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The Future of Learning Technologies: An Interview with Chris Dede

by James L. Morrison and Chris Dede

Chris Dede, Wirth Professor of Learning Technologies at the [Harvard Graduate School of Education](#), is a leading authority on learning technologies and the ways in which they shape education. As a teacher, researcher, and policy advocate, he is a visionary whose fascination with technology has been informed by his commitment to serving the highest ideals of education. I interviewed Dede, who serves on the *Innovate* editorial board, in April 2004.

James Morrison [JM]: Chris, how do you define "learning technologies?"

Chris Dede [CD]: I define learning technologies quite broadly. For example, cell phones can be a learning technology. With the right software, handheld Game Boy devices and other types of entertainment consoles can be learning technologies. My work focuses on information technologies that apply to education—devices that allow users to customize their access to information as they make decisions in an inquiry process. I would not dispute that a blackboard is a learning technology, but it is not the kind of artifact on which I focus my research. My fundamental interest is in how emerging technologies expand human capabilities for knowledge creation, sharing, and mastery, so I am most interested in the learning technologies that lend themselves to complex data manipulation, intensive collaboration, and robust archives. Today, we have an extraordinary menu of technologies that range from massively multiplayer Internet games to various types of handheld devices, and some of them are well-suited for immersive learning environments.

JM: What technologies are particularly appropriate for learning? How might they be used in the near future?

CD: Over the next 10 years, three different interfaces will complement one another in terms of learning. I have developed several scenarios that describe how I see these interfaces changing life in school. Readers should consider both the short descriptions I will provide here and the more elaborate ones published together in a government report (Dede [2002](#)).

The first interface is of the standard "world to the desktop" variety. We are all familiar with how an Internet browser brings distant experts and archives to us. Technologies such as [Internet 2](#) represent the future of that interface: They are faster and offer free streaming video and other high-bandwidth activities. Internet 2 makes technology-based, inquiry-driven projects possible at all levels of education. Imagine that a middle school teacher wanted to develop a project on asthma, which is a growing problem in inner cities. One hypothesis is that air quality is a factor in this epidemic. Students who have a family member or friend with asthma could use simple tools to assess the severity of the person's asthma each day by measuring lung capacity and asking pertinent medical questions; students could upload this information to a national database using the Internet. In turn, every school could access a map with color visualizations that indicated the complex ecological, meteorological, and pollution factors that were used to predict likely allergic reactions in their region. Students could compare these predictions with the reported rates of asthma generated from their own research; they could use their findings to write lab reports, make recommendations for allergy alerts, or design public service announcements about asthma. Teachers could tie this research project to national-standards-based content and skills in biology, ecology, meteorology, epidemiology, and urban planning. [Exhibit 1](#) is a narrative glimpse of how such a project might affect a student and her teacher.

The second kind of interface is the "Alice-in-Wonderland" multiuser virtual environment (MUVE), in which

users imagine themselves on the other side of their screens, within the virtual world. Participants use avatars (self-representations produced as computer graphics) and interact with other participants' avatars, computer-based agents, and digital artifacts. The entertainment industry already understands this interface and its powerful appeal for the next generation of computer users. These users are very involved in online environments, and they participate in activities as simple as instant messaging and as complex as constructing elaborate fantasy lives. Consider [Lineage II](#), a massively multiplayer online game in which participants create complex social, political, and economic relationships that affect the stability and power structures of three medieval kingdoms.

Steinkuehler (2004) has done preliminary research on the forms of cognition generated within multiplayer online games. Her findings support the idea that, armed with sophisticated instructional design, we can embed learning activities in graphically rich virtual worlds. For example, we could have young students encounter ethical dilemmas that increase in complexity as they advance through a Narnia MUVE, which would be based on the stories of C. S. Lewis. Older students could participate in a Star Trek MUVE (Dede and Palombo [2004](#)) that integrates mathematics as they navigate the Starship Enterprise, engineering as they maintain the warp engines, and anthropology as they learn to communicate with alien species. The story in [Exhibit 2](#) imagines the benefits of MUVE-based learning for an elementary school student, while the story in [Exhibit 3](#) reveals how two high school students might use MUVES to complete a team project—though not without some of the personality conflicts often generated in face-to-face meetings.

The third interface involves ubiquitous computing. Instead of staring at a screen or imagining themselves on the other side of the screen, users wander through the real world with wireless mobile devices that allow them to carry the virtual world with them. This interface allows users to interact with smart objects in the real world. For example, a building could have a smart object that sends a message to passersby via their wireless devices, offering them access to information about the building—when it was constructed, its architecture, its history, its current occupants and what they do, and so on. (The story in [Exhibit 4](#) suggests how this technology might enliven museum exhibits and assignments.) Research in this area ranges from the relatively simple use of handheld devices as limited, inexpensive alternatives to notebook computers to the creation of elaborate smart environments that interact with location-aware handheld computers. Eric Klopfer and his colleagues have developed an early example of the latter. In a simulation that they call "[Environmental Detectives](#)," students use a Pocket PC (enabled with global positioning satellite technology) to investigate a virtual chemical spill on the Massachusetts Institute of Technology campus. They have limited time to collect background information, interview experts, test groundwater samples, determine the cause of the spill, and identify the resulting environmental dangers and health risks.

I think that all three interfaces are significant, and I am researching each one to determine what its strengths and limitations are.

JM: Tell us more about your research on these interfaces.

CD: With funding from the Joyce Foundation, I am using Internet 2 technologies to help the [Milwaukee Public Schools](#) design and evaluate a professional development portal for new teacher induction and retention. With support from the National Science Foundation, I have created and am still assessing a [MUVE](#) that helps middle school students learn complex inquiry skills such as hypothesis formation and experimental design. Harvard's provost funds a [ubiquitous computing project](#) that includes a suite of Pocket PC devices with various peripherals; I am working to understand how these devices extend the learning outcomes in 10 different courses in the Harvard Graduate School of Education.

JM: How do we combine these technologies with pedagogies that require students to construct their own knowledge rather than passively assimilate information?

CD: Any technology or medium can be implemented with a wide spectrum of pedagogies—from assimilative, presentational teaching to guided, learning-by-doing programs to apprenticeships and mentoring. Media are

containers that may be filled with various types of content and pedagogy. One could create a virtual environment where an educator delivers a traditional lecture, but I doubt that this would be any more useful than listening to a lecture in the real world. Virtual environments have the potential to support active learning because they allow us to do a kind of magic we cannot or would not do in the real world. In MUVES, learners teleport and transcend distance; they see intangible things that would not normally be accessible to their senses. With handheld devices, students can interact with something like a chemical spill, which no teacher would create in the real world. Students and teachers are able to engage in guided, learning-by-doing activities that parallel the types of simulation we already value in educational contexts.

JM: Chris, are you suggesting that we appeal to young people's sense of adventure and use "edutainment" to induce them to meet curricular objectives?

CD: We are appealing to learners' sense of adventure, but we are also exploring the power of immersion. Sitting at a desktop, staring at a screen, and interacting via streaming video with someone across the country is one type of immersion. Going through a screen, being inside a virtual environment, and using your avatar to interact is a second type of immersion. It is like attending Mardi Gras and wearing masks; you can try on different identities and approaches to learning within the experience. Navigating the real world by consulting the screen of a handheld device that interacts with other devices in order to provide you with information is a third kind of immersion.

For the first time in human history, we have exotic immersive technologies available to us. Now we need to understand to what extent these technologies are useful for learning, and to what extent they are just fun and interesting. Which ones have the leverage necessary for educational purposes? In other words, which technologies are golden geese, and which are wild geese?

JM: Your research consistently focuses on the golden geese: technologies that are not merely dazzling, but that meet learner's needs in new and constructive ways. Thanks for your time, Chris, and for your important contributions to this field.

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