

Implementing Wireless PDA Technology in the IT Curriculum

*Requiring students
in an introductory
course to use PDAs
taught the IT
department how
to implement them
in the curriculum*

By **David R. Rawlinson** and
Kimberlee Bartel

Colleges and public universities must stay abreast of rapid changes in the application of information technology, typically on very limited budgets. Additionally, students increasingly expect faculty to apply bleeding-edge technology in the classroom and integrate it into the curriculum. This article briefly notes prevailing literature related to wireless technology use in the classroom (see the sidebar) and examines the processes and methods used to successfully integrate wireless personal digital assistant (PDA) networked technology into the IT curriculum at a public university.

PDAs in the Classroom

Information technology has rapidly changed how business and educational institutions create, store, and manipulate data, especially since the rapid

adoption of personal computers in the 1980s. The field of education has benefited heavily from the integration of computer technologies into classroom and curricula. As a result, laptops and PDAs are commonly used to access network resources wirelessly.

Although originally designed as personal information managers, PDAs have the ability to access network resources anytime, anywhere. PDAs can be used for note taking, data collection, and digital imaging. Additionally, they can facilitate file and data sharing.¹ Limitations to the use of PDAs in the classroom do exist, however.

The small size of the screen, shorter battery life (compared to laptop computers), and lack of large amounts of nonvolatile storage limit the use of PDAs in certain scenarios. Effective use of the small screen as an input device requires

fine-motor skills and visual abilities that some students, particularly those with disabilities, do not possess. Shorter battery life affects the service time before recharging the battery becomes necessary. Built-in storage is typically limited on a PDA, although additional storage capability is available (for an additional charge) using memory modules.

Wireless PDA Technology in an IT Course: A Case Study

How was wireless handheld computer technology integrated into the IT curricu-

lum at a publicly funded university curriculum? How effectively? The remainder of this article examines the methods applied to implement student study and use of wireless PDAs in the Department of Information Technology and Administrative Management (ITAM) curriculum at Central Washington University. We explain some pertinent issues encountered and how they were successfully resolved.

Departmental Support

The first step in implementing wireless technology in the curriculum was

gaining departmental faculty support for the project. After studying the proposal and receiving satisfactory answers to important questions, the ITAM faculty voted unanimously to require student purchase and application of wireless PDAs in its Introduction to Information Technology course.

All instructional and support staff in the ITAM department, including the administrative assistant, were provided with a PDA identical to the model required for student use. Periodic learning workshops for staff encouraged

Literature Review

The benefit to students of access to information technology is apparent. Teachers whose students had access to computers have said that the students produced a higher quality of work, exhibited more self-confidence, had greater enthusiasm, demonstrated an increased depth of knowledge, and were more engaged with other learners. They missed fewer assignments and earned improved grades, and their awareness of how technologies can be applied increased.¹

Exposing students to computers gives them access to organizational tools such as date books, phone books, and task lists.² Students asked to describe the advantages to having a computer in the classroom responded that it helped them learn computer skills, helped with school assignments, provided Internet access, and helped them become more organized.³ Additional benefits are expanded library instruction, increased awareness of the practical values of new technology, and the ability to guide students to quality information.⁴

The use of IT tools alone offers benefits to students. In addition to gaining access to outside materials, students

also increased their understanding of computers.⁵ Students with access to computers in the classroom not only learned better computer skills but also "used computers more extensively for a variety of production and research functions."⁶ Computers in the classroom make it easier to instruct students in library use,⁷ and in the library itself, using a computer instead of textbooks for research can aid students who find themselves easily distracted or who have learning disabilities that make it difficult for them to gather and synthesize data.⁸ Librarians benefit through easier inventories of library listings and hands-on instruction to students.⁹

Computer networks are one of the most significant developments in human communication since the telephone. Education is a direct beneficiary of the ability to share information and resources easily using computer networks such as the Internet, which is the first place teachers and students look for information.¹⁰ A desktop computer connected to a wired network is a great teaching tool; it is not very flexible, however, because students are tethered to a physical location.¹¹ The implementation of wireless networks

is increasing because they are less expensive to install than a comparable wired network, resulting in the installation of additional computer networks where there were none before and ultimately increasing the availability of information to more of us. Recent evidence indicates that the use of wireless computer networks is increasing with advances in security, standards, and management.¹² It therefore follows that wireless networks in a school setting are no longer a novel idea.¹³

Wireless networks offer new capabilities for learning in both secondary and higher education as well.¹⁴ Wireless networks on many college and university campuses take advantage of real-time accessibility to shared information and provide a more effective medium for active learning pedagogies. The United States Academy at West Point is deploying wireless network capability across its campus so that students can become more active participants in the learning process.¹⁵ Active participation in learning is supplemented by access to the Internet, identified as one of the most important resources for effective research.¹⁶

One of the most mobile computing

Continued on page 43

them to apply their PDAs as instructional tools. Broader PDA use by faculty made them important role models for students and gave students a real-world perspective instead of one limited to applications for a single course.

PDA Purchase Specifications

Before selecting a specific PDA, faculty created a list of performance objectives for integrating them in the curriculum, followed by a list of required technical specifications.² Finally, the specifications were matched to a particular make and

model of PDA that could accomplish the established performance objectives—the Dell Axim 30 (312 MHz) PDA.

A major concern among faculty was the cost to students, recognizing that most students have limited budgets. After much discussion, ITAM faculty set a cost limit of \$300 per PDA. Several attempts to negotiate a discounted purchase agreement with Dell failed, however. The most cost-effective method for students to purchase the required PDA was directly from Dell through its online purchasing program. To keep stu-

dent costs down, the Introduction to Information Technology course instructor agreed not to require a textbook, instead providing learning materials and units.

Technical Support

Another challenge encountered was technical support. At the time of implementation, the director of the Information Technology Services (ITS) department at CWU, which provides university-wide technical support, was not prepared to offer staff or technical

devices is the personal digital assistant (PDA). These wireless devices are appropriate for use in an instructional environment.¹⁷ A recent study that polled teachers from PDA-equipped classrooms found that 90 percent believed the devices were a positive and effective complement to learning.¹⁸ A PDA lets students share ideas anonymously with teachers and other students, which aids classroom discussions because students need not fear standing out and don't feel as threatened by the possibility of providing an incorrect answer.¹⁹

Wireless networking technology in the classroom gives students instant access to class discussion lists, online quizzes, Web-based simulations, case studies, and class exercises.²⁰ Instructors can present material including movies, slideshows, and Web-hosted content and administer quizzes using commercially available PDA software,²¹ and students can return the completed quizzes to the teacher for grading.²² A wireless network of PDAs in the classroom lets teachers show the students how they did in comparison with their peers and receive feedback from students on their understanding

of lecture material.²³ Students can also turn in their homework electronically, and instructors can create data tables to determine where students are having problems on the quizzes and which questions they miss.²⁴

Endnotes

1. J. M. Le Ber et al., "Portable Classrooms Lead to Partnerships," *Medical Reference Services Quarterly*, Vol. 23, No. 2, Summer 2004, p. 41.
2. C. A. Leibiger, *Beyond the Organizer: A Manual of Educational Uses for the Handheld Computer*, 2002; available from the ERIC database, Accession No. ED471953.
3. D. L. Lowther, S. M. Ross, and G. R. Morrison, *Evaluation of a Laptop Program: Successes and Recommendations*, 2001; available from the ERIC database, Accession No. ED462937.
4. Le Ber et al., op. cit.
5. V. E. Varvel and C. Thurston, "Perceptions of a Wireless Network," *Journal of Research on Technology in Education*, Vol. 34, No. 4, 2002, pp. 487–502.
6. Lowther, Ross, and Morrison, op. cit.
7. Le Ber, op. cit.
8. M. M. Behrmann, "Assistive Technology for Young Children in Special Education," *Association for Supervision and Curriculum Development Yearbook*, Vol. 73, 1998.
9. G. Ginzburg, "Goin' Mobile: Using a Wireless Network in the Library," *Computers in Libraries*, Vol. 21, No. 3, 2001, pp. 40–45.
10. H. Falk, "Electronic Campuses," *The Electronic Library*, Vol. 21, No. 1, 2003, pp. 63–67.
11. T. C. Liu et al., "Wireless and Mobile Technologies to Enhance Teaching and Learning," *Journal of Computer Assisted Learning*, Vol. 19, No. 3, 2003, pp. 371–382; ProQuest Education Journals database, document id 423711881 (retrieved November 17, 2005).
12. D. Molta, "Market Analysis: WLANs Bust Out," *Network Computing*, February 17, 2005, pp. 37–38, 40, 42, 46, 48.
13. Ginzburg, op. cit.
14. J. Cox, "West Point Learns Wireless Lessons," *Networking World*, Vol. 20, No. 8, 2003, pp. 19–21.
15. Cox, op. cit.
16. Falk, op. cit.
17. Leibiger, op. cit.
18. J. Roschelle, "Unlocking the Learning Values of Wireless Mobile Devices," *Journal of Computer Assisted Learning*, Vol. 19, No. 3, 2003, pp. 260–272; ProQuest Education Journals database, document id 423711941 (retrieved November 17, 2005).
19. S. Davis, "Observations in Classrooms Using a Network of Handheld Devices," *Journal of Computer Assisted Learning*, Vol. 19, No. 3, 2003, pp. 298–307; ProQuest Education Journals database, document id 423711901 (retrieved November 17, 2005).
20. M. Cain, "Media Rich Learning Through Universal Computing and Wireless Thin Clients," presentation at EDUCAUSE 2000 in Nashville, Tennessee, Oct. 2000, <<http://www.educause.edu/ir/library/pdf/EDU0050.pdf>>.
21. Liu et al., op. cit.
22. Leibiger, op. cit.
23. Falk, op. cit.
24. Liu et al., op. cit.

resources. Thus, two ITAM faculty—Rawlinson and Bartel—took responsibility for determining procedures to access the CWU system and providing ongoing support. An instruction sheet was developed and used for the Introduction to Information Technology course.³

Student Learning Opportunities

The PDA technology provided abundant academic and personal learning opportunities for students. Initially, students were required to configure, initialize, and customize their systems. These tasks varied from setting time and date options to choosing screen preferences. Furthermore, students had to configure custom wireless settings that would allow Internet access via the CWU backbone and open wireless access points.

The wireless PDA software and integrated hardware that students used proved to be unstable and inconsistent. Whether the responsibility belongs with the hardware manufacturer, the software manufacturer, or the CWU wireless infrastructure remains unclear. Regardless, the wireless systems worked sporadically at best and required repeated resetting and reconfiguring. Student reaction to this was negative. One student commented that the CWU wireless infrastructure should be “more PDA friendly.” Another stated, “I don’t think wireless network cards should be necessary. However, I can now surf the Web while waiting for a class to start.”

Understandably, some students became hesitant to use the system because they considered it unreliable. “I currently only use my PDA for games,” said one student. However, savvy students with prior technology experience enjoyed the challenges of working with technology still in its infancy. Students commented about PDA use that “It was worth purchasing them b/c [sic] now I have it for personal & school related activities” and “Learning about wireless became more clear because I had a PDA and could experience it.”

The Windows CE operating system uses a file and data management structure that differs from that of its Windows XP counterpart. Students had to

study the manual and other materials to understand how the new system worked. Once they understood the differences between the two operating systems, they became quite comfortable with file and data management.

Adapting to the PDA form factor required the least effort from students. In fact, they enjoyed learning several new technologies that are currently available on PDAs but not yet on the CWU desktop systems, such as the input options of transcribing and graffiti.

One unanticipated shift in attitude occurred: students realized that a PDA is not a productivity tool but an assistive tool, meant to be used in a mobile environment. Initial expectations were that the PDAs would replace desktop or notebook computers, but the size and technology limitations preclude this. For example, the keyboard on a PDA does not lend itself to the same effective, efficient use as a desktop or notebook keyboard. Some students purchased external keyboards for their PDAs. These students reported significantly increased levels of satisfaction and use of their PDAs, including in other classes as note-taking tools.

Student Attitudes and Responses

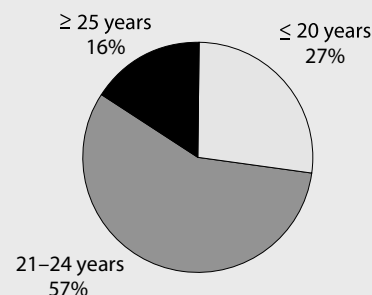
Students who completed the introductory course and were required, as part of the course, to purchase and use a PDA provided insight from their perspective about this project. A survey instrument gathered data about student attitudes toward the PDAs, current applications, and expected future applications.

Students completed the survey during the last week of the course. One important note is the small sample size. The PDA program began in fall quarter 2004, and only two classes of students have participated as of the writing of this article. The fall class (37 students) completed a short survey that covered only the Opinion Items section, while the winter quarter class completed a more extensive survey. Results of the surveys follow (74 students for the two classes combined).

Figures 1 and 2 illustrate demographic data results for the 37 students who responded to the initial survey, 19 (51

Figure 1

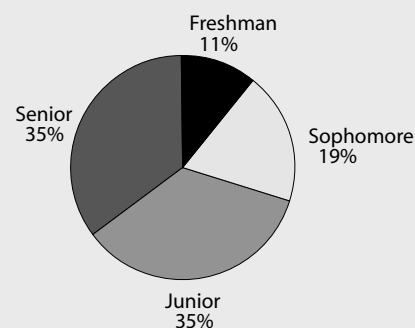
Respondent Age*



* n = 37

Figure 2

Respondent Grade Level*



* n = 37

percent) of whom were male and 18 (49 percent) female. Table 1 details the students' prior access to technology including wireless ($n = 37$), and Table 2 shows students' opinions regarding the use of PDAs in the introductory class ($n = 74$). Students' general uses of PDAs at the time they were enrolled in the IT course encompassed school (89 percent, or 33 of the 37 respondents), work (38 percent, or 14 students), and personal (89 percent). Table 3 indicates the PDA applications students learned in the course ($n = 37$). Table 4 lists the applications students expect to use on their PDAs in the future. Of the 37 student respondents, 26 planned to keep their PDAs following completion of the course, while 10 did not and 1 was undecided.

Students commented,

■ “If there are language programs so that I can download Japanese or Korean, I think I will use [the] PDA much more.”

Table 1**Prior Access to Technology***

Technology	Prior Access	Wireless Capable
Desktop computer	33 (89%)	15 (41%)
Cellular phone	28 (76%)	20 (54%)
Notebook computer	19 (51%)	14 (38%)
PDA	4 (11%)	0 (0%)

* n = 37

Table 2**Student Opinions of PDAs**

Opinion Statement	Total Responses	Mean* (scale 1–4)	Standard Deviation
1. When I first learned that PDAs would be required for this class, I was excited.	74	2.8	0.87
2. Purchasing and using my PDA has been a valuable experience.	74	3.0	0.85
3. The cost of the PDA was acceptable.	72**	2.8	0.75
4. I will continue to use my PDA for school-related activities.	73**	3.0	0.90
5. I will, or would if given the opportunity, continue to use my PDA for work-related activities.	74	3.3	0.72
6. I will continue to use my PDA for personal activities.	74	3.3	0.86
7. I recommend that PDAs continue to be a required purchase for all IT 228 students.	72**	2.8	0.97

* Scale: 1 = Strongly Disagree; 2 = Disagree; 3 = Agree; 4 = Strongly Agree

** Differences in n sizes from 74 due to no response provided

Table 3**PDA Applications Used in the Course***

Application	Responses (Percent)
World Wide Web access	36 (97%)
E-mail	33 (89%)
Games	32 (86%)
File sharing/IrDA	32 (86%)
Scheduler	30 (81%)
File sharing/Bluetooth	29 (78%)
Pocket Word	25 (68%)
Tasks	24 (65%)
Notes	24 (65%)
Contacts	23 (62%)
Mobi-Pocket Reader	22 (59%)
Pocket Excel	11 (30%)

* n = 37

Table 4**Expected Future PDA Applications***

Application	Responses (Percent)
E-mail	26 (100%)
World Wide Web access	26 (100%)
Scheduler	24 (92%)
Notes	23 (88%)
Tasks	22 (85%)
Contacts	22 (85%)
Games	22 (85%)
Pocket Word	21 (81%)
File sharing/Bluetooth	17 (65%)
Pocket Excel	15 (58%)
File sharing/IrDA	15 (58%)
Mobi-Pocket Reader	12 (46%)

* n = 26

- "I really liked using the PDA. It was a little too high in cost."
- "While a little costly—I think students will get much more use out of a PDA than a used textbook."

Using the PDA to improve learning provided students with a rewarding experience. The ability to conduct World Wide Web research and communicate electronically while in a remote environment, such as a non-wired classroom, proved invaluable for students.

Several students commented that they had used their PDAs in classes other than the Introduction to Information Technology course to conduct online research during class time that would otherwise have required outside time. When questions arose during class discussions, for example, IT students could conduct online research immediately to answer the questions or provide further information. Traditionally, either the students or the instructor would have

to delay answers or responses until a later class.

Students also used their PDAs for personal applications. After classroom lessons in scheduling and file sharing, students used both the IrDA and Bluetooth technologies to share files. In addition, they learned to use ActivSync software to synchronize their PDA data with their desktop computer files.

The two most popular personal applications proved to be playing games and downloading music. Several gaming sites exist for students to download and play electronic games, and students often competed with each other using the same games on their PDAs. Students also enjoyed downloading and listening to music using their PDAs. Game and music downloads were students' primary motivation for purchasing additional memory for their systems.

Challenges

Several challenges and obstacles arose during the PDA implementation process. First, although every effort was made to offset the expense, the purchase price was prohibitive for some students. Suggestions to remedy this obstacle include

- encouraging students to share the purchase and use of a PDA and
- providing an opportunity for students to sell the equipment to new students following completion of the course.

Neither of these options is ideal, but the few students (5 or 6 per quarter) who employ one of these methods typically are not IT majors and do not see a future need for a PDA.

Another challenge was accommodating students who do not have personal desktop computers on which to use the ActiveSync software. A desktop system located in the ITAM department was provided for students to learn and use the ActiveSync application in those cases.

Scheduling PDA instruction during the course was a consideration. Students needed time to order and receive their PDAs. Additionally, students who relied on a financial aid subsidy could not purchase PDAs until they received their funds for the quarter, which occurred

during the second week of the 10-week course. To remedy this problem, the first few weeks of the quarter were spent covering other topics pertinent to an introductory IT course.

Delivery time from the factory to the student also factored into the timing problem. If a student ordered a PDA that included custom upgrades, the manufacturer had to build a custom system, adding considerably to the delivery schedule. A course deadline was set for receiving PDAs, after which class time and assignments were dedicated to learning PDA use and applications. Students without PDAs were required to work with students who already had their systems.

Emerging Effects for the IT Classroom

The ITAM department plans to implement PDAs in all its classes. As more and more students complete the Introduction to Information Technology course, they are equipped with, and trained to use, PDAs. Integrating PDA use throughout the curriculum is an integral component of helping students gain as much real-world IT experience and application possible prior to graduation.

Several classroom applications for the PDA have been developed and, to varying degrees, will be applied in IT classes. First, instructors and students will be able to share files. For example, a student who missed class could receive materials distributed during that time from the instructor wirelessly during the next class session, eliminating the need for the instructor to carry past materials to classes. Students could also get the information by e-mail or download it from a class Web site if the course instructor provided those capabilities. Instructors can also distribute and/or collect quizzes, exams, and assignments wirelessly. If an impromptu quiz becomes necessary, the instructor could distribute and receive it wirelessly using PDAs instead of creating a hard copy.

Instructors will also use PDAs for scheduling, including personal appointments with students, assignment due dates, and examination dates. Lists of tasks related to courses can be organized

using the PDA. Finally, electronic materials and e-books may be made available to students, saving unnecessary paper and copy expenses. Screens on PDAs are increasingly larger, brighter, and clearer than earlier models, and text size is adjustable. With the proper software, readers can annotate and bookmark text and take notes.

Recommendations

Because the process of integrating wireless PDAs into the IT curriculum has just begun, we believe addressing the following considerations would strengthen the program.

Support from ITS. Completing the CWU Information Technology Services registration and configuration process can be confusing for students. Also, wireless PDA technology does not yet work consistently. Many students could not get their systems to work wirelessly without one-on-one technical support. Because the ITS department was not prepared to provide that service, all technical support fell on us as the two instructors involved with the program. This created a significant workload burden for us. The IT support department at a university should commit to offering technical support prior to any department's beginning a new classroom technology program.

Ongoing Faculty Training and Applications. To make this program meaningful for students requires that they use PDAs following the completion of the introductory course. The best method for ensuring continued use is to train faculty and provide meaningful classroom activities in which PDA use would be appropriate. Faculty also must be encouraged to use their PDAs as part of their daily work.

Funding to Offset Student Costs. Integrated wireless PDAs remain cost-prohibitive for some students and a burden for others. Funding in the form of grants, subsidies, or manufacturer discounts should be pursued as a means of decreasing the financial burden for students.

Enhanced Learning Opportunities. More class time and assignments in the Introduction to Information Technology course should be dedicated to understanding and applying PDAs. Several students mentioned in the course evaluations that they would have liked to spend even more time thoroughly learning how to use and become confident with PDA technology.

Development of Wireless PDA Technology. As integrated wireless technology evolves for PDA applications, it should become user-friendly as well as more consistent and dependable. Such natural advances in the technology will eliminate many of the problems encountered in the initial stages of our PDA program.

Continued Research. The program to integrate PDAs in the classroom is in the early stages. Additionally, integrated wireless PDA technology

has only recently become available. Continued research is necessary to assess, and reassess, the viability of such a program. Issues such as securing wireless PDAs from viruses and providing accessibility to all students regardless of physical abilities need to be addressed immediately. Until these problems are resolved, they will continue to challenge our efforts to further integrate wireless technology in the classroom. Finally, this study should be replicated within the next few years to determine whether PDAs continue to be used on campus and, if so, for what specific purposes and benefits, both academic and personal. *e*

Acknowledgments

We thank undergraduate research assistants Michael P. Insalaco and Michael Buckmaster for their work with this project. Both have since graduated from Department of Information Technology and Administrative Management, Central Washington University.

Endnotes

1. H. U. Hoppe et al., "Wireless and Mobile Technologies in Education," guest editorial, *Journal of Computer Assisted Learning*, Vol. 19, Issue 3, 2003, pp. 255-259, <<http://www.blackwell-synergy.com/toc/jca/19/3>> (accessed October 26, 2005; subscription required).
2. Access the PDA specification document at <<http://www.cwu.edu/~rawlinsd/Appendices.html>> (accessed October 26, 2005).
3. See the instruction sheet for PDA users to access the CWU wireless system at <<http://www.cwu.edu/~rawlinsd/Appendices.html>> (accessed October 26, 2005).

David R. Rawlinson (rawlinsd@cwu.edu) is Assistant Professor of Information Technology and Kimberlee Bartel is Associate Professor in the Department of Information Technology and Administrative Management at Central Washington University in Ellensburg, Washington.