seen as a coping strategy (i.e. they experience an arousing "buzz" or a "high" or, paradoxically, a tranquillizing feel of "escape" or "numbing"). *Tolerance* – This is the process whereby increasing amounts of video game play are required to

achieve the former mood modifying effects. This basically means that for someone

engaged in video game playing, they gradually build up the amount of time they spend

online engaged in the behavior. *Withdrawal symptoms* – These are the unpleasant

feeling states and/or physical effects that occur when video game play is discontinued

or suddenly reduced, for example, the shakes, moodiness, and irritability. *Conflict* –

This refers to the conflicts between the video game player and those around them

(interpersonal conflict), conflicts with other activities (job, school-work, social life,

hobbies and interests) or from within the individual themselves (intrapsychic conflict

and/or subjective feelings of loss of control) which are concerned with spending too

much time engaged in video game play. (6) Relapse – This is the tendency for repeated

reversions to earlier patterns of video game play to recur and for even the most extreme

patterns typical at the height of excessive video game play to be quickly restored after

periods of abstinence or control. (p. 26)

Griffiths (2010) was careful to point out that this addictive behavior is somewhat rare and

does not affect a large amount of people, as the author had only encountered a handful of

people he would classify as dangerously addicted to digital gaming. Nevertheless, instructors

should be aware some learners may suffer from this disorder and instructors may need to

make special non-digital gaming related concessions when designing and implementing

instructions for these specific learners.

    Technology problems. A major continuous obstacle when choosing to use digital

gaming as part of a learning environment is ensuring that all of the elements required to use

the game are in working condition. Mahon, Bryant, Brown, and Kim (2010) reported on

major issues they had to overcome when studying the use of *Second Life* in a learning

environment. They were forced to overcome numerous computers crashing and a server that was slowed because of the graphic processing required for game play. All components exceeded the required computing power to use *Second Life*, but problems still occurred. The physical environment became less than optimal as students had to share computers and take turns using limited server space. The virtual environment had to be scaled back as well because the virtual world would slow down if too many participants were in an area at any given time. Even with all of these issues, the researchers found *Second Life* to be beneficial, but with better software and hardware support, *Second Life* could have led to a more effective learning environment.

Considerations for Implementation

Digital games in educational environments are diverse and can be simple or complex. The more complex games have multiple goals, immersive graphics, cooperative play, and environments that could be manipulated. The simple games have much smaller and quicker achievable goals, toned down graphics, and can lack social interaction. Devlin-Scherer and Sardone (2010) found preservice teachers preferred simple games over complex games, as they were easier and more fun to play. Although these games may not provide a player with multiple objectives, the simplified play of the game may make it easier for learners to conquer, which could lead to greater engagement with the digital game amongst participants. Drummond (2008) found a simplistic digital game could help basketball players become better decisions makers on the court. By using a simple two-dimensional overhead shot of a basketball court *IntelliGym* helped hone the players' skills from an intellectual sense on the court. Within the game, players constantly have to make basketball related decisions based on various offensive and defensive alignments of the computer controlled drones.

Consequently the players were able to translate those skills to the hardwood court. Many collegiate basketball teams that have gone deep into the National Collegiate Athletic Association tournament have praised the use of this simple digital game and the advantages it gave their respective teams.

Financial. The inclusion of digital gaming within learning environments has increased as their variety has increased and financially they have become more affordable. Becker (2007) noted computers have more memory and the processor speeds have increased, while the price for the hardware has dropped significantly. Becker also reported instructors, who years ago did not have the means to incorporate digital games into their learning environments, now have a better chance of producing a digital games based learning environment. For those public instructional institutions that simply do not have the funding for digital interventions, the federal government may offer assistance. Since 1996 the United States Government has an incentive laden solution, the education rate program commonly known as e-rate. E-rate is a volunteer program that could fund or partially fund many Internet related projects for qualifying public educational institutions. An *Electronic Educational Report* article (E-rate, 2007) listed e-rate's ten-year funding total as greater than 18 billion dollars with a yearly annual provision of up to 2.25 billion dollars. By providing the necessary digital infrastructure, E-rate can potentially be used to fund the incorporation of digital gaming within a learning environment.

Home Games. Educational digital games have become a great asset to effective educational environments, but some instructors have found much greater value in the use of commercial games that were intended for home usage. Repurposed commercial digital games are being used in many learning environments. Shelton and Scoresby (2011) explain

the entertainment value from commercial games can far exceed that of educational games and lead to greater motivation from the participants. The learners are also more likely to spend time away from the classroom with commercial games than they are with educational games. Studies have shown one negative aspect of using commercial games is the majority of learning is secondary or unintentional. "Secondary or unintentional learning occurs when a player learns concepts or skills not associated with the goals of the activity" (p. 117). These concepts can still be considered beneficial, but they might not meet the needs of the terminal objectives set forth by the instructor. As with educational games, it is important for the instructor to carefully choose which commercial games to employ in their respective learning environments.

Genres. Digital games as a form of media range widely in content. "There are many game genres in the market, such as simulation games, virtual games, competition games, command games, and role-play games. As long as the game does not involve bloodshed, violence, or pornography, it has some educational value" (Feng, 2011, p. 1330). According to Hong, Cheng, Hwang, Lee and Chang (2009) there are seven major genres within digital gaming:

- action,
- adventure,
- fighting,
- role-playing,
- simulation,
- sports, and
- strategies.

It is important to note most games fit more than one genre, but for marketing purposes are often categorized under only one. According to Maliszewski (2011), one of the most important things an instructor needs to do when considering the use of digital gaming in support of a positive learning environment is to actually play the game themselves. By doing this they are able to fully realize the educational value of a game and what gaming genres it contains.

Not all digital games are appropriate for learning environments. "There are clearly many commercial games that are simply inappropriate for most classroom environments, and this should come as no surprise, as there are also a great many films and books that are similarly inappropriate for classroom use" (Becker, 2007, p. 481). With such a large amount of digital games on the market, educators must be careful when choosing a digital game for a specific educational purpose. Hong et al. (2009) found seven categories educators should look for when playing a digital game:

- mentality change (did the learner find solutions in various ways?),
- emotional fulfillment (are emotional needs satisfied?),
- knowledge enhancement (what was actually learned?),
- thinking skill development (this includes memorization, observation, and perception),
- interpersonal skills (did the learner emotionally learn from losing and self perception?),
- spatial ability (having to decipher various relations within the digital realm),
- bodily coordination (the actual physical movements required to play a digital game).

These seven categories all represent important learning opportunities within the realm of digital gaming. Digital games that present great opportunities for learning may cover multiple categories, but may also take more time to incorporate as a learning aid.

    Appropriate. Instructors should also ensure the actual game play is appropriate for their learners. A digital game could have great potential content wise, but it must also capture the attention and motivation of the learners, otherwise the actual act of gaming could become voided and no longer serve a purpose.

> It is also very important that games offer a range of difficulty levels, starting with activities that are relatively easy in order to build players' confidence and mastery and give them a sense of success and enjoyment, but not so easy as to be trivial and boring. Also, each level should have enough different activities that players do not get anxious to move on to the next one before they are ready.
>
> (Infante, Weitz, Reyes, Nussbaum, and Gomez, 2008, p. 191)

By ensuring the game play is appropriate for the situation, instructors have a greater chance of full engagement, as well as continued engagement by the various learners.

Ensuring a Secure Digital Environment

    One of the considerations instructors should carefully think about before using digital gaming as a learning tool is providing a secure digital environment. If a digital game is Internet based or has networking components to it, it is important to realize the risks and take various precautions. Computer viruses are a common problem facing computer users on a daily basis. In a recent study, Teer, Kruck and Kruck (2007) used a simple survey of 100 undergraduate students. The researchers found that 47% of users surveyed had at least one virus detected in the past year. The article states, "The responses to the question regarding

the number of viruses students had experienced in the last 12 months indicated that 47 % of

the students had one or more viruses during the past year" (p. 105). Another study found

almost identical results for professional organizations. In 2008, Poremba reported, "A 2007

study of 494 IT security personnel conducted by the Computer Security Institute found that,

while the numbers are slowly decreasing, 46% of the respondents said their company

experienced a security incident in the past year" (Poremba, 2008, p.33).

Even secure commercial digital gaming servers have come under attack by cyber

criminals. Wingfield, Sherr, and Worthen (2011) of the Wall Street Journal reported on a

cyber attack that victimized users of the Sony Playstation network. Personal and financial

information of over 77 million people who play online games was illegally accessed. Sony

took down the network for a brief time and asked all users to be aware of unusual credit card

activities. In this instance, there was not much gamers could have done to avoid this

situation other than to simply not use the network.

With cyber crimes affecting nearly the entire world, governments have taken notice

of the damages caused by computer related crimes, and have started to respond. Sandham

reported in 2008,

> The US National Academy of Engineering has recognized the importance of securing
>
> cyberspace by declaring it one of 14 Grand Challenges for engineering, alongside
>
> such issues such as providing energy from fusion, preventing nuclear terror, and
>
> making clean water accessible to all. (Sandham, 2008, p.70)

Tremendous damages have occurred and computer users throughout the world have begun to

realize that protecting their computers should be as commonplace as locking one's door at

night.

Wireless computing adds an additional layer of risk to the security of an organization's computing environments. In the past, computer security experts only worried about the physical computing components and the users within the physical parameters of the organization, but with newer technologies have come newer threats. "The strength of a computer system's security is always measured by its weakest component. In most systems, the weakest components are the end users, particularly when they are accessing the corporation's databases with wireless facilities at home" (Loo, 2008, p. 68). End users sometimes turn off built-in wireless security to their routers in favor of accessibility. With many digital games using Internet technologies, as opposed to a more secure in-house network, the risk from a home end user caused security breach is rising.

Passwords and password-based encryption is a main tool for most computer securing professionals. Many systems require password changes at preset intervals with passwords that meet or exceed certain requirements. The learner or end user is seen as being the weakest link using this form of security. "In theory, users should use different passwords (and account names) for different accounts. In practice, many people use the same password for multiple purposes as it is extremely difficult to remember all accounts and passwords" (Loo, 2008, p. 69). Knowing this, hackers that have intercepted one password, usually from a less secure environment such as Facebook or Twitter, can use that password to find a user's password that can get them through much more secure systems, such as a corporate billing network.

Organizations with solid secure computing environments still need to deal with the users of those environments. A study done on computer users with at least ten years of experience found 87 percent of those users don't understand major security threats. Some of

the subjects even claimed knowledge of fictitious viruses (Schmidt, Johnston, Arnett, Chen, & Xi'an, 2008). Corporations have turned to awareness as a major combatant in the fight against security threats. "Corporations should educate their employees to the risks and appropriate countermeasures" (Loo, 2008 p. 70). Educating the end users not only can help the organization avoid many user caused security breaches, it can also explain why so many tedious measures must be taken to ensure a secure computing environment exists. The more the learners are aware of a risk the less likely they are to jeopardize a learning environment with reckless gaming.

Conclusions and Recommendations

Qualities and Beneficial Outcomes

Back to our young gamer and his epic battle, the champion was conquered, not by physical strength, but by perseverance. Through the motivating characteristics of the game, our young new champion studied each digital fighter such that he knew what was about to happen, perhaps even before the processor within the game knew. He used this knowledge to correctly hypothesize and take counter action as the game played out. Our young champion was truly in the *flow experience* and as such, was in a prime learning state.

When administered correctly, the benefits of using the digital realm of gaming for instructional purposes are plentiful. According to Jinn (2011), learners can become more engaged, motivated, and collaborative, which can all lead to the beneficial effects of the *flow experience*. We are living in an age where the majority of us use digital games on a weekly basis. Newer gaming technologies are even making sedentary digital games a thing of the past. According to Danforth (2011), challenging the body by using new gaming technologies such as the Wii can lead to the sharpening of cognitive skills. The potential positives of digital gaming are overwhelmingly present.

Negative Outcomes, Implementation, and Security

The negative aspect of digital gaming can be detrimental to participants. Health concerns, as well as some potential learners having limited interests, are all obstacles that need to be addressed before integrating digital games within a learning environment. Instructors must also be aware of the security risks that can come with digital gaming and take necessary precautions. Above all, in order for the digital game to be an effective

learning tool, the instructor must ensure that the content and the game play are appropriate for the given situation.

Recommendations

"The world has entered a bright new technology-driven era, yet the education system remains rooted in a gray industrial past" (Cohen, 2011, p. 16). Is it time for educators from all disciplines to realize the benefits digital games can offer a learning environment and begin to harness these powers to create optimal learning situations for today's learners? From commercial to educational, online virtual to simplistic, collaborative to stand-alone, sedentary to gross motor, digital gaming has proven its educational worth. The research reviewed suggests digital gaming can be beneficial within many educational disciplines. When choosing to implement digital gaming, instructors should consider the benefits and the negatives, as well as fully immerse themselves within the game before having a student use it. It is important to note that, as with the world, digital games will be forever evolving and the latest research should always be used to make informed decisions on the uses of digital game based learning environments. As digital gaming evolves so should the research, from mobile computing, to game consoles the research should always continue. Specifically, research should continue to find connections with positive outcomes and game play as this is the best way to demonstrate a specific game's effectiveness in the learning realm.

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