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Handheld Technologies

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Using Handheld Technologies in Schools

Is a computer for every student—a laptop or even a ratio of one desktop computer per student—still a dream for most schools? Across the Southeast, the response would be a resounding, "Yes!" Several schools, however, are testing handheld computers, such as Palm's Palm Pilots and Hewlett Packard's Jornadas, as possible technologies to provide each student. Many high school students already own a graphing calculator that costs about the same amount as many of these handheld devices. So why provide a student a handheld computer? In addition to being a graphing calculator, a handheld computer can serve as a time-management tool, a graphic organizer, a word processor, a web browser, an e-mail device, and much more.

Originally marketed as a personal organizer for on-the-go business executives and ardent technophiles, personal digital assistants (PDAs) have evolved into handheld computing devices and have become one of the most ubiquitous electronic devices in both the consumer and business worlds. Sometimes known as PDAs, palmtops, pocket PCs, personal PCs, handheld devices, or handheld computers, these devices were described in the *Chicago Tribune* as looking like a "cross between a cell phone and a Nintendo Game Boy."

Due to lower costs, increased functionality, and the availability of new software designed specifically for education, K–12 schools are beginning to take a serious look at handheld computing for teaching and learning, administrative tasks, and communication and collaboration. In fact, the potential for using handhelds in education is almost limitless. Now is the time to begin discovering whether or not these

computing devices can be used to help fulfill the promise of educational computing. They just may be the answer to overcoming the problem of access to technology and to creating equity of use in the classroom. This issue of the **SEIR◆TEC NewsWire** is devoted to exploring the possibilities of handheld computing in K–12 schools. ◆

The Impact of Technology on Education

Although it is difficult to generalize findings from technology research, there should be little question that technology has an important role to play in education. Ask any teacher who really uses technology effectively in the classroom. Ask students who use technology as a tool in their own learning. They'll confirm what the research (Valdez et al., 2000) says:

- Technology makes learning more interactive, more enjoyable, and more customizable. It improves students' attitudes toward content and their interest in learning.
- Technology offers opportunities for learner-control, increased motivation, and connections to the real world.
- Technology can improve student achievement—as indicated by increases in standardized text scores—when it is used to support instruction in the classroom.
- Technology can help students investigate and answer complex questions, develop thinking skills, and learn to access, sort, evaluate, and synthesize information.
- Technology can help students set goals, form and test hypotheses, and make discoveries on their own—helping them develop skills they will encounter in life after school.
- Technology offers tools to share knowledge and learn cooperatively instead of individually.
- Technology can make students more efficient and organized.
- Technology can help students clarify their questions, locate potential answers, and decide on validity, appropriateness, and perspective.
- Technology can be a powerful tool for assembling, modifying, assessing, and studying information; manipulating data; and generating new knowledge and deep understanding.
- Technology enables learners to communicate in new ways with their peers, with experts, and with others around the corner and around the world.

Many studies, however, have shown technology has *not* had a great impact on teaching and learning. Why not? There may be many reasons, but lack of access to technology seems to be among the top culprits. In a study conducted by Elliot Soloway and the Hi-Ce project at the University of Michigan, 50% of the 6,000 respondents (teachers) to a survey reported that their students use computers less than 15 minutes a week (Soloway et al., 2000). Why? Sixty percent of the 6,000 respondents reported that they had one or no computer in their classrooms. Neither they nor their students have access to computers for any extended period of time. According to Soloway and his colleagues, "It's unreasonable to expect computers to have a positive impact on learning and teaching [when students and teachers] have limited access to them and thus aren't using them" (Soloway et al., 2001).

While every student cannot be provided with a $1,000 desktop computer, it is not outside the realm of possibility to imagine a time when every student can be provided with his or her own $100 personal handheld computing device. These affordable devices could overcome the access barrier that is limiting the impact of technology on teaching and learning. Time will tell the story. ◆

References:

Soloway, E., Becker, H., Norris, C., & Topp, N. (2000, June). Teachers & technology: Easing the way. *Communications of the ACM*, *43*(6).

Soloway, E., Norris, C., Blumenfeld, P., Fishman, B., Krajcik, J., & Marx, R. (2001). Devices are ready-at-hand. Retrieved from www.handheld.hice-dev.org/readyAtHand.htm.

Valdez, G., McNabb, M., Foertsch, M., Anderson, M., Hawkes, M., & Raack, L. (2000). *Computer-based technology and learning: Evolving uses and expectations*. Retrieved from www.ncrel.org/tplan/cbtl/toc.htm.

Handheld Technology: The Basics

What is a Handheld Computer?

Handheld computers include those devices originally referred to as personal digital assistants (PDAs) and others that have evolved from that concept. These devices now offer many more computing functions than the original PDAs, which mainly included calendars, address books, and "to do" lists. These devices range in size from those that fit into one hand and use a stylus for input to those with keyboards that are approximately ½ to ⅓ the size of a typical laptop. The term *palmtop* is occasionally used—referring to the natural progression from desktop to laptop to palmtop—however, *palmtop* can be confused with the brand name Palm™, so now the more popular term for these devices is *handheld computer* or *handheld device*.

How They Evolved

Apple Computer, Inc. developed the Apple Newton™ in 1993. The company introduced it as the first PDA and sold it as the ultimate information appliance. John Sculley, former chairman of Apple, predicted PDAs would become ubiquitous tools that would hold telephone numbers, keep calendars, store notes, and send and receive data wirelessly. Unfortunately, the Newton was ahead of its time and did not find a market large enough to survive.

In 1996, Palm, Inc. delivered the first truly successful handheld computer, the Palm Pilot. This device helped people organize their lives by providing instant, anytime access to schedules, important phone numbers, addresses, "to do" lists, and other key information. The business world quickly embraced the small and powerful Palm handhelds.

Because of the popularity of the Palm Pilot, several other manufacturers began releasing their own PDA devices. These devices utilized a new operating system from Microsoft called Windows CE, which was basically a scaled-back version of the Windows desktop environment. The most recent version of Windows CE is now called Pocket PC.

Most of the producers of PDA-type devices are trying to encourage the public to think of these devices not as PDAs but as handheld computers. Many producers are not only adding on computer-type capabilities but also combining their devices with other electronics, such as wireless phones, cameras, and probes.

How They Work

Operating Systems—While there are many handheld manufacturers in the market these days, there are really only two major operating systems in direct competition at the time of this publication: the Palm OS, (used by Palm, Handspring, and Sony manufacturers to name a few) and Windows CE/Pocket PC (used by Hewlett Packard, Compaq, Casio, NEC, Toshiba, etc.). In general, the Palm OS represents a more basic approach, and the devices are cheaper. The Windows CE/Pocket PC system is more robust, and the devices are generally more expensive and, due to their more complex system, require more technical support. Currently, handheld devices using the Palm OS have approximately 75% of the market share; however, there are advantages and disadvantages to both operating systems, and the decision to use one or the other depends upon users' needs. Other handheld operating systems being used today include Symbian, used in

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Expansion and Peripherals: Adding On

The original handheld devices were most often used exclusively as personal data assistants (PDAs) to hold telephone numbers and addresses, keep calendars, and store notes. Manufacturers began to realize the benefits of adding peripherals to increase the functionality and desirability of the simple PDAs. Below is a listing of some of the devices available for handheld computers.

- **Portable keyboards:**
  - Palm OS compatible resources
    - www.palm.com
    - www.targus.com
    - www.seiko.com
    - www.landware.com
    - www.fellowes.com
    - www.ibizcorp.com
  - Windows CE compatible resources
    - www.landware.com
    - www.ibizcorp.com
    - www.hp.com
    - www.targus.com
- **Digital camera attachments:**
  - Palm OS compatible resources
    - www.eyemodule.com
    - www.kodak.com
    - www.sonystyle.com/micros/clie
    - www.targus.com
  - Windows CE compatible resources
    - www.casio.com
    - www.nexian.com
- **Optical accessories (barcode scanners):**
  - Palm OS compatible resources
    - www.symbol.com
  - Windows CE compatible resources
    - www.socketcom.com
- **Wireless telecommunications accessories (modems and devices):**
  - Palm OS compatible resources
    - www.palmgear.com
    - www.novatelwireless.com
    - www.synchroscan.com
    - www.red-m.com
    - www1.sprintpcs.com
    - www.handspring.com
  - Windows CE compatible resources
    - www.pretec.com
    - www.novatelwireless.com
    - www.targus.com
- **Accessory to connect handheld to digital projector or VGA display:**
  - Palm OS and Windows CE compatible
    - www.margi.com

cellular phone technology; RIM, used in the BlackBerry™ line of handheld devices; and the Psion EPOC system.

Input—There are a number of options for entering data into a handheld, depending on the model:

- ***Onscreen keyboard***—The user punches letters and numbers on an onscreen representation of a standard keyboard.
- ***Character recognition program***—The user "handwrites" data using the stylus (e.g., Graffiti for Palm OS and Character Recognizer for Windows CE/Pocket PC).
- ***Synchronizing***—Since handhelds don't have floppy drives to transfer data and programs, they must be "synched" with a desktop/notebook computer. This is done with a program installed on both devices (HotSync for Palm OS and ActiveSync for Windows CE/Pocket PC) and a connection between the devices. Depending on the model, this can be done using a cradle, a cable connection, or wirelessly. During synching, schedule and address book information, e-mails, and other specified data are shared between the devices. Synching is also used to install new software on a handheld device.
- ***Memory-stick***—The latest models of the Palm OS technology allow data to be shared through memory sticks. These postage-stamp-size memory modules can be easily inserted into the handheld unit for access to pre-recorded applications and data or used to store additional data as one would with a floppy disk or CD-ROM.
- ***Infrared port***—Most handhelds have an infrared port that allows users to "beam" or wirelessly transfer programs and data between handheld devices. The infrared port is considered by many to be a major advantage in educational use. This process requires a fairly close proximity between the devices and a clear line of sight.
- ***External keyboard***—There are many models that attach to handhelds to allow full-size typing capabilities.
- ***Other peripherals***—Data can also be input with probes, modems, network cards, cameras, and many other add-on peripherals.

Output—There are also many ways to output data from handhelds:

- ***Screen***—Screens are the most common output method for handhelds, and they vary widely in size, resolution, and readability.
- ***Infrared port***—See *Input* above.
- ***Synchronizing***—Data can be sent from the handheld back to desktop computers for further manipulation.
- ***Peripherals***—Data can be output to peripherals, such as memory sticks, modems, network cards, and printers. ◆

An Overview of Wireless Networking

One of the advantages of handheld technologies is their mobility. However, in order to be truly "mobile," it is important to think about Internet access, and this leads us into the world of wireless communications.

In general, *wireless* is a term used to refer to network-type communications that take place without physical connections (wires), but there are many types of wireless access.

One type of wireless is cellular, which is the same technology that is used with mobile phones. This type of wireless communication is typically used to facilitate long distance communications, such as phone calls. Examples of this type of wireless use include mobile phones, pagers, BlackBerry™ devices, and Internet access via a handheld, such as a Palm or Handspring device. This type of service typically incurs a monthly service fee, which can range from $20 a month and up, depending on the nature of the service. Handhelds that use this technology include Palm's i705 handheld, Handspring's Treo communicator, and various other devices and add-on modules that have wireless modems.

Another type of wireless can be used to facilitate localized communications. Typically, this type of wireless allows a device, such as a computer, to connect to a LAN without a cable connection. An important thing to note about this technology is that it goes through walls and up and down stairs, so there aren't the line of sight issues that exist with infrared technology.

There are three main varieties of this technology:

Bluetooth™—Bluetooth is a wireless solution with a 30-meter radius range. Bluetooth works well for hard cable replacement, and, therefore, printing is likely to be the most important Bluetooth application. Bluetooth supports Ethernet, but because of its slow speed, it is not a typical use. Bluetooth supports voice, and this flexibility is likely to yield some popular applications that relate to automated phone switching between cellular and land-line service. Bluetooth is also likely to be the technology used to enable cashless vending machines and other purchases through cell phones or other Bluetooth-enabled devices. There are new Bluetooth cards available for Palm handhelds, and some of the early applications for these are geared toward document collaboration.

802.11b (also known as Wi-Fi or wireless Ethernet)—802.11b is a protocol used for wireless networking. It is great for locations like older school buildings that are difficult (or expensive) to wire. The range for this technology is typically 150–300 meters in radius and supports up to 11 megabit data rates, which is very fast for Internet access and other applications. This is the technology that Apple is using for its AirPort system, which is very popular with schools. Xircom (a division of Intel) makes Wi-Fi modules for a variety of handhelds. Some Pocket PC handhelds come with Wi-Fi capability built-in.

Home RF—This is a wireless networking protocol similar to 802.11b that is compatible with Ethernet but is considerably slower at 2 megabit. One advantage of Home RF is that it is designed to carry voice data. However, it is waning in popularity and is not currently compatible with Macintosh computers.

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There are two basic configurations that can be used for local wireless access—peer-to-peer and infrastructure. Peer-to-peer does not require a central access point; it works from device to device. Infrastructure uses a central access point or base station that connects to the network and can serve multiple devices within the specified radius.

802.11b supports both peer-to-peer and infrastructure use, but it is typically implemented as infrastructure. In order to set up 802.11b in this way, two types of hardware are typically used: a base station or access point and a device card. There may be one or more access points, depending on how large the service area is. The device card goes into each device (computer, handheld, etc.) that is to have wireless access. Typically, these device cards are in the form of a PC card or other similar device. Access points can cost from $179–$500 and up. Device cards are typically around $100–$400 each. Prices are expected to drop as the technology matures and economies of scale are achieved.

Bluetooth was designed to use peer-to-peer communications and is typically used this way; however, recently, the notion of an access point has been added for Bluetooth installations.

It is important to know that these various protocols are not compatible with each other. It is also important to recognize that within one type of technology, not all access points are compatible with all device cards. Because this is an emerging technology, compatibility testing of components is vital. ◆

Resources for Wireless Networks in Schools

Becoming a Wireless Campus—www.thejournal.com/magazine/vault/A3482.cfm

Bluetooth Group—www.bluetooth.com

eSchoolNews Report on Wireless Networking (*free, but requires a sign-up*)—www.eschoolnews.com/resources/reports/wireless0801

Three Reasons to Consider Wireless Networking—www.eschoolnews.com/news/showStory.cfm?ArticleID=1460

WiFi-WECA site—www.wi-fi.org

Wireless Laptops and Local Area Networks—www.thejournal.com/magazine/vault/A3536.cfm

If you are thinking about buying a handheld, here are some technology considerations to keep in mind as you make your decision.

Size, Weight, Appearance

- ❑ How will you be carrying your handheld? Pocket, briefcase, purse? Since portability is the key advantage of handhelds, the device should be light and small enough so that you will take it with you. (If you are going to take it with you, does it have a case to protect it while not in use?)
- ❑ Handheld technologies vary from palmtop size to those roughly half the size of a laptop with a built-in keyboard. Which form factor makes the most sense for your use?
- ❑ Is the appearance (color and design) of the handheld device important to you?

Changeable Battery vs. Cradle-Charging System

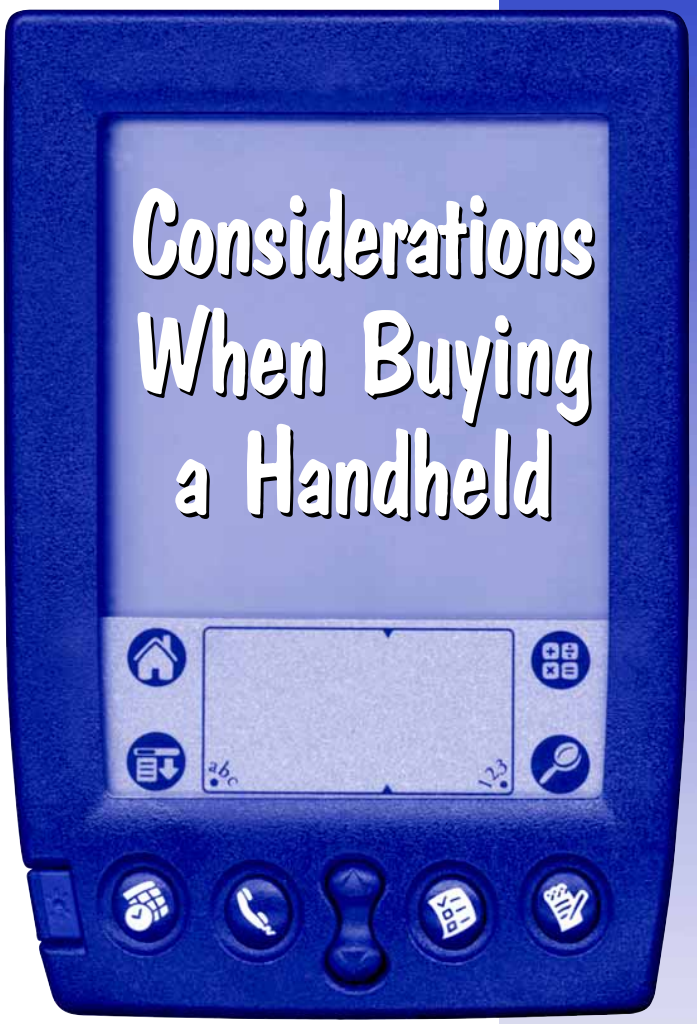
Which is best for your specific situation?

- ❑ Some devices use a number of batteries, such as AAA, and you should always carry extras when traveling.
- ❑ Others contain rechargeable batteries that get their charge when the device is plugged into the cradle or optional portable charging adapter.
- ❑ Consider the average battery life.

Capability vs. Ease of Use

Which operating system will suit your needs?

- ❑ In general, devices using the Palm operating system are less expensive and simpler to use, but include less built-in multimedia capabilities.
- ❑ Devices using the Pocket PC operating system are more expensive, may be more complex to use, and may require more technical support; however, they include more functionality including built-in multimedia support.
- ❑ Consider which platform most of the peers with whom you will possibly be sharing data use.



Memory

How much memory does the device have?

- ❑ For Palm OS devices, 8 MB will be adequate for most users. Pocket PC device users will require more memory because of the operating system requirements.
- ❑ Is the memory upgradeable if it becomes necessary?

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Available Software

What do you want to do with your handheld?

- ❑ Just as with desktop computers, the real power of handheld devices comes from the software applications you are able to add.
- ❑ In terms of sheer volume, the Palm OS is the clear leader, with the software library for Pocket PC slowly improving. It doesn't matter how many programs are available, but whether or not the programs you **need** are available.
- ❑ Basic desktop-type programs (databases, presentation tools, document readers, etc.) are generally available on both platforms; however, as you start to look for more specialized applications, Palm OS devices have the advantage again.

Screen Display

Is color display important to you?

- ❑ With most handheld devices, color displays are more readable, but monochrome displays require less power so batteries last longer.
- ❑ What is the screen resolution? Active Matrix color screens are typically higher in resolution and richer in color, depth, and brightness in various light conditions.
- ❑ Does the handheld have a backlight?
- ❑ How "readable" is the screen?
- ❑ Where will you be using this device most of the time? Be sure to consider the lighting conditions (indoor under different lighting, outdoor in direct sunlight, etc.).

Peripherals

What kind of peripherals do you need?

- ❑ Do you need digital cameras, modems, telephones, wireless Ethernet expansion, bar code scanners, projection modules, scientific data sensors, etc.?
- ❑ Is the device Internet capable? Internet capability may be added through landline or wireless and may be built-in or added through expansion.

Cost

What is the cost of the handheld?

- ❑ What are the up-front purchase costs of the handheld device?
- ❑ What are the costs for related things like software, expansion modules, and accessories?

References for Buying Handhelds

Buyer's Guide to Handhelds. (2002). ZDNet Reviews. Retrieved from www.zdnet.com/products/stories/reviews/0,4161,2585429,00.html.

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CNET Handheld Hardware Comparative Reviews. (2002). CNET. Retrieved from http://computers.cnet.com/hardware/0-14448.html?tag=st.co.1087.more.14448.

PDA Buyer's Guide. (2001, November). pdaED.com. Retrieved from www.pdaed.com/vertical/tutorials/buyersguide2.xml.

What to Look For in a Handheld. (2002). CNET. Retrieved from http://computers.cnet.com/hardware/0-2645869-7-1480993.html?tag=dir.

Educational Advantages

Why are educators considering purchasing handheld technologies for school use? The educational advantages of handhelds over full-sized, varied-functioning computers range from cost to size to ease of use. The list below is a good initial set of reasons to consider handheld devices for your school.

- **Cost**—Handhelds usually range in price from as low as $100 to as high as $1,000 depending upon the capabilities. A basic handheld for the typical student can be found in the $100–$300 range, with educational discounts available for large quantities.
- **Mobility**—This is possibly one of the biggest advantages, since handhelds can be taken practically anywhere instead of being confined to the lab or classroom. Because there is no need for electrical connections while it's being used, it can be used outside or while traveling.
- **Wireless**—The ability to transfer or share data and programs wirelessly overcomes the need for a more hard-wired infrastructure and adds to the mobility.
- **Size**—This really provides a number of benefits:
  - Physical storage of devices—Because of their small size, it's not necessary to have a separate lab for a classroom set.
  - Media storage—Devices can be loaded with electronic versions of large reference materials in a portable format.
  - **Ubiquitous access**—Users can carry them in pockets, backpacks, purses, and briefcases and always have access to information and programs.
- **Ownership**—Because of the feeling of ownership, along with the "cool factor," students take care of the devices so they don't lose the privilege of using them.
- **Access**—Because of the relatively low cost, entire classroom sets of handheld devices can be purchased for the price of three or four desktop computers and can provide access to many more students for much longer time spans.
- **Collaboration and Sharing**—Beaming has been found to be an extremely effective technique for encouraging students to work together and share information.
- **Simplicity/Ease of Use**—Particularly with the more basic educational applications, teachers do not have to spend a lot of time teaching students how to use them. ◆

References for Educational Advantages

Pfeifer, R. S. (2001, May). Beaming your school into the 21st century. [Electronic version] *Principal Leadership* (High School Ed.), *1*(9), 30–4. Retrieved from www.principals.org/news/beamingschool.html.

Along with examples of uses of handheld computers in a Maryland high school, a number of advantages of using handheld computers are discussed.

Soloway, E. (2001, April). Making palm-sized computers the PC of choice for K–12. [Electronic version]. *Learning and Leading with Technology*, *28*(7), 32–34, 56–57. Retrieved from www.iste.org/L&L/archive/vol28/no7.

Describes how palm-sized computers, outfitted with suitable software, can provide the K–12 community with personal, pervasive access to networked computational resources to support student learning. The benefits of using palm-sized computers to support collaboration, sharing, and revision are discussed.

Educational Concerns

Introducing handheld technologies into the school program has some potential concerns. These technologies may be small, but small does not always mean simple and easy. Consider the issues below before deciding that handheld technologies are right for your school.

- **Compatibility**—Palm OS and Windows CE/Pocket PC devices are not compatible. While some data can be interchanged, programs cannot. The other compatibility issue comes into play when a desktop computer is involved. While some programs support both desktop platforms, in general, more handheld applications are written to work with Windows desktop computers than with Macintosh.
- **Cheating**—By using an infrared port similar to that of a TV remote control, handheld computers can beam information to other handhelds. This allows students to share information easily, but it also raises the possibility of cheating since students can beam answers to each other. Fortunately, with most handhelds, there are ways to restrict beaming for this very reason. With these unique concerns in mind, your school may want to revisit acceptable use policies to ensure that potential issues are addressed. Most guidelines applied to the use of the Internet and classroom computers can be adapted to the use of wireless handheld technologies.
- **Distraction**—The very versatility of handheld devices also makes them highly conducive to off-task behavior, such as game playing or Web surfing.
- **Effectiveness/Research**—At present, we don't really know how the use of these devices affects student achievement. They haven't been around long enough for many extensive studies.
- **Infrastructure**—Although handheld computers are not expensive, peripherals such as keyboards, cameras, cases, styli, and hardware modules must also be purchased. Decisions about who needs what equipment must be made. Software must be added and regularly upgraded.
- **Ownership**—Who will own the handhelds? Students or schools?
- **Professional Development**—What resources are available for training both student and staff on the proper and effective use of handheld technologies? Even though handhelds tend to be less complicated in use, a level of professional development and orientation is required to fully utilize the technology.
- **Replacement Issues**—This includes concerns about durability and warranties.
- **Safety**—Little is known about the handheld computer's possible impact on students' health, such as eyestrain and carpal tunnel effects.
- **Screen Readability**—Even the largest handheld device has a small screen-viewing area. The issues here really revolve around the intended use of the device (extensive reading vs. quick formula calculation), the physical location of its use (lighting), and the age of the user.
- **Screen Size**—Not just readability of text but also many graphics, such as charts and graphs, do not translate well to the small size screen.
- **Security**—There are a number of security issues involved:
  - **Theft**—One of the biggest advantages of handhelds—their size—also makes them prone to theft.
  - **Data**—Developers are scrambling to build in data security safeguards like those in place for desktop computers, but it's a new field, with new concerns.
  - **Viruses**—Yes, they exist for handhelds, too. Although not in the large numbers experienced by desktop users, viruses are increasing, and virus protection programs for handhelds are becoming more popular.
- **Tech Support**—They need to be fixed in a timely manner for effective use. On the plus side, it's not too expensive to have some "loaners" available as a quick fix, which isn't really a viable option with larger, more expensive desktop models. ◆

References for Educational Concerns

Pownell, D. (2001, June). Getting a Handle on Handhelds. *Electronic School*. Retrieved from www.electronic-school.com/2001/06/0601handhelds.html.

Suggests questions to ask about leadership, teaching and learning, staff development, technology support, planning, infrastructure, safety, ethics, evaluation, security, curriculum, change, and equity regarding the use of handheld computers in the classroom.

Robertson, S. I. (1997, July). The use and effectiveness of palmtop computers in education. *British Journal of Educational Technology, 28*, 177–189.

Researchers present a few problems educators found when using handhelds in the classroom (screen size, limited memory, theft of device, lost files, lack of training).

Student Teachers and High School Seniors Beam the Internet

Seniors in an English class at New Hanover High School (NHHS) in Wilmington, North Carolina, have a totally different approach to Senior Project papers and student teacher interns. As part of the Technology for Reflection and Assessment Coalition, a Preparing Tomorrow's Teachers to Use Technology (PT3) grant at the Watson School of Education at the University of North Carolina at Wilmington (UNC-W), the NHHS seniors used the Hewlett Packard Jornada handheld wireless technology to collect and organize information for their assigned papers.

Amy Hawk, one of the student teacher interns from UNC-W, used 30 Jornadas with her senior English class. The seniors used the Jornada's word processing application and its wireless Internet connection to develop a letter of intent on the research paper topic, conduct Internet research on the topic, participate in class literature research activities, and produce a final product. With the capability to beam their work to the school network and to access the Internet wirelessly whenever they wanted, the students completed their Senior Project papers in less time than their counterparts who used the school computer lab. Ms. Hawk also used the Jornadas with her sophomore English class. They used the Jornadas for word processing and Internet research as well as for class activities to create their own Anglo Saxon riddles.

Using the handheld technology in the English classes was a new but exciting experience for the student-teacher intern and is one of the UNC-W PT3 project goals of accelerating the infusion of technology throughout the teacher preparation program. Ms. Hawk reported that, for the students, the handheld devices were efficient and effective ways to manage their research and writing time and to provide greater access time to the Internet than using the one school computer lab. For her as a student-teacher intern, the devices provided instant availability to search the Web during class activities and an incentive to incorporate technology into her teaching. She noted that it is important that school administrators support using handheld technologies in teaching and learning and believe that students will benefit from the experience. This was certainly true at New Hanover High School, and it was a factor in the success of the project. ◆

101 Great Educational Uses for Your Handheld Computer

Administrative Applications

1. Keep your schedule
2. Track student progress on specific skills
3. Conduct authentic assessment
4. Use a calculator
5. Make a database of key content and concepts for student use
6. Take attendance
7. Instantly access student information, such as schedules, demographics, or parent contacts
8. Organize your reading lists
9. Take notes at a meeting
10. Record and tabulate grades
11. Track computer hardware and software inventory
12. Enhance school safety with bar code passes
13. Access lesson plans
14. Use a rubric to assess and score student work
15. Access a database of curriculum standards and related curriculum resources
16. Keep an inventory of books and materials
17. Store and track student IEPs
18. Track technical support requests
19. Keep a list of all your important contacts
20. Evaluate student teacher performance and record observation notes
21. Access a library book list
22. Track, organize, and control inventories and safety information for chemicals in the lab
23. Let students have constant access to their current grades (very motivating!)
24. Track teacher recruiting activities
25. Access human resources benefits information
26. Look up technical troubleshooting information
27. Keep emergency procedures and checklists readily accessible

Communication and Collaboration Applications

28. Send an e-mail
29. Schedule school meetings as a group
30. Collaborate on a graphic organizer
31. Send a fax
32. Make a presentation
33. Make a phone call
34. Distribute school activity information to students and parents
35. Send assignment information home to parents
36. Exchange information with a colleague
37. Have students beam in an assignment
38. Get parents' sign-offs
39. Share a downloaded Web page with someone

40. Transfer a file from your PC for instant access
41. Write an eBook and share it with others
42. Track and exchange data on team activities
43. Receive instant messages
44. Conduct group writing activities
45. Record voice notes
46. Transmit close captioning of lectures for the hearing impaired
47. Access online educational events

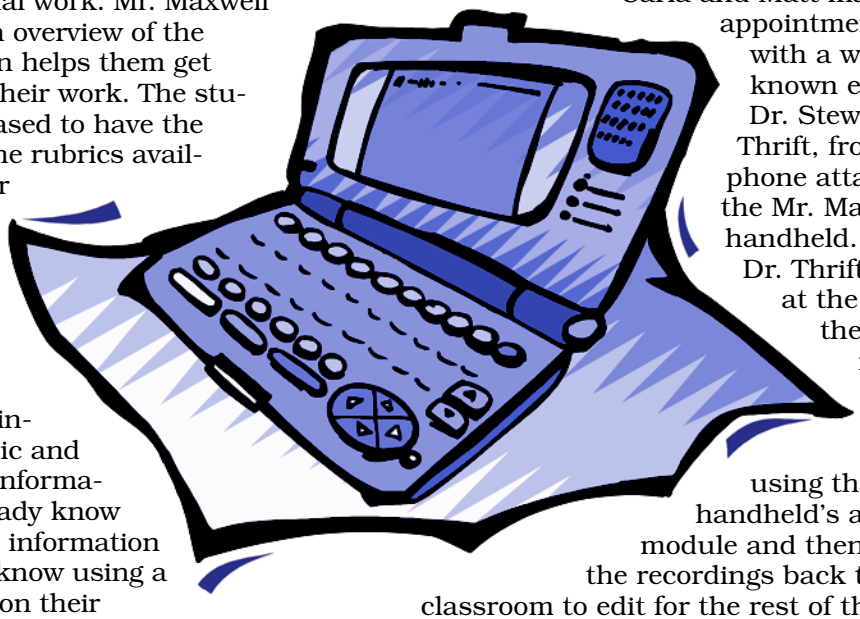
Teaching and Learning Applications

48. Take and store digital photos for a report
49. Make a spreadsheet
50. Draw a picture
51. Make a concept map summarizing a chapter
52. Form, visualize, and solve equations
53. Keep track of your class schedules
54. Take notes on a field trip
55. Read an eBook
56. Find locations with a GPS
57. Take field notes by GPS location
58. Graph data
59. View maps
60. Organize your assignments
61. Gather data on temperature, light, voltage, pH, and more with data probes
62. Program your own handheld application
63. Give (or take) a quiz
64. Look up a word in a dictionary
65. Use flashcards
66. Use a tutorial for self-study
67. Do homework
68. Write a report
69. Take notes in class
70. Complete a worksheet
71. Study a foreign language
72. Listen to reenactments of historic speeches
73. Play a game that simulates the transfer of viruses
74. Do research on the Web
75. Send and receive individual or class questions
76. Gather data on transportation use, food intake, and energy use to gauge ecological impact
77. Make a timeline
78. Look up a word in a thesaurus
79. Create an outline
80. Study for a test
81. Give students step-by-step instructions or visual plans for projects
82. Keep a journal
83. See real-time data and graphs of position, velocity, and acceleration change over time
84. Access writing prompts
85. Learn to read and write Japanese characters
86. Download notes for a research paper
87. Practice multiplication tables
88. Access the periodic table
89. Use a glossary of technical terms
90. Look at reference diagrams on parts of the human body
91. Play a collaborative problem-solving game to learn about genetics
92. Listen to and study classical music
93. Build a robot controlled by a handheld device
94. Use a stopwatch to track times
95. Read about the latest current events
96. Access notes from a class lecture
97. Create a map using GPS data
98. Listen to and practice pronunciation with a voice recorder (English language learners)
99. Have classes create their own mobile information channels to share information with other classes or the community
100. Create a database on endangered species
101. Read historical primary source documents

SEIR•TEC

Picture This!

An exciting and innovative unit is beginning in Mr. Maxwell's class. The students are eager to find out what the topic for this week's research project will be. While the students synchronize their handheld computers, the details of their assignment are provided along with rubrics for evaluating their final work. Mr. Maxwell gives them an overview of the topic and then helps them get started with their work. The students are pleased to have the outline and the rubrics available whenever they need them.



The class is divided into several teams. Team members brainstorm the topic and organize the information they already know as well as the information they want to know using a concept map on their handheld. When they are finished, they divide the work to be done, and pairs of students take responsibility for gathering different kinds of information on their handheld computers to bring back to the group. They use the calendar function of the handheld to set deadlines for gathering information, for creating a draft report, and for the final review by all team members. They set alarms to remind them of deadlines and create "to do" lists for the whole project and for each pair of students.

Maria and Jermaine are responsible for finding appropriate images for the topic. They head to the media center and search for clip art and public domain images, download them to the computer, convert them to images for their handheld, and make notes, including the citations, about each image.

Margaret and Bill create a vocabulary list by consulting with each team, doing some basic library research, and typing their notes into their handheld computers; they use their handheld computer dictionary and thesaurus modules to create a glossary for the project.

The job of interviewing several experts is assigned to four students—Carla, Beth, Matt, and Jeremy. They access the Internet's yellow pages to find some experts in the community and then make a list of questions they will ask each expert.

Carla and Matt make appointments with a well-known expert, Dr. Stewart Thrift, from the phone attached to the Mr. Maxwell's handheld. When Dr. Thrift arrives at the school, they record their interviews using their handheld's audio module and then take the recordings back to the classroom to edit for the rest of the group. Beth also snaps a few pictures of Dr. Thrift and some of the artifacts he brought with him using the digital camera attached to her handheld computer.

Meanwhile, Beth and Jeremy find that one of the teachers in the school, Mr. Samuel Justice, is also an expert on the topic. They e-mail him from their handheld computer, and he responds that he'd be willing to answer any questions, but it would be easiest for him to work by e-mail. The next morning, they find his answers waiting for them when they check their e-mail on their handheld computer. They export the e-mail to a word processor and edit the interview.

Robbie and Barbara use their handhelds to search for specific information on the Internet right from their classroom. They summarize the information using the word processing program on one of their handheld computers.

Miguel and Sarah find that their school has several books on the topic, and the media specialist helps them download the electronic book version of one critical

work to their handhelds so that they can review it in the classroom.

Sydney and Logan collect data from a variety of sources, including probeware they borrow from the science teacher. They enter the data into a spreadsheet program on their handhelds and then calculate and sort the data. They use this data to generate several charts and graphs for use in their final report.

The team beams information to each other from time to time so that they all share the information that each person has found. Using one of the classroom computers and a presentation template, they each create a portion of the presentation and then combine the portions into one final product. They refer to the document on their handhelds that contains the rubrics Mr. Maxwell provided, checking each item to be sure they have included everything required.

Now it's time to show the presentation. They send the presentation over the school network to the presentation-station handheld and take turns explaining their findings to the rest of the class. Their classmates evaluate the presentation and beam their results to Mr. Maxwell, who adds his comments and then shares them with the team. To be sure each student has mastered the basics of the topic, Mr. Maxwell prepares a short quiz with true-false, multiple choice, short answer, and one challenging essay question on his computer. The students download the quiz, and when they take it, the handheld locks out access to any other information on the device until they have beamed the answers to the teacher.

All the students are excited about what they have learned and prepare a Web page to share their presentations with their parents and the community. Mr. Maxwell e-mails the parents with the URL and invites them to access the students' work. Sydney's mother gets the e-mail on her handheld computer on her way home from a business trip and, while waiting at the airport, takes a look at the class's work. She is proud of her daughter and tells her so when she gets home. She e-mails the teacher as well. Mr. Maxwell receives the e-mail just as he finishes synchronizing his handheld computer with his desktop computer, transferring the grades and comments for each student and recording their progress against the standards and benchmarks the district curriculum requires.

Time to begin a new project? The students are ready to take on new roles and responsibilities. As long as they have their handheld computers, they know they can do the job. ◆

More Uses, Ideas, Software, and Case Studies for Handhelds in Education

Center for Highly Interactive Computing in Education (Hi-Ce), University of Michigan—www.hi-ce.org

Reports on the Center's development of a variety of free handheld applications for education

K12 Handhelds—
www.k12handhelds.com/casestudy

Provides case studies on the use of handhelds in education

Palm in Education—
www.palm.com/education

Includes case studies, programs, research, and resources

PEP Ideabank—
www.palmgrants.sri.com/ideabank.html

Provides links and innovative ideas for using handhelds in education

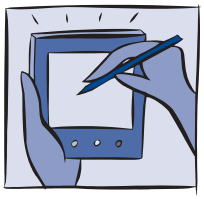
SEIR•TEC

Using Handheld Technologies in Schools

The Beaufort County Schools (South Carolina) and the Johnston County Schools (North Carolina) have both undertaken pilot projects involving the use of handhelds in the classroom. In the following interview, Cyndi Pride, Beaufort County Schools' Curriculum and Instruction Technology Specialist, and Diana Skinner, Johnston County Schools' Technology Director, share their experiences with their handheld technologies projects and offer some lessons learned. The experiences of these two districts provide insight and guidance for others interested in this use of technology.

Beaufort County Schools Project

- 270 students in grades 4–12



Johnston County Schools Project

- 5 schools, 60 students per site
- Participants included:
  - All district principals (32)
  - All technology leaders (32)
  - 35 media coordinators
  - Superintendent's Administrative Cabinet members (6)

SEIR◆TEC: Why did your school district initiate a project on using handheld technologies in the classroom?

Diana: Both the Assistant Superintendent for Technology, E.D. Hall, and I had owned a Palm Pilot for a number of years and had become addicted to the tool. Upon reading articles from professional journals and visiting vendors at conferences, we purchased some devices and experimented with them for educational value. I prepared a PowerPoint presentation to answer questions regarding use, cost, and educational value that I then showed to teachers and administrators. We applied to be a Palm Education Training Provider (PETP) trainer and attended training conducted by Palm in May 2001 in San Jose, California. Endowed with a lot of resources and materials, probes, software, and training materials, we began our initiative in summer 2001.

E.D. Hall

Cyndi: Our first handheld technologies program involved teachers and grew out of the recognition that the handheld, long used in business applications, could provide a means for teachers to have one ready-at-hand tool to collect and manage digital data about teaching activities and student learning. The handheld would provide the teachers with a means to more easily collate student information into a meaningful report, eliminating double entry and reiterative behaviors. Placing handhelds into the hands of students seems to be a logical next step. The handheld promotes equity in access at an affordable price, allowing us to bring more technology into the classroom. The size and portability allows for ease of movement from class to class and promotes use in the field. Although the size and weight of the handhelds would seem to increase the chance of technology "walking out the door," this has not been an issue.

SEIR◆TEC: Tell us about your project: goals, who is/was participating, how long it has been/was in operation, and products you used.

Diana: Our pilot this year has been investigative and administrative in nature. We have placed 30 Palms in the hands of fifth-graders, sixth-graders, eighth-graders, and eleventh-graders with a different curriculum focus for each grade. The Palms have been used for language arts, math, science, computer skills, and writing assignments. We are also investigating their use as a communication device between home and school. All principals, media coordinators, technology leaders, and most Advanced Placement teachers have Palms, as do our central office administrators. This is a study to remove paper (for example, meeting agendas), to share information and technology tips, and to access data as a PDA. Administrators are accessing student information; parents and students are accessing homework and school calendars, and teachers are accessing observation notes. We began in September 2001 with administrative training and in October with training of students and teachers. We are using a variety of Palm products—m100, m105, m505, 111c, and 5vx. Our software varies by curriculum, but we all use Docs To Go, PiCo Maps, Imageware, Notepad, Handy Sheets, and Cooties.

Cyndi: The goal of our first project (Assessment…It's in the Palm of Your Hand) was to provide teachers with a tool (Palm) to assist them in managing data from a variety of assessments to gain a better picture of student learning and thus to guide instruction. Nineteen teachers participated in the program, beginning in February 2001, with a review of literature on the topic of assessment. Training was provided in the mechanics of using the Palm, including entering information, synchronizing the Palm, and transferring data from one application (for example, the Memo Pad) to another (for example, a Word document). Teachers used the basic Palm applications, a spreadsheet application, and Teacher's P.E.T., a grade book and learning management program. Additionally, each teacher reviewed and evaluated other software that might be applicable in a teaching environment. At the beginning of our project, there were only a few software applications specifically for educators, but now more are available, as developers have discovered this unique niche. Titles that were reviewed include Learner Profile to Go, Thought Manager, and Praesto Grade, to name a few. The teachers met weekly through the spring and continue to meet monthly, to share information, ideas, tips, and tricks.

As a recipient of a Palm Education Pioneer (PEP) Research Hub Grant, Beaufort County School District was able to expand the program to include students in the fall of 2001. Two hundred seventy students in grades 4–12 use Palm Pilots to determine if the Palm helps students be more cognizant of their achievement because of the opportunity for self-assessment in project-based learning activities. We have three different models in the program: classes where students are issued Palms and use them at school and at home, class sets of Palms that are shared by several students for special projects, and daily

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in-class use of Palms by assigned students. Teachers and students make extensive use of freeware, such as Hi-Ce's PiCo Map and Cooties (www.handheld.hice-dev.org), Big Clock, and Diddlebug. As the program evolves, and new software applications are developed, we expect that schools will begin to budget for additional software. Some of our schools have augmented the Palms with peripherals including keyboards, digital cameras, and probeware. Several of our schools have purchased additional Palms for both student groups and teachers. Teachers in primary school classrooms are using the Palms, in part, to collect data for the South Carolina Readiness Assessment. Additionally, we have two schools that have purchased class sets of Pocket PCs, keyboards, and some wireless cards.

SEIR◆TEC: What was the reaction by students to the handheld technologies? Teachers? Administrators?

Diana: They love them and want more devices! Those schools not involved in the pilot want to be included. We have even had a few parents purchase them for their students so the students did not have to share the school-provided Palm. Everyone wants us to develop more grant proposals to obtain more Palms!

Cyndi: Most users have met the handhelds with enthusiasm: teachers, administrators, and students alike. All users appreciate the simplicity of the Palm interface and the avenues for communication and collaboration that result from being able to beam data from one Palm to another. Teachers, especially, appreciate the ability to carry the Palm everywhere and to take or refer to notes anytime. Although some may think this insignificant, teachers have commented that women's clothing does not always have pockets or belts, so some users carry alternatives, such as small shoulder bags and special lanyards.

Administrators at several schools have also adopted handhelds. Administrators are using both Palm OS and Pocket PC platforms. Administrators are interested in synchronizing student information data (SASIxp) onto their handhelds for anytime/anywhere access to student schedules, teacher schedules, bus assignments, and discipline records. With few exceptions, our users find their Palms to be indispensable. I have even been treated to more than one round of applause from students when introduced as the person who was responsible for the grant that got the students the Palms!

SEIR◆TEC: Describe the training you conducted and tell us what training you think is essential for anyone considering a handheld implementation for the classroom.

Diana: Our training is systematic and thorough. Only two of us conduct initial training, but teachers and technology leaders work with teachers and students at each grade level. For phase one, it is extremely important that small groups are trained well and supported as they have questions and develop ideas. We are producing a training manual and software recommendations as "must haves" to affect student learning and achievement. We will share these at conferences and with other counties in North Carolina. You must have a cutting-edge team always ready to test the new software and devices. Lessons we learned were to set and maintain standards, to retain plenty of written documentation, to have clear objectives as to why to use the Palms, to do follow-up training, and to adjust training as necessary.

Cyndi: Many of our users found that organized training for the Palm was not necessary, but a few workshops were made available to less assured teachers, administrators, and even board members. To get users started, we offered an introduction to the Palm applications, buttons and screen views, preferences, creating and using catego-

ries, tapping, typing, and beaming. The second workshop encompassed skills such as changing settings for buttons, using the shortcut stroke, and creating shortcut commands, phone lookup functions, and menu options. During training sessions, dialogue about classroom applications was encouraged, and tips and tricks were shared among users. Another training opportunity assisted users in loading the Palm desktop software and synching with Outlook and reviewed how to add programs to the Palm. Although we didn't have formal training for specific software titles, the teachers met to share notes and assist each other with these new applications. Teachers using the Pocket PC handhelds were able to adjust to the CE versions of Word and Excel with little difficulty, once they understood the mechanics of tapping and typing. Teachers using this platform met for several hours to experiment with the tool and to brainstorm ways in which to use the handheld with students in the classroom. They received instruction in the class, along with the students, on how to connect to the network using wireless cards. Each school has a lead teacher who assists other users if problems or questions arise. In some schools, the lead teacher received the handheld prior to other teachers and had the opportunity to practice with its use and to participate in training. The teachers became the primary instructors for their students. Some teachers offered additional training for parents so they could use the Palm to correspond with the teacher. In schools where the Palms go home with the students, teachers and parents have begun to communicate with each other in the Memo Pad application. Although training is not essential, it can help teachers maximize the utility of the handheld. Several of our teachers and administrators had used their Palms independently for a period of time, but many had not discovered special timesaving features, such as how to create shortcuts and use the shortcut stroke to make notations faster. Synchronizing the handheld and working with e-mail is problematic for some users. Additional training may also be required for wireless connectivity in future models.

SEIR◆TEC: What were the most successful uses of the handheld technologies by students? Teachers? Administrators?

Diana: For students, the most successful uses were the calendar, PiCo maps, and probes. For teachers, it was the Handy Sheets website with digital worksheets for the Palm. Administrators really used the Doc To Go for teacher performance assessment.

Cyndi: One of the greatest benefits of the handheld is the ability to share information via infrared. Our teachers and students have capitalized on this feature. In a drama class, the teacher beamed scripts to the students in Memo Pad. Students also have journal questions beamed to them frequently, which they respond to, and either beam back their responses or sync their handhelds to the class computer. Beaming allows students to work collaboratively as well. In one class, students built sentences to review sentence structure and parts of speech. Students have also been able to work collaboratively to share research findings. In classes where we have used PCs connected to the Network, students were able to take notes from different sites on the Internet and then share those, by beaming, with other students. Students have also received a project "to do" list elaborating the steps of a project, which they can check off as each phase is completed. Teachers and students have worked together to define levels of accomplishment as a rubric for specific assignments. This can be beamed to students for reference as they complete the task. Students have used the Address Book feature to keep contact information for study

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buddies, and the calendar feature is used to track assignments. The alarm feature of the calendar has been especially useful to remind students as long-term assignments come close to their due date. The calculator is helpful as it eliminates the need for another tool. Some math teachers have especially liked the fact that students can view, copy, and paste "recent calculations" into a memo, where they can describe their solution step-by-step. One high school teacher has used a demo version of MathWorks (www.imagiworks.com) that allows the Palm to function like a graphing calculator. She plans to purchase this software for students next year.

SEIR◆TEC: What recommendations would you offer to schools and districts considering implementing handheld technologies?

Diana: Even though we have only worked with the handhelds a short time, we highly recommend a four-step process: pilot, support, train, and support some more. We would also recommend gathering data and documenting and sharing the lessons learned with others. This is how we have built justification for extending our project and obtained new ideas to try.

Cyndi: The first decision schools or districts must make before implementing a program is what handheld platform to purchase and support. Currently, we have programs with each platform, and we will be reviewing the pros and cons for each as we move forward. Another consideration in purchasing a handheld is power. Generally, it is easier to recharge units than to constantly replace batteries. Schools will need to plan for how they will recharge a number of units; however, the cradle or charging cord is included in the purchase price. Although there is much to be gained in using the handheld straight out of the box, peripheral equipment and optional software greatly increase the utility of the technology. Therefore, planning for additional expenses is wise. From our experience, we feel it is important that the first teachers selected for the program have a basic comfort level with computer technology. Synching to the computer and moving documents from memo pads to Word and back might be intimidating to some teachers.

Although formal training does not seem to have been a key indicator of success in using handhelds effectively in our projects, our teachers have commented that they benefited greatly from having the opportunity to talk with other users and share ideas. It has also proved helpful to have a designated point person in each building who is well versed in the workings of the handheld platform selected for the school. One other consideration is whether the handhelds will be used strictly in the classroom and during the school day, perhaps on field trips, or whether they will go home with students. ◆

Using eBooks on Handhelds

Electronic books, or eBooks, are electronic versions of books, magazines, journals, reference manuals, textbooks, or any other document traditionally occurring as a printed volume. Electronic books can be viewed on a traditional computer screen and are also becoming increasingly popular on smaller, portable reader devices, including handheld devices. The appeal of these devices is that they can be carried around, much as a traditional book might, but can also contain numerous volumes and special features that are not available in the print versions of books.

The features included in eBooks vary depending on the reader type and the document format. Many eBooks include features such as searching, built-in dictionaries, annotation tools, bookmarks, variable font size, hyperlinks, and auto-scrolling.

Screen resolution is the biggest technical issue that is yet to be resolved with eBooks. Until screen resolutions improve, reading eBooks puts more strain on one's eyes than reading printed words on paper.

There are thousands of eBooks currently available on a wide variety of topics. Some are free, and others sell for prices that are typically somewhat, but not drastically, below average print book prices. It is expected that more educational materials, including textbooks, will be made available as eBooks. ◆

Book Document Formats

Format	Description	Compatibility
Doc	This is a common eBook format and works on a wide variety of platforms and with most viewers. *(Note: This is not the same as the .doc files of Microsoft Word.)*	Palm, PPC, EPOC
isilo	Offers higher compression and extended formatting capabilities	Palm
LIT	Format for Microsoft eBook Reader; supports ClearType™ display technology	PPC
MemoPad	Imports directly into Memo Pad; limited to 4K	Palm
MobiPocket	Offers extended formatting capabilities and support of multiple platforms	Palm, PPC, EPOC
PalmReader	Offers extended formatting capabilities	Palm, PPC
Text	Generic ASCII files	Palm, PPC, EPOC
TomeRaider	Offers extended formatting capabilities and support of multiple platforms	Palm, PPC, EPOC

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- Time Warner eBooks—www.twbookmark.com/ebooks
- TealPoint Software—www.tealpoint.com/content.htm
- University of Virginia's Electronic Text Center—http://etext.lib.virginia.edu

Using Handheld Computers in Education: A Sampling of Projects

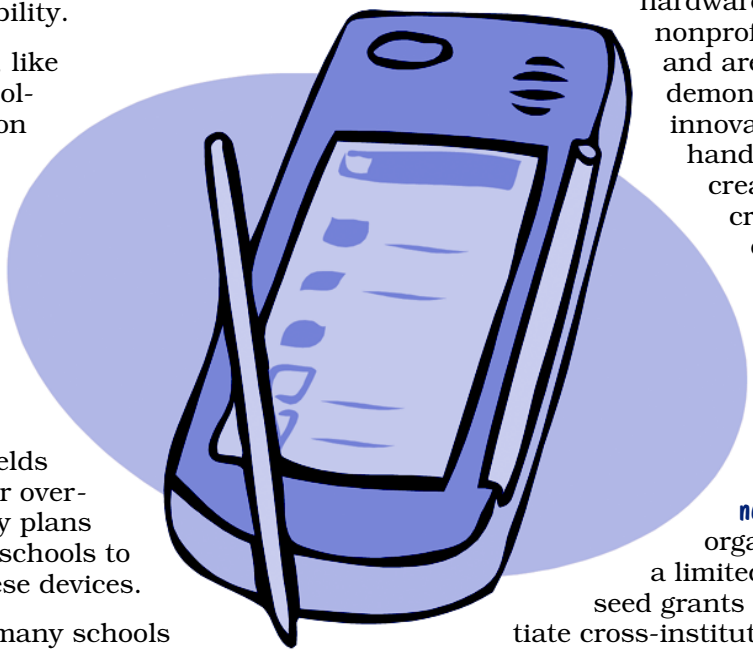
Key Uses	Users	Reference
◆ Gathering data ◆ Beaming ◆ Reference ◆ Word processing ◆ Scheduling ◆ Organization	◆ High school students and teachers	*Consolidated High School District 230 makes use of handhelds.* An overview of a large handheld pilot involving nearly 1,700 students and 65 teachers. www.d230.org/Handheld
◆ Organization ◆ Data gathering ◆ Beaming	◆ High school students and teachers	*Handhelds go to class*—New short film and story. A large school district equipped students and teachers with 2,200 handheld computers in the fall of 2000. According to English, biology, and social studies teachers in the district, use of the handhelds has increased student productivity and efficiency across all disciplines. http://glef.org/orlandpk.html
◆ Communication ◆ Organization	◆ All teachers and administrators	Leeuwenburg, Todd. (January 1999). *Dick Tracy goes digital.* Electronic School. An early, but still applicable, discussion of the professional uses of handhelds for educators. www.electronic-school.com/199901/0199toolsofthetrade.htm
◆ Databases ◆ Spreadsheets ◆ Presentations ◆ eBooks	◆ High school students	*High school students learn workplace skills with Palm handhelds.* A team of students in a school-to-work program use handhelds as an efficient way to manage jobs, equipment, and personnel and to share information and communicate easily. www.palm.com/education/studies/study14.html
◆ Schedules ◆ Student database ◆ Data gathering ◆ Probes ◆ Beaming homework ◆ Other possibilities	◆ High school administrators, students, and bus drivers	Stover, Del. (March 2001). *Hands-on learning.* Electronic School. One company wants to use bar-code scanners to allow bus drivers to record the pickup and delivery of students by scanning their ID cards. Principals use the handhelds as a tool that allows them to check their schedule on the fly, determine if a student in the hallway is supposed to be in class, or jot down a note for later reference. www.electronic-school.com/2001/03/0301f4.html
◆ Probes	◆ Middle and high school students	*Handhelds and probes become keystone of learning environment.* This describes a mobile learning environment that makes it easy to collect and analyze scientific data and to collaborate between classes and schools. www.palm.com/education/studies/study15.html
◆ Organization ◆ Graphing calculators ◆ Note-taking ◆ Reference tools ◆ Internet access	◆ High school special education students	*Independence.* Describes a project to help special education students excel through the use of handheld technology. www.palm.com/education/studies/study3.html
◆ Student database access ◆ Coordinating professional schedules	◆ Administrators	*Pushing barriers.* Providing administrators with instant student information and productivity tools. www.palm.com/education/studies/study4.html
◆ Internet access ◆ Reference tools	◆ Middle and high school students	*E-WIRE.* (January 2001). Electronic School. Highlights several applications of handheld computer usage in a variety of classroom settings. www.electronic-school.com/2001/01/0101ewire.html
◆ eBooks ◆ Organizers ◆ Probes ◆ E-mail assignments ◆ Downloadable worksheets	◆ High school teachers and students	Thomas, Karen. (May 28, 2001). Inexpensive handheld PCs find way into classrooms. *Detroit News Online.* Discusses a high school where all 450 ninth-graders and 30 teachers were issued handheld computers. http://detnews.com/2001/technews/0105/28/a11-228994.htm

Key Uses	Users	Reference
◆ Searchable reference tools ◆ Internet access ◆ Schedules ◆ Assessment ◆ Electronic flashcards	◆ University medical students	Stanford University School of Medicine Palm Project—This project was created to improve the experience of Stanford medical students by making available educational tools that are mobile, comprehensive, and interactive. http://Palm.Stanford.edu
◆ Internet access ◆ Concept mapping	◆ High school students	Trotter, Andrew. (September 26, 2001). Handheld computing: new best tech tool or just a fad? *Education Week*. Descriptions of a variety of pilot projects using handhelds in different subject areas, along with some of the educators' concerns. www.edweek.com/ew/ew_printstory.cfm?slug=04palm.h21
◆ eBooks	◆ All students	Flanigan, Robin L. (March 2001). *Tools of the trade*. Electronic School. Discussion of eBooks with examples from a number of different school pilot studies. www.electronic-school.com/2001/03/0301toolsofthetrade.html
◆ eBooks	◆ High school students	Pickett, Debra. (June 26, 2001). Will handheld devices replace textbooks? *Chicago Sun-Times*. Highlights the use of the goReader in a junior class on American literature. www.suntimes.com/output/tech/conf26.html
◆ Assessment ◆ Grading ◆ Class management	◆ Physical education teachers	Dorman, Steve M. (May 1998). Enhancing school physical education with technology. *The Journal of School Health*, 68(5), 219–220. The use of handheld devices that assist with fitness testing, grading, and class management is increasing. These devices help the physical educator collect and input information in the classroom or in an outdoor setting.
◆ Digital imaging & captioning ◆ Beaming	◆ Elementary students	Vandenabeele, Janet. (July 23, 2001). Science class gets boost: Handheld computers enhance school's enrichment lessons. *Detroit News Online*. Describes a summer program that utilizes handhelds packed with educational software. http://detnews.com/2001/schools/0107/23/c03-252214.htm
◆ Barcode scanners ◆ Radio Frequency Identification (RFID) tags ◆ Beaming ◆ Web access ◆ Reference ◆ Circulation systems ◆ eBooks ◆ Policies	◆ Media specialists	Embrey, Theresa Ross. (March 2002). *Today's PDAs can put OPAC in the Palm of your hand*. This article contains a wealth of current and possible future uses of handheld devices in the media center. www.infotoday.com/cilmag/mar02/embrey.htm
◆ Scheduling ◆ Web access ◆ Reference ◆ Organization	◆ High school teachers and administrators	McCampbell, Bill. (March 2001). Taking a look at pocket digital assistants. *Principal Leadership*, *1*(7), 72–74. Course schedules and assignments put on a class Web page and updated to PDAs using the sync capability. Supplemental reading material can be posted to students' devices. Calculators, conversion charts, checklists, and other class paraphernalia replaced with handhelds.
◆ Organization ◆ Word processing ◆ Scheduling ◆ Beaming ◆ Presentations ◆ Professional collaboration ◆ Assessment ◆ Data gathering ◆ Classroom management ◆ Internet access ◆ E-mail	◆ All teachers	McFadden, A., Price, B.J., & Marsh, G. (September, 2001) *A valuable technology tool for student teachers*. Three University of Alabama educational-technology experts describe how handheld computers can enhance productivity, classroom information management, and instructional support. While it targets student teachers, many of these scenarios apply to any educator. www.glef.org/pdatool.html

Grant Opportunities

Any grant opportunity for educational technology is one that can be tapped for handheld computers. Just remember to address the specific grant requirements by including handheld applications and programs that address specific instructional goals. For example, if you are writing a grant for materials to support science instruction, you might include handhelds, science data probes, curriculum materials, graphing calculator software, and digital cameras. In addition, make sure to emphasize the way that handhelds can address equity and access issues because of their low cost and mobility.

Some grants, like Texas' Technology Integration in Education (TIE) grants, even specifically allow handhelds as an eligible use. Progressive states are starting to make handhelds a part of their overall technology plans and funding schools to purchase these devices.



In addition, many schools are using professional development grants to purchase handheld workshops (some of these include handheld devices in the cost). This is a creative way to fund professional development and the handhelds themselves all in one.

Here are a few grants that are specifically geared toward handhelds:

Palm Education Pioneer Grant Program—This program gives Palm handhelds to K–12 teachers and their students so they can use them in new ways for teaching and learning. This program is administered by SRI International's Center for Technology in Learning. It is limited to hardware grants. While the program does not have a next round of grants scheduled at the time of this writing, check their website at www.palmgrants.sri.com. This website also has many great ideas about how to use handhelds in education.

Handspring Foundation Grants—This foundation offers both cash and product grants to qualifying organizations. The cash grants are made to nonprofit organizations that focus on issues relating to children and youth who are at risk. These grants range from $1,000 to $25,000. The product grants provide hardware to qualified nonprofit organizations and are geared toward demonstrations of an innovative use of handhelds that will creatively address critical community concerns. More information is available at www.handspring.com/company/foundation.

Center for Innovative Learning Technologies—This organization offers a limited number of seed grants each year to initiate cross-institutional collaborations in the area of learning technologies. The themes of the program are Visualization and Modeling, Ubiquitous Computing, Community Tools, and Technology in Learning Assessments. The range of award is $6,000 to $15,000. More information can be found at www.cilt.org/seedgrant/projects.html.

TI-Navigator Collaboration Grants—This program awards grants that allow for the purchase of the TI-Navigator system at a reduced price of $5,500 versus the list price of $9,800. For more information, call the TI-Navigator Collaboration Grants office at 866-846-2844 or e-mail them at ti-navigator@ti.com.

There are some other organizations that offer grants in the general area of educational technology and have funded handheld projects in the past. One such organization is Intel. Check out its website at www.intel.com/education/grants.

Also, make sure to check with your state educational technology office to see what educational technology and professional development grants they have available.

As with any grant application, the following tips are useful to remember when you are writing grants for handheld programs:

- Read the grant request for proposal carefully and tailor your proposal to those requirements.
- Focus on student achievement and the improvements your proposed program will make; make sure to indicate specific and measurable objectives.
- Design a program that can be replicated by other schools and include how you will share information about your experience with others.
- Make sure to include information on how your program will be evaluated.
- Make the budget detailed, reasonable, and representative of the rest of your proposal.
- Make sure you meet all the technical requirements of the proposal.
- If your program doesn't get funded by this grant, try again. Many wonderful programs aren't funded the first time around. ◆

Professional Development and Handheld Technologies

Connected University's Pocket CU—A prototype of an online class utilizing a handheld device as the delivery medium. The content for this class is "Teaching to Standards." http://cu.classroom.com/palm

K12 Handhelds—A variety of both on-site workshops and online courses that start with an introduction to handhelds for beginners and then build to more advanced courses that focus on applications for administrators, teachers, and students. www.k12handhelds.com/dev.php

Palm PETC Program—The Palm Education Training Coordinator (PETC) program is a train-the-trainer program designed to support K–12 in-service and pre-service professional development programs focused on the educational uses of Palm handheld computers. www.palm.com/education/training

Palm PETP Program—Regional workshops conducted by Palm Education Training Providers (PETP). PETPs are Palm Certified Trainers with expertise in the Palm OS and years of personal experience as K–12 educators and administrators. www.palm.com/education/programs/regional

Note: *A few universities, colleges, and private training centers are now offering distance education courses that are designed around handheld delivery methods. For example, Brigham Young University offers a high school course for U.S. History that is taken with Palm OS devices in addition to the traditional computer connected to the Internet.*

Sample Educational Software

Productivity Tools (Teachers and Students)

TITLE	DESCRIPTION	WEBSITE	TYPE	HANDHELD OPERATING SYSTEM	DESKTOP COMPONENT AVAILABLE
ClassPro	Digital organizer specifically designed for students.	*www.developerone.com/pocketpc/classpro*	Commercial product	Windows CE	Win
Documents to Go (Dataviz)	Allows users to transfer Word, Excel, and PowerPoint to the handheld, view and edit files, then transfer back to the desktop computer.	*www.dataviz.com/products/documentstogo/index.html*	Commercial product Free demo	Palm™	Mac/Win
ePrincipal Mobile (Media-X)	School analysis of grades, learning skills, attendance, at-risk students, and standardized tests.	*www.media-x.com/products/eprincipal/mobile.php*	Commercial product Free demo	Palm	Mac/Win
eStandards (Media-X)	Curriculum standards databases (currently available for California, Texas, Florida, Wisconsin, Kansas, and Ontario; other states and districts under development); also allows the creation of your own database of standards for browsing and tracking.	*www.media-x.com/products/estandards/index.php*	Commercial product Free demo	Palm	Mac/Win
eTeacher Mobile (Media-X)	Standards-based planning, assessment, and reporting for teachers, including rubric-centered assessment. (Note: Requires desktop program to create student lists, standards lists, activities, rubrics, learning skills, etc.)	*www.media-x.com/products/eteacher/mobile.php*	Commercial product Free demo	Palm	Mac/Win
Go 'n Tell (Hi-Ce)	Allows you to create a virtual scrapbook with pictures and text that can later be converted into a website.	*www.handheld.hice-dev.org/download.htm*	Free product	Palm	Mac/Win
HandBase Plus (DDH Software, Inc.)	An information management tool (database) that can be used for homework assignments, student attendance, project management, and student assessment.	*www.ddhsoftware.com/software.html?view=handbase*	Commercial product Free demo	Palm/ Windows CE	Mac/Win
HandySheets (Hi-Ce)	Create customized worksheets, download them to students, and then collect them for grading.	*www.handheld.hice-dev.org/download.htm*	Free product	Palm	Mac/Win
Learner Profile To Go (Sunburst)	Handheld extension to Learner Profile on the desktop; lets teachers assess classroom learning, evaluate student portfolios, and collect anecdotal records. (Awaiting release.)	*www.sunburst.com*	Commercial product	Palm	Mac/Win
Making the Grade (Grade-busters)	Gradebook and attendance tool.	*www.gradebusters.com*	Commercial product Free demo	Palm/ Windows CE	Mac/Win
PiCoMap (Hi-Ce)	Concept mapping tool.	*www.handheld.hice-dev.org/download.htm*	Free product	Palm	Mac/Win

Quizzler Pro	Makes and delivers quizzes.	*www.quizzlerpro.com*	Commercial product Free demo	Palm/ Windows CE	Mac/Win
Student Teacher (Scholarus Wireless)	A wireless resource for student teachers; contains lesson plans, tips, rules and regulations, and other educational resources.	*www.pocketgear.com/software_detail.asp?id=1342*	Commercial product	Windows CE	N/A
Teacher's P.E.T. (Coffee Pot Software)	Manages grading, attendance, and contact information for up to ten classes.	*www.coffeepotsoftware.com*	Commercial product Free demo	Palm	Mac/Win
TeachFile (EddieSoft)	Provides classroom management, tracking assignments, attendance, and general status information.	*www.eddiesoft.com*	Shareware	Palm	Win
ThoughtManager for Teachers (HandsHigh Software)	Organizes ideas, projects, agendas, notes, task lists, speeches, class outlines, and more.	*www.handshigh.com/html/tmteachers.html*	Commercial product Free demo	Palm	Win
Tracker (True Image Management Systems)	Provides access to student information system, such as student schedule and emergency contact information.	*www.schoolid.com*	Commercial product	Palm	Mac/Win
Classroom Wizard (Scantron)	Handheld quiz-to-desktop grading and data assessment.	*www.classroomwizard.com*	Commercial product Online demo	Palm	Win
WordSmith (Blue Nomad Software)	A full-featured word processor, document viewer, and enhanced memo pad.	*www.bluenomad.com*	Commercial product Free demo	Palm	Mac/Win
FreeWrite (Hi-Ce)	A word processor, featuring a 109,000-word spellchecker.	*www.handheld.hice-dev.org/download.htm*	Free product	Palm	N/A

Communication and Collaboration Applications

TITLE	DESCRIPTION	WEBSITE	TYPE	HANDHELD OPERATING SYSTEM	DESKTOP COMPONENT AVAILABLE
AvantGo Mobile Internet Service	Provides access to personalized Web-based content; includes news, maps, stock updates, educational information, and more.	*www.avantgo.com*	Free product and online service	Palm/ Windows CE	Mac/Win
Blazer (Handspring, Inc.)	Web browser.	*www.handspring.com/software/hs_software.jhtml*	Commercial product	Palm	N/A
eHomeRoom.com	Collects, aggregates, and tracks school activities in one integrated calendar for administrators, teachers, parents, and students.	*www.ehomeroom.com*	Commercial product Free demo	Palm	Win

Communication and Collaboration Applications (continued)

TITLE	DESCRIPTION	WEBSITE	TYPE	HANDHELD OPERATING SYSTEM	DESKTOP COMPONENT AVAILABLE
Eudora Internet Suite (Eudora)	E-mail and browser bundle.	*www.eudora.com/internetsuite/eudora4palm.html*	Free product	Palm	Mac/Win/Linux/Unix
Fling It (Hi-Ce)	Takes any Web page from desktop computer and sends it to your handheld to be viewed offline.	*www.handheld.hice-dev.org/download.htm*	Free product	Palm	Mac/Win
Scholastic Wireless	Provides educational content for students and planning tools for teachers.	*http://teacher.scholastic.com/wireless/index.htm*	Free online service	Palm/Windows CE	N/A

Reference

TITLE	DESCRIPTION	WEBSITE	TYPE	HANDHELD OPERATING SYSTEM	DESKTOP COMPONENT AVAILABLE
Alex Electronic Texts (Infomotions, Inc.)	Online collection of digital documents.	*www.infomotions.com/alex*	Free online resources	Palm	N/A
Atlas CE	Comprehensive almanac with statistics, flags, population, languages, etc.	*http://pocketgear.com*	Commercial product Free demo	Windows CE	Win
Franklin Reader (Franklin)	eBook reader with search capabilities.	*www.franklin.com/estore/download/fepreader.asp*	Free product	Palm	Win
Merriam-Webster® Dictionary (Franklin)	Dictionary that includes over 100,000 words and 300,000 definitions.	*www.franklin.com*	Commercial product	Palm	Win
NoahLite (ArsLexis)	Dictionary containing definitions of 122,000 words.	*www.arslexis.com*	Free product	Palm	Win
Palm Reader (Palm)	Electronic book reader. Pages may be bookmarked/annotated.	*www.peanutpress.com*	Free product	Palm/Windows CE	Win
RoadLingua	Shell program for a large variety of multilingual and specialty dictionaries.	*http://ppc.absoluteword.com*	Shareware	Palm/Windows CE	Mac/Win
Thesaurus/SpellCheck (DDH Software, Inc.)	Thesaurus contains 50,000 entries cross-referenced and indexed for speed.	*www.ddhsoftware.com/software.html?view=thesaurus*	Commercial product Free demo	Palm	Mac/Win
TrueTerm English/Spanish 2.6 (AlphaSoft)	A travel dictionary consisting of basic and supplementary vocabulary.	*www.pocketgear.com/software_detail.asp?id=898*	Free product	Windows CE	Win

Instructional/Curriculum

TITLE	DESCRIPTION	WEBSITE	TYPE	HANDHELD OPERATING SYSTEM	DESKTOP COMPONENT AVAILABLE
BugBand (MiniMusic)	Practice sight reading for piano or guitar and learn the letter names of notes.	*www.minimusic.com*	Commercial product Free demo	Palm	N/A
Cooties (Hi-Ce)	A virus-transfer simulation program.	*www.handheld.hice-dev.org/download.htm*	Free product	Palm	Mac/Win
Expedition ES (EddieSoft)	Surveying tool providing altitude, azimuth and distance measurements, and calculations.	*www.eddiesoft.com*	Shareware	Palm	N/A
Geney (Simon Fraser University EDGE Lab)	A collaborative problem-solving application to explore genetics.	*www.geney.net*	Free product	Palm	Mac/Win
ImagiMath (Imagiworks)	Includes ImagiGraph, a mathematics visualizer, ImagiCalc, a full-featured calculator, and ImagiSolve, a mathematical worksheet and equation solver.	*www.imagiworks.com*	Commercial product Free demo	Palm	Mac/Win
ImagiProbe (ImagiWorks)	Enables students to collect and analyze scientific data through data probes; includes software and Sensor Interface. (Sensors must be purchased separately.)	*www.imagiworks.com*	Commercial product	Palm	Mac/Win
Notepad (MiniMusic)	A music writer/editor/player.	*www.minimusic.com*	Commercial product Free demo	Palm	Mac/Win
PocketGraph	Displays data charts from PocketExcel or PocketWord.	*http://microsoft.handango.com/PlatformProductDetail.jsp?siteId=75&platformId=2&productType=2&productId=16135&sectionId=0&catalog=30*	Commercial product	Windows CE	Win
PowerOne Graph (Infinity Softworks)	Turns a handheld into a graphing calculator with 230 built-in math, science, and graphing functions.	*www.infinitysw.com/Products/powerOne_Graph.html*	Commercial product Free demo	Palm	Mac/Win
Word Wizard	Practice spelling, parts of speech, and vocabulary skills.	*www.pocketgear.com/software_detail.asp?id=2307*	Commercial product Free demo	Windows CE	Win

Handheld Resources

Hardware Manufacturers

Palm OS

- **Palm**
  www.palm.com
- **Handspring**
  www.handspring.com
- **Sony Clie**
  www.sonystyle.com/vaio/clie/index.shtml
- **Symbol**
  www.symbol.com/products/mobile_computers/mobile_computers.html

Windows CE/Pocket PC

- **Compaq—iPAQ Pocket PCs**
  www.compaq.com/products/handhelds/pocketpc/index.html
- **Casio**
  www.casio.com/personalpcs/section.cfm?section=19
- **Hewlett Packard**
  Jornada www.hp.com/jornada
- **Symbol**
  www.symbol.com/products/mobile_computers/mobile_computers.html

Software Resources

- **C|NET Downloads**—Shareware, freeware, and demo software for Palm and Windows CE/Pocket PC
  http://download.cnet.com/downloads/0-1726360.html?tag=stbc.gp
- **EuroCool**—Shareware, freeware, and demo software for Palm
  www.eurocool.com
- **Handango**—Shareware, freeware, demos, and commercial software for Palm and Windows CE/Pocket PC
  www.handango.com
- **Hi-Ce Learning in the Palm of Your Hand**—Free educational software for Palm
  www.handheld.hice-dev.org/download.htm
- **Palm Boulevard**—Shareware, freeware, and demo software for Palm
  http://palmblvd.com
- **Palm Education**—Educational software downloads and reviews for Palm
  www.palm.com/education
- **Palmgear**—Shareware, freeware, demos, and commercial software for Palm
  www.palmgear.com
- **PalmSpot**—Freeware, shareware, and commercial applications for Palm. Also sells hardware add-ons
  www.palmspot.com
- **Peanutpress**—Electronic books for Palm and Windows CE/Pocket PC
  www.peanutpress.com
- **Tucows**—Shareware, freeware, and demo software for Palm and Windows CE/Pocket PC
  www.tucows.com

Educational Hardware/ Software Resellers

The following companies accept educational purchase orders and offer academic pricing:

- **Educational Resources** *www.educationalresources.com*
- **K12 Handhelds** *www.k12handhelds.com*
- **MicroWarehouse** *www.microwarehouse.com*
- **Software Express** *www.swexpress.com*

Journals/Newsletters

- **Curriculum Administrators: Education in Hand**—A supplement to Curriculum Administrator, case studies in handheld educational uses *www.ca-magazine.com/SpecialReports/eih.asp*
- **Handheld Computing**—Printed monthly magazine for Palm devices *www.hhcmag.com*
- **InSync Online**—Palm, Inc.'s monthly electronic newsletter *www.insync-palm.com*
- **Mobile Computing**—Printed monthly magazine covering portable computers and handheld devices *www.mobilecomputing.com*
- **Palm Power Magazine**—An online magazine for Palm *www.palmpower.com*
- **Pocket PC**—Printed monthly magazine for Pocket PC devices *www.pocketpcmag.com*

News, Reviews, and Support

- **NearlyMobile**—Information dedicated to the new Palm user who is not technology savvy *www.nearlymobile.com*
- **Palm Infocenter.com**—The latest Palm OS industry news *www.palminfocenter.com*
- **Palm Knowledge Finder**—Online database of Palm tips and tricks, help, etc. *www.palm.com/support/kb/link_to_kb.html*
- **Palmtops/PDAs**—News, reviews, FAQs, and software links *http://palmtops.about.com*
- **PDA Constituent Group**—Discussion of issues and challenges concerning use of PDAs in higher education *www.educause.edu/memdir/cg/pda.html*
- **PDA Geek**—News, reviews, tips, and tricks *www.geek.com/pdageek/pdamain.htm*
- **PDABuzz**—News, reviews, forums, and other resources *www.PDABuzz.com*
- **PDAStreet**—The PDA Network of free downloads, reviews, news, and message boards for all the major handhelds *http://pdastreet.com*
- **pdaED.com**—News and reviews about handhelds in general. Bulletin boards specifically devoted to handhelds in education *www.pdaed.com*
- **Slashdot**—PDA news for nerds *http://slashdot.org/search.pl?topic=100*
- **ZDNet Shopper**—Comparison pricing for handhelds *http://zdnetshopper.cnet.com/shopping/0-11013-1401-0-0.html?tag=dir*

SEIR•TEC

Glossary of Terms Used with Handheld Technologies

802.11b—See Wi-Fi

Archive Files—copies of deleted or purged handheld data that exist on the desktop computer and can be used to restore some deleted or purged data.

Beam—describes the use of infrared to transfer data from one handheld to another. With appropriate software, beaming can also be used to send a document from the handheld to an infrared-capable printer.

Bluetooth™—a wireless technology with a range of approximately 30-meter radius; works well for hard cable replacement.

Cradle—the stand that a handheld computer sits in to sync to a desktop computer. Used with some models as a battery charger.

eBook—an electronically formatted book, designed to be read from a computer, which may be a desktop computer, a handheld computer, or a specialized electronic book reading device.

Expansion Modules—items that are added on to a handheld device; these can be memory cards with software, such as large dictionaries or eBooks, or hardware items, such as digital cameras, GPSs, MP3 players, or science data probes.

GPS or Global Positioning System—a device that uses a network of satellites to determine precise positioning data; GPSs are used for navigation, mapping, surveying, and other applications where precise positioning information is needed.

Graffiti®—handwriting recognition software program that is the primary means of data input for the Palm OS.

Handheld Computer or Handheld—small computerized devices that fit into the palm of the hand and are designed for mobile computing.

MMC or Multimedia Card—a type of expansion card supported by the latest Palm handheld devices; these cards are very small, about the size of a postage stamp; see also "Secure Digital."

MP3—a format to facilitate the storage, management, promotion, and delivery of digital music.

OS or Operating System—software that is designed to manage hardware devices in order to enable applications and users to access it easily; examples of operating systems used for handheld computers include Windows CE® and the Palm OS®.

Palm Desktop®—software that runs on a desktop computer and can be used to enter, edit, or view data from a Palm OS handheld; data is updated and exchanged between the desktop and the handheld through the HotSync process.

Palm OS®—the operating system developed by Palm, Inc. for handheld devices; handheld devices produced by Palm, Handspring, IBM, Sony, and others use this operating system.

PAN—Personal Area Network.

PDA or Personal Digital Assistant—a specific type of handheld device that serves the purpose of organizing personal information; these may include calendars, address books, notepads, calculators, and other useful tools.

PDB—a common Palm OS file extension that represents data or a database.

PIM or Personal Information Manager—a specific type of handheld device that serves the purpose of organizing personal information; these may include calendars, address books, notepads, calculators, and other useful tools.

Pocket PC—a generic term for a handheld computer running the Windows CE operating system; see "Windows CE" for more information.

PRC—a common Palm OS file extension that represents an application.

SD or Secure Digital—a type of expansion card supported by the latest Palm handheld devices; these cards use Flash technology and are writeable.

Springboard® Module—an expansion module that extends the functionality of a Handspring Visor handheld device; examples of Springboard modules include digital cameras, GPSs, and MP3 players.

Sync—short for synchronize.

Synchronization—The process by which the desktop computer and the handheld exchange and update information.

Ubiquitous Computing—computing that is omnipresent and is, or appears to be, everywhere all the time; may involve many different computing devices that are embedded in various devices or appliances and operate in the background.

USB or Universal Serial Bus—a type of connection to a desktop computer, which can be used to HotSync data; generally much faster than a standard serial connection.

Web Clipping—used to describe the editing or "clipping" of parts of Web pages to make them more readable on a handheld device. Companies such as AvantGo provide this service.

Wi-Fi (also known as 802.11b)—a wireless technology with a range of approximately 150–300 meters in radius and supports up to 11 megabit data rates, which makes it appropriate for wireless Internet access; this is the technology used by Apple AirPorts and Xircom's Wireless Ethernet modules.

Windows CE® OS—the operating system developed by the Microsoft Corporation for embedded systems and handheld devices; handheld devices produced by Compaq, Hewlett Packard, and others use this operating system.

Wireless—generally used to describe a device having intranet or Internet connectivity without wires; this can be achieved through wireless modem technology similar to a cellular phone or through wireless Ethernet cards using 802.11b technology.

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SREB