**Integrating Video Games in K-12 Curricula**

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Traditional classroom learning is not often considered fun, engaging, or meaningful. Seymour Papert asserts the reason students dislike school is because it is boring (1998). Video games are fun, engaging, and often include real world meaning within their gameplay (Squire, 2003). They almost always incorporate aspects of learning and instructional theories within or aligning with their design and functionality. Video games can engage a learner while instilling useful and transferable real world knowledge and skills (Papert, 1998). Many popular games, such as *Angry Birds*, *Age of Empires*, *Trauma Center*, and *SimCity*, include real world concepts like physics, history, anatomy, civic engineering, and economics. They use these knowledge bases as their fundamental building blocks for gameplay and storylines, but can be utilized in the classroom to teach the same knowledge in a creative and beneficial manner. Video games manage to keep the players interested and motivated to play, and *should* be used in the classroom to help students enjoy learning in a meaningful and creative way.

There are sound educational theories that can be associated with nearly every video game's design in some manner. Though games are not typically designed around educational theories, the theories align well with the designers' goals for keeping a player motivated and engaged. This alignment helps support the theoretical value games can contribute to instruction and learning. Robert Gagné's theory of instruction can be seen within many video games' designs, along with Lev Vygotsky's concepts of scaffolding and the zone of proximal development. Also included are concepts of self-efficacy and intrinsic and extrinsic motivational structures. In addition to good learning and instructional theories in the games themselves, the players tend to utilize modeling, self-regulating processes, and even experience what Csikszentmihalyi called *flow*, or "optimal experience" (1990). All of these elements are considered part of, essential for, or have a great impact on learning. Most importantly, they are

integrated within a technology that many people find to be fun, challenging, and inspiring. With all of these learning related ideas present in video games, it would seem appropriate to put these games to a productive and enriching educational use, thereby transforming learning from something dull and disengaging into something meaningful and motivating.

**What Are Video Games and Serious Video Games?**

To understand the role that video games can take in school systems, a video game must be defined. Though Merriam-Webster's online dictionary defines a video game as "an electronic game played by means of images on a video screen and often emphasizing fast action" (2012), a more accurate definition for the context of this discussion can be synthesized from Marc Prensky's key structure elements of games and the dictionary definition. Those elements include rules, goals and objectives, outcomes and feedback, conflict/competition/challenge/opposition, interaction, and representation or story. Prensky posits these elements are required for an activity to be considered a game (2001). Adding an electronic visual display and control system creates the video game. The fact that information is displayed graphically is important, not the device on which a game is played. This distinction is made for two reasons. First, the fast pace of technological advancement today means what we consider a platform for a video game to be played on may not be the same as it will be in five years. Second, the platform on which a video game is played is irrelevant to its usefulness in the classroom. Surely, some platforms will be considered superior for some games and objectives, while others will be more affordable, easier to learn and use, or more attractive in other ways. Therefore, video games are simply a game played that uses a graphical display, and they are typically used for amusement.

Educational video games follow the same general requirements for being considered a video game, but are used specifically for teaching and training purposes (Annetta, 2008).

Commercial video games, produced for entertainment purposes, have also been used in educational contexts. Serious video games include those developed specifically for educational purposes, such as *Quest Atlantis* (www.questatlantis.org), and commercial games used in an educational way. Rieber, Smith, and Noah (1998) provide an example of a serious video game while describing an economics lesson taught in high school with the aid of a commercial game originally intended for amusement, *SimCity*.

Although there have been arguments made for the effectiveness of serious games in schools (see Annetta, 2008; Randel, Morris, Wetzel, & Whitehill, 1992; Rieber et al., 1998), many, if not all, video games for amusement have similar designs that include solid learning and motivational theories. Adding the game experience to formal instruction will allow students to derive meaning from those games, transfer that experience to the classroom, and remain motivated to learn. The key to integrating video games into schools is to find popular games that contain the concepts an instructor intends to present and recognize the educational theories that align with the games' designs and the instructor's instructional theory beliefs.

**Cognitive Theory**

To utilize any technology successfully within education, there must be some underlying, sound, educational fundamentals within the technology. Identifying some of these fundamentals within video games can validate and legitimize its use in education. As an educational technology, video games can add value to formal instruction. Finding the value begins with a look into the theories that align with the design of video games.

One such theory is Robert Gagné's nine events of instruction, which Driscoll asserts must occur for learning to take place (Driscoll, 2005). Table 1 associates Gagné's events with common game design elements. Many games begin by gaining the attention of the player with a

short cinematic movie introducing the story, character, or a necessary prologue to give the game content a context. The player is often then presented with a sense of the overall objective of the game. Short-term objectives are often presented throughout the game as a series of goals required to continue the story. Most games offer a tutorial mode or weave a tutorial of game mechanics and control techniques into the first few minutes of play. As the player progresses through the game and new mechanics or techniques become available, many games include brief periods of hinting or guidance to familiarize the player with these new controls. After the player successfully performs certain tasks, greater challenges are often presented to allow forward progress. While the player is performing actions, a visual or auditory form of feedback is often given (e.g., hit markers, points awarded for the action, chime for time limits approaching). Almost all games keep track of a player's progress in the form of objectives met, new or hidden features found, gameplay statistics (e.g., accuracy, points scored, enemies defeated), or time spent playing. These are meant to be assessments to inform the player about his/her performance, though they usually do not impact the ability to progress through the game. At the end of each segment of the game, most games require the player to perform challenges or defeat difficult enemies, testing their mastery of the skills learned throughout the game. Some games also allow extra practice on skills that are not fully mastered or understood, especially before attempting the challenges at the end of each segment.

Table 1

*Gagné's Nine Events of Instruction with the Related Game Design Elements*

| Instructional Event | Game Element |
|---|---|
| **1.** Gaining attention | Initial cinematic introduction |
| **2.** Informing the learner of the objective | Overall game objective presented (e.g., "save the princess") |
| **3.** Stimulating recall of prior learning | Prologue |
| **4.** Presenting the stimulus | Game story |
| **5.** Providing learning guidance | Tutorial mode, beginning gameplay, hints/tips |
| **6.** Eliciting performance | Tasks required for progress |
| **7.** Providing feedback | Visual/auditory cues of success/failure of actions |
| **8.** Assessing performance | Score, statistics, time log |
| **9.** Enhancing retention and transfer | Replay availability, practice modes, earn new features/content |

An example of the nine events built into a popular video game has been described about the game *Tomb Raider: The Last Revelation*. Gee (2007) explained how a supporting character, Professor Von Croy, teaches the main character (the player), Lara Croft, how to play the game. He detailed the conversation between the two characters and how the instruction was built seamlessly into the game, activating event 5, or providing learning guidance. An example of event 7 can be seen while playing *Angry Birds.* The player receives informative feedback after each attempt at fulfilling the current stage's goal. The player pulls back a slingshot loaded with a bird character and attempts to destroy targets. Following the release of the slingshot, the arc the bird travels is displayed by a dotted line, allowing the player to reference the initial trajectory and compensate for future attempts.

To illustrate how an instructor can activate Gagné's events in a social studies class, a game, such as *Age of Empires*, that includes a campaign editor, can be used. Campaign editors are a tool in some games that allows the player to create a playable scenario that includes

designing the virtual environment and determining objectives and goals. In *Age of Empires*, the editor uses realistic, period appropriate military units and structures. An instructor could utilize the campaign editor within *Age of Empires* to simulate the Huns invasion of Europe. To add meaning, context, and engagement to a social studies lesson on the Huns, the instructor could then distribute the campaign to his/her students and allow them to "play history." The game has feedback components built into it, presents stimuli, and will enhance retention of the classroom material by allowing the students to actively participate. The instructor can build into the game an opening sequence to get the attention of the students and provide an list of objectives as the game begins, thus activating several of Gagné's events.

**The Zone of Proximal Development, Scaffolding, and Models**

In multiplayer games, guidance is rarely received from a formal instructor; rather players look to more experienced players. Especially in massive multiplayer online (MMO) games, players will join established groups of experienced players in an effort to develop their character and knowledge of effective strategies quicker than if they attempted to gain the same development and knowledge alone. This follows the exact idea of Lev Vygotsky's zone of proximal development (ZPD) (Vygotsky, 1978/1997).

Use of the ZPD in popular video games can be examined by looking at the genre of first person shooters. All multiplayer first person shooting games employ some mechanism for matching players and pitting them against each other. Many of these games use a system that pairs and pits players against other players within a small range (such as 5 ranks) above or below one another. This is typically done to create fair, balanced, yet challenging competition. More experienced players are able to try new tactics and refine existing skills against less skillful

opponents; while less experienced players have the opportunity to learn effective skills demonstrated by the more experienced players. Driscoll (2005) suggests that this partnership between the novice and expert is a positive force in learning and asserts the partners "should not be equal in terms of their present level of knowledge and skill. The more advanced partner, whether adult or peer, will function to bring about cognitive development in the less advanced partner" (p. 257). In direct relation, Driscoll explains this relationship is aligned with the concept of scaffolding.

Many video games contain scaffolding structures such as, limiting guidance, providing assistance as necessary, and gradually removing the guiding structures. The game *Command & Conquer: Red Alert* 3 is an excellent example. *Red Alert 3* is a real-time strategy game that places the player in command of a military force. The basic game play consists of gathering resources, constructing buildings to provide new troops, vehicles, and technology upgrades, amassing an army, and engaging the opposing forces to complete the mission goal. The game is broken into several missions, each with more complex or difficult objectives as the game progresses. In the early missions, the player is prompted on screen with the exact object to click on, and the associated action to take. On-screen hints and tips are provided to allow the player to learn the controls of the game and strategies and methods of basic gameplay. As the game continues through more missions, these hints become less frequent, only occurring when new actions or methods are available the player has not experienced before. Eventually these prompts are completely removed. Although the prompts are not displayed, the actions and methods first taught to the player are still required to successfully complete the mission objects. The player can, at any time, disable the hints if, for example, the player has already beaten the game once and is playing on a harder difficulty level. Gee (2005) describes the method of providing

information as needed, or wanted, stating that "games almost always give verbal information either 'just in time' – that is, right when players need and can use it – or "on demand", that is, when the player feels a need for it, wants it, is ready for it, and can make good use of it" (p. 36). Gee also claims this is how students should receive information at school.

To teach economics, the game *SimCity* has been used, as mentioned before, and it offers the ability to traverse the ZPD and provides scaffolding structures that can be enabled or disabled at anytime. The goal in *SimCity* is to create a well functioning city from the ground up. The player starts with a set amount of money and a plot of land. The player must take all sorts of financial elements of city planning into account, including natural disaster relief, police/fire resources, taxes, and the like. For the beginner, some of these services are automatically taken care of by the game, and after a player masters the easy scenarios, the player can manage these services him/herself. Expert players can also start with fewer funds and less land. An instructor can work with students at different levels and begin with easy economic principles that will allow any level player to succeed. As the principles become more complex, the players can add complexity (and less guidance) to their games to learn the economic principles with more depth and understanding. This allows instructors and students to take advantage of the built in scaffolding features of the game as the students more concretely understand the underlying economics.

In addition to the scaffolding features within games, players tend to use the concept of modeling while engaged in the activity. While there are typically no formal instructors in video games, new players will often find an expert to gain knowledge of the best methods to develop a character, ways of beating difficult bosses, or solutions to solving challenging puzzles. These models come in a variety of forms, just as a model for a particular educational lesson might be a

teacher, peer, sibling, or other person with knowledge about completing the lesson successfully. Some of these models for video games include video demonstrations of gameplay, such as a YouTube walkthrough (RovioMobile, 2009). Other models can include a commercially published player's guide or another person playing in the same location as the player.

To utilize the tendency for players to look for models to assist their understanding of complex problems and to reinforce self-regulation, an instructor can make use of video games while teaching about physics, for example, using the game *Bridge Constructor*. In this game, the player is given limited supplies (e.g. beams, upright supports, cables,) and an expanse that needs to be crossed. The instructor can provide resources detailing real-world examples of similar bridges to assist students in drawing their own designs. By demonstrating a level of the game while also explaining the concepts of triangles and their role in support, an instructor can provide the model for the students. By allowing students to collaborate on their own designs, their peers become the models. Each of these methods would help add meaning to the concepts. Instructors could have students who skillfully beat the levels demonstrate to their peers the methods they chose, why the methods were chosen, and how they came up with that idea and what external resources they may have used. In this manner, the creative use of the video game can assist an instructor in allowing students to refine their self-regulation.

**Self-regulation, Self-efficacy, and Motivation**

Self-regulation, self-efficacy, and motivation also exist in video games and the practices that many players follow. Many games allow players to determine the game's challenge level based on how skilled or experienced they are with games of that genre. Some games require the player to test their abilities and set the level after completing the assessment. Players can often

reevaluate their skill level and increase or decrease the difficulty after beginning the game. MMOs, such as *World of WarCraft*, allow players to customize their character to suit their skills or playing style. MMOs also tend to require the player to set his/her long-term objectives and interact with other players in a manner productive enough to make progress toward those objectives. These games typically do not have any predetermined "end," and allow a player to continue playing well after their character has reached the maximum "level" or experience rank (Gee, 2007). While MMOs are often open-ended and allow non-linear game play, novice players typically attempt quests that are outlined for the beginner; while expert players will find their own way through the game in a style they feel most comfortable and skilled. As their skill level increases, intrinsic motivation guides the novice toward attempting more challenging quests. This self-motivating behavior may be able to assist in education.

Prensky (2002) maintains motivation is one of the prominent issues in formal education. Prensky implies learning cannot occur without effort stating, "all learning requires effort, and, like crime, people rarely do it without a motive" (p. 5). He explains that students' motives in school combine intrinsic and extrinsic motivational components (e.g., goals and rewards) with psychological components (e.g., fears and needs). He also describes the motivation of video game players to include goals, rewards, and social status. Prensky adds that the experience while playing is the most powerful motivator. Gee (2003) believes video games are highly motivating for many people, and that we can learn from the games' motivational successes. Motivation, in Gee's opinion is the critical element that enables learning. He stresses that "when motivation dies, learning dies" (p. 3).

The motivational components video games use keep players engaged for many tens to hundreds of hours. The motivational factors include bragging rights amongst friends or other

players throughout the world and a personal sense of accomplishment and completeness. These factors are aligned with Maslow's (1943) hierarchy of needs, specifically the esteem and self-actualization needs.

The bragging rights factor mentioned corresponds well with the esteem need in that the player desires a sense of respect from other players. Many online games have symbols that are readily visible by a player's username that describe the player's experience level, and sometimes other achievements, to show other players how well he/she has performed. For example, the game *Battlefield 3* (an online, multiplayer first person shooter) shows the player a "kill screen" when killed by an opponent. This screen displays the opponent's experience level, proficiencies, and some achievements. Achievements are not uncommon in video games and are used as motivation to keep players engaged for longer periods of time (King, Delfabbro, & Griffiths, 2009).

The sense of accomplishment motivator falls in line with the self-actualization need. Probably the most motivating factor for playing a single player game (without an online component) would be a need to finish the game with 100 percent completion. Games like *Angry Birds* have multiple levels of completion. Each stage in the game has a "star rating," and depending on the amount of points earned when the player has successfully cleared the stage, a rating of one, two, or three stars is awarded. *Angry Birds* has special stages that are only available if you have earned three stars on every other stage. A player will play the game over and over until he/she has unlocked and completed the special stages. In the role playing game *The Elder Scrolls V: Skyrim*, a player can play for over 100 hours without ever beating the game to a 100 percent completion status. There is the main quest that will allow the player to "beat" the game when completed, however there are hundreds of side quests to attend to that have little

or no impact on the main story. The depth of several arcing storylines in *Skyrim* allows a player to wonder what else there is to find in the world.

By tapping into the motivation that players have to play video games, instructors can engage their students and provide a method for learning in an environment they want to spend time in. An instructor can utilize a popular game, designed specifically to keep a player engaged, to teach real-world concepts. For example, in the game *Trauma Center*, players must evaluate and treat patients with various injuries to different parts of their body, including the body's organs. An instructor could tailor lessons on anatomy and physiology to align with in-game tasks and patient scenarios, allowing users to see the simulated body parts and functions. The students can continue playing and describe an additional function/body part that relates to the lesson, and the scene within the game where they encountered that part. Using the game's designed mechanisms to keep the player engaged, the instructor would be able to augment a lesson that might be dense or bland with a fun and meaningful simulation after which the student is likely to want to continue playing, gaining more transferable knowledge.

By looking at video games as a tool to enhance classroom learning, instructors are able to provide a more enriching and thought-provoking experience. Using the educational theories embedded in video games and their ability to keep a player's attention, more meaningful learning can occur. For this to occur the video games used must align with the classroom objectives. If instructors can use the content from the game's story and the invoked actions of the player in a manner that augments the formal lesson, students will likely retain the knowledge and be able to transfer that knowledge to other real world situations. With that in mind, a look at the current

research on video games in education, the advantages and drawbacks, and implementation of this technology will determine their overall feasibility in the classroom.

**Current Research on Video Games in Education**

In most cases, the current research on video games in education presents positive results. Some cases, however, suggest there are no significant differences between the use of video games and traditional teaching methods. Studies have shown video games positively affect visual attention, spatial abilities, hand-eye coordination, and perceptual accuracy and speed (Barlett et al., 2009), along with motivation, appeal/enjoyment, and retention over time (Barab et al., 2012). There are also concerns about negative effects transferring from the use of violent video games. Some disadvantages in researching video games exist within an educational context (Griffiths, 2002).

Research suggests that incorporating games into education is not a new concept. In a review of research into the effectiveness of games in education, Randel et al. (1992) looked at studies conducted during the 1980's. The results of their research were mixed with positive influences of game use and insignificant differences between games and traditional methods. Their findings focused on student performance, retention over time, and interest. In regards to performance, half of the studies reviewed found no difference between games and traditional instruction, a third of the studies found differences in favor of games, and only 5% had differences in favor of traditional instruction. Looking at knowledge retention, the studies showed games created greater retention over time than traditional instruction. In addition, over 85% of the studies found that students reported a higher interest in the gaming activities than the traditional instructional activities. Randel et al. suggest the active participation in learning caused

by the student's engagement in games gives the knowledge a better chance of being retained. They also propose that classes with motivation issues would benefit from games.

Barab et al. (2012) found observations that support game-based learning and its ability to provide a more engaged and enjoyable educational experience. Using the *Quest Atlantis* program (www.questatlantis.org), their study found that students in a game-based group out-performed and were more intrinsically motivated than a more traditionally taught group of students. They reported the differences in levels of flow (Csikszentmihalyi, 1990) were found to be statistically significant (using a p-value = .10), with the students in the game-based group experiencing a much higher level of flow. Barab et al. also noted that students were more prone to work collaboratively in the game-based group, and that the students gained a sense of experiential consequentiality.

Barlett et al. (2009) found both positive and negative physiological and attitudinal effects of video games on students. They found that players had increased abilities in visual attention and spatial manipulation. They also presented findings providing evidence that students who played games they could relate to increased their self-knowledge and communicated that knowledge more openly. Their negative findings suggest that students who played violent video games had greater tendencies toward anger and hostility, and desensitization toward real violence. Barlett et al. also discussed evidence of exposure to the rapidly changing stimuli present in video games and its association with symptoms of attention disorders such as attention deficit hyperactivity disorder (ADHD). They argue that while many studies suggest such a link more research is necessary in this area.

Contrasting the suggestion that video games are negatively associated with ADHD by Barlett et al. (2009), a study by Farrace-Di Zinno et al. (2001) found video games help reduce

certain ADHD tendencies in adolescent males. They posit their findings support a suggestion that "when tests are attractive (activating), ADHD children are able to sustain attention for longer periods" (p. 616). Farrace-Di Zinno et al. also suggest that while it appears that interactive formats, such as video games, may assist instructors in maintaining these students' attention on tasks, there is a need for additional research.

Griffiths (2002) agrees with the beneficial aspect of video games on improving the focus of students with ADHD. Griffiths discusses a study with findings that show improved brain-wave patterns and attention spans along with decreased levels of impulsiveness and hyperactive behavior. Griffiths also mentions that parents of these students reported their children did better in school. In the study, the test group of students had no dropouts and less no-shows than the control group. In his research, Griffiths discusses issues when looking at video games in an educational research context. He suggests that video games cause excitement and thus create many confounding variables, including individual skills. He also poses the argument that, due to the fast-paced speed of video game evolution, it is "hard to evaluate educational impact across studies" and that "experience and practice may enhance a participants performance on particular games, which may skew results" (p. 48).

Both Rieber et al. (1998) and Whelan (2005) offer concrete examples of boosted engagement and motivation due to the integration of video games into their curricula. Rieber et al. describe a high school social studies teacher and his experience integrating the game *SimCity* into his lessons on economics. The instructor found students approached the coursework with great seriousness and would even run back to class to continue their work. Whelan also provides an example of a sixth-grade science and math instructor's use of the video game *WhyVille*

(www.whyville.net) to teach lessons on epidemiology. Whelan tells how the students would visit the library during lunch and after school to continue their work in *WhyVille*.

By looking at the positive and negative effects these studies have found, some trends start to appear. Some studies suggest video game usage may be linked to attention disorders, such as ADHD, and exposure to violent video games may increase the likelihood of violence or negative attitudes in children. Others position games as aids in reducing these tendencies. In addition, the positive aspects of video game use and, specifically, their use in an educational context seem to address the issue of engagement and motivation across the studies. The beneficial aspect of increased performance in areas of retention over time may be linked to the situated learning experienced. Many of the studies, both on the negative and positives sides, express more research studies are necessary to put forth any solid conclusions. Using the current research studies and advocacy for video game use, some recommendations follow for integrating video games into K-12 curricula as another method of bolstering student engagement, motivation, and information retention and contextualization.

**Recommendations**

As with many other innovations in education that share similarities with video games, there are challenges that educational institutions and systems would need to overcome to successfully integrate the new technology. These challenges can be met by providing theoretical and practical evidence of the beneficial potential video games have toward improving the overall quality of education and the promotion of life-long learning. Outlined within are recommendations for dispersing the supporting research and case studies, managing the financial

aspects of adding this new technology, and a discussion of tackling the inherent challenges students, teachers, and administrators may face.

To implement any innovation, Rogers (1995) asserts that the innovation must go through a process for each person involved in the decision to adopt. This diffusion model includes five stages:

1. *Knowledge* – learning that the innovation exists; how to use the innovation, and specifically how to use the innovation in an educational context; and how/why the innovation can achieve its intended purpose
2. *Persuasion* – determining personal beliefs about the innovation, confirmation/evaluation of the innovation by one's peers or colleagues; shaping or reshaping attitudes toward the innovation
3. *Decision* – making the choice to, or not to, adopt the innovation
4. *Implementation* – putting into practice the innovation; adapting or modifying the innovation as it is put into practice
5. *Confirmation* – evaluating the overall performance of the innovation; seeking confirmation of suspected outcomes of the innovation

Following these five stages in an effort to integrate video games into K-12 systems, it would be logical to begin by informing the decision makers about the educational value games can bring with them into the curricula. According to Groff & Mouza (2008), key decision makers for the adoption of new technologies in education include teachers, administrators, and parents of the students that would be affected by the innovation. It is important to inform these parties of the educational value, such as the theory and practice described in this paper, including the discussion of possible negative outcomes.

Teachers must be informed about the level of skill required for successful use of video games and the amount of personal time and effort that would be required for integration. Groff & Mouza (2008) express the importance in determining and making available and known the technological support avenues to teachers such as human and digital/online resources. This would include the technical administrators in schools and districts along with professional external support services for maintaining equipment, development of course materials, and training.

Administrators must also be informed of the educational value video games possess, but need to be informed of the barriers that teachers will undoubtedly face with the adoption of the innovation. Teachers need to have time for training, program development, and personal exploration of new technologies. They also need access to the physical technology; in the case of video games this could include consoles, computers, and tablets, along with the software/games. Administrators need to direct funding toward these activities and components. Along with funding, monitoring and assessing the ongoing needs is an important role of the administrator, especially since these games are a constantly evolving technology (Earle, 2002; Ertmer, 1999). Administrators must also support the use of the technology (Groff & Mouza, 2008).

The parents of students must also know that the how the use of video games in the classroom is not only play, rather that serious education is occurring. Griffiths (2002) believes that most parents would support the educational use of video games in classrooms. He suggests their support would depend on whether or not school subjects were being taught through the games.

Knowing about video games and their educational value is not enough to cause adoption. Many educators and administrators have personal beliefs or biases (Ertmer, 1999) that need to be

addressed. Trial periods of the innovation, small test groups, and opportunities to see the innovation in practice, such as visiting other teacher's classrooms or attending conferences covering the innovation, will help ease teachers' and administrators' apprehension (Ertmer, 1999; Sahin, 2006). Earle (2002) adds to the observational ideas of Ertmer by suggesting teachers gain experience using the technology. Affording teachers time to play games and find the connections to their curriculum would aid in softening biases against the innovation. Whalen (2005) suggests school librarians, due to their typical status as the most tech-savvy educators in schools, would be an excellent resource to show teachers how video games can be used as an instructional aid.

In addition to personal beliefs and biases, cost factors into the adoption of new technologies. To help address cost issues with new information technologies, Ertmer (1999) suggests funding can be obtained "through fund-raisers, donations, and grants, as well as through the formation of partnerships with businesses, universities, libraries, and community and vocational colleges" (p. 56). In addition to these suggestions, product manufacturers such as Apple (www.apple.com/education) and Microsoft (www.microsoft.com/education) offer education discounts, financing, and programs for adding video gaming technology into the classroom. Both companies offer free and paid resources for curriculum development and teacher training. By utilizing the multiple finance options and various resources available from the manufacturers, administrators can budget appropriately. Ertmer also offers suggestions for scheduled partial implementation of technologies if funding for a system wide implementation is not available.

Once the decision to integrate video games into the curriculum has been made, teachers and support staff must spend a great deal of time working the technology into their lessons

during the implementation phase. They need to ensure that using video games as an instructional aid is not just restating the same information that would be taught in a conventional method. Jayakanthan (2002) argues for games "to be truly effective, gaming should be thought of as an entirely new playing field and as a totally new canvas" (p. 101). To that effect, several researchers agree the most useful way to implement the new technology is to make sure the technology aligns to the curriculum rather than attempting to fit the curriculum within the technology (Carr-Chellman, 2012; Earle, 2002; Griffiths, 2002). Both Griffiths and Carr-Chellman offer cautionary statements about using video games in education. Griffiths warns that without proper knowledge of their use, video games may end up as toys rather than tools and that "care should be taken that enthusiastic use of [video games] does not displace other more effective techniques" (p. 50). Carr-Chellman supports the idea of using main-stream recreational games over educational games under the notion that kids can tell what is and is not an educational game, and that they want nothing to do with them. She expresses her recommendation for using commercial video games by "working [video games] into the curricular objectives, state standards, and federal core competencies" (p. 49). Carr-Chellman also declares there is not enough time in the curriculum for students to learn to play many of the complex games. She offers the idea of assigning the gameplay as homework and having students write reflections on their experiences and achievements to be discussed later in the classroom. With the pressure of high-stakes exams and a long list of standards teachers must attend to, Carr-Chellman's suggestion may be an attractive option for some teachers and may alleviate some concerns over video games being used as a toy rather than a tool. This presents a new challenge that needs to be researched. How do students obtain the proper equipment for home use? Manufacturers offer student discounts, although that may not be enough.

After integrating video games into the curriculum, confirmation would be sought to ensure the educational benefits are truly being realized. Teachers should monitor and assess students' progress and evaluate whether or not the students are performing at or above previous students' levels. Surveying students about their experience, reading student reflections, and measure student engagement would provide teachers and administrators with a sense of the technology's overall effectiveness. The discussion by Rieber et al. (1998) of the high school teacher's use of *SimCity* to teach economics lessons included the teacher's confirmation that video games had positively influenced his students' engagement and motivation. The teacher described it as surprising how serious his students' attitudes were toward the project and their enthusiasm to return to the project. In addition, as with any method or strategy, teachers must revisit their lesson plans and assess, modify, or update their technology use as newer technology becomes more widely accepted.

When looking at the journey video games must take through Rogers' (1995) diffusion model, a look at computer technologies can help demonstrate the overall challenges video games may face. Computer technologies have been successfully integrated, in some form or another, into the majority of classrooms and education systems (Gray et al., 2010). Though now used throughout, computer technologies suffered from the same barriers video games face (ChanLin, 2007; Earle, 2002; Ertmer, 1999; Granger et al., 2002). Earle talks about the use of computers by educators in the late 1990's and states that "fewer than half of the teachers used computers for instructional purposes, rather than word-processing, spreadsheets, or graphics for personal productivity only" (p. 7). In Gray et al.'s report covering statistics of computer use in 2009, 97% of teachers sampled had computers in their classroom, and 40% reported using them often during instructional time. In addition, 29% of teachers reported using computers at least some of the

time during instructional time. Computer technologies managed to overcome the challenges now facing video games, and became a viable, useful tool for education.

**Conclusions**

Can, and should, video games truly be integrated within K-12 curricula? It would appear they have already begun the process and provide great potential for engaging students in meaningful, situated learning (Barab & Dede, 2007; Whalen, 2005). The key to unlocking this potential is to take care during the implementation. Video games need to be carefully selected and fit into, or aligned with, current curricular objectives and they must be used as an aid and not the only source of instruction.

If video games are to be used by instructors, not only should care be taken with their use and implementation, but efforts to assist, train, and support the instructors is a necessity. As with any new technology, users must be taught how to use it effectively. Proponents of video games in education believe that good use of video games in classroom environments requires teachers to become well versed in gaming and gaming cultures (Griffiths, 2002; Guyne, 2007). Like anything else in the world, all of this costs money. Proper financial support from administrators is absolutely crucial to fully integrate video games into curricula. Some costs can be lessened or removed altogether by taking advantage of technology grants, along with discounted hardware and software from manufactures, business partnerships, and many free curriculum development programs from major retailers.

If training, resources, and support can be provided to instructors and administrators, video games certainly appear to be a feasible addition to instruction and a realistic source of motivation and engagement. With this being said, video game use needs to be studied in more

depth. Longitudinal studies would be helpful for determining any possible, concrete, long-term effects along with gauging a student's retention of material. However, the current research studies and attitudes of researchers show great promise.

By empowering students to take control of their learning and actively participate in the knowledge creation or discovery, they are able to learn the life-long skill of *how to learn* (Papert, 1998). Whelan (2005) describes teachers' fears about giving students charge of their own learning, thereby lessening their role as the decision maker in the classroom. She states, however, "educators need to accept that gaming technology does work in the classroom" (p. 4). Now is the time to implement video games and grow with them as they mature in the world of academia (Whelan, 2005).

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