

Wireless Technologies in Education

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BACKGROUND

The development and change in computer technologies today is so incredibly fast, and the lifecycle of technologies has been so shortened, that new technologies sprout up to replace old ones like bamboo shoots after a spring rain. However, the utilization of common features of the computer and the Internet, such as using spreadsheets and searching for resources over the Internet, are still considered to be essential for supporting learning in all levels of education. The Internet began facilitating Web-based learning in the early 1990s, and wireless technology has been offering stunning opportunities for educators since the late 1990s. A growing volume of research suggests that wireless and mobile technologies have the potential to enable collaborative learning (DiGiano, Yarnall, Patton, Roschelle, Tatar, & Manley, 2002), sharing of resources faster and more effectively (Kranz, 2002), and connection to resources at any time and from any place, as well as to have a positive impact on motivation (Wangemann, Lewis & Squires, 2003). Boerner (2002) has identified the benefits of implementing wireless networking on campus; these include mobility, ease of installation, less space constraints, less cost, and the flexibility to expand and upgrade systems. Improving communication technologies and affordable mobile devices accelerates the adoption of wireless technologies in the classroom, and more and more schools have been connecting to the Internet with wireless technologies.

INTRODUCTION OF WIRELESS TECHNOLOGIES

Wireless technologies extend the use of LANs (local area networks) and WANs (wide area networks), and enable communication via the airwaves with infrared (IR, which means beaming) or radio frequency (RF,

including 802.11, and mobile phones), better known as Wi-Fi. The convenience of networking without wires increases the utilization of online resources and the mobility of portable devices. Through the Access Point (AP)—an antenna that transmits and receives signals—users can connect to the Internet and to other computers or devices.

The Institute of Electrical and Electronic Engineers' (IEEE) official 802 committee approved 802.11 for a wireless network standard protocol in 1997 (CyberScience Lab, 2003). Then IEEE enhanced the 802.11 wireless networking standard and made revisions, which include 802.11b, 802.11a, and 802.11g, all to help adapt the technology to the industry's needs. The IEEE 802.11b standard so far is the most widely used, because of the faster transmission speeds and smaller expense that it offers (Prakash, 2001). The newly introduced mobile devices all comply with this standard to ensure their compatibility in the wireless environment.

Compared to the wired network, wireless technologies require less infrastructure work, share resources more effectively, and support ubiquitous learning, and have the potential to enable “anytime, anywhere” learning. Rather than discussing the technological terms, the following sections address the practices, opportunities, and issues about the use of wireless technologies in education.

CHARACTERISTICS OF MOBILE DEVICES WITH WIRELESS TECHNOLOGIES

The push for wireless technologies brings learning opportunities with numerous possibilities. The mobility that wireless technologies offer makes the entire campus become a learning environment. Currently, the common devices of wireless technologies in educational use today include the following mobile devices: the PDA (Personal Digital Assistant), the

laptop computer, and the TabletPC. These mobile devices and the wireless network are extremely complementary.

The PDA is a handheld device providing numerous functions for personal or business use, such as computing and information storing, retrieving, and organizing. Compared to other mobile devices, the PDA is thin, small, and mobile, and it can connect to the Internet through Wi-Fi, or communicate with another PDA through infrared. The cost of the PDA is relatively small compared to other mobile devices, which helps make 1:1 student-to-computer ratios affordable (CTL, n.d.). The criticism of the use of a PDA for learning purposes centers on its limited screen and inconvenient input method. Learners have to use a stylus to write letter-by-letter on the tiny screen, or install an expensive external keyboard in order to input data. Connecting to a desktop or laptop is still necessary in order to fully utilize the functions of the PDA.

The laptop is a portable computer that provides almost the same functions as a desktop. Compared to a desktop, a laptop is easy to carry; however, it is difficult to use on the move (Wood, 2003). Although a laptop is compatible with the wireless network, the batteries on some models are weak, and a power cord is required in order to use them for long periods of time, which means that mobility is indeed limited.

The TabletPC is an adaptation of the laptop. TabletPCs are equipped with large and touch-sensitive screens. Users can draw larger graphics or make notes on the screen directly with a stylus, which is a vast improvement for inputting data. For example, compared to a laptop, a TabletPC easily allows one to illustrate scientific charts, mathematical notations, or diagrams. Besides, these drawings can be saved into JPEG-compressed format, which is a common used file format to optimize images and makes sharing files with others more convenient. The TabletPC provides docking stations and infrared keyboards so the users can decide how to assemble their TabletPC to accommodate different learning environments.

The common feature of these devices is mobility. In a wireless environment, users can remain connected to the Internet with the mobile devices regardless of the geographical constraint, which allows instructors to integrate these devices in various educational settings and to assign diverse tasks. Based on their educational needs, learners can use the periph-

eral extensions of mobile devices to connect to digital cameras, GPSs (global positioning systems), or other modules to make them more versatile and enrich their learning experiences.

OPPORTUNITIES GENERATED BY UBIQUITOUS COMPUTING IN EDUCATION

The convergence of wireless technologies and mobile devices provides new possibilities to enable ubiquitous learning. In addition, instructors can design learning activities that are less dependent on locations (e.g., libraries or computer labs). Current researchers (Chang, Sheu & Chan, 2003; Roschelle, 2003) have identified the following types of learning activities that accommodate wireless technologies and mobile devices, and which have a great potential to enable both collaborative and individual learning.

- 1) **Data gathering:** Gathering and analyzing data is a critical activity for field trips. The University of Michigan combined the TabletPC, wireless networking GPS into the GeoPad to support students in gathering geological data collaboratively during a field trip, and to visualize the data gathered by the whole group immediately (Russell, 2004). The other successful project was conducted by the University of Berkeley, and encouraged learners to aggregate data collaboratively on an observational activity, then use a Web-based Inquiry Science Environment (WISE) to grasp difficult scientific concepts (Aleahmad & Slotta, 2002). In these research activities, mobile devices provided necessary mobility, and the wireless network offered a channel for an individual learner to observe data contributed by the group. Learners could analyze and interpret results collaboratively after gathering the data.
- 2) **Instant feedback:** Instructors can gauge students' level of understanding by sending out questions, and asking them to reply immediately and anonymously after delivering the instructional content. Similarly, instructors might require students to participate in polling to share their ideas with the whole class or to gather the

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