Teaching and Learning in the Wireless Classroom

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Wireless networks now support Web browsing, e-mail, real-time chat, and access to remote computing resources. With the increasing use of small portable computers, this emerging communications infrastructure will enable many new Internet applications. Two innovative projects at the University of North Carolina at Wilmington (UNCW) are currently exploring how educators can use portable handheld computers with wireless Internet access to improve teaching and learning in both local and wide area network environments.

LOCAL AREA WIRELESS ACCESS

The objective of Project Numina, a cooperative effort among faculty at UNCW, Pearson Education (Prentice-Hall), and Hypercube (http://aa.uncwil.edu/numina), is to use one seamless format to facilitate learning of abstract scientific and mathematical concepts by integrating media, interactive exercises, and hypertext materials into the classroom.

Using handheld PCs (H/PCs) equipped with the appropriate software and connected by a wireless network to the Internet exposes students to a rich variety of Web resources that can help them learn abstract chemistry, mathematics, and computer science concepts. This approach also enhances the learning experience by increasing student-instructor and student-student interactions.

Student response pads

One of the project's many educational applications is a Web-based interactive student response pad developed for use in large classroom settings. Numina's classroom environment consists of four Cisco Aironet wireless access points and 100 Hewlett-Packard Jornada H/PCs. Students use the H/PCs to respond to the instructor's questions, and the system stores their responses in a remote database and displays the collective responses graphically at the front of the classroom.

SWATT. The Student Web Answer Technology Template, a server-side Web application implemented as a Java servlet, drives the system. SWATT is completely Web-based and does not require any special software on the client side other than a Web browser.

The instructor poses a question in a multiple-choice, true-false, or yes-no format and directs students to a Web site that generates a Web form on their computer screens through which they submit their responses. Multiple question-and-answer scenarios are possible. A back-end database stores only responses to questions, not information about the student, so responses are anonymous.

Real-time learning. The instructor controls the question number and whether to display the results—which appear as a dynamically updated bar chart generated from student responses as they are submitted to the database—on an overhead projector that all the students can view. Another interface provides a quiz-like format for questions and tracks responses by student identification number.

In contrast to the typical 2 to 3 percent response rate in a more traditional classroom setting, all of the students participating in our project respond to the instructor's questions. This suggests that students are more comfortable responding to a question when they see others doing the same. Another advantage of SWATT is that instructors can see immediately how well students comprehend a specific topic they have presented.

Combining handheld PCs with wireless Internet access offers new possibilities for both educators and students.

The future. Project Numina continues to develop SWATT software. We are adding additional student interfaces and will improve the options available for the instructor to control the response pad and its representation on student screens. Many controlled experiments are now under way to study the technology's effect on student learning and comprehension.

Other applications

Project Numina is testing several other applications of Internet technology in the classroom. For example, we are studying how instructors and students use an electronic version of a widely adopted chemistry textbook that is on the Web—complete with graphics, equations, and illustrations—along with online references

and other utilities that take advantage of the HTML format (see http://cw.prenhall.com/bookbind/pubbooks/brown).

We are also evaluating a pocket PC version of HyperChem, a software application from Hypercube that provides all the standard functions a student needs for general and organic chemistry on an H/PC. Finally, we are testing legacy DOS applications in the classroom using the Jornada H/PC, which supports MS-DOS emulation.

WIDE AREA WIRELESS ACCESS

Another project, funded by a UNCW Information Technology Systems Division grant, experiments with a wide-area field-based implementation of wireless H/PC technology (http://www.uncwil.edu/people/shotsbergerp/jornada.htm). The project's primary goal is to extend the reach of technology into high school mathematics classrooms where computing resources are either nonexistent or not easily accessible.

Teacher training places a heavy emphasis on integrating technology with instruction and learning, yet the reality of inadequate school facilities often dismays instructors. Mobile computing technology provides the functionality of a desktop PC to teachers who are displaced from their room, cannot incorporate technology into presentations, or do not have a computer at home.

In January 2001, we loaned 12 secondary mathematics interns and their partnership teachers HP Jornada 720 handheld computers, mobile digital telephones, and supporting software that enables a wide range of functions:

- access to Web browsing, real-time chat, and e-mail functions;
- the ability to create and edit Word and Excel documents;
- the ability to make PowerPoint presentations from a handheld device;
- access to calendar, task, and contact features; and
- the option of synchronizing the Jornada to a desktop machine.

The interns and partnership teachers have complete freedom to use some or all of the Jornada suite's features for a semester.

Removing barriers

While we use the term "just-in-time" to describe computer-supported professional development, in fact, time constraints remain a significant barrier to teacher work. Obstacles range from limited availability of network connections at schools to the problem of scheduling collaborative meetings within the constraints of a full teaching schedule.

Wireless handheld PCs will expand the reach of technology into classrooms with limited or nonexistent computing resources.

For teachers in older school buildings that do not have wired network connections or those who "float" from class to class and do not have a permanent room assignment, using a handheld device facilitates communication with colleagues and parents. Using wireless devices eliminates the need for teachers to wait for access to a typically limited number of computers with an Internet connection and allows them to research Web resources or send e-mail to parents or absent students at their convenience.

Expanding options

Wireless devices enhance Web-based professional development by giving teachers immediate access to other colleagues. For example, at small, rural schools, only one or two teachers from the same discipline may be available for collaboration at any given time. Participants from different schools could use wireless devices to notify colleagues of their availability to chat synchronously online; if the chat is text-based, the transcript could become part of an archive asynchronously accessible by all participants.

Surfing the Web while they conduct a chat would help teachers jointly plan lessons that incorporate Web resources while they also benefit from having access to the experiences and insights of a large pool of practicing teachers. This would be especially useful to teachers in training, who often only have the opportunity to collaborate with their mentors.

The education community has long lamented that teachers generally do not produce written or even oral records of their classroom strategies. Handheld wireless devices could give teachers a highly portable way of documenting implementation results, which they could then share with colleagues face to face, in a chat room, on a discussion board, or as a Web page. H/PC features such as handwriting-recognition software and the ability to record short voice messages will expand a teacher's options for record keeping both in and out of the classroom.

As yet, little is known about the potential impact of wireless technology on teaching and learning. Anecdotal evidence suggests that students enjoy the technology and become more active in their learning when H/PCs are used in the classroom. There is every indication that in the near future wireless data devices will be as widespread as wireless voice devices are now. Rather than just migrating a few PC functions to a mobile platform, we envision these devices as actually replacing the desktop PC's full functionality.

Popular technologies such as palmtops and Internet-ready cell phones lack a full-scale browser that can handle a wide variety of Web content. In contrast, in addition to playing audio and video files, H/PCs already have browsers that support HTML, Java, and JavaScript. Given the increasing importance of the Web to both educators and developers of educational materials, this difference has profound implications for teaching and learning. ✷

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