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#### The Twenty-First Century Learner and Game-Based Learning

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#### **Abstract**

This article reports on research that illustrates the increasing use of technologies by middle grade learners. Focus group results are showcased and creatively expressed through an original video, entitled "Having Our Say," which was designed and produced by Lodge McCammon, a doctoral student in the College of Education at North Carolina State University (view the video at <http://www.fi.ncsu.edu/initiatives/havingoursay/video.html>). Additionally, the article provides an overview of research that is being conducted at NC State on game-based learning environments and emphasizes the potential of gameplay as one context in which 21st century skills can be taught. The authors encourage educators to take student perspectives into account in the creation of new learning environments and focus on research breakthroughs that will facilitate 21st century teaching and learning.

#### **Introduction**

Growing consensus among policy makers and educational leaders suggests that if the current generation of students is to be competitive in the 21st century, our education system must be transformed to address the needs of a connected global economy. Central to our system's evolution is defining the knowledge and skills (Partnership for 21st Century Skills, 2007), as well as the performances and dispositions (Dede, 2007) that are necessary for 21st century life and work. Subsequently, K-12 educational experiences and assessments must be designed to align with evolving *21st century ways of knowing, being, and doing* (Spires, McCammon, & Bouterse, 2007). Obviously, today's students have opportunities to learn in different ways from those of previous generations, with much of the change due to advancements in information technologies. Growing trends among students demonstrate increased passion for and reliance on technologies for entertainment and communication (Pew Internet and American Life Project, 2007). In many cases, out-of-school technology use is outpacing in-school technology use (see National School Boards Association, 2007). Schools and educators are searching for proven, low-cost ways to engage students that lead to increased academic achievement.

Young people's enthusiasm for the Internet is not a trivial trend. Over one billion people, one sixth of the world's population, were accessing the Internet in 2005 (see [Internet World Stats: Usage and Population Statistics](#)). Even a conservative estimate would suggest that nearly half of the world's population will be online within the next five years. In the U. S., the Pew Internet and American Life Project has conducted surveys on children and teen's technology use since 2000. In the most recent survey, Lenhart and Maddan (2007) reported that 93% of teens use the Internet. A recent global study conducted by MTV, Nickelodeon, and Microsoft surveyed 18,000 youth from 16 countries and found that digital technologies have revolutionized how young people around the world communicate with their peers. A few of the results include:

- Technology has enabled young people to have more and closer friendships thanks to constant connectivity.
- Youth don't love the technology itself—they just love how it enables them to communicate all the time, express themselves, and be entertained.
- Despite the remarkable advances in communication technology, youth culture looks surprisingly familiar, with almost all young people using technology to enhance rather than replace face-to-face interaction (see <http://www.cdtv.net/users/node/14372>).

## **The Twenty-First Century Middle Grades Learner**

On a local level, we recently conducted a survey of 4,000 middle school students who attended after school programs in North Carolina and asked them what they needed to be academically successful and engaged in school (for a full report of these findings see Spires, Lee, Turner, & Johnson, 2008). This mixed-methods study included a survey, as well as a sample of 48 students drawn from the larger group who participated in one-hour focus group interview sessions. In this previously published report, we organized the survey findings into seven categories: 1) Computer Usage, 2) Basic Computer Skills, 3) Technology Use for Sharing Work and Productivity, 4) Technology Usage for Communication and Entertainment, 5) Activities Liked Best in School, 6) Rural and Low Income Schools, and 7) Gender and Ethnicity. In general, students reported high frequency computer use at home and at school with the higher frequency users of computers reporting using computers more at home than they used computers at school. Students also reported high levels of basic computer skills, including word processing and spreadsheet skills, and reported that these skills were developed primarily in school-based contexts. Additional questions focused on how students used technology for completing and sharing school-based work. A majority of students reported using word processing, painting, and design technologies to complete and share their work. The focus group interview data took shape in four thematic areas: 1) "Do U Know Us?" 2) "Engage Us," 3) "Prepare Us for Jobs of the Future," and 4) "Let's Not Get Left Behind." In general, students expressed beliefs about technology that confirmed their digitally native status (Prensky, 2006). Students described uses of technology that were authentic, personal, and social. They used entertainment and communication technologies at home and made clear distinctions between inside and outside school uses of technology as being separately focused on academics (primarily computer-based in school technology use) and personal/social (outside school both computer-based and personal communication/entertainment technologies). These four themes are creatively expressed through an original video, entitled "Having Our Say," designed and produced by Lodge McCammon, a doctoral student in the College of Education at North Carolina State University (view the video at <http://www.fi.ncsu.edu/initiatives/havingoursay/video.html>).

In addition to basic computer skills and computer-based productivity tools use, students reported high frequency usage of digital games, music services, email, instant messaging, and cell phone services. These technologies were used predominately out-of-school. This finding identified differences between what students said about their in-school and out-of-school technology uses. Students were also asked about where they found information for completing their work, and 86.3% of respondents indicated that they used the Web as opposed to printed materials. When asked about activities they enjoyed in school, students listed working with computers as their top activity—above working on projects in a group, working on a project independently, listening to the teacher explain things, and doing worksheets.

## **The Connection Between 21st Century Skills and Game-Based Learning**

Not surprisingly and as mentioned earlier, one of the findings that emerged from our research was that students spend a large proportion of their time out-of-school playing digital games. International trends are in line with what we found and suggest that growing numbers of people around the world are playing computer games. As the economic and social implications of this phenomenon are just beginning to be understood, educators are attempting to find ways to appropriate the best features of game-based learning and bring them into the formal classroom. In his book, *How Computer Games Help Children Learn*, David Williamson Shaffer (2007) describes a wide range of new learning games that are emerging from university research labs at Harvard, the University of Wisconsin, and MIT. Because these videogames give students the chance to creatively manipulate a virtual world, Shaffer (2007) claims that the games can promote creativity and innovation, abilities that are more important than ever in today's competitive global economy. His most radical assertion is that students who play videogames will think and learn very differently than students of prior generations. Shaffer (2007) states that rather than collecting facts and skills, students will learn how to creatively adapt and apply knowledge in a variety of real-world situations. Not surprisingly, the two 21st century skills of complex communication and expert problem solving (Levy & Murnane, 2004) are dominant features that cut across most game genres. For the most part, traditional schools are not designed to provide learning contexts that promote these two skills. Problem-based learning scenarios have been used for years to try to approximate real life problems and have met with some success in education. But typically problem-based learning modules have not approached the cognitive complexity and fast-paced processing that game contexts afford.

The contemporary work environment is about managing complex information streams, which increasingly is a critical part of job performance. Games can provide a context for situated learning in which players are immersed in complex problem solving tasks that require expertise. Examining the role of expertise in modern culture, John Bransford and his colleagues (e.g., Schwartz, Bransford, & Sears, 2005) distinguish between routine and adaptive expertise. Routine experts are adept at solving every day routine problems; adaptive experts exhibit flexibility, which is highly valued in today's workplace since knowledge and skill requirements change significantly over the course of a career. While routine experts may be efficient and technically skillful, they may not be able to flexibly adapt to solve new problems; adaptive experts are able to adapt to as well as seek out new learning situations (Hatano & Oura, 2003). Adaptive expertise is clearly

a key feature of game environments. Beck and Wade (2004) describe five characteristics that distinguish game environments as adaptive:

- Rapidly analyze new situations.
- Interact with characters they don't really know.
- Solve problems quickly and independently.
- Think strategically in a chaotic world.
- Collaborate effectively in teams.

Beck and Wade's (2004) characteristics are illustrated in both *online commercial games*, as well as *academic games* that are being designed for research purposes. Following is a discussion of Beck and Wade's (2004) gameplay characteristics relative to these two categories.

### **Online Commercial Gaming Environments**

Beck and Wade's characteristics are evident in commercial massively multiplayer online games (MMOGs) like *World of War Craft*, or *Everquest 2*. MMOGs share many of the same features of other games, except they are played online. Steinkuehler (2004) asserts that these games can be cognitively demanding, requiring exploration of complex, multi-dimensional problem spaces, as well as empirical model building systems. These environments require the negotiation of meaning and values within the online community, as well as the coordination of avatars and multiple forms of text. *Civilization III* is an example of a commercial entertainment game that provides extensive experience in problem solving. As players lead a civilization from 4000 BC to the present, they seek out geographical resources, manage complex economies, and hold diplomatic summits with other nations. Squire (2004) conducted a study to see what students learned about social studies from *Civilization III*, even though the game is designed primarily for entertainment. Although Squire (2004) found serious challenges to using the complex game environment of *Civilization III*, he concluded that the students in his study developed various conceptual understandings (e.g. monotheism and monarchy) in world history, geography, and politics through *Civilization III* gameplay.

Following up on Squire's research, a group of North Carolina State researchers (Lee, 2007b) explored specific teacher-directed learning that emerged while high school students played *Civilization III*. Gameplay for students in the class featured in this study differed from the typical gameplay in several ways. *Civilization III* gameplay is typically single-player and quite lengthy. Advanced games can last 40 hours or more and usually involve the development of complex multilayered civilizations with dozens of cities and possibly hundreds of individual game tasks underway. The gameplay studied here involved a high school history class of twelve students and their teacher collaborating about specific moves. The game was played over nine class periods averaging 27 minutes per day for a total of just over four hours. Gameplay began in the tutorial mode, which involves regular gameplay supported with tutorial screens that explain and even suggest specific actions a player might take, including building a city, working, exploring, and warring, among other things. After two days of tutorial play, the class played a regular game, building three cities and reaching several game goals, including mining for gold/wealth, defending cities with walls, fortifying military forces, road construction, establishing embassies, constructing a palace, building a colossus, and building a granary. The class also made several cultural advancements, including developing the following game technologies and skills: the wheel, bronze and iron working, ceremonial burial, horseback riding, the alphabet, a code of laws, and mathematics. Each of these advancements was completed as a result of teacher-guided class-based decisions made during the gameplay. The teacher and students discussed the options for gameplay that were available, and the teacher often guided students directly toward their selections.

The class's gameplay reflected Beck and Wade's (2004) characteristics of gameplay, in particular strategic thinking and collaboration. Students worked together to make strategic decisions, often taking the advice of their teacher but sometimes reaching decisions different than the teacher recommended. For example, the class decided to build their first city in a low lying area against the advice of the teacher. Decisions such as this one reflect three primary forms of strategic decision-making which relate to the following: 1) cultural advances, 2) game units to build, and 3) locations of existing units. Students had to make decisions about cultural advances. These decisions involved the class weighing options about the short and long term benefits of acquiring certain cultural attributes. Students had to decide what types of game units to build. With the exception of Washington, each city was able to build new units. Washington was limited due to the city's location in a low-lying area and the resulting inability to maintain stable growth. Students in the class had to decide where to move existing units and what to have those units do after they moved.

In another study of online gameplay, a group of North Carolina State researchers (Lee, 2007a) studied how young children interacted in online social gaming environments. This study reflects an emerging phenomena in which children and adults can play games at all times in ongoing and life-situated contexts using computers, televisions, handheld devices, and even cell phones. As these environments have proliferated, educators have become increasingly interested in the dynamics of what happens within online

social gaming worlds such as Club Penguin, Habbo Hotel, Maple Story, Millsberry, Neopets, and Webkinz. Scholars are voicing an increasingly common belief that the experiences children have while engaging social gaming environments demand new literacies and related skills (see Jenkins, Clinton, Purushotma, Robinson, & Weigel, 2006; New London Group, 1996). Calls for educators to give serious thought to how gaming environments facilitate learning have permeated recent popular and scholarly press (see Beck & Wade, 2006; Gee, 2006; Johnson, 2005; Prensky & Thiagarajan, 2007; Shaffer, 2007).

Online social games are often embedded in immersive web-based environments that enable players to interact around like interests using avatars, text-based communication, real-life like contexts, and various levels of social interaction related to civic concepts such as rules, authority, and responsibility as well as local economies (virtual and real). Thomas (2006) argues that these environments, sometimes called "pervasive games," do not follow the typical patterns of gameplay which suggest that play, with specific start and stop signals, is outside of real-life experiences (p. 42). Evidence of social play in such gaming environments has been reported by Inal and Cagiltay (2007) who studied the flow experiences of children playing games in social settings finding that "children have a tendency to form a group while playing" (p. 462). Others have argued that online gaming environments for children are problematic with regard to the uses of immersive advertising (Grimes & Shade, 2005), intergenerational differences and dispositions regarding gaming (Aarsand, 2007), increased social isolation among gamers (Colwell & Payne, 2000), and gaming violence and addiction (Glazer, 2006).

In this study, five children ages 5-7 engaged in gameplay in the Webkinz online gaming world. Webkinz is an online social gaming environment that enables players to care for virtual pets that are representations of stuffed animals which must be purchased with real money. Each stuffed animal includes a code that unlocks the virtual pet and other resources. In addition to caring for pets, players can accumulate virtual money by completing tasks and playing games. This virtual money can be used to purchase food, housing, toys, and other items for the virtual pets. Webkinz also allows players to interact in various ways. Findings in this study emerged around concepts of online identity, situated-learning, and self-monitoring. The online social worlds that children engaged in their Webkinz gameplay and the online identities they assumed were alternatively described as real and not real, but consistently different than the physical place the children inhabited. Students agreed that situated learning (Brown, Collins, & Duguid, 1989) could take place in online gaming worlds but were limited in their understanding of how that learning was situated in their own social lives. Students also expressed an understanding that gameplay was an act that started and stopped, but interestingly they did not monitor their gameplay or the related social aspects of the gameplay solely within the constructs of the gaming environment. For example, talk about gameplay permeated their expressions of how they interacted with friends in and out of the online environment. During their gameplay, children engaged in a constant real-life chatter about what they were doing and how they could play in the online environment together. The children also sought out other friends who were not present to play with in the online Webkinz gaming environment. By blurring the lines between reality and online gameplay, the students in this study engaged in the sort of collaboration highlighted by Beck and Wade (2004) as characteristic of gaming.

#### **Games for Research Purposes: The Case of Crystal Island**

Beck and Wade's (2004) characteristics are also evident in non-commercial games, such as Dede's long standing *River City*, an immersive simulation for middle school students. This MUVE (Multiuser Virtual Environment) is an example of an academic enterprise that was created using designed-based research and promotes both complex communication and expert problem solving. Following the path of *River City*, with the addition of intelligent tutors, *Crystal Island*, is being developed at North Carolina State University by a team of computer scientists and educational researchers. This NSF funded project is an example of an academic innovation that targets science education for eighth grade middle students. Taking their cues from Jerome Bruner (1990), who observed that the way people organize their experience and knowledge with the social world "is narrative rather than conceptual" (p.35), the creators are using a narrative centered learning environment to explore concepts related to microbiology (Mott & Lester, 2006). The learning environment (see Figure 1) is set on a recently discovered volcanic island where a research station has been established to study the unique flora and fauna. The user plays the role of the daughter (or son) of a visiting scientist who is attempting to discover the origins of an unidentified illness at the research station. The environment begins by introducing the student to the island and the members of the research team for which her father serves as the lead scientist. As members of the research team fall ill, it is her task to discover the cause of the outbreak. She is free to explore the world to collect physical evidence and interact with other characters. Through the course of her adventure she must gather enough evidence to correctly choose among candidate diagnoses including botulism, cholera, salmonellosis, and tick paralysis, as well as identify the source of the disease relying on her knowledge of genetics to solve the mystery.



Figure 1. The CRYSTAL ISLAND learning environment.

The task-oriented environment of *Crystal Island*, its semiautonomous characters, and the user interface are implemented with Valve Software's Source™ engine, the 3-D game platform for *Half-Life 2*. The user can perform a broad range of actions including performing experiments in the laboratory, interacting with other characters, reading "virtual books" to obtain background information on diseases, and collecting data about the food recently eaten by the members of the research team. Throughout the mystery, users can walk around the island and visit the infirmary, the lab, the dining hall, and the living quarters of each member of the team. In the current test bed, there are 20 goals users can achieve, three hundred unique actions the user can carry out, and over fifty unique locations in which the actions can be performed.

In an attempt to increase student interest and engagement levels with *Crystal Island* we conducted two sets of focus studies, one with individual student sessions and the other with groups of four students. A total of 14 eighth grade students solved the mystery and then participated in conversations reflecting on their experience. Discussions centered on the topics of plot, characters, and setting; findings of these studies as they relate to interest and engagement are summarized below:

- **Plot.** Students enjoyed the science mystery but suggested that more conflict would add to the story. Recommendations included developing conflicts between characters and introducing misleading storylines, such as a rogue researcher accused of poisoning the sickened team members. These additional plot elements would presumably enhance students' curiosity, supporting the goal of enhancing intrinsic motivation. Students also focused on the story's introduction, recommending that a "training" level be utilized to establish plot, characters, and setting. Discussions emphasized an interactive scenario over a scripted cinematic sequence, providing exercises to establish navigational controls and foreshadow task objectives.

- **Characters.** Students suggested that *Crystal Island* characters needed to be more expressive and active. They wanted the learning environment to be populated by characters who could develop relationships, perhaps as active collaborators in the pursuit of solving the mystery. There was also an interest in further developing character-student conversations. Students related to other games that provide multiple-choice responses where the player has control of the dialog and perceived control of plot progression. Believable, meaningful character interactions can aid in immersing the student in the story world, thereby supporting intrinsic motivation through enriched curiosity and fantasy. Several students expressed interest in being able to design their own characters along several possible dimensions including role, gender, and physical features (e.g., hair, eyes, and clothing). This level of control over characters' appearance potentially allows students to better identify with the character, investing themselves in the story and enhancing motivation.

- **Setting.** During group sessions, students worked together to draw new maps of *Crystal Island*. The students designed the world to include areas that would evoke interest, curiosity, and opportunities for science learning. Beyond the base camp, where the current *Crystal Island* mystery is set, students envisioned a rich landscape replete with volcanoes, mountains, woods, caves, lakes, and streams.

Based on results of the pilot study, the research team made appropriate modifications to *Crystal Island* in an effort to increase interest and potential student engagement with the environment. A second data collection involved 60 eighth grade students who solved the mystery and responded to a series of questionnaires that assessed student engagement and academic dispositions (i.e., student achievement, teacher ratings of student persistence, and goal mastery orientation). We are assessing the relationship among student engagement, academic dispositions, and success in the *Crystal Island* environment (i.e.,

number of goals and actions completed and amount of time to solve the mystery). Results from this analysis, which will be presented at the 2008 American Educational Research Association meeting in New York (McQuiggan & Lester, 2008; Spires, Turner, Lester, & McQuiggan, 2008), will provide important insights into individual differences among game players that will contribute to future customization of content and game design features. Future data collections will target the effects of *Crystal Island* on student problem solving and affect. As a narrative centered learning environment, *Crystal Island* incorporates three of Beck and Wade's (2004) gameplay characteristics: the opportunity to rapidly analyze new situations, to interact with unfamiliar characters, and to solve problems quickly and independently. Additionally, *Crystal Island* satisfies Malone & Leper's (1987) criteria of challenge, curiosity, control and fantasy; learning includes competence and direction in the face of novelty, complexity, and ambiguity.

## Conclusion

As educators continue the quest to ensure that all students have the opportunity to participate fully in society, multiple paths for learning must be explored. Although in its infancy, game-based technologies hold promise in forging new models of learning and teaching for the formal schooling process. Central to this challenge in the 21st century is finding cross-sector partners who are willing to take up the research and development mantle in order to shed more light on the educational benefits of games. Gee (2003) identified 36 learning elements embedded within games that he analyzed. He concluded: "Better theories of learning are embedded in the video games many children in elementary and high school play than in the schools they attend. Furthermore, the theory of learning in good video games fits better with the modern, high-tech global worlds of today's children and teenagers live in than do the theories (and practices) of learning they see in school" (p.7). Gee's assertion, no doubt, is designed to be provocative, but his statement holds some truth. As games become more popular, however, generalized, non-substantiated statements will not serve the field well. We need a systematic way to analyze the learning features of games and conduct educational research that will help articulate the cognitive, affective, and social benefits for education. Students are becoming increasingly vocal about what they need to be engaged and successful in school; it behooves us not only to hear what they are saying but to help create the research breakthroughs that will facilitate 21st century teaching and learning.

## About the Authors



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