Video Games in Education

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ABSTRACT

Computer and video games are a maturing medium and industry and have caught the attention of scholars across a variety of disciplines. By and large, computer and video games have been ignored by educators. When educators have discussed games, they have focused on the social consequences of game play, ignoring important educational potentials of gaming. This paper examines the history of games in educational research, and argues that the cognitive potential of games have been largely ignored by educators. Contemporary developments in gaming, particularly interactive stories, digital authoring tools, and collaborative worlds, suggest powerful new opportunities for educational media.

VIDEO GAMES IN AMERICAN CULTURE

Now just over thirty years old, video games have quickly become one of the most pervasive, profitable, and influential forms of entertainment in the United States and across the world[1]. In 2001, computer and console game software and hardware exceeded $6.35 billion in the United States, and an estimated $19 billion worldwide (IDSA 2002). To contextualize these figures, in October 23, 2001, the Sony PlayStation system debuted in the US, netting well over $150 million in twenty-four hours, over six times the opening day revenues of *Star Wars: The Phantom Menace*, which netted $25 million. Twenty-five million Americans or, one out of every four households, owns a Sony Playstation (Sony Corporate website 2000). Not only are video games a powerful force not only in the entertainment and economic sector, but in the American cultural landscape, as well.

[1] There may be distinctions between the technical features and cultural significance of computer and video games that are worth exploring when discussing games in education, but for the purposes of this paper, they will both be treated as "video games" to simplify matters.

Nintendo's *Pokemon*, which, like *Pac-Man and The Mario Brothers,* before it, has evolved from a video game into a cultural phenomena. In the past few years, *Pokemon* has spun off a television show, a full feature film, a line of toys, and a series of trading cards, making these little creatures giants in youth culture.

Given the pervasive influence of video games on American culture, many educators have taken an interest in what the effects these games have on players, and how some of the motivating aspects of video games might be harnessed to facilitate learning. Other educators fear that video games might foster violence, aggression, negative imagery of women, or social isolation (Provenzo 1991). Other educators see video games as powerfully motivating digital environments and study video games in order to determine how motivational components of popular video games might be integrated into instructional design (Bowman 1982; Bracey 1992; Driskell & Dwyer 1984). Conducted during the age of Nintendo, these studies are few in number and somewhat outdated, given recent advancements in game theory and game design. These studies also tend to focus on deriving principles from traditional action (or "twitch") games, missing important design knowledge embodied in adventure, sports, strategy, puzzle, or role-playing games (RPGs), as well as hybrid games which combine multiple genres (Appleman & Goldsworthy 1999; Saltzman 1999). Likewise, they fail to consider the social contexts of gaming and more recent developments in gaming, such as the Internet.

In this paper, I argue that video games are such a popular and influential medium for a combination of many factors. Primarily, however, video games elicit powerful emotional reactions in their players, such as fear, power, aggression, wonder, or joy. Video game designers create these emotions by a balancing a number of game components, such as character traits, game rewards, obstacles, game narrative, competition with other humans, and opportunities for collaboration with other

players. Understanding the dynamics behind these design considerations might be useful for instructional technologists who design interactive digital learning environments. Further, video game playing occurs in rich socio-cultural contexts, bringing friends and family together, serving as an outlet for adolescents, and providing the "raw material" for youth culture. Finally, video game research reveals many patterns in how humans interact with technology that become increasingly important to instructional technologists as they become designers of digital environments. Through studying video games, instructional technologists can better understand the impact of technology on individuals and communities, how to support digital environments by situating them in rich social contexts.

LEARNERS AS "PAC-MAN" PLAYERS: USING VIDEO GAMES TO UNDERSTAND ENGAGEMENT

Since the widespread popularity of Pac-Man in the early 1980s, some educators have wondered if "the magic of 'Pac-Man- 'cannot be bottled and unleashed in the classroom to enhance student involvement, enjoyment, and commitment" (Bowman 1982, p. 14). A few educators have undertaken this project, defining elements of game design that might be used to make learning environments more engaging (Bowman 1982; Bracey 1992; Driskell & Dwyer 1984; Malone 1981). Through a series of observations, surveys, and interviews, Malone (1981) generated three main elements that "Make video games fun": Challenge, fantasy, and curiosity. Malone uses these concepts to outline several guidelines for creating enjoyable education programs. Malone (1981) argues that educational programs should have:

- clear goals that students find meaningful,
- multiple goal structures and scoring to give students feedback on their progress,
- multiple difficulty levels to adjust the game difficulty to learner skill,
- random elements of surprise,
- an emotionally appealing fantasy and metaphor that is related to game skills.

In a case study of *Super Mario Brothers 2,* Provenzo (1991) finds this framework very powerful in explaining why *Super Mario Brothers 2* has become one of the most successful video games of all time. Bowman's checklist provides educators an excellent starting point for understanding game design and analyzing educational games, but at best, it only suggests an underlying theoretical model of why games engage users.

Bowman (1982) offers a very similar framework to Malone, developed through an analysis of *Pac-Man* players. Using Csikzentmihalyi and Larson's (1980) discussion of "flow," Bowman describes the power of video games as their ability to place users in "flow states; " That is,

> It (Pac-Man) is an action system where skills and challenges are progressively balanced, goals are clear, feedback is immediate and unambiguous, and relevant stimuli can be differentiated from irrelevant stimuli. Together, this combination contributes to the formation of a flow experience (Bowman, 1982 p. 15).

"Pac-Man," players are in control of their actions, actively pursue their own goals, are challenged to the optimal extent of their abilities, and they are given clear feedback on their performance. Csikszentmihalyi (1990) describes flow as a state of optimal experience, whereby a person is so engaged in activity that self-consciousness disappears, time becomes distorted, and people engage in complex, goal-directed activity not for external rewards, but for simply the exhilaration of doing. By situating his discussion of video games within flow,

Bowman gives educators a theoretical framework for understanding the underlying mechanisms of video games, and a starting place for designing more engaging learning environments.

Bowman contrasts video gamers, who are engaged in states of flow, with students in traditional school environments. Students in traditional, teacher led classes have little control over what they learn, are passive recipients of material chosen by teachers, must conform to the pace and ability level of the group (group instruction), and are given shallow, imprecise, normative feedback on their work (See also Sizer 1989). Contrasting characteristics of video game playing and traditional schooling are expanded in Appendix 1.

Bowman suggests that educators could use video games as a model for improving learning environments, by providing clear goals, challenging students, allowing for collaboration, using criterion based assessments, giving students more control over the learning process, and incorporating novelty into the environment.[2] Bowman acknowledges that well designed learning environments use many of these design features in order to engage learners in states of "flow"; educational approaches such as problem-based learning environments, case based reasoning, learning through participation in communities of practice (i.e. apprenticeships), or inquiry-based learning all place learners in active roles, pursuing goals meaningful to them. Advances in assessment, such as peer-based assessment or performance-based assessment provide learners multiple sources of feedback based on their performance in authentic contexts. Indeed, considering recent developments in the new paradigm of instruction, students are beginning to resemble "Pac-Man" players more than ever (Reigeluth 1999; Reigeluth & Squire 1998).

[2] *These principles, sound as they may be, are not new to education. Simulations and games are a long standing part of educational technology traditions and a good deal is known about how to use them in learning environments (Heinich, Molenda, Russell, & Smoldino, 1996; Gredler, 1996).*

More recently, Cordova and Lepper (1996) have begun linking these basic underlying factors of games: choice, fantasy, and challenge to specific learning outcomes. Cordova and Lepper compared students who choices in fantasies with those who did not and found that students who could choose what fantasies were represented in games outperformed those who did not. For Cordova and Lepper, fostering intrinsic motivation is a complex design process that hinges on individuals' tastes and preferences, and educators need to carefully consider whose fantasies are represented in computer games and be sure that they are not excluding students by creating fantasy situations for their games.

Of course, educators and educators have used simulations and games to foster learning for decades, and many are already leveraging advancements in gaming and technology (Gredler 1996; Heinich, Molenda, Russell, & Smaldino 1996; Reigeluth & Schwartz 1989). Simulations and drill and practice games already are used in the military, schools, and industry for learning (Thiagarajan 1998). In the military for example, commercial games have been used to measure learners' eye-to-hand abilities, simulators are used to train pilots, and simulator technology is sold to commercial developers to be implemented into flight or tank simulators. Further, many "edutainment" products such as *Gettysburg*, *SimEarth*, or *Railroad Tycoon* have already made their way into K-12 classrooms, as they allow students to explore the complex dynamics of microworlds. The past ten years have seen tremendous advancements in gaming technology that have not been explored within the instructional technology community. In the next section, I discuss some of the advancements in gaming over the past decade and describe how they are being used in educational settings.

VIDEOGAMES IN EDUCATIONAL SETTINGS

Over the past ten years, videogames have begun to mature as an entertainment form. Most obviously, tremendous advancements in

technology have enabled designers to create rich digital worlds with vastly improved sound and graphics. Developments in video game design go much further, as today's contemporary gaming experience is much richer than "Pac-Man." Video games still include action games, but they also include simulations, strategy, role playing, sports, puzzles and adventure. Good video game design across these genres immerses users in a rich interactive digital microworlds. Video gamers can be at the helm of an F-14 fighter or an entire civilization (*Civilization*, *Age of Empires*, *Alpha Centauri*); they can raise a family (*The Sims*), socially engineer a race of creatures (*Creatures*), explore rich interactive environments (*Shenmue*), or engage in fantasy/role play (*Final Fantasy VIII*). As software companies market titles with educational potential as "edutainment" educators have begun using video games, particularly simulations in classrooms. However, very little empirical study has been done on how these games are used, and the existing research has failed to yield a useful research framework (Gredler 1996). This section describes some of the unique attributes of existing video games and simulations, suggests where they might be useful for educators[3].

Games: Drill and Practice

Historically, computers have been used in education primarily as tools for supporting drill and practice for factual recall (Jonassen 1988). Drill and practice games such as *Alga-Blaster, Reader Rabbit*, or *Knowledge Munchers* have been popular because they can easily be integrated into a traditional, didactic curriculum as "enrichment exercises" during independent study time. Good drill and practice games use the "action" genre of video games to engage learners (Bowman 1982; Malone 1980). Little, if any research has been done on the effectiveness of these games, but there is little reason to believe that a well designed video game will produce results which are substantially different from non-computer based games (Clark 1983). Although drill and practice games can have an important role in student-centered learning environments such as problem-based learning (Savery & Duffy 1995), using video games to support student exploration of microworlds or as a construction tool (Papert 1980; Rieber 1996) is more consistent with the emerging paradigm of instruction.

Simulations and Strategy Games

Unlike games, which suspend the rules of reality in order to use the rules of a game, simulations attempt to model a system in a manner that is consistent with reality (Heinich, et al. 1996). Simulations model physical systems or social systems through another symbol system, such as a computer interface. Thiagarajan (1998) distinguishes between high and low fidelity simulations.[4] Hi-fidelity simulations attempt to model every interaction in a system in as life-like a manner as possible, whereas low fidelity simulations simplify a system in order to highlight key components of the system. Because they are expensive to produce, hi-fidelity simulations are usually used when engaging in the actual activity is either cost-prohibitive or too dangerous, such as in training pilots (Thiagarajan 1992). The military makes extensive use of these simulations, often repackaging and selling them as commercial entertainment software (Herz 1997). The strength in hi-fidelity simulations lies in their ability to produce particular situations consistent with other situations in which learners are expected to participate.

Low -fidelity simulations are also used when the emphasis is on developing a conceptual understanding because they allow students to interact with complex systems while reducing or eliminating extraneous variables. Many low-fidelity simulations do not use computer technology; they use board games or

[3] I deliberately use the word education rather than training to discuss the potentials of games. Many of these issues have direct analogs in training, although they are not discussed here. For a good discussion of training programs using game-based technology, see Prenksy, 2000.

[4] Hi fidelity simulations need not be digital, however, as a "dress rehearsal" of an event or procedure might be considered a simulation.

role-playing to simulate a system, such as in *Ghetto*! or *Consultants* (Thiagarajan 1999). However, computerized simulations, or edutainment video games can be powerful tools for learning[5]. They allow learners to:

(a) Manipulate otherwise unalterable variables. With simulations of natural systems such as *SimEarth*, learners can observe the effects of changing the globes oxygen levels, or raising the global temperature.

(b) Enable students to view phenomena from new perspectives. In the simulation *Hidden Agenda*, learners can assume the position of a president in a Central American country, learning about economics, history, politics, sociology, and culture in the process.

(c) Observe systems behavior over time. For example, in simulations like *SimCity* or *Civilization*, learners can observe social systems' behavior over years or centuries. Similarly, in a Virtual Solar System course, students created models of the Solar System where they could observe the solar system in motion, examining rotations, revolutions, and eclipses (Barnett, Barab, & Hay in review). Whereas most physical models tend to be static, computer based simulations allow you to manipulate time (Herz 1997). Simulation games, such as Railroad Tycoon, add a gaming element in order to bolster student engagement.

(d) Pose hypothetical questions to a system. In historical simulations, such as *Antietam*, learners can simulate hypothetical events, such as what if

(e) Visualize a system in three dimensions (Barab, Hay, & Duffy 1999). In the *Digital Weather Station*, learners use special 3-D tools to visualize weather systems in three dimensions (Hay 1999).

(f) Compare simulations with their understanding of a system. Simulations do not represent reality; they reflect a designers conception of reality (Thiagarajan 1998). . For example, *SimCity* is weighted heavily toward public transportation, reflect author Will Wright's fondness for public transportation (Herz 1997). Educators can capitalize on this discrepancy and have students examine a simulation for bias or inaccuracies.

By enabling them to interact directly with a model of a complex system, simulations place learners in a unique position to understand a system's dynamics. However, the educational value of simulations does not necessarily lie in the program itself, but rather in the overall experience of the simulation. Simply using a simulation does not ensure that learners will generate the kinds of understandings that educators might desire (Thiagarajan 1998). Rather, learners need opportunities to debrief and reflect, and the amount of time spent on reflection should equal the amount of time engaging in a game or simulation (Heinich, et al, 1996; Thiagarajan 1998). Instructors play an important role in this process fostering collaboration, promoting reflection, and coordinating extension activities (Hawley, Lloyd, Mikulecky, & Duffy 1997). Reigeluth and Schwartz (1989) provide an "instructional theory for the design of computer-based simulations" that offers thorough guidance for developing simulations *and* the instructional overlays that accompany them.

[5] Although these simulations use powerful computer technology, they are considered low fidelity because it is obvious to the player that he/she is using a model of the system, and not the controlling the Earth's weather. A high fidelity simulation would place more emphasis on actually reproducing weather conditions.

While video games and simulations (edutainment) are becoming more and more widespread in education, very little is known about how they work. Much of the research in this area has focused on comparing game playing to lecturing, which is often inappropriate because each is a different pedagogical technique which usually embodies different values on the part of the instructional designer and is suited for different types of learning experiences. Instead of isolating variables which contribute to good game design or comparing games versus other instructional approaches, instructional technologists would benefit from studying programs that use simulations, in the form of case studies, or design experiments (Brown 1992). Design experiments use case study techniques to understand and improve a design. Design experiments do not necessarily yield generalizable knowledge, but they can serve to inspire other designers in similar situations (Bracey 1992). Educators can also use Reigeluth and Schwartz's instructional-design theory for simulations (1989) as a framework for understanding the dynamics of educational applications of simulations. Regardless, more grounded research is needed to help educators understand the dynamics of using simulations to promote learning.

A WORLD OF VIDEOKIDS?

Many educators have expressed concern about the effects of video games on learners, and at the wisdom of bringing more video game technology into the classroom (Provenzo 1991). Provenzo, the most outspoken and oft-quoted of video game critics, raises four main concerns with video games. Video games:

a) can lead to violent, aggressive behavior,
b) employ destructive gender stereotyping,
c) promote unhealthy "rugged individualist" attitudes, and
d) stifle creative play (Provenzo 1991; 1992).

Certainly, some of Provenzo's concerns are justified. The plot of many video games still consists of little more than "kill or be killed," and many games incorporate themes, which, if accepted uncritically are potentially destructive.

Thusfar, video game research has found no relationship between video game usage and social maladjustment. The rapidly evolving nature of video game graphics, violence, and realism cautions against any definitive statement about the impact of video games on social behavior. However, I maintain that concern about video games effects is largely unfounded, and there is very little cause for concern about their effects on players. In fact, recent developments in video game design are beginning to reverse these trends; thematically, video games are increasing in complexity, incorporating story, character development, and collaboration in the game design. Educators should pay attention to these emerging developments in video gaming, as they hold promise for generating many new theories of engaging learners in interactive digital environments.

Aggression, Violence, Social Maladjustment, and Video Games

If educators are going to embrace the idea of using video games to support learning, it is difficult to avoid the topic of aggression and social maladjustment due to video games, a concern most clearly articulated by Eugene Provenzo (1991) in *Video Kids*. Research on the impact of video games on aggression and violent behavior has consisted primarily of two types of studies: a) experimental designs where players' amounts of aggression are measured before and after playing violent games versus non-violent games, and (b) correlational studies that look for patterns of behavior in frequent video game players. The majority of these studies took place in the early 1990s, which means that video game research is approximately two generations behind home console developments. Regardless, research thusfar has been inconclusive. Some research (Anderson and Ford 1986; Calvert & Tan 1994; Graybill, Kirsch, & Esselman 1985) suggests that video games cause some increase in violent thoughts

or feelings as measured by inventories. Others have examined children's free play after playing violent video games. Schutte, Malouff, Post-Gorden, and Rodasta (1988) found increased violent play in children who played violent games compared to those who played nonviolent games, and Cooper and Mackie (1986) found increased in aggressive play in girls, but not in boys. Silvern and Williamson (1987) found increased amounts of aggressive play in children who played *Space Invaders* when compared to children who had not played games, but *no* effect when compared to those who had watched television cartoons. On the other hand, Graybill, Strawniak, Hunter, and O'Leary (1987) found no increases in violent thoughts in children who played violent video games.

In an attempt to determine if there are any connections between regular video game use and violent behavior or poor school performance, researchers have conducted survey studies looking for correlations between video game play and violent behavior, or video game play and poor academic performance (Dominick 1984; Lin & Lepper 1987). None of these studies uncovered any correlations between regular video game play and violence, aggression, anti-social behavior, or poor academic performance, although Lin and Lepper did find small negative correlations around (-.30) between regular arcade play and school performance. Perhaps, not surprisingly, children who spent more than 15 hours per week in arcades did not do well in school. In summary, research on video game violence has failed to show that video games cause violent, anti-social, or aggressive behavior or poor school performance.

As Nikki Douglass, a video game designer points out, cultural critics should hesitate before dismissing the competitive nature of most video games as unhealthy (Jenkins 1998). Assertiveness is a socially redeeming quality, is promoted in video games (Graybill et al. 1987). Video game players learn to interact with digital technology at an early age, developing technological literacy which can serve them later in a digital economy (Subrahmanyam & Greenfield 1998). Although there is no thorough research supporting this claim, there is substantial antidotal evidence that video game playing often leads to a fascination with technology, which then can lead to an interest in technology related fields (Herz 1997; Subrahmanyam & Greenfield 1998). In fact, this concern has led some researchers design games which might attract girls, and thus, close the technology gender gap (Cassell & Jenkins 1998b; Greenfield 1984; Kafai 1998). Indeed, if this logic is valid, then playing video games (in moderation) might actually have possible social benefits.

From Barbie and Mortal Combat to Interactive Fiction

Since Donkey Kong, the game where Mario attempted to rescue a princess from Kong, video games have relied on storylines familiar to popular entertainment. Much like in King Kong or in silent films, women have been often portrayed as a prize in video games (Provenzo 1991). Outside of Ms. Pac-Man, few women protagonists have been featured in games. There are women characters in fighting games, although with their exaggerating sexual features and high heeled stilettos, they overwhelming resemble adolescent male fantasies rather than any well-rounded female character. In 1996, Core Design attempted to reverse this pattern by creating Lara Croft, the Indiana Jones of Playstation and the star of *Tomb Raider*. Lara, however, has also evolved into a sexually exaggerated character who has served to alienate many women (Jenkins 1998). As Herz (1997) describes in her interview with Brenda Garno, a software designer, none of these patterns would seem as insidious if females had more power in designing video games and game characters. Not surprisingly, women have not flocked to video games. Female gamers represent about 20% of video game players (Kaplan 1983; Kubey & Larson 1990), with over 50% of the girls surveyed by Lin and Lepper (1987) playing home games once a month or less.

In an effort to uncover what video game designers can do to make video games more accessible to females, Cassell and Jenkins

(1998a) edited a volume: *From Barbie to Mortal Kombat: Gender and Video Gamest*. Focusing on the unprecedented success of Barbie: Fashion Designer, which sold more than 500,000 copies, Subrahmanyam and Greenfield (1998) argue that video games focus too heavily on violence and competition and not enough on story, character development and collaboration in order to attract girls. Predictably, a group of "grrrl gamers" interviewed in this volume (Jenkins, 1998) finds this focus on traditional female characteristics offensive, if not repulsive, and argues that aggressiveness and competitiveness are worthwhile qualities that girls should be encouraged to develop through playing video games. As Herz (1999) argues in her review of *From Barbie to Mortal Combat*, the most interesting and worthwhile implications for video game designers come from the authors in the volume who are trying to create quality, creative games with broad appeal. Designers such as Duncan and Gesue (1998) are writing games that capture the user with rich, interactive narrative and deep characters development. Educators can look to these authors's games, such as *Chop Suey* or *Smarty* for models of games that push game themes beyond the traditional "shoot 'em up" and into the realm of interactive fiction. As Murray argues (1998) interactive digital storytelling should emerge as a legitimate art form in the upcoming years, and video games seem to be paving the way. Educators can study this emerging for new ways to engage learners in digital environments. For example, interactive storytelling might be one way of "anchoring instruction" (Cognition and Technology Group at Vanderbilt 1993).

From Rugged Individualism to Collaboration

The image of the "lone ranger" is as prevalent in video games as it is in any other popular American medium (Herz 1997). Games from Asteroids to Doom capitalize on making gamers feel isolated, taking the world on alone. More recently, however, MUDs (Multi User Dungeons) and MOOs have revolutionized the gaming industry. MUDs are text-based online environments where users can collaborate in groups to complete quests, solve puzzles, or slay villains.[6] In Avatar, for example, game difficulty and variables are manipulated so that gamers are forced to quickly collaborate with other players and create the bonds that can sustain an online gaming community. Consistent with the Role Playing Game genre, characters are given unique strengths and weaknesses, and no character can survive without collaborating with others. Gaming communities like Avatar have a wealth of experience designing challenges which foster community building. With the development of graphical online RPGs like *Everquest*, which has thousands of players online at any given time, and the next generation of console systems coming equipped with modems, online gaming appears to be an increasingly important part of the gaming environment. Given recent pedagogical interest in communities of practice (Barab & Duffy 2000; Lave & Wenger 1991), MUDs may offer designers guidance on how to foster community in online environments.

At the Media Lab at M.I.T., educators have begun designing online environments specifically to foster learning (Bruckman & De Bonte 1997). In MOOSE, a text-based virtual reality environment designed to support constructionist learning, Bruckman (1993a; 1998) found that the community supports for learning were much more important than the environment itself. In current iterations of the design experiment, MOOSE has been redesigned to better foster collaboration and explicitly address collaboration. The resulting product, *Pet Park*, reflects a different kind of thinking. De Bonte (1998) recognizes that "every aspect of the design should be evaluated to see what kind of an effect it might have on the developing community." Bruckman (1993b; 1994) has examined some of the social interworkings of MUDs, such as how communities handle deviant behavior or how cultural boundaries are tested through MUDs. As educators continue to design online environments to support community, further

[6]Some MUDs focus less on collaboration than others. For the purposes of this discussion, I will focus on those that specifically foster collaboration.

study of MUDs and MOOs, can uncover the mechanisms that designers use to foster collaboration and contribute to community building.

From Video Game Consumers to Creators

Provenzo's (1991) last critique of video games is that they place children in consumer roles, where they enter other designers' worlds instead of creating their own through play. In an argument that closely mirrors those made against television, he argues that children are losing opportunities to develop their creativity by playing video games. This argument has seemed compelling to a number of pundits over the years (See MediaScope 1996). However, current research suggests that video games are a form of popular culture very similar to film or television. In all but extreme cases, video game use has no visible negative effects on children (Lin & Lepper 1987). Indeed, the largest evidence contradicting this rationale might be that over the past two decades, where video games have infiltrated American Youth culture, there has been little evidence to suggest that children have grown up without the ability to think creatively. In other words, as the first two generations of "video kids" have grown up, becoming, perhaps more savvy consumers of and creators with digital media (Herz 1997).

Entering another's virtual world is as old as storytelling, and has been a continued tradition through printed literature, television, film, and now interactive digital media. Taken in this historical context, critics' concern with video games seems awfully familiar; critics were concerned that sound and color would ruin film, and later, were concerned that Americans would never leave the comforts of their homes, transfixed by the hypnotizing effects of television. Certainly, one could make persuasive arguments that television has had some negative effects on American culture, but short of killing pop culture, there is not much that can be done to stem any of these cultural patterns. However, when understood in its historical context, there is little reason to believe that video games will taint a generation of youth.

What Provenzo (1991) and likeminded critics fail to consider is that children are not just passive consumers of popular culture, but they reappropriate its symbols and forms and integrate it into their own play, as well. Video game playing occurs in social contexts; video game playing is not only a child (or group) of children in front of a console, it is also children talking about a game on the school bus, acting out scenes from a game on the playground, or discussing games on online bulletin boards. Ellis (1983) argues that like any popular media, video games become the building blocks of children's worlds. They are children's stories, characters, and heroes. Children do not play games in isolation. Often, they play in groups, and when they do not, they share their experiences socially. Arcades, for example, have always been about much more than video games; they are a meeting place for adolescents to meet, display skills, and socialize free from parental control (Michaels 1993). And, home video game use is not just about playing a game; it is most often about friends getting together; for example, in order to explore the effects of a video game console system on a family, Mitchell (1985) gave video game consoles to twenty families and measured their effects on family interactions. Mitchell (1985) found that most families used the game systems as a way for the family together, to share play activity. Instead of leading to poor school performance, or strained family interactions, video game were a positive force on family interactions, "reminiscent of days of Monopoly, checkers, card games, and jigsaw puzzles" (Mitchell 1985 p.134). These findings suggest that video game play cannot be properly understood as simply a human-machine interaction; video game playing is situated in social and cultural spheres that are perhaps more important than the game itself.

As authors of digital environments and designers of interactions with technology, instructional technologists can learn from this debate about the social contexts of video games. Video gamers love their pixels, sounds, and hardware, but gaming, fundamentally, is a social phenomena, occurring in social groups distributed both through traditional social networks (work, school, family) and through the

internet. In many ways, these groups resemble communities of practice; they have their own practice (game playing), language, and socially acceptable ways of behaving. Educators could benefit by studying these communities that form around gaming, in order to understand what *non-game* elements contribute to the engaging activity that is video game playing. For example, an instructional designer could study a group of video game players playing games together, or socializing outside of game play, such as on the internet, to understand what the social contexts are that help define game play as an activity. At the very least, studying video game players shows us that to take the human-computer relationship as the fundamental unit of analysis in determining what makes video gaming fun is misguided and suggests that a theory of motivation derived from video game playing ought to account for the social activities in which video game playing is embedded.

THE FUTURE OF VIDEO GAMES IN EDUCATION

In the 1980s, there was great enthusiasm for harnessing the design knowledge embedded in video games to improve instruction. Educators learned some guidelines about designing engaging environments, most of which have become incorporated into student centered learning environments (Jonassen & Land 2000). Since then, gaming technology has improved dramatically, but very little has been done to study how these improvements might be incorporated into learning environments.

First, many teachers and educators have begun using commercially available "edutainment" products, but there has been very little empirical research into how these environments work. Design experiments (Brown 1992), which examine how instructional programs which employ video games could be useful for instructional technologists. Through such design experiments, instructional technologists might be able to empirically ground the work on instructional-design theory for simulations and games initiated by Reigeluth and Schwartz (1989). Taking a design approach to researching games might provide a useful framework for studying games, which thus far, have lacked a coherent research paradigm (Gredler 1996).

As designers of interactive learning environments, instructional technologists can also learn from current developments in gaming. Interactive fiction and online games are two areas of gaming that have not been studied much at all, and can inform the design of learning environments. Developments in interactive games can produce guidelines on developing socially based microworlds, and character development in interactive environments. Online games offer instructional technologists opportunities to understand how online environments are designed to support community development.

Last, video games, as one of the first, best developed, and most popular truly digital mediums embody a wealth of knowledge about interface, aesthetic, and interactivity issues. Historically, video games have been on the technological cutting edge of technically of what is possible, whether it is building online communities on the Internet, creating rich worlds using 3D graphics cards, or allowing dynamic synchronous interaction play by streaming information over the Internet. Indeed, even a cursory glance at the latest games can leave the designer blown away by what is currently possible with technology and inspired by the sleek interface or production values games contain. In fact, the greatest benefit of studying games may not be as much in generating theoretical understandings of human experience in technology or guidelines for instructional design, but rather, in inspiring us to create new designs.

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Appendix I

Pac-Man	**Traditional Schooling**
Player controls how much she plays and when she plays.	Groups of students learn at one pace, and are given very little freedom to manage the content and pacing of their learning.
Students are actively engaged in quick and varied activity.	Students passively absorb information in routine activities, such as lecture.
Players play and practice until they master the game; players can take all of the time they need to master Pac-Man.	Students must all go at the same pace, regardless of achievement. As Reigeluth (1992) describes, traditional schooling holds time constant, allowing achievement to vary, instead of holding achievement constant (ensuring that all students master material) and allowing time to vary.
Players have feeling of mastering the environment, becoming more powerful, knowledgeable and skillful in the environment.	Students learn knowledge abstracted by teachers and regurgitate this knowledge on pencil and paper tests, rarely applying it in any dynamic context.
Video game players work together, sharing tips and trading secrets.	Students perform in isolation, and cannot use one another as resources.
Performance is criterion based; each student competes against his/her ability to master the game, to reach new goals. Every student can reach a state of "mastery" over the game.	Students are graded normatively, graded against one another's performance and encouraged to compete against one another.
Games are played for the intrinsic reward of playing them, for the emotional state they produce (Herz, 1997).	Schools are structured around extrinsic rewards, such as good grades or a fear of failure (flunking).

Contrasting "Pac-Man" with Traditional Schooling