Journal of Curriculum and Instruction (JoCI)
March 2013, Vol. 6, No. 2, Pp. 60-75
http://www.joci.ecu.edu

ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

The Use of Game Dynamics to Enhance Curriculum and Instruction: What Teachers Can Learn from the Design of Video Games

Curtis Chandler
Kansas State University

Abstract

Video games have received an increased amount of attention from educational institutions due to their widespread use and their ability to engage and sustain players in difficult learning tasks for extended amounts of time. Many studies have been conducted on the potential of video games to influence learning. Recently, however, some educational researchers have begun to analyze how the game dynamics embedded in video games are used to immerse students in difficult problem-solving and to support their learning. This article examines the need for public school educators to adapt a *game design mentality* when designing secondary level curriculum and instruction. Game design is presented as a tool for improving student learning and suggestions are offered for how educators can incorporate game dynamics such as narrative context, explicit interconnectedness, well-ordered problems, control, choice, customization, and co-design.

Human beings are hard-wired to do two things – to learn and to play (Alexander, Schallert, & Reynolds, 2009; Ortlieb, 2010). The first is fairly obvious and has been explored for centuries. The latter, however, is only beginning to come into focus. This may seem odd since games have been an integral part of the human experience for thousands of years. Archaeological research shows that gaming culture was widespread and considered a necessity of ancient life as early as 5,000 years ago (Voorhies, 2012).

In the last century, Dewey (1938) wrote of the cooperative and interactive benefits of games in curriculum and instruction, while Piaget (1962) and Fisher (1992) insisted that play was a precursor for emerging cognitive, linguistic, and social development. More recently, researchers have underscored other key benefits of play that include creativity, learner development, and imagination (Bodrova & Leong, 2003; Ginsburg, 2007; Hirsh-Pasek, Golinkoff, & Eyer, 2003; Zigler, Singer, & Bishop-Josef, 2004).

However, video games are a rather recent development and have only been in existence for about 40 years. The study of game-based learning has only been around for half that long (Pivec, 2009). Video games represent a multi-billion dollar business that will soon rival the movie industry, and it has been reported that between 90% and 97% of United States teens play some type of video game on a regular basis (Lenhart et al., 2008). It should come as no surprise, therefore, that education has recently developed an increased interest in the use of commercial and customized video games and has begun to take a closer look at the game mechanics and game dynamics used by video game designers to support players as they work to solve complex problems (Gee, 2007, 2008; Wastiau, Kearney, & Van den Berghe, 2009). While the two terms

Copyright 2013
ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

are often used interchangeably, game *mechanics* refers to the components selected by the game designer during game construction, while game *dynamics* denotes the way in which those mechanics are actualized throughout interplay between the player and the game itself (Sedano, Sutinen, Vinni, & Laine, 2012; Tragazikis, Kirginas, Gouscos, & Meimaris, 2011).

What Students Can Learn from Video Games

While teachers have employed board games such as chess and Monopoly for decades, it now seems that video games are the ones garnering the most attention. Several studies tie them to increased student motivation and engagement, although not all researchers agree on the basis of this motivation. Some studies find that motivation is linked to intrinsic motivators, such as rewards and goals within games (Amory, Naicker, Vincent, & Adams, 1999; Denis & Jouvelot, 2005; Jennings, 2001), while others attribute increased learner motivation to the narrative context that games often provide (Dickey, 2005, 2006; Fisch, 2005; Waraich, 2004). Nevertheless, the studies tend to agree that motivation is a significant characteristic of learning tasks that are embedded in – or tied to – video games (Dondlinger, 2007).

One key advantage of video games is the extent to which they provide immersive learning opportunities that might otherwise be difficult or impossible. For example, I recently visited a high school health classroom where students were discussing the potentially harmful effects that result from an improper diet and lack of physical activity. Using a free simulation from the University of Colorado at Boulder (http://phet.colorado.edu/en/simulation/eating-and-exercise), the students used avatars to experience and observe the effects of various food and exercise habits. This simulation, one of more than 100 designed and offered by the university, provides learners with crucial opportunities to safely interact with content, to think, to understand, to prepare, and to execute actions (Gee, 2008; Pannese & Carlesi, 2007). Researchers concur that in science and other related content areas, simulations tend to augment students' ability to learn scientific facts, to apply knowledge, and to perform other higher level thinking tasks (Hattie, 2009; LeJeune, 2002).

Additional perceived benefits for students who use video games are piquing the interest of educators. Studies indicate improved visual and spatial skills, multi-tasking, as well as higher academic achievement and interest levels when video games are well-integrated with other classroom learning activities (Dorval & Pepin, 1986; Kearney, 2005; Stevens, 2000; Wylie, 2001). Research also shows that problem-solving can be improved by video games; however questions abound about how well this ability can be applied outside the context of the game itself (Curtis & Lawson, 2002; Ko, 2002; Kovalik & Kovalik, 2008; Pillay, 2002). Games seem to be a particularly effective form of intervention with students for academic challenges (McKenna, 1991). While video games are widely played by learners of all ages, they tend to have the highest impact on mathematic achievement when used with students in secondary grade levels (Lee, 1990).

Journal of Curriculum and Instruction (JoCI)
March 2013, Vol. 6, No. 2, Pp. 60-75
http://www.joci.ecu.edu

ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

What Teachers Can Learn from Video Games

One of the greatest plagues of education is that of student disengagement. As Steinburg, Brown, and Dornbusch (1997) wrote, "So many students are physically present but psychologically absent" (p. 57). They also claimed that approximately 40% of students are merely "going through the motions" (p. 15). Video games may offer a means for addressing this problem. For years, I have been intrigued by secondary students who play *Minecraft*, *Rise of Nations,* or *World of WarCraft* who willingly work at solving complex problems, collaborate, and persist at difficult challenges for significant amounts of time. Gee (2007) noted that the design of these video games has

> a great deal to teach us about how to facilitate learning, even in domains outside of games. Good computer and video games are complex, challenging, and long; they can take 50 or so more hours to finish. If a game cannot be learned well, then it will fail…therefore good games have to incorporate good learning principles in virtue of which they get themselves well learned. (p. 45)

As educators begin taking a more serious look at video games, we begin to ask questions such as "What is it that makes a video game so motivating?" and more importantly, "How can teachers utilize the learning principles embedded in video games in their own curricula and classrooms?"

Several reviews of the literature on educational games have been completed within the last decade (De Aguilera & Mendiz, 2003; O'Neil, Wainess, & Baker, 2005). Most of these reviews, however, focused on what players learn from video games rather than the potential for educators to work like game designers and utilize the learning principles embedded within video games to improve learning. Yet in the past few years, the literature has begun to reveal a number of distinct game dynamics that could be employed by educators to stimulate desired learning outcomes. These include (a) narrative context, (b) explicit interconnectedness, (c) well-ordered problems, (d) choice and control, and (e) customization and co-design (Dondlinger, 2007; Fisch, 2005; Gee, 2007; Ke, 2009; Pivec, 2009). These game design elements are described below.

Game Dynamic: Provide Narrative Context

Teachers would be wise to start by examining game designers' powerful use of *narrative context* within video games. Many video games use story lines and visual narratives to introduce and to build upon learners' real-world knowledge. A narrative serves as a sandbox, or realistic problem space, where the danger of failure is greatly mitigated (Dickey, 2005, 2006; Gee, 2007; Warren, Dondlinger, & Barab, 2008). Teachers can adapt this narrative aspect of game design into curriculum and instruction by working to construct narrative contexts or stories for situating cognition and contextualizing learning. The goal should be to place educational content at the heart of the narrative as students learn to play and play to learn (Fisch, 2005).

Journal of Curriculum and Instruction (JoCI)
March 2013, Vol. 6, No. 2, Pp. 60-75
http://www.joci.ecu.edu

ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

One way for teachers to put the narrative game dynamic to use is to transform existing curricular narrative texts into problem spaces. For example, just before the end of last school year, I visited with a seventh grade language arts teacher whose class was in the process of finishing Robert Louis Stevenson's *Treasure Island.* But, unlike many other adolescents' experiences with classical literature, these students were listening and following along intently as their teacher read a few excerpts with them before they started their independent tasks. I noted that the students kept glancing back and forth from the words on the pages to a chart that they had next to their book. All the while they were whispering to each other. Upon investigation, I discovered a simplistic, but well-utilized game dynamic: a contextualized narrative environment for students to make and evaluate choices in order to reach a desired goal.

It turned out that before ever opening the book, their teacher had issued the students a challenge: "Let's see if you can survive the journey to Treasure Island." He organized his class into groups and told them that their first task was to "Persuade for Doubloons," or pirate gold. Specifically, they were to use argumentative writing to convince the King of England, a group of settlers, a company of merchants, or a combination of the three to invest in the risky journey to Treasure Island. Interestingly, nearly all groups resolved to attempt the most difficult option and sought the support of all three of the investors in order to secure a higher number of doubloons to be paid by the teacher. The doubloons were used in the subsequent task to construct a ship, crew, and supplies for the journey across the ocean. Students debated the options with the rest of their group, made their choices, cashed in their chips, and then began reading the book, anxious to see how the voyage turned out for the crew and ready to evaluate their own selections and purchases from the pre-reading activity. The narrative context of *Treasure Island* became a problem-space that engaged students in classical literature. More importantly, it engaged them in higher-level learning.

In content areas that do not traditionally lend themselves to narrative texts, such as science, educators can seek to incorporate the narrative game dynamic by constructing a storyline that helps unify content, lessons, and units. For example, I worked for two weeks in the company of an educator who has authored a unique, narrative-based science unit called *Bio-Hazard 5* for his junior and senior biology students. The premise of the story is that decades from now, the world is on the verge of a series of environmental catastrophes, so a hero has been sent back in time to solve the future's problems. He needs help from scientists-in-training, or biology students, who are tasked with helping the hero to master biology modules on everything from abiogenesis to zygotic selection. The same content is covered on the Advanced Placement biology exam.

Educators might consider a similar use of a narrative game dynamic in their own classroom, because in video games and in life, humans find story elements profoundly meaningful (Gee, 2007). Therefore, for learning tasks to be meaningful and engaging to students, teachers must think like game designers and provide a strong narrative, or context for testing out new content, skills, and ideas (Waraich, 2004).

Journal of Curriculum and Instruction (JoCI)
March 2013, Vol. 6, No. 2, Pp. 60-75
http://www.joci.ecu.edu

ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

Game Dynamic: Explicit Interconnectedness

Another dynamic that can be readily applied in classroom learning is *explicit interconnectedness.* Unlike some classrooms, games do not go on haphazardly or by a succession of improvisations (Dewey, 1938). Classroom rules are often designed to maintain order and are perceived by students as restrictions (Thornburg, 2008), but in video games, rules are used to help organize conduct and to orchestrate success. Players see – and utilize – the connections between the rules, game plot, challenges, and solutions (Dondlinger, 2007). Players not only know and abide by the games' rules, but they defend them fiercely when they are violated by other players.

Some may argue that, in contrast, most of what goes on in schools is disconnected and fragmented (Gee, 2004). From some students' perspectives, much of what they are asked to learn seems to operate in isolation. Information and skills in one class, for example, are often disjointed and disconnected from subsequent lessons and from concepts taught in other classes. Even when content is interrelated and interconnected, some students struggle to see the association. In a video game, these connections are more obvious, and at times, are made explicit to the learner. Early tasks are designed to lead players to develop skills and knowledge in order to solve subsequently more difficult tasks. Consequently, earlier parts of a well-designed game help learners look forward to later parts (Gee, 2007).

Teachers who adapt a game design mindset must find ways to make the relevance and connections in learning activities more noticeable, if not explicit, to students. For example, educators often utilize curricula integration in symbiotic subjects such as language arts and history in order to capitalize on student learning and to establish connections to the real world (Rennie, Venville, & Wallace, 2012). When language arts and history teachers combine efforts to help students research and synthesize different 20th century perspectives on women's suffrage, instructors must also underscore and clarify how curricula are being integrated. This can be accomplished with teacher-student interaction before, during, and after learning activities in the form of assignment overviews, discussions of standards' alignment, or opportunities for assessments and projects that address the content of two or more subject areas (Hudson, 2012).

Game Dynamic: Well-Ordered Problems

Teachers can also seek to help students develop greater expertise in a subject or area through *well-ordered problems*. Game designers consciously orchestrate and sequence learning activities so that they build upon each other and interweave with previous and future concepts. As a result, progressive, repeated cycles of challenges force learners to think again, learn anew, and develop hypotheses that work well for more difficult challenges later on (Bereiter & Scardamalia, 1993). Gee (2008) explained that easier initial problems offer opportunities to respond to problems consciously designed by teachers to facilitate the discovery and encourage the practice of fruitful

Journal of Curriculum and Instruction (JoCI)
March 2013, Vol. 6, No. 2, Pp. 60-75
http://www.joci.ecu.edu

ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

patterns and generalizations in regard to the skills and strategies that learners are developing.

In games such as *Halo* and *Pikmin*, for example, players are confronted by challenges that alternate practice with new trials of increasing sophistication, thereby producing an incremental learning curve as the game progresses (Gee, 2007). Teachers seeking to implement a game dynamic of well-ordered problems must design curriculum with a range of challenges that allow students to operate and explore in slightly different parameters (Koster, 2005). In addition, the design and sequence of these problems should force participants to develop the ability to learn, to reflect, and to integrate old abilities with new challenges, rather than asking them to engage in rote memorization or simple comprehension (Dondlinger, 2007; Gee, 2007).

This year, I visited an eighth grade classroom that utilized the game dynamic of well-ordered problems. Students pretended to be planetary scientists who were investigating two newly discovered, fictitious planets made by their teacher out of Styrofoam, plaster, clay, and paint. The teacher explained that their class was tasked with determining if human life could be supported on either planet. To make this determination, students were first introduced to actual satellite photos of Earth. They then worked to determine what oceans, clouds, and various land habitats look like from miles above our planet's surface. The following day, the teacher encouraged the class to investigate the "new" planets' surfaces. Students worked in teams to formulate hypotheses about whether the observed colors and textures on the new planets might indicate water, forests, deserts or some other type of terrain. In the days that followed, similar, but increasingly difficult, activities were conducted to compare the Earth's atmospheric composition and temperature with that of the two new planets. Finally, each student compiled a scientific report, supported by evidence collected throughout the week, with a hypothesis of each planet's ability to sustain human life. Much like a well-designed video game, the Planetary Scientist activity was orchestrated to ensure that students surmounted a series of challenges and that they experienced the degree of success on each subsequent level that proved essential to achieving their final goal (Koster, 2005).

Game Dynamic: Control and Choice

Another motivating aspect of games is a user-centered design that arouses a player's interest to exercise *control* over the outcome via the *choices* a player makes (Clark, 2003). Such control is a key to motivating students as they endeavor to direct and evaluate their efforts (Hattie, 2009). While games are designed by developers, they are set in motion in any particular direction by players in terms of affordances or *choices* offered by the game (Gee, 2005b). Whether they are carrying out a military mission in *Call of Duty*, solving a puzzle in *Tetris,* or harvesting resources in *Minecraft*, players exercise control in order to carry out and achieve their goals. Learner motivation results from an interplay between desire and pleasure – the desire to be competent and the resulting pleasure when one is (Dondlinger, 2007).

Journal of Curriculum and Instruction (JoCI)
March 2013, Vol. 6, No. 2, Pp. 60-75
http://www.joci.ecu.edu

ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

In this way, video games have a built-in advantage in the creation of motivation for extended engagement (Clark, 2003). Whether they are in a game or in a classroom, learners are more likely to take risks and try out new skills and strategies when they are able to make choices and exercise control (Harvey & Goudvis, 2000). When applying this game dynamic in the classroom, educators should keep in mind that outcomes are consistently higher when students have some degree of control over their learning (Niemic, Sikorski, & Walberg, 1996). Curricula designers and instructors can utilize a control and choice game dynamic through pacing, time allocations for mastery, sequencing and pacing of instructional materials, and choice of practice items (Hattie, 2009).

Video games also tend to be motivating because the choice of game genres allows individuals to pursue challenges based on their own perceived strengths and interests. Genres include strategy, action, adventure, shooter, sports, puzzle, and role-playing games. People who invest time and money in a game have usually selected it based on a variety of criteria that correspond to their aptitudes and personality (Koster, 2005). Effective instructors could adapt this principle by finding opportunities for students to make choices regarding what they learn, how they learn, or how they demonstrate understanding (Benjamin, 2006).

Curricula designers and implementers can incorporate this game dynamic by creating opportunities for choice and control throughout the learning activities offered to students. In a science class for example, two very similar assignments could be constructed for separate informational texts of comparable difficulty, one on nebulas and another on black holes. Students could then be encouraged to choose between topics, while still completing the same learning objectives as their classmates. Choice could also be extended in the means by which students are assessed. For example, performance assessment, portfolio, or other more traditional formats could be used. As a result, the role of the instructor would become more facilitative and permit the learner to exert more control over learning outcomes (Reynolds & Trehan, 2000).

Game Dynamic: Customization and Co-Design

Video games also possess the unique ability to extend control and choice to learners through *customization* and *co-design.* Customization in games means that players are able to adjust the game to accommodate their own interests, style, and objectives. Gee (2007) observed that classrooms adopting this principle would allow students to discover their favored learning styles and to try new ones without fear. In the act of customizing their own learning, students would learn a good deal about their own thinking, reflection, and ways of solving problems.

For example, I recently observed a ninth grade math teacher who started class by asking her students to help her determine how many stars exist in the known universe. She explained that before looking at any formulas or equations used by other mathematicians, she wanted to hear how her students might go about solving the problem and insisted that there were likely several valid approaches. Students were

Journal of Curriculum and Instruction (JoCI)
March 2013, Vol. 6, No. 2, Pp. 60-75
http://www.joci.ecu.edu

ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

given the option of working alone or with others, and then they spent time formulating responses. The class period was spent sharing, evaluating, and revising various approaches created by students. The following day, students were asked to self-select a station where they could review the theories of accomplished scientists either by listening, watching, or reading excerpts of commentaries by various astronomers and mathematicians. Students then worked at their stations to discuss and critique the various theoretical approaches. The instructor pointed out that the experts in the field utilized different approaches to solving the problem and that many disagreed on the estimated number of stars. In this way, her students learned that this activity's design was not to achieve a single "right" answer in mathematics, but rather to pose questions, explore, analyze, and develop the ability to reason. Be it in math or other content areas, teachers can work like game designers to create opportunities for reflective learning, developing strategies, and selecting learning styles appropriate to specific learning tasks (Coffield, Moseley, Hall, Ecclestone, & Hall, 2004).

Video games also utilize the game dynamic of co-design to ensure that players feel like active agents and not just passive recipients (Gee, 2005a; Li, 2012; Olsafsky, 2006). Effectively designed games provide players the opportunity to create, to author, and to shape (Koster, 2005); their choices and actions have a significant impact on the direction and outcome of challenges placed before them. In a classroom, co-design could take the form of students' ownership, buy-in, and engaged participation. Students would come to understand the design of the domain they are learning so that they might make choices to improve what and how they learn (Gee, 2007). This comes in stark contrast to the frequent intellectual dependency that is too often found in classrooms in which students must wait for teachers to tell them what to do (Gatto, 1992).

Game Dynamics in Schools

While the use of games and game dynamics in schools appears to have a highly positive impact on student learning (Ke, 2009), a few cautions and considerations must be kept in mind. The first is that there is a tremendous lack of knowledge amongst the majority of educators regarding how to best utilize games and game dynamics (Mishra & Koehler, 2006; Pivec, 2009). Even when teachers are willing to incorporate game design into their lessons, research, techniques, and suggestions are rarely published in journals commonly read by educators (Pivec, 2009; Sprague, 2004). Gaming and education tend to operate independent of one another, but future collaboration between the two is likely to have a positive impact on our students. As a result, it would be wise to consider ways to foster more strategic, disciplinary, and collaborative research between game designers, curriculum developers, and curriculum enactors (Tzuo, Ling, Yang, & Chen, 2012).

Unfortunately, despite recent interest in game-based learning, teachers are most often trained in methods that traditionally focus neither on games nor game design as a part of the curriculum. As a result, it is mostly researchers and a handful of innovative educators who are willing to utilize games and game design (Pivec, 2009). Even when games and simulations mesh well with curriculum, studies continually underscore the need to use video games to supplement traditional lessons, rather than to supplant them (Egenfeldt-Nielsen, 2005). Mitgutsch (2007) further argues that it is not the game itself, but the interaction surrounding the game that truly promotes learning. Therefore, it is imperative that teachers and curricula designers embed games and game dynamics as part of larger experiences and constructive activities, often through dialogue, reflection, and debriefing (Garris, Ahlers, & Driskell, 2002; Koster, 2005). It must also be noted that research regarding the use of games and game dynamics in schools is fairly new and extremely varied – sometimes even contradictory – in design, methodology, context, and results (Druckman, 1995; Egenfeldt-Nielsen, 2007; Subrahmanyam, Kraut, Greenfield, & Gross, 2000). Much more robust, empirical research is needed, particularly studies that attempt to narrow down the types of game dynamics that prove to be the most effective with certain types of learners and in certain contexts.

Despite these concerns, the question is no longer *if* games impact learning, but rather *how* they do so. More importantly, how can those of us designing and implementing curricula affect learning? The answer most likely centers on game dynamics: the heart and soul of game design (Tobias & Fletcher, 2011). Getting inside of a game – how it is designed and executed – could be a key to engaging students and sustaining their learning. Lately, in an attempt to glean from the learning principles embedded in video games, I have brushed away some of the cobwebs and tried to play some of the video games that are the most popular with my students; then I worked to compile a list of strategies employed by the game itself that helped me “learn” to play. At times, it seems that game designers may be more adept at supporting learning than some teachers. Game designers appear to recognize that learners, or players, persist longer in learning tasks, even difficult ones, if they are enjoying the challenge at hand.

Teachers and curricula developers might benefit from thinking like game designers and considering the nuanced features of games (Khoo & Gentile, 2007). By consciously interweaving game dynamics – immersion, narrative context, explicit interconnectedness, well-ordered problems, control, choice, customization, and co-design – teachers might successfully transform the *interest* of a learner into motivation, problem-solving, and critical thinking. In the classroom, stakes for learning are higher than ever (Friedman, 2005; Lipman, 2003); yet, right now, too many students fail to learn and, eventually, learn to fail. There is currently an unfortunate distinction in schools between games and education. Humans are wired for learning, but they are *also* wired to play (Alexander et al., 2009; Ortlieb, 2010). As educators, we should consider game dynamics as a way to help our students do both.

References

Alexander, P. A., Schallert, D. L., & Reynolds, R. E. (2009). What is learning anyway? A topographical perspective considered. *Educational Psychologist, 44*(3), 176–192. CrossRef GS Search

Copyright 2013
ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

Amory, A., Naicker, K., Vincent, J., & Adams, C. (1999). The use of computer games as an educational tool: Identification of appropriate game types and game elements. *British Journal of Educational Technology, 30*(4), 311-321. CrossRef GS Search

Benjamin, A. (2006). Valuing differentiated instruction. *Leadership Compass*, *72*(1), 57-59. GS Search

Bereiter, C., & Scardamalia, M. (1993). *Surpassing ourselves: An inquiry into the nature and implications of expertise.* Chicago, IL: Open Court. GS Search

Bodrova, E., & Leong, D. J. (2003). The importance of being playful. *Educational Leadership, 60*(7), 50–53. GS Search

Clark, A. (2003). *Natural-born cyborgs: Why minds and technologies are designed to merge*. Oxford, England: Oxford University Press. GS Search

Coffield, F., Moseley, D., Hall, E., Ecclestone, K., & Hall, E. (2004). *Learning styles and pedagogy: A systematic and critical review.* London, England: Learning and Skills Research Council. GS Scholar

Curtis, D., & Lawson, M. (2002). Computer adventure games as problem-solving environments. *International Education Journal, 3*(4), 43-56. GS Search

De Aguilera, M., & Mendiz, A. (2003). Video games and education: (Education in the face of a "parallel school"). *ACM Computers in Entertainment, 1*(1), 10-10. doi: 10.1145/950566.950583

Denis, G., & Jouvelot, P. (2005). *Motivation-driven educational game design: applying best practices to music education.* Paper presented at the 2005 ACM SIGCHI International Conference on Advances in Computer Entertainment Technology, Valencia, Spain. CrossRef GS Scholar

Dewey, J. (1938). *Experience and education*. New York, NY: Macmillan. GS Scholar

Dickey, M. D. (2005). Three-dimensional virtual worlds and distance learning: Two case studies of Active Worlds as a medium for distance education. *British Journal of Educational Technology, 36*(3), 439-451. CrossRef GS Scholar

Dickey, M. D. (2006). *"Ninja Looting" for instructional design: The design challenges of creating a game-based learning environment.* Paper presented at the ACM SIGGRAPH 2006 conference, Boston, MA. CrossRef GS Scholar

Dondlinger, M. (2007). Educational video game design: A review of the literature. *Journal of Applied Educational Technology. 4*(1), 21-31. Available from http://www.eduquery.com/jaet/JAET4-1_Dondlinger.pdf

ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

Dorval, M., & Pepin, M. (1986). Effect of playing a video game on a measure of spatial visualization. *Perceptual Motor Skills*, *62*(1), 159-162. CrossRef GS Scholar

Druckman, D. (1995). The educational effectiveness of interactive games. In D. Crookall & K. Arai (Eds.), *Simulation and gaming across disciplines and cultures: ISAGA at a watershed* (pp. 178-187). London, England: Sage Publications.

Egenfeldt-Nielsen, S. (2005). *Beyond edutainment: Exploring the educational potential of video games.* (Unpublished dissertation). IT-University of Copenhagen, Copenhagen, Denmark.

Egenfeldt-Nielsen, S. (2007). Third generation educational use of computer games. *Journal of Educational Multimedia and Hypermedia. 16*(3), 263-281. GS Scholar

Fisch, S. M. (2005). *Making educational computer games "educational."* Paper presented at the 2005 Conference on Interaction Design and Children, Boulder, CO. GS Scholar

Fisher, E. P. (1992). The impact of play on development: A meta-analysis. *Play and Culture, 5*(2), 159-181.

Friedman, T. L. (2005). *The world is flat: A brief history of the twenty-first century*. New York, NY: Farrar, Straus and Giroux.

Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. *Simulation & Gaming, 33*(4), 441-467. CrossRef GS Search

Gatto, J. T. (1992). *Dumbing us down: The hidden curriculum of compulsory schooling*. Philadelphia, PA: New Society Publishers.

Gee, J. P., (2004). *Situated language and learning: A critique of traditional schooling.* London, England: Routledge.

Gee, J. P. (2005a). Learning by design: Good video games as learning machines. *E-Learning and Digital Media*, *2*(1), 5-16. CrossRef GS Search

Gee, J. P. (2005b). *Why video games are good for your soul: Pleasure and learning*. Melbourne, Australia: Common Ground.

Gee, J. P. (2007) *Good video games + good learning: Collected essays on video games, learning, and literacy.* New York, NY: P. Lang.

Gee, J. P. (2008). *What video games have to teach us about learning and literacy*. Houndsmills, Basingstoke, Hampshire, United Kingdom: Palgrave Macmillan.

Copyright 2013
ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

Ginsburg, K. R. (2007). The importance of play in promoting healthy child development and maintaining strong parent-child bonds. *Pediatrics, 119*(1), 182–191. CrossRef GS Search

Harvey, S., & Goudvis, A. (2000). *Strategies that work: Teaching comprehension to enhance understanding*. Portland, ME: Stenhouse Publishers.

Hattie, J. (2009). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. London, England: Routledge.

Hirsh-Pasek, K., Golinkoff, R. M., & Eyer, D. E. (2003). *Einstein never used flashcards: How our children really learn – and why they need to play more and memorize less.* New York, NY: Rodale.

Hudson, P. (2012). A model for curricula integration using the Australian curriculum. teaching science. *The Journal of the Australian Science Teachers Association, 58*(3), 40-45.

Jennings, M. (2001). *Best practices in corporate training and the role of aesthetics: Interviews with eight experts.* Paper presented at the 2001 ACM SIGCPR Conference on Computer Personnel Research, San Diego, CA. CrossRef

Ke, F. (2009). A qualitative meta-analysis of computer games as learning tools. In R. E. Ferdig (Ed.), *Handbook of research on effective electronic gaming in education* (pp. 1–32). New York, NY: IGI Global.

Kearney, P. (2005). *Cognitive callisthenics: Do FPS computer games enhance the player's cognitive abilities?* Paper presented at the DiGRA 2005 Changing Views: Worlds in Play International Conference, Vancouver, Canada. GS Search

Khoo, A., & Gentile, D. A. (2007). Problem-based learning in the world of digital games. In O. Tan (Ed.), *Problem-based Learning and e-learning breakthroughs* (pp. 97-129). Singapore: Thompson Learning.

Ko, S. (2002). An empirical analysis of children's thinking and learning in a computer game context. *Educational Psychology, 22*(2), 219-233. CrossRef GS Search

Koster, R. (2005). *A theory of fun for game design*. Scottsdale, AZ: Paraglyph Press.

Kovalik, L. M., & Kovalik, D. (2008) A lesson learned through gaming. *Simulation & Gaming. An Interdisciplinary Journal of Theory, Practice and Research. 29*(1), 118-125. GS Search

ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

Lee, W. L. (1990). The effectiveness of computer-assisted instruction and computer programming in elementary and secondary mathematics: A meta-analysis. (Unpublished doctoral dissertation). University of Massachusetts, Amherst, MA.

LeJeune, J. V. (2002). *A meta-analysis of outcomes from the use of computer-simulated experiments in science education.* (Unpublished doctoral dissertation.) Texas A&M University, College Station, TX.

Lenhart, A., Kahne, J., Middaugh, E., Macgill, A. R., Evans, C., & Vitak, J. (2008, September 16). Teens, video games, and civics. Retrieved from http://www.pewinternet.org/Reports/2008/Teens-Video-Games-and-Civics.aspx

Li, Q. (2012). Understanding enactivism: A study of affordances and constraints of engaging practicing teachers as digital game designers. *Educational Technology, Research and Development, 60*(5), 785-806. CrossRef

Lipman, P. (2003). *High stakes education: Inequality, globalization, and urban school reform.* New York, NY: RoutledgeFalmer.

McKenna, K. (1991). *The use and effectiveness of computer-based models of the economy in the teaching of macroeconomics.* (Unpublished doctoral dissertation.) University of Western Australia, Perth, Australia.

Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record, 108*(6), 1017-1054. CrossRef GS Search

Mitgutsch, K. (2007). *Digital play-based learning; A philosophical-pedagogical perspective on learning anew*. Paper presented at the Games in Action Conference, Gothenburg, Sweden.

Niemic, R. P., Sikorski, C., & Walberg, H. J. (1996). Learner-control effects: A review of reviews and a meta-analysis. *Journal of Educational and Computing Research*, *15*(2), 157-174. CrossRef GS Search

Olsafsky, B. L. (2006). *Rethinking learner-centered instructional design in the context of "no child left behind".* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses.

O'Neil, H. F., Wainess, R., & Baker, E. L. (2005). Classification of learning outcomes: Evidence from the computer games literature. *The Curriculum Journal, 16*(5), 455-474. CrossRef GS Search

Ortlieb, E. T. (2010). The pursuit of play within the curriculum. *Journal of Instructional Psychology*, *37*(3), 241-246. GS Search

Copyright 2013
ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

Pannese, L., & Carlesi, M. (2007). Games and learning come together to maximise effectiveness: The challenge of bridging the gap. *British Journal of Educational Technology, 38*(3), 438-454. CrossRef GS Search

Piaget, J. (1962). *Play, dreams, and imitation in childhood*. New York, NY: Norton.

Pillay, H. (2002). An investigation of cognitive processes engaged in by recreational computer game players: Implications for skills of the future*. Journal of Research on Technology in Education, 34*(3), 336-350. GS Search

Pivec, M. (2009, March). *Games in schools*. Invited presentation at Game Based Learning 2009 Conference, London, England.

Rennie, L., Venville, G., & Wallace, J, (2012). *Knowledge that counts in a global community: Exploring the contribution of integrated curriculum*. New York, NY: Routledge.

Reynolds, M., & Trehan, K. (2000). Assessment: A critical perspective. *Studies in Higher Education, 25*(3), 267-278. CrossRef GS Scholar

Sedano, C. I., Sutinen, E., Vinni, M., & Laine, T. H. (2012). Designing hypercontextualized games: A case study with LieksaMyst. *Journal of Educational Technology & Society, 15*(2), 257-270. GS Search

Sprague, D. (2004). Technology and teacher education: Are we talking to ourselves? *Contemporary Issues in Technology and Teacher Education, 3*(4), 353-361. GS Scholar

Steinberg, L. D., Brown, B. B., & Dornbusch, S. M. (1997). *Beyond the classroom: Why school reform has failed and what parents need to do.* New York, NY: Simon and Schuster.

Stevens, D. A. (2000). *Leveraging technology to improve test scores: A case study of low-income Hispanic students*. Paper presented at the International Conference on Learning with Technology, Ambler, PA. GS Scholar

Subrahmanyam, K., Kraut, R., Greenfield, P., & Gross, E. (2000). The impact of home computer use on children's activities and development. *Children and Computer Technology, 10*(2), 123-144. GS Scholar

Thornburg, R. (2008). School children's reasoning about school rules. *Research Papers in Education, 23*(1), 37-52. CrossRef GS Scholar

Tobias, S. & Fletcher, J. D. (2011). *Computer games and instruction.* Charlotte, NC: Information Age Publishing.

Journal of Curriculum and Instruction (JoCI)
March 2013, Vol. 6, No. 2, Pp. 60-75
http://www.joci.ecu.edu

ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

Tragazikis, P., Kirginas, S., Gouscos, D., & Meimaris, M. (2011). Digital games evaluation and educational assessment - a review and proposal for an open methodological framework (OMEGA). *Proceedings of the European Conference on Games Based Learning* (pp. 604-612). Athens, Greece. GS Scholar

Tzuo, P., Ling, J. I. O. P., Yang, C., & Chen, V. H. (2012). Reconceptualizing pedagogical usability of and teachers' roles in computer game-based learning in school. *Educational Research and Reviews, 7*(20), 419-429. CrossRef GS Scholar

Voorhies, B. (2012). Games ancient people played. *Archaeology*, *65*(3), 48-51. GS Search

Waraich, A. (2004). *Using narrative as a motivating device to teach binary arithmetic and logic gates.* Paper presented at the 9th annual SIGCSE Conference on Innovation and Technology in Computer Science Education, Leeds, England. GS Search

Wastiau, P., Kearney, C., & Van den Berghe, W. (2009). How are digital games used in schools? European Schoolnet. Retrieved from http://games.eun.org/upload/gis-sythenesis_report_en.pdf

Wylie, C. (2001). *Making sense: Relations between literacy, television use, computer use and other uses of children's time.* Paper presented at the Annual Conference of the New Zealand Association for Research in Education, Christchurch, New Zealand. GS Search

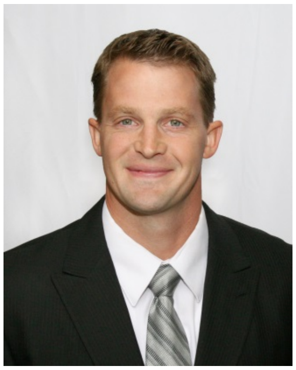
Warren, S. J., Dondlinger, M. J., & Barab, S. A. (2008). A MUVE towards PBL writing: Effects of a digital learning environment designed to improve elementary student writing. *Journal of Research on Technology in Education, 41*(1), 113-140. GS Search

Zigler, E. F., Singer, D. G., & Bishop-Josef, S. J. (2004). *Children's play: The roots of reading.* Washington, DC: Zero To Three: National Center for Infants, Toddlers and Families.

Journal of Curriculum and Instruction (JoCI)
March 2013, Vol. 6, No. 2, Pp. 60-75
http://www.joci.ecu.edu

ISSN: 1937-3928
doi: 10.3776/joci.2013.v6n2p60-75

About the Author



Curtis Chandler is an educator, staff developer, and doctoral student at Kansas State University who has worked with the Center for Teacher Quality, the Council of Chief State School Officers, and with school districts around the nation to enhance the instructional capacity and preparation of teachers. His current projects involve strategic work to infuse game dynamics into curriculum and instruction. Curtis was named the Kansas State Teacher of the Year in 2011 and was also an inductee into the Mid-America Educator Hall of Fame. He currently serves on the board of directors for MACE in order to help schools improve the use of instructional technology. Above all, he enjoys spending time with his wife and favorite "students"–his four boys ranging in age from two to nine years of age. Email: chandlerc@usd320.com