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21st Century Skills and Serious Games: Preparing the N Generation

> *If it were possible to define the mission of education, it could be said that its fundamental purpose is to ensure that all students benefit from learning in ways that allow them to participate fully in public, community, and economic life* (New London Group, 2000, p. 9).

INTRODUCTION

Ensuring that all students have the opportunity to participate fully in society is a daunting challenge for educators. Central to this challenge in the 21st century is changing how we view learning. Serious games, an area that is gaining momentum in education, has potential to transform how we view learning as we meet the fast-paced, ever-changing demands of modern life. Forging a conceptual bridge between serious games and highly-valued emerging skills, this chapter: 1) defines evolving characteristics of the 21st century learner, 2) synthesizes proposed 21st century skills from different disciplines, and 3) analyzes how certain features of serious games can promote the highly valued 21st century skills of *expert problem-solving* and *complex communication*. The chapter closes with a call for more thoughtful empirical studies in order to establish a research base for the emerging field of serious games.

THE 21ST CENTURY LEARNER

Today's students, commonly referred to as the N generation, millenials, or digital natives, were born into social and educational environments where digital technologies are pervasive. The emergence of this first technologically savvy generation creates new challenges for parents (e.g., monitoring time devoted to digital interactions and appropriate content) as well as for educators. Digitally native students bring different skills, interests, and needs to the classroom and educators are grappling to understand these unique attributes in order to design instruction accordingly. Many educators decry the violence and inappropriateness of content both on the web and in games, while others look past the immediate problems and see potential for educational applications. The learning principles that are embedded within games and to which they owe much of their popularity are often overlooked. As the numbers of game players increase it becomes even more important that educators find ways to harness this phenomenon for educational purposes.

Young people's enthusiasm for the Internet and video games is not a trivial trend. Over one billion people, one sixth of the world's population, were accessing the Internet in 2005 (Internet World Stats: Usage and Population Statistics, n.d.).

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.K., 74% of children and young people aged nine to nineteen have access to the Internet at home, and most of these are daily or weekly Internet users (Livingstone & Bober, 2005). In Japan, 98% of homes have access to the Internet with broadband 16 times faster than that found in the U.S. In the US, the Pew Internet & American Life Project has conducted surveys on children and teens technology use since 2000. In the most recent survey Lenhart and Maddan (2007) reported that 93% of teens use the Internet. More than half of online teens indicated that they were creating content in the form of blogs, videos, or music.

At the state level, a recent survey was conducted of 4000 middle grades students (sixth, seventh, and eighth grades) who were in a North Carolina statewide after-school program (Spires, Lee, Turner & Johnson, in press). This mixed-methods study included the survey as well as a sample of 48 students drawn from the larger group who participated in one-hour focus group sessions. Students reported high frequency usage of video and online games, music services as well as email, instant messaging, and cell phone services out of school. There was a difference between what students said about in school and out of school technology uses. In school students reported high levels of computer-based skills work and moderate levels of Internet-based research. Students were also asked about where they found information for completing their work and 86% of respondents indicated that they used the Web as opposed to printed materials. When asked about activities they enjoyed in school, students listed doing research on the Internet above working on projects in a group, listening to the teacher explain things, and doing worksheets. Analysis of survey data revealed no significant differences in computer usage in and out of school among ethnic groups as well as rural and non-rural students' uses of computers.

The main distinctions that emerge between in and out of school technology use relate to the intent of the technology use and the actual devices being used. Outside of school students are using technology for communication and entertainment purposes. They also are more likely to use smaller handheld and gaming devices outside of school. Inside school students are using desktop computers for web-based research, word-processing and other productivity purposes (spreadsheets, PowerPoint, etc.). The surveys suggested that students' technology use inside school is often less creative and meaningful than their technology use outside of school. Students expressed strong opinions in all the surveys about what technologies they thought should be in school and how they thought these technologies should be used, and they viewed technology skills and understandings in general as essential for their success in adult workplaces. Interestingly, research suggests that while they are frequent users of technology tools, Net-Geners typically lack information literacy skills, and their critical thinking skills are often weak (Oblinger & Oblinger, 2005). They may be digital natives, but they do not necessarily understand how their use of technology affects their ways of learning.

WHAT KNOWLEDGE AND SKILLS ARE ESSENTIAL FOR THE 21ST CENTURY?

In 1900 in his seminal essay*, What Knowledge is of Most Worth?,* social theorist Herbert Spencer stated that this question needed to be answered before designing curriculum or instruction. As we make our way into the 21st century, Spencer's provocative question is still front and center but this time in the midst of fast-paced technological changes that are driving the global economy. With ongoing advancements in information technologies creating much of the change we experience, different groups are thinking hard about the new knowledge and skills that are needed for workplace productivity. Even though it is impossible to predict the future, based on current expectations from the business community trends are emerging in terms of new skills that are needed. The Partnership for 21st Century Skills (P21) (2005) is the latest in a series of business-education consortia that have delineated core content, skills, and processes that are deemed critical to the twenty-first century workplace. P21's perspective is consistent with that of many economists and nonprofit organizations that address workforce-capacity issues (Levy & Murnane, 2004; Dede, Korte, Nelson, Valdez, & Ward, 2005). Arguing to "bridge the gap between how students live and how they learn" (p. 4), P21 has identified six key elements for 21st century education including, core subjects and learning skills as well as 21st century tools, contexts, content, and assessment. These six elements shape an educational reform agenda that P21 argues will enable young people to develop a wide range of skills (e.g., media, communication critical thinking, creative, problem solving, interpersonal, collaborative) while using information and communication technologies in real world contexts. Interestingly, P21's claims are similar to the SCAN report that emerged in the 1990's.

P21 suggests that technology plays an important role in educational change and much of the proposed change is tied to the tools and resources students use in their everyday lives. As reported earlier, students are becoming increasingly dependent on technologies to communicate, gather information, extend social experiences, and be entertained. Obviously, as students move into the workplace their interest in technologies transfers with them; the workplace, however, often expects workers to have even more sophisticated technological skills and know-how and a disposition receptive to change.

Coming from a popular press perspective and being more global with his concepts than P21, Daniel Pink in *A Whole New Mind*, (2005) boldly claims that "the future belongs to a very different kind of person with a very different kind of mind—creators and empathizers, pattern recognizers, and meaning makers. These people . . . will now reap society's richest rewards and share its greatest joys." (p.1). Arguing that we have already passed from the informational age to the conceptual age, Pink claims that in addition to left brain-directed reasoning, which was dominant in the information age, right-brain approaches are also essential in the conceptual age in order to be successful. Table 1 depicts the six senses that Pink asserts must prevail to be successful in today's society.

Table 1. A Whole New Mind: Moving from the Information Age to the Conceptual Age. (Pink, 2005).

Right-Brain Senses	*Description*
Design	Creating something aesthetically appealing, whimsical or emotionally engaging.
Story	A tool that is enriched by emotion, a deeper understanding of how we fit in the world and why that matters.
Symphony	The ability to put together the pieces; to synthesize rather than to analyze; to see relationships among unrelated fields, to detect patterns; to invent something new by combining elements nobody else thought to pair.
Empathy	Being able to discern what makes a fellow woman or man tick to forge relationships and to care for others.
Play	Ample evidence points to the enormous health and professional benefits of laughter, lightheartedness, games, and humor.
Meaning	Our abundance has freed millions of people to pursue significant desires: purpose, transcendence, and spiritual fulfillment.

Another group that has done advanced thinking in the area of 21st century skills is MIT Professor Henry Jenkins (2007) and his colleagues. The skills that Jenkins promotes are more localized to media literacies than the global skills that Pink and the P21 group target. Prompted by the rich media landscape that exists today, Jenkins has articulated a new skill set that involves social skills developed through collaboration and social networking. These skills build on the foundation of traditional literacy, research skills, technical skills, and critical analysis skills taught in the classroom. Table 2 depicts these new media literacies, which are contextualized within digital media environments. Note that both Pink and Jenkins point to "play" as a 21st century skill, although they define it in different ways (see Chapter 4 of this text for a discussion of educational play). Pink points to the health and professional byproducts of play; Jenkins, on the other hand, claims play is as an approach to problem solving. Interestingly, both authors use "empathy" and "negotiation" as very similar concepts.

Table 2. New Media Literacies (Jenkins, 2007)

New Media Literacy	*Description*
Play	Capacity to experiment with one's surroundings as a form of problem-solving.
Performance	Ability to adopt alternative identities for improvisation and discovery.
Simulation	Ability to interpret and construct dynamic models of real-world processes.
Appropriation	Ability to meaningfully sample and remix media content.
Multitasking	Ability to scan one's environment and shift focus as needed to salient details.
Distributed Cognition	Ability to interact meaningfully with tools that expand mental capacities.
Collective Intelligence	Ability to pool knowledge & compare notes with others toward a common goal.
Judgment	Ability to evaluate the reliability & credibility of different information sources.
Transmedia Navigation	Ability to follow the flow of stories and information across multiple modalities.
Networking	Ability to search for, synthesize, and disseminate information.
Negotiation	Ability to travel across diverse communities, discerning and respecting multiple perspectives, and grasping and following alternative norms.

Dede (2007) astutely argues that proposed skills and knowledge are not robust enough to encompass what is needed for the future; but rather *understandings* and *performances* will better serve our transition into 21st century work and life. Levy and Murnane (2004) suggest that expert thinking and complex communication are essential for contemporary work, since these are the two areas in the workplace that computers cannot replace human beings. Expert problem solving involves effective pattern matching based on detailed knowledge, metacognition, and the set of skills used by the perplexed expert to determine when to end one strategy and try the next. Complex communication involves managing multiple information streams as well as the capability to interpret subtleties and present convincing arguments. In an economy flooded with new concepts and invented language, communicating complex information effectively is an increasingly valued skill. Complex problem solving, quick and intuitive decision-making ability, collaboration skills, and resourcefulness are the keys to success in the workplace.

The rapid pace of change and the need for continuous learning makes the capacity to learn a highly valued competency as well.

If we synthesize across the various taxonomies that have been described, it appears that the bottom line for 21st century life and work is that we need, first, continuous learners who can forge understandings in ambiguous and complex problem solving landscapes. Second, we need learners who can collaborate with multiple information and communication streams. In an era of high stakes testing, schools do not typically place these two performances at the center of education. The question that many educators are asking is, "How do we turn the educational corner to nurture these dispositions in our schooling process?" Multiple agendas are emerging in order to answer this question; one area that shows promise but still needs much research is the area of serious games.

HOW CAN SERIOUS GAMES ENABLE 21ST CENTURY SKILLS IN EDUCATIONAL SETTINGS?

With growing numbers of people around the world playing computer games, the economic and social implications of this phenomenon are not trivial. A single definition of serious games does not appear to exist, although typically the term depicts games that are used for training, advertising, simulation, or education. Educators are attempting to find ways to appropriate the best features of game-based learning and bring them into the formal classroom. Not surprisingly, the two 21st century skills of complex communication and expert problem solving are dominant features that cut across most game genres. For the most part, traditional schools are not set up 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. Additionally, there is a gap between what students have a growing demand for, what our global economy requires, and what traditional schools can afford. While game-based learning will not be a singular answer to filling the gap, it can provide movement in the right direction.

The modern 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 routine problems every day; 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.

Becker & Wade (2004) deconstruct complex communication and expert problem solving further and assert that the following characteristics of gamers map on to the needs of the 21st century workplace. Gamers are able to:

- 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

These characteristics are clearly 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 (2003) conducted a study to see what students learned about social studies from Civilization III, even though the game is designed primarily for entertainment. Students understood the concepts of monotheism and monarchy as well as learned how to synthesize disparate periods of history.

Becker and Wade's characteristics are also evident in non-commercial games, such as Dede's (see Chapter 3 of this text) 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 (Lester, Spires, & Nietfeld, 2007) is an example of an academic innovation that targets science education for 8th grade middle students. Taking their cues from Jerome Bruner (1990, p. 35), who observed that the way people organize their experience and knowledge with the social world "is narrative rather than conceptual," the creators used a narrative centered learning environment to explore concepts related to microbiology (Mott & Lester, 2006).

The mystery-based task-oriented environment of *Crystal Island*, its semiautonomous characters, and the user interface were implemented with Valve Software's Source™ engine, the 3D 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. As a narrative centered learning environment, *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. A series of experiments are underway that will assess the effects that using *Crystal Island* has on student problem solving and affect. Additionally, the research is examining how well performance in the environment predicts a range of academic dispositions.

As we continue our quest to ensure that all students have the opportunity to participate fully in society, we must explore multiple paths for learning. 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 mantel 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.

Gaming technology will need to overcome the same types of resistance that, in recent years, other technologies have confronted, (e.g., computers as tools for analysis and the Internet as a primary form of communication within business). As the field moves forward, essential questions for the educational research community are: What are the critical factors built into game-based environments and how can they inform our current theories of teaching and learning? How can we appropriate the very best of what games have to offer for educational purposes in the 21st century? In the best interest of the N generation and future learners to come, we need to answer these questions thoughtfully and thoroughly—and we need to answer them sooner rather than later.

REFERENCES

Becker, J. C., & Wade, M. (2004). *Got game: How the gamer generation is reshaping business forever*. Boston: Harvard Business School Press.

Bruner, J. (1990). *Acts of meaning*. Cambridge: Harvard University Press.

Dede, C. (in press). *Transforming Education for the 21st Century: New Pedagogies that Help All Students Attain Sophisticated Learning Outcomes*. Raleigh, NC: Friday Institute, North Carolina State University, in press.

Dede, C., Korte, S., Nelson, R., Valdez, G., & Ward, D. (2005). *Transforming Education for the 21st Century: An Economic Imperative.* Chicago, IL: Learning Point Associates, 2005. http://www.learningpt.org/tech/transforming.htm

Gee, J.P. (2003). *What video games can teach us about literacy and learning*. New York: Palgrave-McMillan.

Hatano, G., & Oura, Y. (2003). Reconceptualizing transfer using insight from expertise research. *Educational Researcher, 32*(8), 26-29.

Jenkins, H. (2007). *Confronting the challenges of participatory cultures: Media education for the 21st century*. MacArthur Foundation: Chicago, IL.

Lenhart, A. & Maddan, M. (2007). *Social Networking Websites and Teens: An Overview*. Retrieved April 27, 2007, from http://www.pewinternet.org/PPF/r/198/report_display.asp

Levy, F. & Murnane, R. (2004). *The new division of labor: How computers are creating the next job market*. Princeton, NJ: Princeton University Press.

Livingstone, S., & Bober, M. (2005). *UK children go online*: *Final report of key project findings.* Project Report. London: London School of Economics and Political Science.

Malone, T., and Lepper, M. (1987). Making learning fun: A taxonomy of intrinsic motivations for learning. In Snow, R., and Farr, M. (Eds.), *Aptitude, Learning, and Instruction: Cognitive and Affective Process Analyses* (pp. 223-253). Erlbaum, Hillsdale, NJ.

Mott, B., and Lester, J. (2006). Narrative-Centered Tutorial Planning for Inquiry-Based Learning Environments. In *Proceedings of the Eighth International Conference on Intelligent Tutoring Systems*, Jhongli, Taiwan, 675-684.

New London Group (2000). A pedagogy of multiliteracies: Designing social futures. In B. Cope & M. Kalantzis, (Eds.), *Multiliteracies: Literacy Learning and the Design of Social Futures* (pp. 9-38) London: Routledge.

Oblinger D. G., & Oblinger, J. L. (2005). *Educating the net generation*. Boulder, CO: Educause.

Partnership for 21st Century Skills. (2005). *P21 backgrounder*. Retrieved Nov. 25, 2006 from http://www.21stcenturyskills.org/images/stories/otherdocs/P21%20Backgrounder%20March%202005.pdf

Pink, D. H. (2005). *A whole new mind: Moving from the information age to the conceptual age.* New York, NY: Riverhead Books.

Schwartz, D., Bransford, J., & Sears, D. (2005). Efficiency and innovation in transfer. In J. Mestre (Ed.) *Transfer of learning* (pp. 1 – 51). Greenwich, CT: Information Age Publishing.

Spires, H., Lee, J., Turner, K., & Johnson, J. (in press). Having our say: Middle grade students' perspectives on school, technologies, and academic engagement. *Journal of Research in Technology & Education.*

Squire, K. (2003, April). Replaying history: Teaching social studies with Civilization III. *Paper presented at the annual meeting of the American Educational Research Association, Chicago, IL.*

Steinkuehler, C. A. (2004). Learning in massively multiplayer online games. *Paper presented at the 6th International Conference of the Learning Sciences, Mahwah, NJ.*

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