

Literature Synthesis for Applying Research

Impacts of playing video games on learning in children

EDIT 6900
Dr. Janette Hill

Spring 2006

March 29, 2006

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Introduction

It has been fascinating for me to watch my 6-year old nephew playing video games since he was three. Many family members have expressed their concerns regarding the number of hours he spends playing video games, about consequences related to his social and behavioral development, and so forth. Thus far, we see no negative influence in his social and behavioral outcomes. According to his mother, he learns Bible stories by playing video games, and he has even learned how to read through a video game. His mother who is a high school teacher is a strong believer in using computer or video games for children in learning. She also stated that more educationally structured computer or video games are needed for young children. Ironically, the video games that taught my nephew how to read were not considered “educational” games.

I have another nephew with severe learning disabilities, Attention Deficit/Hyperactivity Disorder (ADHD) being one of them. The only thing that keeps him focused and stable for more than 30 minutes is playing computer or video games. His caregiver has tried different games to engage him with learning. Regardless of the caregiver’s strong belief in using games for him to learn simple arithmetic, he has not made significant progress yet on learning basic mathematics. Nonetheless, the caregiver insists that it is because there are not many computer and video games that are designed for children like my nephew with severe learning disabilities regardless of whether or not the games are educational.

It is commonly known that the average attention span in young children or children with learning disabilities is very limited. Considering that, it is amazing to watch my nephews intensively playing video games for hours at a time. According to

VanDeventer & White (2002), an average child (not an advanced video game player) may spend from 50 to 300 hours annually playing video games and that by the age of 10, a child may have had thousands of hours of experience with video games. It is no surprise that the video game market grew in annual sales from \$100 million in 1985 to \$4 billion in 1990 (Emes, 1997) and \$7 billion in 2005, more than doubling sales within the software industry since 1996 (Entertainment Software Association, 2006). Today, it is obvious that children spend a lot of time playing video games and their parents spend a lot of resources providing their children or even themselves with video games in America and worldwide.

While it does not seem realistic to prohibit children from playing video games, researchers have attempted to answer questions for concerned parents, caregivers and educators: “Are video games harmful to our children?” (Emes, 1997, p.409), “Do children who play video games learn better than peers who do not?” (Din & Calao, 2001, p.98), “Can video games be a useful tool in promoting learning within the classroom?” (Rosas et al., 2003, p.71), “What are the consequences of game play on the cognition of those who play them?” (Squire, 2004, p.34), “Can meaningful learning occur while children play video games?” and so forth.

To start exploring the potential impact or implications of playing games at a young age, I informally interviewed several adult game players. They indicated that they started playing video games when they were between 8 and 10 years of age. They stated that they typically prefer playing video games with friends and acknowledged that playing games with friends is a valuable social activity. They also admitted that violent contents or other negative contents might influence young audiences in negative ways. At

the same time, they also acknowledged potential positive impacts of playing video games on problem-solving skills, decision-making skills, and cognitive development.

That leaves me with an overarching question: If children can learn something and/or benefit from playing video games, why should we not find a way to facilitate and guide the activities?

Research Questions

I intend to synthesize potential advantages and disadvantages for children who play video games in regard to learning, cognitive development, and social and behavioral issues. More detailed research questions are as follow:

- Can meaningful learning occur while children play video games?
- What are the positive and negative consequences of game play on children?

Methods

In this review, the term *video games* is used to refer to electronically controlled games played on any platform such as computer, over the Internet, handheld devices, console systems, and various game-like technology toys. I originally narrowed this research focus to young children between ages 3 and 8. However, it has been extremely difficult to locate such literatures with credible authors. Therefore, I have expanded the focus to include studies targeting children at any elementary school age or younger.

Literature searches have been conducted through the GALILEO databases including *Education Full Text*, *ERIC*, *Psyc INFO* and *Web of Science*. I also have found *Google Scholar* useful for locating more general articles or documents. I have used the following search terms to identify relevant literature: children and video game, children

and computer game, children, violence and video game, children, and cognition and video game.

In addition, an online journal *Innovate* was thoroughly reviewed for potential literature since the journal featured “gaming and education” in multiple occasions. I also solicited Dr. Lloyd Rieber, a professor in Instructional Technology at the University of Georgia, and Michael Barbour, a doctoral candidate in Instructional Technology at the University of Georgia, for advice in locating such literatures. *The Journal of Computing in Childhood Education* was reviewed as recommended by Dr. Reiber, and he also led me to a book chapter written by Dr. Yasmin Kafai (1994). Michael Barbour recommended an electronic journal, *Games and Culture* from Sage Publications and *Innovate*, and an online magazine *Game Developer Magazine*. He also offered his collections of gaming literatures that are related to education. As a result, I located over 40 peer-reviewed publications and many other related documents and articles to write this literature synthesis.

Literature Synthesis

The influence of video games has been one of the most controversial issues regarding children. Some researchers have proposed that children could become violent by playing video games and children could also become less sociable as a result of playing video games (Griffith, 1999). By contrast, Squire et al. (2005) found playing games (a computer game, *Civilization III*, in this case) to be fundamentally a social experience with every participant showing a desire to share his or her game play with other people. In order to understand consequences of playing video games on children, it

is important to understand today's children, "the new generation", and how they are different from their predecessors.

The New Generation

The average American child grows up in a home with two televisions, three tape players, three radios, two VCRs, two CD players, one video game player and one computer (Kaiser Family Foundation, 2005). According to parents, children between the ages of 2 and 17 spend almost 6½ hours a day in front of electronic video screens – television, video games or a computer (Woodward & Gridina, 2000). A study of over 2,000 young persons ages 8 to 18 years (3rd through 12th graders) found that 83% of them have at least one video game player in their home, 31% have 3 or more video game players in their home, and 49% have video game players in their bedrooms (Roberts, Foehner, and Rideout, 2005 as cited by Institute on Media and the Family, 2001).

According to Prensky (2001b):

Our children today are being socialized in a way that is vastly different from their parents. The numbers are overwhelming: over 10,000 hours playing video games, over 200,000 emails and instant messages sent and received; over 10,000 hours talking on digital cell phones; over 20,000 hours watching TV, over 500,000 commercials seen – all before the kids leave college (p. 1)

Prensky (2001a) uses the term ***Digital Natives*** to refer to today's children: 'They – K through college – are all "native speakers" of the digital language of computers, video games and the Internet' (p.1). Recently, more researchers have shared the similar notion that there is a new generation entirely different from their predecessors and those differences are driven by one central factor: growing up playing video games and

surrounded by other electronic media (Beck & Wade, 2004; Carstens & Beck, 2005; Kirkley & Kirkley, 2005; Shaffer, Squire, Halverson, & Gee, 2005; Gros, 2003; Simpson, 2005).

According to Prensky (2001a), it becomes clear that as a result of this ubiquitous environment and the sheer volume of their interaction with it, today's children think and process information fundamentally differently from their predecessors. Therefore, they are no longer the people our educational system was designed to teach. This new generation – *Digital Natives* – is accustomed to the twitch-speed, multitasking, random-access, graphics-first, active, connected, fun, fantasy, quick-payoff world of their video games, MTV, and Internet (Prensky, 2001b). Of the ubiquitous environment that today's children are exposed to, this paper is focused on video games and synthesized foundations of the relationship between video games and well-known learning theories in the next section.

Foundations of Video Games and Learning

Rieber, Smith & Noah (1998) introduce two distinct applications of games in education: game playing and game designing. Whereas game playing is the traditional approach where one provides ready-made games to students, game designing assumes that the act of building a game is itself a path to learning. Learning by designing is a central idea in constructivism (Harel & Papert, 1990, 1992; Perkins, 1986 as cited by Rieber, Smith, & Noah, 1998) and game design is beginning to attract attention in the constructivist literature (Kafai, 1992, 1994a, 1994b as cited by Rieber, Smith, & Noah, 1998). Nonetheless, the scope of this paper is limited to the “playing” aspects of video games in relation to learning.

Play is one of the most natural and spontaneous activities for young children (Curry & Arnaud, 1995). Rieber, Smith & Noah (1998) assert that play is derived from the longstanding goal in education of how to promote situations where a person is motivated to learn, is engaged in the learning act, is willing to go to great lengths to ensure that learning will occur, and at the same time finds the learning process to be satisfying and rewarding; therefore, play is an essential part of the learning process throughout life and should not be neglected. Rieber, Smith, & Noah (1998) call it “serious play” to refer to a special kind of intense learning experience in which both adults and children voluntarily devote enormous amounts of time, energy and commitment and at the same time derive great enjoyment from the experience.

This kind of play is an ideal construct for linking human cognition and educational applications of technology. It is important to note that for many of today’s children, the chosen form of play is video games (VanDeventer & White, 2002) as more children play video games for longer periods of time and the average age that a child starts playing video games is getting much younger now a days. Kaiser Family Foundation conducted random-digital-dial telephone survey of more than 1,000 children and their parents (2003): 30% of children ages zero to six have played video games; by the time they are preschoolers, 16% of children are more likely to play video games on a daily basis (24% of boys; 8% of girls).

Although the primary purpose of video games is entertainment, the underlying design employs a variety of strategies and techniques intended to engage players in “gameplay” (Dickey, 2005). Research into psychological and sociological benefits of play also revealed that games support intrinsic motivation as well as opportunities for

imitation and learning by providing feedback, fantasy, and challenges (Rieber, 1996). Gee (2005) argues that good commercial video games are already state-of-the-art learning games because they have been so successful in attracting and maintaining players. Although the games are often long, hard and complex, it is clear that commercially successful games appear to have solved this central paradox of learning.

The theoretical foundations of engaged learning can be found in both cognitive and constructivist perspectives. Research from a constructivist perspective focuses on the relationship between the player-learner and the environment, and the social aspects of the design, whereas research from a cognitive perspective focuses on the internal aspects of motivation and schema as fostered by design (Dickey, 2005). It is productive to view these perspectives as mutually complementary points of view (Sfard, 1998).

Conceptualized by Piaget (1970) but also applied within the work of other influential figures such as Vygotsky (1978), Biggs (1999), and Wenger (1998), constructivist theory suggests that learning is intrinsically linked to learners' sense of identity. While playing video games, learners come to know themselves and what they are becoming through personal experience and critical reflection on their beliefs about the world in which they live and the domains in which they hold affective agency (Begg, Dewhurst, & Macleod, 2005). By creating virtual worlds, games integrate knowing and doing. Games bring together ways of knowing, ways of doing, ways of being, and ways of caring: the situated understanding, effective social practices, powerful identities, and shared values that make someone an expert (Shaffer et al., 2005). Too often, "fun games are designed and instructional designers come in and suck all the fun out of it" in the quest to meet instructional goals (Kirkley & Kirkley, 2005, p.43). With advances in

technologies, there are exciting opportunities to design learning environments that are realistic, authentic, engaging and extremely fun (Kirkley & Kirkley, 2005).

Some researchers have proposed criteria for the elements that make video games effective on attracting and engaging players and retaining their attention. For example, according to Rosas et al. (2003), the most highlighted features that make video games effective are as follows (p.75):

- A clear goal: almost all video games are goal-related; the games have a clear and specific goal that children must try to reach (e.g. rescuing the princess, etc.)
- Adequate level of complexity, not too low but not too high
- High speed: most video games have a much faster speed than traditional mechanical games
- Incorporated instructions: in most video games, children are given instructions while playing the game and do not need to read instructions
- Independence from physical laws: video games normally do not follow the physical laws of the nature
- Holding power: they capture players' attention and continue to do so as the game builds a microworld with its own rules and regulations

Therefore, enjoyable educational video games must include elements of 1) challenge: clear, meaningful and multiple goals, uncertain outcomes, variable difficulty levels, randomness, and constant feedback, 2) fantasy: a character with whom players can identify, use of an emotionally appealing fantasy directly linked to the activity, and use of metaphors, 3) two types of curiosity: sensory curiosity (audio and visual effects) and

cognitive curiosity (surprises and constructive feedback) (Beltra, 1990; Kafai, 1997; Lepper & Malone, 1987; Malone, 1980 as cited by Rosas et al., 2003).

Findings from Research Studies

Like books, movies, and television show, video games can be used in antisocial ways. Games are inherently simplifications of reality, and current games are often associated with violent and sometimes misogynistic themes (Shaffer et al., 2005). As Griffiths (1999) points out, one of the main concerns that has constantly been raised against video and computer games is that most of the games are claimed to feature aggressive elements. This has led some critiques to state that children become more aggressive after playing such games (Koop, 1982; Zimbardo, 1982 as cited by Griffiths, 1999). However, these assertions have been made without adequate empirical support.

As cited by VanDeventer & White (2002), earlier studies of “non-educational” video games have focused largely on issues of sex stereotypes, aggression, and equity and culture. Some studies have examined motor and spatial skills, simulation and tracking tasks. For example, a study by Irwin and Gross (1995) sought to identify effects of playing an “aggressive” versus “non-aggressive” video game on second-grade boys identified as impulsive or reflective. Boys who played the aggressive game, compared to those who had played the non-aggressive game, displayed more verbal and physical aggression to inanimate objects and playmates during a subsequent free play session. Moreover, these differences were not related to the boys’ impulsive or reflective traits.

Kirsh (1997 as cited by Cesarone, 1998) also investigated the effects of playing a violent versus a non-violent video game. After playing these games, third- and fourth-graders were asked questions about a hypothetical story. On three of six questions, the

children who had played the violent game responded more negatively about the harmful actions of a story character whose intent was ambiguous than did the other children. These results suggest that playing violent video games may make children more likely to attribute hostile intentions to others.

Nonetheless, Funk, Germann, and Buchman (1997) state that there is insufficient laboratory research to support strong causal statements about the effects of playing violent video games on children's aggression based on a review of video game research in the 1980s and 1990s. They note that in studies that use behavioral observation to measure aggression, trends suggest some increases in aggression after children play or watch violent games. However, these trends are not so clear in studies that use other measures of aggression (e.g. measuring children's willingness to help or hurt another child). According to Griffiths (1999), a growing number of studies examining the effects of video games on aggression have only involved a measure of possible short-term aggressive consequences. The majority of the studies on very young children – as opposed to those in their teens upwards – tended to show that children do become more aggressive after either playing or watching a violent video game but these were all based on the observation of a child's free play. There is much speculation as to whether the procedures to measure aggression levels are valid and reliable.

An interesting study was conducted by Fortis-Diaz (1998) on children's aggressive behaviors after watching or playing violent contents through video games, television or any other media. She observed her kindergarten students during several periods of free play. Particular attention was given to the occurrences of aggression in their play and the circumstances surrounding them. Different strategies were

implemented in an effort to redirect the aggressive acts after watching or playing video games which may or may not include “violent contents”. She reports a slight decline in the children’s aggressive play. She concludes that “we can do something to help redirect the aggression that they are so ready to imitate, if we just take the time to watch and guide” (p.237).

On the other hand, studies of “educational” games have primarily examined design, cognitive and curriculum aspects (VanDeventer & White, 2002). Din and Calao (2001) conducted a study with 47 preschool age children from two classes of an urban school in the northeastern region. The experimental group who played educational video games showed significant increase in spelling and decoding areas than the control group but no difference was found in the math area. The authors concluded that playing the Lightspan educational video games for these young students might have played a facilitative role in their learning of the verbal skills, which are age appropriate tasks for them. However, the experimental group did not show significant improvements in math perhaps because these children were not ready in terms of maturity.

A similar study was conducted by Rosas et al. (2003) in Santiago de Chile with 1,274 first- and second-grade students, their 30 school teachers, and directors of six schools. The authors used mixed quantitative and qualitative methods over a 3-month period. Although no significant differences were found in academic performance that would suggest a relationship with playing video games, teacher reports and classroom observations confirm an improvement in participants’ motivation to learn, and a positive technological transfer of the experimental tool. The authors concluded that further studies regarding the effects of learning through videogame use are imperative. However, they

acknowledge positive effects on motivation and classroom dynamics indicating that the introduction of educational video games can be a useful tool in promoting learning within the classroom.

In the similar notion, Squire et al. (2005) conducted design-based research attempting to find consequences of game play on the cognition of those who play them. Eleven elementary students who were African-American and socio-economically challenged attended twice a week in two-hour sessions and were observed and interviewed for five weeks. The authors argue that these children developed expertise in playing the historical simulation game *Civilization III* as a form of digital literacy. This study suggests that expert strategy simulation game knowledge is a flexible, systemic level understanding of a game system rather than a simple heuristic understanding. All participants reported increased knowledge of maps, timelines and historical terms and, as has been hypothesized by game theorists, factual knowledge “came for free” for these players. Children playing in pairs led to increased engagement as they had 1) someone with whom to discuss strategies, leading to greater reflection and less confusion and 2) someone to share in struggles, leading them to not “blame themselves” for their confusion. Game play was fundamentally a social experience and every participant showed a desire to share his/her game play with other people. The multiplayer game format amplified interest for most male players. This finding suggests the potential value of collaborative/competitive multiplayer games for literacy. The role of the facilitators as expert game players thoroughly mediated gamers’ experience.

Another approach of determining educational effects of playing video games was introduced by VanDeventer and White (2002). They conducted a study investigating the

display of “expert” behavior by outstanding video game-playing children. Seven highly proficient, video game playing, 10- and 11-year-old children were observed in the act of teaching adult “foils” how to play one of two popular home video games. The evidence indicated that the children demonstrate expert behaviors. The authors assert that this finding has significant potential import for educators because it may be possible to leverage these expert skills to more commonly valued academic domains. For example, can pattern recognition skills demonstrated in video game play be applied to pattern recognition in mathematics and science?

Conclusion

As indicated in *the New Generation* section, it is clear that today’s children live in a whole different world than the one in which their parents and teachers grew up. Like it or not as a parent or a teacher, children play video games and will continue to play them. As Carstens and Beck (2005) state, “sooner or later, those who grew up without video games will have to understand the gamers” (p.22) which means not only learning what encourages them to learn and how they learn, but also finding ways to redesign educational and training curricula around their needs.

This paper provides a strong foundation of video games in relation to learning and suggests potential benefits that well-designed video games can bring to the community of practice (parents, teachers, educators, researchers and students/children). As cited in *the Foundation of Video Games and Learning* section, many studies suggest that good video games engage children and sustain their attention for a longer time than any other educational environment can. The question is whether or not we, as parents, teachers,

educators and researchers, are ready to support learning for the new generation in the ways that today's children are accustomed to.

As we know there is no one perfect standardized environment for our children to learn and live and there never will be, and worst of all, the world is continually shifting on us: Are we ready to guide our children of the new generation in the ever-changing world? In the past, I have not believed in exposing young children to multimedia especially video games. However, I am beginning to believe that there might be something that we, as adults who did not grow up with the same kinds of multimedia and technologies that are presently available, simply do not understand.

Implications for Practice

Are you ready for the game generation?

Prensky (2001b) defines that “those of us who were not born into the digital world but have, at some later point in our lives, become fascinated by and adopted many or most aspects of the new technology are *Digital Immigrants*”(p.1) as opposed to the new generation of *Digital Natives*. As video games become a bigger influence on our culture, we will need to pay attention to the ins and outs of what gamers are thinking not only today, but also tomorrow. It is going to take some effort, but in the end, it will keep you in the game (Carstens & Beck, 2005).

Shaffer et al.(2005) assert that our children will learn from video games. This interest in games is encouraging, but most educational games to date have been produced in the absence of any coherent theory of learning or underlying body of research. We, as researchers and educators, need to understand 1) how the conventions of good commercial games create compelling virtual worlds 2) how inhabiting a virtual world

develops situated knowledge 3) how game players develop effective social practices and skills in navigating complex systems and 3) how those skills can support learning in other complex domains. Video games have the potential to change the landscape of education as we know it.

According to the survey conducted by Kaiser Family Foundation (2003), whereas 72% of parents of young children (ages six years or younger) believe that using a computer “mostly helps” children learn, and just 5% believe that it “mostly hurts”, parents are less enthusiastic about the educational value of video games than any other medium – computer, Internet and television – addressed in this survey. 40% of parents from the same group believe video games mostly hurt children’s learning, 22% think they mostly help children’s learning, meanwhile 27% believe they don’t have much effect one way or the other. Parents of older children (ages 8 through 18) think either they do not feel that their children spend too much time playing with electronic media including video games or they have given up trying to discourage them from playing (Kaiser Family Foundation, 2005). Nonetheless, parents are the driving force behind the video game industry (Simpson, 2005). In 2004, over 50% of parents polled said they were going to buy their child a video game for Christmas (Entertainment Software Association, 2004 as cited by Simpson, 2005). Today’s parents are clueless as to what their children are doing with the video games that they are so eager to buy.

The majority of today’s teachers are women (79%) with an average age of 46. In some states, 60% of the teachers are over 50 (National Center for Educational Statistics, 2003). Teachers typically do not see the video game as a learning tool. Many school leaders and teachers react negatively to video games and gaming culture, bashing video

games as diversionary threats to the integrity of schooling or as destructive activities that corrupt moral capacity and create a sedentary, motivation-destroying lifestyle (Halverson, 2005). While teachers are working within an environment where change tends to be slow, money scarce and bureaucracy plentiful, their students are living in an environment where change is rapid, constant and anticipated (Simpson, 2005). The success of video games at motivating students suggests that schools may bring gaming in from the periphery to reconsider the institutional barriers to change. Simply recognizing games as potent learning environments would be a start for counteracting the current anti-gaming rhetoric. Schools can then take steps to incorporate gaming principles in the design of school learning environments (Halverson, 2005).

As a parent, teacher, or educator, Prensky (2006) suggests taking these seven steps to ensure your children's education and future (pp.141-149):

- Educate yourself by locating sources of positive information about digital kids, about video gaming, and what your kids are learning from their games and by getting a feel for what it's like to learn from games
- Start asking your kids the right questions: ask open-ended questions that show you are truly curious to find out about what they are involved in.
- Educate your family by sharing articles and quotes
- Look over your kid's shoulder (with permission)
- Go game browsing with your kids
- Play a game or two yourself
- Help organize LAN parties and/or start a game club: this is a radical solution for those who really get into games

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