A Learning Theory for 21st-Century Students
by Marie Sontag

According to a 2008 Pew report, 97% of American teens aged 12-17 play computer, console, or cell phone games, and three-fourths of these teens play them with others at least some of the time (Lenhart et al. 2008). 93% use the Internet, 61% go online daily, and 51% create content that others can view online (Lenhart et al. 2007). Eleven million students under the age of 18 use MySpace (Owyang 2008). The site myYearbook, a social networking site created specifically for 12- to 17-year-olds, boasts 7 million members (Loten 2008). In short, many, perhaps even most, of the current generation of learners are enmeshed in connective technologies.

Evidence indicates that these social changes impact cognitive processes. Studies by Nisbett et al. (2001) found that the environment and culture in which people grow up affect their thought processes and that cognitive processes are far more malleable than previously assumed. Evidence provided by magnetoencephalographic (MEG) imaging suggests that structural rewiring of the brain "can and does occur via experience" (O'Boyle and Gill 1998, 406). Interactive and interpersonal applications of digital technology shape the social and cognitive development of those who use them (Shumar and Renninger 2002). Oblinger (2004) claims that "constant exposure to the Internet and other digital media has shaped how [students] receive information and how they learn" ("Abstract," ¶1). Some of these changes include "the development of a new type of multimedia or information literacy" which "parallels other shifts in how we approach learning such as of moving from an environment of being told or authority-based learning to one based on discovery or experiential learning" ("4. How People Learn," ¶7). In addition, immersion in technology has influenced these students' learning preferences and styles. Students "tend toward teamwork, experiential activities . . . and the use of technology. Their strengths include multitasking, goal orientation, . . . and a collaborative style" ("2. Changes in Students," ¶1).

Unfortunately, current learning theories, while recognizing some of these changes, have failed to take into account their impact on cognitive processing. Schaller and Allison-Bunnell (2003) compare this failure to perceive such changes in the big picture of education to the story of the blind men in John Godfrey Saxe's poem "The Blindmen and the Elephant" who cannot describe the whole elephant because each has felt only one part of it. Recent educational research seems to have suffered a similar fate, failing to account for the effect that ubiquitous digital technology has had on the way students learn. A theory of learning that takes these important developmental changes into account to provide a picture of the whole educational elephant can structure more engaging and effective instructional environments. In this article I describe my social- and cognitive-connectedness schemata (SCCS) theory and present a study that shows increases in learning transfer with the implementation of an instructional design model based on SCCS theory.

The Whole Elephant

Technology leaders, futurists, journalists, and educators opine that society is experiencing a paradigm shift (Exhibit 1). Negroponte (1995) declares that we have now passed into a post-information age, leaving behind the information age; Zelenka (2007) refers to our present paradigm as the connected age. Societal paradigm shifts have historically prompted upheavals in learning theory. As new theories have developed to meet the changing needs of learners, however, they have often been deployed without any thought as to how they could best be integrated with strengths of previous theories (Kirshner and Whitson 1997). New societal patterns produce new educational paradigms that too frequently completely discard the old. For example, Bednar et al. (1992) insist that cognitivism, the predominant educational theory of the 1960s, and constructivism, a more recent theory designed to meet the needs of information-age learners, are incompatible.

Rather than tossing out old theories, instructional designers need to incorporate those elements that remain relevant and restructure them "into substantially different configurations to meet the new needs of those whom we serve" (Reigeluth 1999, 27). SCCS theory responds to this call, integrating the best of previous learning theories to meet the needs of today's learners. With its inclusion of game elements, which foster attention, memory, and motivation, SCCS provides a bridge between behaviorist and cognitivist learning theories. SCCS theory also prompts instructors to employ cognitive strategies elaborated by the four-component instructional design (4C/ID) model (van Merriënboer, Kirschner, and Kesteret 2003) and Mayer's (1999) select, organize, and integrate (SOI) model and incorporates essential features of constructivism and social learning theory. Finally, the integration of features from Wiggins and McTighe's (1998) understanding by design model prompts instructors to identify the knowledge structures, cognitive functions, and mental representations they will assess after students have been given opportunities to use their social- and cognitive-connectedness schemata in learning environments that invoke elements of constructivism and situated learning theory.

SCCS Learning Theory

SCCS learning theory focuses on the formation of schemata in the process of learning, particularly social-connectedness and cognitive-connectedness schemata. Schemata are the existing structures of knowledge and understanding upon which new knowledge is built; as such, they are shaped by students' previous experiences and shape all future learning (Exhibit 2). The social-connectedness schema governs and is structured by the ability and desire to connect socially with others; the affordances of today's technologies have resulted in massive changes in this schema as students have more opportunities to connect in a wider variety of contexts. Students engage their social-connectedness schema in a set of behaviors that I describe as "link, lurk, and lunge": Students *link* up with others who have the knowledge they need; they *lurk*, watching others who know how do to what they want to do; and they *lunge*, jumping in to try new things often without seeking guidance beforehand (Brown 2000). Students' social-connectedness schema underlies their ability to create and sustain physical, virtual, and hybrid social networks (Oblinger and Oblinger 2005).

The cognitive-connectedness schema structures a student's ability and desire to know how what they are learning connects to a larger picture. Changes in their cognitive-connectedness schema have enabled today's students to see knowledge not as separate bits of information but as something that has "constituent parts [that] index the world and so are inextricably a product of the activity and situations in which they are produced" (Brown, Collins, and Duguid 1989, ¶11). For example, one high school student recently praised his math teacher for making math "interesting and connected to the rest of the world" by spending "an entire class investigating the application of logarithms in music: complete with a working string instrument" (Arthus 2008). The student responded to an approach that demonstrated how logarithms were not discrete bits of information to be learned for math class but rather constituent parts of a process that indexed the world of music and connected music and mathematics. These changes are reflected in a cognitive-connectedness schema that includes constructs for digital navigation literacy; a preference for interactive, discovery-based learning; and the desire to make reasoned judgments based on independent exploration of digital resources (Brown 1999). All of these attributes are sharpened by the availability of digital tools that make information instantly available and the connections between different pieces of information clearly visible. Students' use of these tools has become part of their lifeworld, shaping the development of their cognitive-connectedness schema.

The SCCS Instructional Design Model

The SCCS instructional design model accommodates these schematic shifts by synthesizing elements from Wiggins and McTighe's (1998) understanding by design model; Mayer’s (1999) SOI model; and van Merriënboer, Kirschner, and Kesteret’s (2003) 4C/ID model. Wiggins and McTighe’s model promotes the articulation of enduring understandings, focusing on concepts, principles, or processes rather than on discrete facts or skills. This emphasis reinforces students’ cognitive-connectedness schema by helping them to see how the material covered relates to overarching principles. The SOI model emphasizes facilitating students’ ability to select relevant information, organize it into coherent mental representations, and integrate it with existing knowledge. This strategy can facilitate schemata integration and modification, leading to increased knowledge transfer. The 4C/ID model highlights the four educational components of learning tasks and the importance of providing supportive information, procedural information, and part-task practice. This alignment with the 4C/ID model helps instructors to monitor and prevent cognitive overload by breaking the learning objectives down into smaller parts and allowing for reteaching and scaffolding as needed.

The SCCS instructional model also incorporates games and game-like elements to foster motivation and attention (Aldrich 2004; Costikyan 1994; Jenkins 2005; Youngblut 1998). Rieber (2001) proposes that the “construct of play is our best candidate for wedding cognition and motivation within learning environments” (¶4). The infusion of appropriate gaming elements into instruction helps to facilitate both social-connectedness and cognitive-connectedness schemata by providing support for several of Gagne′s (1965) nine events of instruction. For example, gaming elements stimulate the recall of prior learning, elicit performance, and provide feedback as well as giving students opportunities to interact. In addition, gaming elements tap into the affective domain, a potent but often underutilized source of motivation (Kamradt and Kamradt 1999).

In addition to synthesizing strategies from other models, the SCCS instructional design model also facilitates specific social-connectedness and cognitive-connectedness constructs, including "link, lurk, and lunge" and digital navigation literacy, among others (Figure 1).

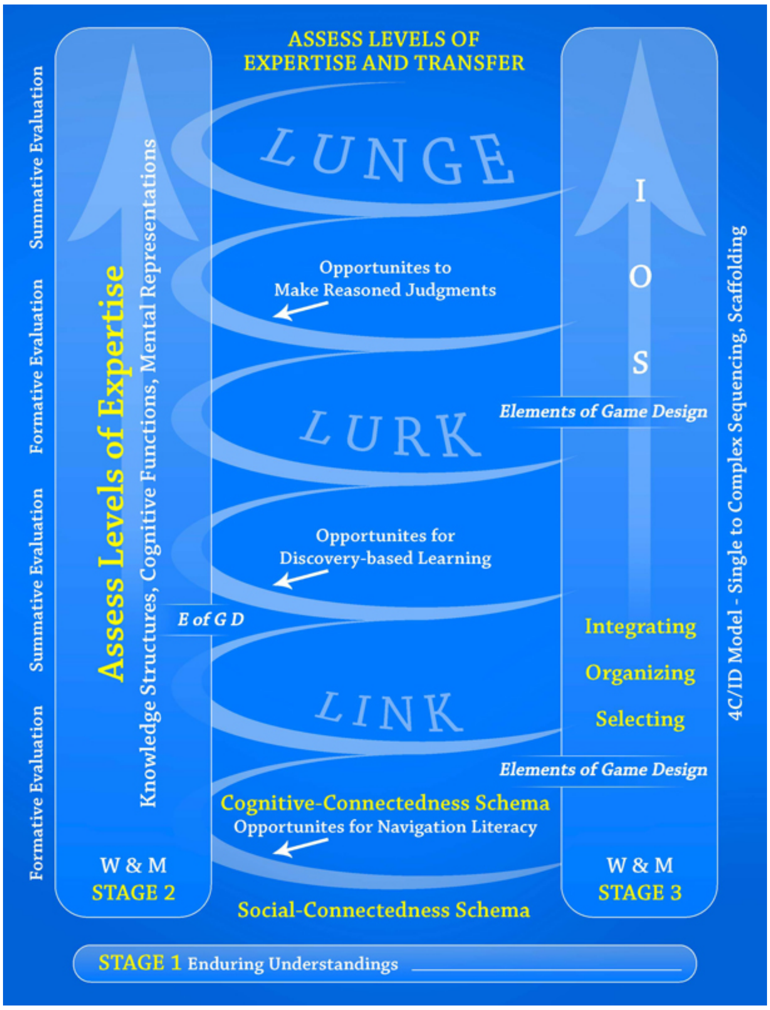

Figure 1. SCCS instructional design model

The SCCS model provides a guide for implementing SCCS theory in the classroom. The model has been used to construct a learning unit for sixth-grade language arts/social studies classes studying the *Aeneid* that included a variety of small-group, individual, and whole-class activities, culminating in a final game in which students took on the roles of characters from the story in an online virtual world called the *Aeneid* Rome KaMOO (Exhibit 3). The design process for that unit provides a framework for understanding the SCCS model.

First, during Stage 1, using a concept from understanding by design, the instructor selects the enduring understandings that students will uncover during the learning unit; in planning the *Aeneid* unit, the instructor elected to focus on the concepts of culture as history in the present and the tension between fate and choice.

During Stage 2, illustrated on the left side of the model, the instructor designs a series of formative and summative evaluations to assess students' expertise and help them move toward the ultimate goal of learning transfer (Lupart, Marini, and McKeough 1995; Clark 2003). The instructor can use charts such as the expertise structures rubric (Figure 2) to target and assess specific structures in a unit. The *Aeneid* unit included a range of activities designed to reveal students' grasp of the enduring understandings articulated in Stage 1 (Exhibit 4).

Not all of the formative and summative evaluations have to be fully developed by the end of Stage 2. Instructors may need to determine the resources they will make available to students, an element of Stage 3 of the model, before finalizing evaluations.

During Stage 3, illustrated on the right side of the model, the instructor employs strategies from the 4C/ID model to sequence and scaffold the resources they will make available to students (Mayer 1999). As students select, organize, and integrate information gathered from these resources, the instructor will continue to sequence and scaffold learning events in ways that will enable the students to incorporate the new information into their existing schemata.

The spiral ascending through the middle of the model represents opportunities the instructor provides for students to employ their SCCS constructs. The instructor aims to create a learning environment that will enable students to develop their navigation literacy skills, experience discovery-based learning, and make reasoned judgments based on a plethora of resources; learning events are designed to allow students to link, lurk, and lunge. For example, after the students read Chapter 2 of the abridged, paraphrased version of the *Aeneid*, the instructor set up a class blog, providing students opportunities to connect with others and share their knowledge (Exhibit 5). These instructional strategies are organized in an upward yet recursive pattern that supports the complex sequencing and scaffolding of the 4C/ID model. The instructors of the *Aeneid* unit conducted formative evaluations throughout the process to monitor the efficacy of the chosen scaffolding methods and the students' current cognitive load.

Game design elements are infused into the instruction at all stages in order to motivate students and engage their social- and cognitive-connectedness schemata more fully. In the *Aeneid* unit, the final game, which students knew about as they studied the book, provided motivation for learning and helped reinforce what had been learned (Exhibit 6); students also played review games along the way.

When implementing SCCS, instructors must have a sufficient grasp of their students' cognitive, technical, and social abilities and choose activities accordingly. Learning activities such as multimedia projects, digital storytelling, voice threads, wikis, and blogs must be purposefully chosen and woven into the instructional design, keeping in mind the ultimate goal of learning transfer. Instructors could start by including only one or two new activities that relate to students' SCCS schemata, making sure that they break concepts into their component parts and provide enough part-task practice to ensure the transfer of learned skills. They should plan formative evaluations that check students' understanding of the component parts and allow time for reteaching as necessary. Additionally, they should pepper the instruction with elements of game design that relate to the skills currently being studied.

Implementing the Model: SCCS Research Results

The *Aeneid* unit described above was used in a 2007 research study that involved three different sixth-grade language arts/social studies classes reading an abridged, paraphrased version of the *Aeneid*. The participants all attended the same middle-class public school in San Jose, California. Participants in Class A and Class B received instruction designed according to the SCCS model while those in Class C received more traditionally structured instruction. For example, before and after reading each chapter, students in Classes A and B participated in class discussions and blogs and completed both individual and group assignments. Class A and Class B students often worked in small groups to complete chapter assignments with teachers providing guidance as needed to encourage the creation of communities of practice. These students also had opportunities to play online review games, both individually and as a group. Students in Class C participated in class discussions but worked individually on chapter assignments and did not participate in review games or group work.

Students in all three classes knew from the outset of the unit that they would participate in a roleplaying game at the end of the unit and that their success in the game would depend upon their understanding of the characters and story of the *Aeneid*. Students in Classes A and B played the game after they had read the *Aeneid*, completed the lessons, and played the review games but before they completed final essays or tests. Students in Class C did not play the game until they had completed final tests and essays.

A comparison of the final test and essay scores for Class A (an experimental group) and Class C (the control group) found that students in Class A scored significantly higher even though students in Class A had lower entry-level abilities in language arts than the students in Class C as evidenced by their California Standardized Test (CST) scores. Students in Class B (also an experimental group) and Class C (the control group) had no significant difference in their entry-level abilities; however, Class B students scored significantly higher on their final tests and essays than students in Class C. These results demonstrate that SCCS instructional design can help to narrow the gap between lower and higher performing students and significantly increase the learning transfer abilities of students (Exhibit 7).

Conclusion

Today's students "do not just think about different things, they actually think differently" (Prensky 2001, 42). And, as Reigeluth (1999) argues, "when a human-activity system (or societal system) changes in significant ways, its subsystems must change in equally significant ways" (16). Education theory must change to accommodate new developments in the way students learn and access information. SCCS synthesizes the best of current learning theories and suggests a methodology for revising instructional design to accommodate students' new schemata. Although more research is needed, initial results suggest that a design model that taps into students' social-connectedness and cognitive-connectedness schemata can facilitate learning transfer and help students achieve learning outcomes.

References

Aldrich, C. 2004. *Simulations and the future of learning: An innovative (and perhaps revolutionary) approach to e-learning*. San Francisco: Pfeiffer.

Arthus. 2008. Top 5 qualities of good teachers. [Weblog entry, May 24.] *Newly Ancient*. http://myfla.ws/blog/2008/05/24/top-5-qualities-of-good-teachers/ (accessed October 4, 2008). Archived at http://www.webcitation.org/5bKr1RSFq.

Bednar, A., D. Cunningham, T. Duffy, and J. Perry. 1992. Theory in practice: How do we link? In *Constructivism and the technology of instruction: A conversation,* eds. T. Duffy and D. Jonassen, 17-35. Hillsdale, NJ: Erlbaum.

Brown, J. S. 1999. *Working and playing in the digital age*. Talk presented at the 1999 Conference on Higher Education, American Association for Higher Education, February. http://serendip.brynmawr.edu/sci_edu/seelybrown/ (accessed August 19, 2008). Archived at http://www.webcitation.org/5aCO1VAnS.

Brown, J. S. 2000. Growing up digital. *Change* (March-April): 11-20.

Brown, J. S., A. Collins, and P. Duguid. 1989. Situated learning and the culture of learning. *Education Researcher* 18 (1): 32-42. http://www.exploratorium.edu/ifi/resources/museumeducation/situated.html (accessed March 31, 2008). Archived at http://www.webcitation.org/5WkRQtYvk.

Clark, R. 2003. *Building expertise: Cognitive methods for training and performance improvement.* Washington, DC: International Society for Performance Improvement.

Costikyan, G. 1994. I have no words & I must design. *Interactive Fantasy #2*. http://www.costik.com/nowords.html (accessed March 31, 2008). Archived at http://www.webcitation.org/5WkRvH3pm.

Gagne, R. 1965. *The conditions of learning.* New York: Holt, Rhinehart and Winston.

Jenkins, H. 2005. Getting into the game. *Educational Leadership* 62:48-51.

Kamradt, T., and E. Kamradt. 1999. Structured design for attitudinal instruction. In *Instructional design theories and models*, vol. 2, ed. C. Reigeluth, 563-590. Mahwah, NJ: Erlbaum.

Kirshner, D., and J. Whitson. 1997. Editors' introduction to situated cognition: Social, semiotic, and psychological perspectives. In *Situated cognition: Social, semiotic, and psychological perspectives*, eds. D. Kirshner and J. Whitson, 1-16. Mahwah, NJ: Erlbaum.

Lenhart, A., J. Kahne, E. Middaugh, A. Macgill, C. Evans, and J. Vitak. 2008. *Teens, video games, and civics: Teens' gaming experiences are diverse and include significant social interaction and civic engagement.* Pew Internet & American Life Project. http://www.pewinternet.org/pdfs/PIP_Teens_Games_and_Civics_Report_FINAL.pdf (accessed October 6, 2008). Archived at http://www.webcitation.org/5bbF9mP9S.

Lenhart, A., M. Madden, A. Macgill, and A. Smith. 2007. *Teens and social media: The use of social media gains a greater foothold in teen life as they embrace the conversational nature of interactive online media.* Pew Internet & American Life Project. http://www.pewinternet.org/pdfs/PIP_Teens_Social_Media_Final.pdf (accessed October 30, 2008). Archived http://www.webcitation.org/5c3uHMywc.

Loten, A. 2008. The accidental millionaires: Catherine, Dave, and Geoff Cook. *Inc.Com*, June. http://www.inc.com/articles/2008/06/accidental-millionaires.html (accessed November 1, 2008). Archived at http://www.webcitation.org/5c3omeYDD.

Lupart, J., A. Marini, and A. McKeough, eds. 1995. *Teaching for transfer: Fostering generalization in learning.* Mahwah, NJ: Erlbaum.

Mayer, R. 1999. Designing instruction for constructivist learning. In *Instructional design theories and models*, vol. 2, ed. C. Reigeluth, 141-159. Mahwah, NJ: Erlbaum.

Negroponte, N. 1995. *Being digital.* Cyberdocks, online edition, OBS, 1996. http://archives.obs-us.com/obs/english/books/nn/ch13c01.htm (accessed November 1, 2008). Archived at http://www.webcitation.org/5cBCH1Ius.

Nisbett, R., K. Peng, I. Choi, and A. Norenzayan. 2001. Culture and systems of thought: Holistic versus analytic cognition. *Psychological Review* 108 (2): 291-310.

Oblinger, D. 2004. The next generation of educational engagement. *Journal of Interactive Media in Education* 8. http://jime.open.ac.uk/2004/8/oblinger-2004-8-disc-paper.html (accessed January 31, 2008). Archived at http://www.webcitation.org/5c42TCjjB.

Oblinger, D., and J. Oblinger. 2005. Is it age or IT: First steps toward understanding the net generation. In *Educating the net generation*, eds. D. Oblinger and J. Oblinger, 2.1-2.20. EDUCAUSE. http://www.educause.edu/educatingthenetgen (accessed March 31, 2008). Archived at http://www.webcitation.org/5WkUBh5Mh.

O'Boyle, M., and H. Gill. 1998. On the relevance of research findings in cognitive neuroscience to educational practice. *Educational Psychology Review* 10 (4): 397-409.

Owyang, J. 2008. Social network stats: Facebook, mySpace, Reunion. [Weblog entry, January 9.] *Web Strategy by Jeremiah.* http://www.web-strategist.com/blog/2008/01/09/social-network-stats-facebook-myspace-reunion-jan-2008/ (accessed October 31, 2008). Archived at http://www.webcitation.org/5c3qsP3r5.

Prensky, M. 2001. *Digital game-based learning.* New York: McGraw-Hill.

Reigeluth, C. 1999. What is instructional-design theory and how is it changing? In *Instructional design theories and models*, vol. 2, ed. C. Reigeluth, 5-29. Mahwah, NJ: Erlbaum.

Rieber, L. 2001. Seriously considering play: Designing interactive learning environments based on the blending of microworlds, simulations, and games. *Educational Technology Research & Development* 44 (2): 43-58. http://www.nowhereroad.com/seriousplay/Rieber-ASCILITE-seriousplay.pdf. (accessed October 31, 2008). Archived at http://www.webcitation.org/5cDNnpa2P.

Schaller, D., and S. Allison-Bunnell. 2003. Practicing what we teach: How learning theory can guide development of online educational activities. Paper presented at Museums and the Web 2003, Charlotte, NC, March. http://www.archimuse.com/mw2003/papers/schaller/schaller.html (accessed March 31, 2008). Archived at http://www.webcitation.org/5WkUc0MF3.

Shumar, W., and K. Renninger. 2002. Introduction: On conceptualizing community. In *Building virtual communities: Learning and change in cyberspace,* eds. K. Renninger and W. Shumar, 1-33. New York: Cambridge University Press.

van Merriënboer, J., P. Kirschner, and L. Kesterer. 2003. Taking the load off a learner's mind: Instructional design for complex learning. *Psychologist* 38 (1): 5-13.

Wiggins, G., and J. McTighe. 1998. *Understanding by design*. Alexandria, VA: Association for Supervision and Curriculum Development.

Youngblut, C. 1998. *Educational uses of virtual reality technology*. IDA Document D-2128. Alexandria, VA:

Institute for Defense Analyses.

Zelenka, A. 2007. From the information age to the connected age. [Weblog entry, October 6.] *GigaOM, Giga Omni Media*. http://gigaom.com/2007/10/06/from-the-information-age-to-the-connected-age/ (accessed November 1, 2008). Archived at http://www.webcitation.org/5f1lCDFUh.

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