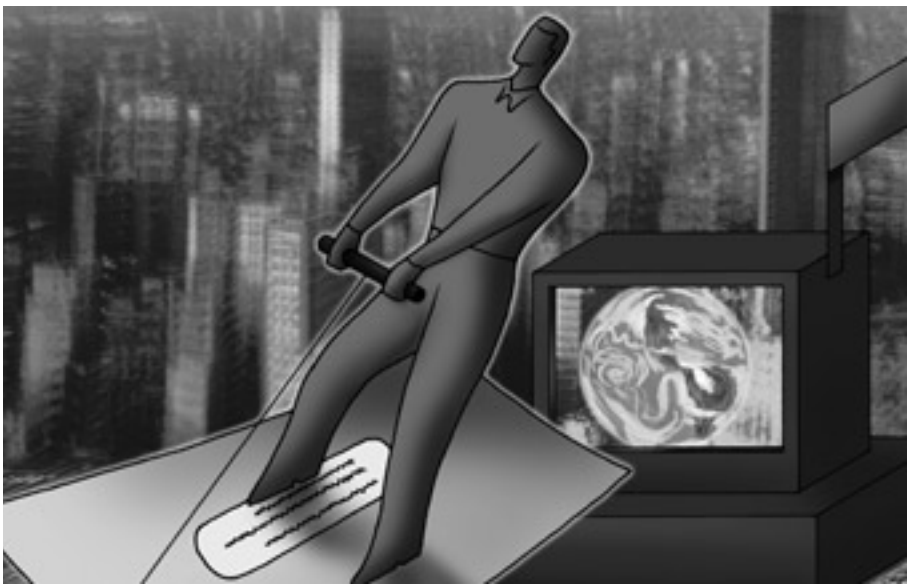
Planning for Neomillennial Learning Styles

Shifts in students' learning style will prompt a shift to active construction of knowledge through mediated immersion

By **Chris Dede**



Rapid advances in information technology are reshaping the learning styles of many students in higher education. The standard "world to the desktop" interface is now complemented by

- multiuser virtual environments in which people's avatars interact with each other, computer-based agents, and digital artifacts in a simulated context; and
- augmented realities in which mobile wireless devices infuse overlays of digital data on physical real-world settings.

Higher education institutions can prosper by using these emerging technologies to deliver instruction matched to the increasingly "neomillennial" learning styles of their students. Based on "mediated immersion," these emerging learning styles include:

- Fluency in multiple media and in simulation-based virtual settings
- Communal learning involving diverse, tacit, situated experience, with knowledge distributed across a community and a context as well as within an individual
- A balance among experiential learning, guided mentoring, and collective reflection
- Expression through nonlinear, associational webs of representations
- Co-design of learning experiences personalized to individual needs and preferences

Many faculty will find such a shift in instruction difficult, but through professional development they can accommodate neomillennial learning styles to continue teaching effectively as the nature of students evolves. Beyond this professional development, to fulfill their students' evolving needs and interests, colleges and universities must reconsider their investments in physical plant, technology infrastructure, and research. Further, in the long run the mission and structure of higher education might alter due to the effect on civilization of these new interactive media.

Millennial Learning Styles

A variety of authors have discussed the influence of media such as the World Wide Web on students' learning styles.[1] For example, by its nature the Web rewards comparison of multiple sources of information, individually incomplete and collectively inconsistent. This induces learning based on seeking, sieving, and synthesizing, rather than on assimilating a single "validated" source of knowledge as from books, television, or a professor's lectures.

Also, digital media and interfaces encourage multitasking: my teenage daughter "does her homework" by simultaneously reading her textbook, listening to her MP3 player, receiving and sending e-mail, utilizing her Web browser, and dialoguing with six of her classmates via instant messaging. Whether multitasking results in a superficial, easily distracted style of gaining information or a sophisticated form of synthesizing new insights depends on the ways in which this learning strategy is used. Certainly, above some

threshold, this strategy results in cognitive overload and concomitant loss of effectiveness.

Another illustration is "Napsterism"—the recombining of others' designs to individual, personally tailored configurations.[2] This is evident in how people of all ages have shifted from purchasing music prepackaged into albums to mixing/tailoring their own sequences of artists and songs. Business increasingly caters to and reinforces this shift by data-mining the choices individuals make, then providing customized services based on patterns of individual characteristics and behaviors (for example, a person who buys dog food at the supermarket will receive unsought mail relating to pet care).

Increasingly, people want educational products and services tailored to their individual needs rather than one-size-fits-all courses of fixed length, content, and pedagogy. Whether this individualization of educational products is effective depends both on the insight with which learners assess their needs and desires and on the degree to which institutions provide quality customized services rather than Frankenstein-like mixtures of learning modules.

Overall, the Internet-based learning styles ascribed to "Millennial" students —those born after 1982—increasingly apply for many people across a wide range of ages, driven by the tools and media they use every day. As computers and telecommunications continue to evolve, what new forms of neomillennial learning styles might emerging media enable, and how can higher education prepare for this shift?

How Emerging Media Foster Psychological Immersion

Over the next decade, three complementary interfaces to information technology will shape how people learn[3]:

- The familiar "world to the desktop" interface, providing access to distant experts and archives and enabling collaborations, mentoring relationships, and virtual communities of practice. This interface is evolving through initiatives such as Internet2.
- "Alice-in-Wonderland" multiuser virtual environment (MUVE) interfaces, in which participants' avatars interact with computer-based agents and digital artifacts in virtual contexts. The initial stages of studies on shared virtual environments are characterized by advances in Internet games and work in virtual reality.
- Interfaces for ubiquitous computing, in which mobile wireless devices infuse virtual resources as we move through the real world. The early stages of augmented reality interfaces are characterized by research on the role of smart objects and intelligent contexts in learning and doing.

The growing prevalence of interfaces to virtual environments and augmented realities is beginning to foster neomillennial learning styles.

The millennial learning styles discussed above stem primarily from the world-to-the-desktop interface. However, the growing prevalence of interfaces to virtual environments and augmented realities is beginning to foster neomillennial learning styles. The crucial factor leading to the augmentation of millennial learning styles with neomillennial characteristics is that the world-to-the-desktop interface is not psychologically immersive, while virtual environments and augmented realities induce a strong sense of virtual "presence." This immersion in virtual environments and augmented realities shapes participants' learning styles beyond what using sophisticated computers and telecommunications has fostered thus far. This shift has multiple implications for higher education.

Prognosticators such as Howard Rheingold[4] and William Mitchell[5] speculated about the impacts of mediated immersion on individuals and civilization as new digital media pervade every aspect of life. For example, Rheingold depicted a future based on distributed networks of information, communication, and activity—as contrasted to the historic pattern of lifestyles centered on face-to-face groups interacting with local resources. In a world composed of these high-end users with access to these new products and services, the following types of experiences would affect people's lifestyles:

- Mobile wireless devices (MWDs)—such as gaming devices, cell phones, digital music players, personal digital assistants—would access media that are virtually connected to locations (such as street signs linked to online maps), objects (such as books linked to online reviews), and services (such as restaurants linked to ratings by their customers).
- MWDs would access every type of data service anywhere (banking and stock market information, weather, tickets and reservations, transport schedules).
- MWDs would locate strangers nearby who have identified themselves as having common interests (people interested in dating and matched on desired attributes, friends of friends, fellow gamers, or fans of a certain team, actor, or author).
- Rather than having core identities defined through a primarily local set of roles and relationships, people would express varied aspects of their multifaceted identities through alternate extended experiences in distributed virtual environments and augmented realities.

Rheingold painted a largely positive picture of this "social revolution," while articulating some concerns about privacy, quality of life, and loss of humanity.

The technology infrastructure necessary for these lifestyles is emerging. As Baker and Green[6] noted, one-third of U.S. households now have broadband access to the Internet. In the past three years, 14 million U.S. families have linked their computers with wireless home networks. Some 55 percent of Americans now carry cell phones, and the first data services—radio, photos,

and short video clips—are starting to take off.

One attribute that makes mediated immersion different and powerful from an educational perspective is the ability to access information resources and psychosocial community distributed across distance and time, broadening and deepening experience. A second important attribute is the ability to create interactions and activities in mediated experience not possible in the real world, such as teleporting within a virtual environment, enabling a distant person to see a real-time image of your local environment, or interacting with a (simulated) chemical spill in a busy public setting. Both of these attributes are actualized in the Alice-in-Wonderland interface.

Immersion in Educational Virtual Environments

Most students now using MUVEs do so in the context of gaming. As Steinkuehler[7] noted:

> Massively multiplayer online games (MMOGs) are highly graphical 2- or 3-D videogames played online, allowing individuals, through their self-created digital characters or "avatars," to interact not only with the gaming software (the designed environment of the game and the computer-controlled characters within it) but with other players' avatars as well. These virtual worlds are persistent social and material worlds, loosely structured by open-ended (fantasy) narratives, where players are largely free to do as they please—slay ogres, [be]siege castles, barter goods in town, or shake the fruit out of trees.... Thanks to out-of-game trading of in-game items, Norrath, the virtual setting of the MMOG EverQuest, is the seventy-seventh largest economy in the real world, with a GNP per capita between that of Russia and Bulgaria. One platinum piece, the unit of currency in Norrath, trades on real-world exchange markets higher than both the Yen and the Lira.

Players of all ages are involved in many different MMOGs and in ancillary activities such as fan fiction Web sites, where people enamored with a particular game or book can add to its genre with their own writing.[8] (These fan fiction archives are substantial; Black documented a multi-fandom archive that contains hundreds of thousands of works of original fan fiction, including more than 20,000 Final Fantasy videogame-related fictions and approximately 127,000 Harry Potter–based texts.) While the content of these games and activities often does not lead to knowledge useful in the real world, rich types of learning and identity formation do take place in these environments, fostering neomillennial learning styles based on characteristics of immersive mediated interaction.

My research on MUVEs crafted for educating young people about higher order inquiry skills illustrates this. With National Science Foundation funding, my colleagues and I are creating and studying graphical MUVEs that use digitized museum resources to enhance middle school students' motivation and learning about science and society (http://muve.gse.harvard.edu/muvees2003/). Our goal is to promote learning for all students, particularly unengaged or low-performing students.

The River City MUVE is centered on skills of hypothesis formation and experimental design, as well as on content related to national standards and assessments in biology and ecology. We are demonstrating how students can gain this knowledge through immersive simulations, interactive virtual museum exhibits, and "participatory" historical situations. Students learn to behave as scientists while they collaboratively identify problems through observation and inference, form and test hypotheses, and deduce evidence-based conclusions about underlying causes.

We are now conducting large-scale studies to assess the strengths and limits of this educational approach, in particular how MUVEs accommodate students' learning styles.[9] Researchers at other organizations that study educational MUVEs designed for young people, such as Quest Atlantis (http://atlantis.crlt.indiana.edu/start/index.html) and Whyville (http://www.whyville.net), are also assessing how immersive virtual environments influence participants' learning styles.[10]

Immersion in Educational Augmented Realities

An emerging interface that complements the Alice-in-Wonderland immersion of MUVEs is augmented reality via ubiquitous computing, in which MWDs immerse participants in virtual resources as they move through the real world. As one example, Hsi and her colleagues have developed a device called eXspot to support, record, and extend exhibit-based, informal science learning at the Exploratorium, an interactive hands-on museum of art, science, and perception in San Francisco.[11] eXspot participants visiting the Exploratorium carry a card with a radio frequency interference device (RFID) tag embedded. Visitors can swipe the card on a RFID reader at the exhibit they are viewing. For example, participants later can view a museum-generated personal Web page listing the dates they visited the museum and the specific exhibits "swiped" that day. Personal photos taken at the exhibits and online content about exhibits are also available. Research shows that many participants value this functionality and choose to access the Web page after leaving the museum.

As another illustration of ubiquitous computing for learning, Klopfer and his colleagues[12] are developing augmented reality simulations that embed students inside lifelike problem-solving situations. The goal is to help them understand complex scientific and social dynamics (http://education.mit.edu/ar). Participants in these distributed simulations use location-aware handheld computers (with Global Positioning System [GPS] technology), allowing them to physically move throughout a real location while collecting place-dependent simulated field data, interviewing virtual characters, and collaboratively investigating simulated scenarios. The "Environmental Detectives" augmented

reality simulation, for example, engages high school and university students in a real-world environmental consulting scenario not possible to implement in a classroom setting.[13] Students role-play environmental scientists investigating a rash of health concerns on the MIT campus linked to the release of toxins in the water supply.

Klopfer and I plan to initiate studies on how immersion in MUVEs complements that in augmented realities and how each type of learning accommodates participants' learning styles.

Neomillennial Learning Styles and Mediated Immersion

What neomillennial learning styles might these media-based lifestyle shifts induce? Research on educational MUVEs and augmented realities suggests that the following may emerge as cross-age learning styles[13]:

- Fluency in multiple media, valuing each for the types of communication, activities, experiences, and expressions it empowers[14]

This goes beyond millennial learning styles, which center on working within a single medium best suited to one's style and preferences.

- Learning based on collectively seeking, sieving, and synthesizing experiences rather than individually locating and absorbing information from a single best source

This goes beyond millennial learning styles in preferring communal learning in diverse, tacit, situated experiences over solo integration of divergent, explicit information sources and in valuing knowledge distributed across a community and a context as well as within an individual.

- Active learning based on experience (real and simulated) that includes frequent opportunities for reflection (for example, infusing experiences in the Virtual University simulation [http://www.virtual-u.org/] in a course on university leadership)

This goes beyond millennial learning styles in valuing bicentric, immersive frames of reference that begin with direct participation, then infuse guidance.

- Expression through nonlinear, associational webs of representations rather than linear "stories" (for example, authoring a simulation and a Web page to express understanding, rather than a paper)

This goes beyond millennial learning styles in using representations involving richly associated, situated simulations rather than branching, but largely hierarchical, multimedia.

- Co-design of learning experiences personalized to individual needs and preferences

This goes beyond millennial learning styles, which emphasize selecting a pre-customized variant from a range of services offered.

Mediated immersion likely has other influences on learning style yet to be discovered, but these initial findings have a variety of implications for strategic planning, investment, and professional development in higher education.

Implications for Strategic Investments

Each section below presents ideas about how the emergence of neomillennial learning styles might influence various aspects of higher education. Emphasis is placed on implications for strategic investments in physical plant, technology infrastructure, and professional development.

Location and Physical Infrastructure

At present, locations and physical infrastructures are configured to accomplish specialized forms of activity (dorm room, classroom, student center, library, computer lab). In the future, wearable devices and universal wireless coverage mean that access, information, and computational power will no longer be tied to physical space (such as a computer lab). Students will distribute many activities across space and time, so institutions will not need to tailor space to particular purposes (such as library reading rooms). Virtual simulations will complement equipment-based science labs.

Smart Objects and Intelligent Contexts

At present, objects and contexts are inert, with information available only via signage. Also, physical presence on campus is the only way of "being there." In the future, MWDs will enable the connection of information to locations (such as campus buildings linked to online maps) and objects (such as textbooks linked to course ratings by students). In addition, immersive virtual environments will provide replicas of distant physical settings.

Social Groupings, Collaboration, and Identity

At present, social groupings depend on co-presence in physical space (roommates, classmates). Collaboration depends on shared physical presence or cumbersome virtual mechanisms. In the future, students will participate in far-flung, loosely bounded virtual communities (independent of cohabitation, common course schedules, or enrollment at a particular campus). Interoperability, open content, and open source will enable seamless information sharing, collaborative virtual manipulation of tools and media, facile shared authoring and design, and collective critiquing. Virtual identity will be unfettered by physical attributes such as gender, race, or disabilities.

Instruction and Assessment

How might these shifts affect instruction and assessment? At present, too often instructors design and deliver "one size fits all" content, pedagogy, and assessment, with students serving as passive recipients. Student products are generally tests or papers; grading centers on individual performance; and learners provide only summative feedback on instructional effectiveness. In the future, student products will often involve products based on new forms

of media (authoring a simulation and a Web page to express understanding of an internship, for example, rather than authoring a paper that synthesizes expert opinions). Peer-developed and peer-rated forms of assessment will complement faculty grading and will often be based on individual accomplishment in a team performance context. Frequent learner-initiated assessments will provide formative feedback on instructional effectiveness.

Coming Soon

These ideas are admittedly speculative rather than based on extensive evidence. The technologies discussed are emerging rather than mature, so their final form and their influences on users are not fully understood. However, anticipating the effects of shifts in students' learning styles is important, and the ideas above may serve to begin a dialogue about implications.

Next Steps

If one accepts much of the analysis above, four implications are apparent for investments in physical and technological infrastructure:

- *Wireless everywhere:* Provide total coverage of the campus; subsidize uniform MWDs offering convergence of media (phone, PDA, gaming, Internet).
- *Multipurpose habitats:* Create layered/blended/personalizable places rather than specialized locations (such as computer labs).
- *Augmented reality:* Experiment with smart objects and intelligent contexts (via GPS and RFID tags and transceivers).
- *Mirroring:* Experiment with virtual environments that replicate physical settings but also provide "magical" capabilities for immersive experience.

This is not to imply that campuses should immediately undertake massive shifts toward these four themes, but rather to suggest that students of all ages with increasingly neomillennial learning styles will be drawn to colleges and universities that have these capabilities.

In the long run, the mission and structure of higher education might change due to the influence of these new interactive media.

Four implications are also apparent for investments in professional development. Faculty will increasingly need capabilities in:

- *Co-design:* Developing learning experiences students can personalize
- *Co-instruction:* Utilizing knowledge sharing among students as a major source of content and pedagogy
- *Guided learning-by-doing pedagogies:* Infusing case-based participatory simulations into presentational/assimilative instruction
- *Assessment beyond tests and papers:* Evaluating collaborative, nonlinear, associational webs of representations; utilizing peer-developed and peer-rated forms of assessment; using student-initiated assessments to provide formative feedback on faculty effectiveness

Some of these shifts are controversial for many faculty, and all involve "unlearning" almost unconscious beliefs, assumptions, and values about the nature of teaching, learning, and the academy. In addition to mastering the intellectual/technical dimensions involved, professional development that requires unlearning necessitates high levels of emotional/social support. As the nature of students alters, instructors must themselves experience mediated immersion and develop neomillennial learning styles to continue effective teaching.

In the long run, the mission and structure of higher education might change due to the influence of these new interactive media. If civilization were to invent higher education today, rather than centuries ago, would we create campuses as they now exist, dominated by lecture rooms, libraries, and labs, with learning centered in fixed time blocks? I suspect instead we would design colleges and universities to distribute their activities broadly across geography and time, focusing on active construction of knowledge rather than assimilative incorporation of information. We now have the technological infrastructure to facilitate a reinvention of our historic approach, as well as promising models from many other sectors of civilization that have already reinvented their missions and organizational structures based on the capabilities of information technology. Hopefully, the changes in student learning styles from the infusion of media in our societal context will inspire us to reinvent as well.

Widespread discussion among members of the academy about the shifts in learning style delineated above is important, whether those involved agree with my conclusions or not. To the extent that these ideas about neomillennial learning styles are accurate, campuses that make strategic investments in physical plant, technical infrastructure, and professional development along the dimensions suggested will gain a considerable competitive advantage in both recruiting top students and teaching them effectively. *e*

Endnotes

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Chris Dede (Chris_Dede@harvard.edu) is Timothyh Professor of Learning Technologies at the Harvard Graduate School of Education in Cambridge, Massachusetts.