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## **Handheld Computers: No Child Left Behind's (NCLB's) Digital Divide Equalizers?**

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### **Abstract**

The No Child Left Behind (NCLB) Act of 2001 allows innovative uses of technology to eliminate the limiting traditional product-oriented curriculum. The technology goals relating to NCLB legislation recommend that teachers provide equitable learning opportunities that optimize learning and prepare students to perform efficiently and effectively on standardized tests. Handheld computers can be very useful classroom management tools for providing technological equity and bridging the digital divide. As part of an Ohio Board of Regents Technology initiative, university teacher educators were trained in the use of handheld computers. The participants discussed and/or demonstrated how the Palm computer software, the Vernier LabPro equipment, the cameras, portable keyboards can be used with their preservice teachers to bridge the digital divide.

### **Introduction**

The No Child Left Behind (NCLB) Act of 2001 mandates choosing instructional materials based on "best practices" research and the U. S. Department of Education has set up a What Works Clearinghouse for information on resources that get results (Education at PalmOne, n.d.). This emphasis on accountability in educational institutions, from the prekindergarten through postsecondary levels, require instant access to the latest research findings, state standards, and online resources so that learning is optimized and students perform efficiently and effectively on standardized tests. Ideally, no child is to be left behind and schools in need of improvement must spend at least 10 percent of their Title 1 – Improving the Academic Achievement of the Disadvantaged – funds to assist teachers in achieving this goal (U.S. Department of Education, n.d.).

The NCLB Act makes it possible for school districts to transfer up to 50 percent of the federal formula-grant funds they receive under different parts of the law: Title II –Improving Teacher Quality and Educational Technology, and Title V – Innovative Programs. The technology goals relating to NCLB legislation recommend that teachers help students learn to show initiative, demonstrate cooperation, and evaluate themselves and others (Education at PalmOne, n.d.). These educators must learn to use the latest computer technology, train their students to obtain and use information technologies, communicate effectively, reason sensibly, plan, solve problems, and engage in self reflection (Heinich, Molenda, Russell, & Smaldino, 2002; Lever-Duffy, McDonald, & Mizell, 2003; Melloni, 2002; Norton & Sprague, 2001; Thorsen, 2006).

Information and computer technology can offer educators the opportunity to introduce students to new learning experiences. Innovative use of technology can eliminate the limiting assumptions of the traditional product-oriented curriculum and push curricular goals beyond their current boundaries (Heinich et al., 2002; Lever-Duffy et al., 2003; Melloni, 2002; Norton & Sprague, 2001; Thorsen, 2006). By providing instruction and meaningful practice, educators can use information and computer technologies to expand the curriculum in new directions for their students. As a result of limited school funds and

scarce resources not all students have access to the latest educational resources and computer and information technologies. NCLB provides an unprecedented amount of flexibility for states to tailor and use their funds to focus on student achievement and what works to improve teaching and learning in order to close equity disparities.

### **Equity and Access to Technology**

Equity is an essential issue for schools planning to implement instructional technology. Access to information and computer technology and opportunity to learn to use it appropriately are key factors for students' economic success both now and in the future (Costello & Stone, 2001; McBride-Stetson, 2004). Unfortunately, socioeconomic differences have the potential to create serious gaps when it comes to technology use. While students from wealthier households are likely to have access to a computer and high tech media such as broadband or digital subscriber line (DSL) cable, cellular telephones, handheld computers such as Blackberry, Palm, and Pocket Personal Computers (PCs), and digital still and video cameras at home, this is not true of students from poorer households (Forcier & Descy, 2002). Schools have a responsibility to help remedy this problem by providing access to high tech media to all students.

The situation in U. S. schools mirrors that of society as a whole. Poorer school districts and those with a higher percentage of minority students have fewer computers per capita and are less likely to have Internet connections than wealthier districts. According to Newby, Stepich, Lehman, and Russell (2000), the ratio of students to computers continues to improve, and efforts to bring the Internet to every school in the United States are well underway. Of course, this is a problem that schools cannot solve alone. Government, communities, and businesses must help schools provide needed access to information and computer technology. However, access is only one facet of the issue; concern about gender equity is another.

### **Equity within Schools**

Gender research indicates that in the elementary and middle-level grades boys and girls are equally computer literate and tend to use the computer, video games, high tech handheld computers such as Blackberry, Palm Pilots and Pocket PCs equally (Costello & Stone, 2001; MacDonald, 2004; McBride-Stetson, 2004). Girls and boys appear to be equally enthusiastic when it comes to using the computer. However, as they move into high school, gender differences and unfair stereotypes begin to emerge. Although girls continue to refine word processing skills and other clerical skills, boys overwhelmingly populate the computer science and programming classes (MacDonald, 2004; Parkins, 2004).

Less affluent and less able students are likely to experience computers as a tool for remediation and drill and practice over basic skills. More affluent and capable students are likely to use computers in creative and complex ways. The role of the teacher is critical to the success of all students. Teachers must believe that all students can benefit from assignments that allow them to use computer applications and media that will lead to greater cognitive development and learning. Bull and Bull (2003) conducted an analysis of various software types and noted that computer gaming and software companies tend to market and emphasize male-dominated activities as games that often include violence and competition as motivation. These software characteristics tend to attract males. Therefore, careful student software selection is essential for addressing gender in the classroom.

School personnel and teachers need to guard against other biases in access to technology. In some schools, available computers are monopolized by a few users that may result from preferential laboratory scheduling for certain classes, historical patterns of use, or other reasons (Forcier & Descy, 2002). To some extent, this is natural; but, educators should make an effort to encourage numerous users. Teachers may unconsciously alienate students by allowing access to a classroom computer as a reward for students getting their work done early. This can create a pattern in which the rapid work completers are rewarded repeatedly and other students are excluded.

## **Limited Access**

Student access to technology is dependent on the financial capabilities of their school or school district. Although student-to-computer ratios are steadily improving, many low socioeconomic schools have limited access to computers and the Internet.

The Universal Service Fund for Schools and Libraries, known as the “E-Rate”, was created in 1996 to provide discounted telecommunication services and equipment to public and private schools and libraries. The E-Rate program has connected more than 98 percent of all schools in the United States to the Internet (Bull & Bull, 2004; Sherriff, 2004). Although Congress and state governments took steps to increase access through the E-Rate and other technology grant initiatives, the gap is still significant. A new type of poverty has emerged.

## **The Digital Divide**

According to the National Telecommunications and Information Administration’s (2004) report, *Falling through the Net: Defining the Digital Divide*, the digital divide is defined as “the disparities in access to telephones, personal computers (PCs), and the Internet across certain demographic groups” (p. 1). Lloyd Morrisett coined the term digital divide to mean “a discrepancy in access to technology resources between socioeconomic groups” (Roblyer, 2003, p. 191). People excluded or segregated from access to information technology are also excluded from many other social goods. Thorsen (2006) defines the digital divide as “a popular term for the cultural barrier that of people who do not have access to technology and the Internet or the ability to use them effectively if they are available” (p.11). This includes not just access to technology, but also access to computer skills training, information technology, various economic opportunities, and the ability to fully participate in culture and democracy (Roblyer, 2003; Thorsen, 2006).

Educators are concerned that this digital divide will create a form of technological and information eliticism. In a technologically oriented economy, people with more computer experience will obtain higher salaries while those with little or no computer experience will be disadvantaged (McDonald & Denning, 2004; Thorsen, 2006). The U.S. Department of Commerce documents the digital divide and reports a 25 to 30 percent increase in the gap since 1994 (U.S. Department of Commerce, 2004). Educators have a responsibility to ensure that all students have sufficient access to computers and the Internet, regardless of geography, education, gender, ethnicity, socioeconomic background, and disability (Costello & Stone, 2001; Landrigan, 2005; McBride-Stetson, 2004; Thorsen, 2006).

Although the U.S. Department of Commerce (2004) documents slight increases in minority access to technology, people with disabilities are only half as likely to have Internet access. Access to technology is more about the effective use and careful integration of technology into the curriculum than simply providing access or the acquisition of hardware and software.

## **Ensuring Access to Technology**

How can adequate and equal access to technology be assured in our classrooms? Ongoing professional development allows and support teachers’ efforts to transform their practice and become computer literate. Teachers, school services personnel and teacher educators must be trained in computer technology use and strive to arrange equitable access and facilitate students’ use of technology. As teachers transform their teaching practices, they can focus on their students’ individual needs, including their cultural identities and insure that all students become a part of the classroom (Costello & Stone, 2001; McBride-Stetson, 2004).

Teachers face multiple challenges in technology-based education. First, they must strive to provide equal access and experiences to computer technology for all students, regardless of age, gender, ethnicity, socioeconomic background, and disability (Forcier & Descy, 2002; Roblyer, 2003). The handheld

computer is an inexpensive way to engage students in developing technology skills and shortening the digital divide between the haves and have-nots. Teachers should plan the use of the handheld computer as they would any other media, with a clear set of objectives, appropriate preparation and integration into the curricular unit and evaluation method (Forcier & Descy, 2002; Roblyer, 2003).

Next, they must promote computer ethics in their classrooms by setting an example of ethical computer use and by using techniques such as role playing and simulations to examine and clarify ethical questions. If educators fail to expose students to the latest technology, a grave disservice has been wrought (Bitter & Pierson, 2002; Forcier & Descy, 2002; Murray, 2004; Roblyer, 2003, Thorsen, 2006). Computer proponents argue that information and computer technologies have the potential to enhance economic opportunity and equity. The size, portability, cost and versatility of the handheld computer makes it an effective tool for bridging the digital divide.

### **Handheld Computers**

Personal digital assistants (PDA), pocket or Palm handheld computers (PHHC), are portable computing devices that recognize handwritten notes and translates them into word-processed documents through the use of handwriting recognition software. These written-to-word-processed documents are then transferred to a desktop computer for storage or further use.

Information may also be entered into the handheld computer using the on screen keyboard, a portable keyboard, or beamed (transferred) using the infrared port. Handheld computers are actually palm size computers that offer simplified office management tools, such as an appointment book, a calendar, and a phone book (Roland, 2003; Weiss, 2003). As these devices continue to evolve, their size and weight continue to decrease while their capabilities increase. Through third party handheld computer vendors, many PHHCs include scaled down versions of familiar computer software such as word processor or electronic spreadsheet.

Handheld computers can be useful classroom management tools because they allow the teacher to make notes on lessons and activities, record and student behavior, and track appointments. The data can be stored for later use and the information can be easily transferred into computerized grade books, lesson plans, and student files. Educators and administrators need ongoing access to information and having it available on a handheld tends to result in more effective instruction and classroom organizational management (Fleischman, 2002).

For teachers and students alike, Palm handheld computing can make note taking, using educational software, or using the Internet as easy and convenient as taking out a pen and pad. Using a handheld computer with wireless access means educators and students can have answers anytime. As this technology evolves, Palm handheld computers will become more powerful. Digital cameras, audio and video players, and even cell phones are integrated into handhelds (Brown & Brown, 2002). As prices decline, their accessibility will increase.

A number of studies over the past five years have focused on the advantages of the hand held computers and their impact on student learning (Crippen & Brooks, 2002). Similar student gains were found in studies of Palm handheld computer use among elementary and secondary students throughout our nation (Crippen & Brooks, 2002; Education at PalmOne, n.d; Roland, 2003).

### **Public School Using the Palm Handheld Computer**

Yankton High School in South Dakota conducted a study that showed handheld computers could improve students' grades (Education at PalmOne, n.d.). Wanting to explore the benefits of one-to-one computing, the district provided Palm handhelds and keyboards to 75 randomly selected students and four teachers. Students signed up, as a group, for four classes: physical science, algebra, English/Speech, and Spanish 1. Teachers developed inquiry-based interdisciplinary units that infused the Palm handheld computer use.

Students began using the handhelds as organizers and quickly moved onto writing, graphing mathematical formulas, taking quizzes, mapping concepts, creating animations, and much more. Teachers and students discovered an array of software, including Documents to Go from Data Viz; GoKnow's Freewrite, Sketchy, PicoMap, and PAAM classroom synchronization manager. They experimented with Palm system software and equipment such as PowerOne Graph from Infinity Softworks; ImagiGraph, ImagiMath, and ImagiProbe from ImagiWorks; Vernier LabPro; Quizzler from Pocket Mobility; Thought Manager by Hands High Software and MathCard from Checkmate Software. The teachers used Margi's Presenter-to-Go for projecting PowerPoint presentations, and Discourse from ETS for getting instant feedback on student answers (Education at PalmOne, n.d.).

Surveys showed that students using the handhelds felt more comfortable trying new technology and were better prepared for classes. They had higher rates of attendance and showed more positive attitudes about completing and turning in work. A science and math teacher noted that the students learned the software programs quickly and developed patience and problem solving skills. In addition, the GPA of the students using handhelds was 3.08 – higher than the 2.79 GPA for students not using handhelds (Education at PalmOne, n.d.).

In recent years, researchers in Ohio conducted regional conferences and workshops in which pre-kindergarten through postsecondary level educators learned to use Palm handheld computers (PHHC). Teachers, especially teacher educators, must be comfortable with their own computer skills before they can effectively model handheld computer use with their students.

Will educators on a university campus embrace Palm handheld computers' use and demonstrate the features and resources to their pre-service teachers? Can the handheld computer be used as a tool to bridge the digital divide? With these foci in mind, a statewide initiative was launched to teach teacher educators to use Palm handheld computers.

### **Ohio Handheld Computer Initiative**

Over a three year period, eighty-five faculty and staff from universities in southwest Ohio participated in Palm handheld computer (PHHC) training. The five rounds of PHHC workshops were part of a statewide Ohio Board of Regents (OBR) Technology initiative in which higher education staff and faculty members were taught to use the devices. The PHHC training consultant was interested in training the teacher educators to use the PHHC and in investigating:

1. To what extent will the participants benefit from Palm handheld computer training? More specifically, will they learn to use the handheld computers?
2. What are some of the creative ways they will use the Palm handheld computers?
3. Can handheld computers be used as tools to bridge the digital divide?
4. Did the participants view them as an equitable tool to bridge the digital divide?

The following sections describe the study's participants and materials, method of data collection and learning to use the PHHC. Implications, troubleshooting, future directions for the Palm handheld computer's use, and bridging the digital divide are also discussed.

### **Participants and Materials**

An invitation was extended to faculty and staff from the training consultant's home institution and five neighboring universities to participate in the OBR Palm handheld computer study. Over a three year period, eighty five university teacher educators participated in a study in which they were taught to use the Palm handheld computer. The participants completed surveys that gauged their computer literacy skills and PHHC knowledge and Memo of Understanding forms in which they agreed to complete all paperwork and attend three 3-hour workshop sessions which culminated in the creation and demonstration of a PHHC project.

The PHHC workshop sessions were held every two weeks with the first, third and fifth round of participants being trained over three summer terms from 2003 until 2005. The second round was held during the fall quarter 2003 while the fourth was held during winter quarter 2005. There were 20 workshop participants in the first round of training, 20 in the second, 17 in the third, 7 in the fourth and 21 in the fifth. All participants provided information about their backgrounds and their history with the project:

- Approximately 40% were in the first training cohort, 20% in the second, and 20% in the third while 20% did not identify their cohort;
- Sixty-eight percent were faculty members and 32% were administrators;
- Almost 90% were from state universities, almost 10% from private colleges or universities;
- Approximately two-thirds were affiliated with the college or department of education at their campuses and one-third was affiliated with other areas.

### Data Collection

A qualitative approach was used in which data were collected and triangulated through multiple measures that included the PHHC surveys, the PHHC training consultant's observations of and discussions with the participants, and the video recordings of each workshop session. Although all participants completed surveys, 12 were selected for interviews based on their performance during the training period and follow-up interactions between trainer and participants. The video recording of each of the third workshop sessions showcased the participants demonstrating how they will use the Palm computer.

The two graduate assistants used a modified version of an interview instrument that was developed by Wexford Incorporated. The interviewers were selected based on their overall capabilities for organizing and conducting interviews, and for their background in instructional technologies. They interviewed the participants over a three month period for approximately 30 to 45 minutes in person or by phone.

Open-ended responses were sorted into two groups utilizing the participants perceived level of technology use. Respondents were coded as "Advanced Technology Users" and "Basic Technology Users" based on a triangulation of their participant responses to survey question 5 (Before you participated in the PHHC Project, how would you rate your use of computers and peripheral devices?) and to open-ended survey questions related to training and implementation. Figure 1 lists the percentages of participants' technology use before participating in the study.

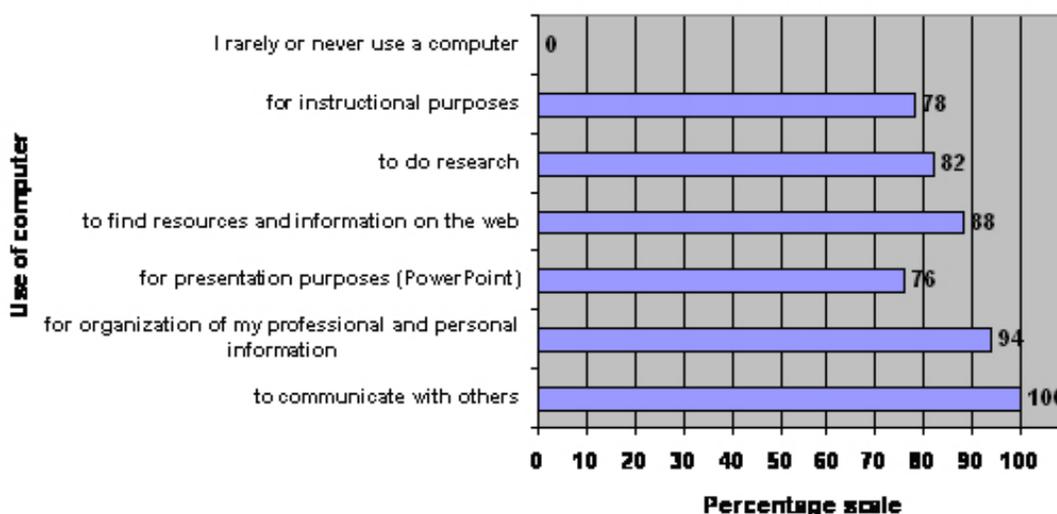


Figure 1: Percentage of Participants' Technology Use prior to the PHHC Study (N = 85)

## **Data Analysis**

### *Advanced Technology Users*

Participants with the following characteristics were considered to be Advanced Technology Users (ATUs):

Use of technology for personal and professional use --

- Participants use of a variety of technology tools (computers, PHHCs, probes, digital cameras and video) and reported using a variety of specific software for personal use, classroom management, data management, etc.

Use of technology for instructional purposes --

- Participants use a variety of technology tools for instruction and project-based learning.
- Participants use technology beyond the simple use of PowerPoint/LCD projectors for lesson presentation.
- Participants require students to use technology to learn content or skills and develop multi-media products/projects.

Technology Background/Experience --

- Participants had an extensive technology background due to their educational background in computer science or educational technology.
- Participants had experience instructing teachers on how to use technology in the classroom or had experience coordinating technology grants or programs.

### *Basic Technology Users*

Participants with the following characteristics were considered to be Basic Technology Users (BTUs):

Use of technology for personal and professional use --

- Participants use technology was limited to word processing, simple spreadsheets, use of PHHCs for personal organization (calendar, to-do lists), basic Internet searches, and discussion boards on WebCT.

Use of technology for instructional purposes --

- Participants use computers, overhead and LCD projectors for PowerPoint presentations in class.

## **Survey Findings**

The following section provides survey information from the participant-respondents about their experiences and benefits from the Project.

*Question 1: Have you participated in other technology or PHHC training?*

*Advanced Technology Users.* Twenty-eight of 37 respondents stated they have received other technology or PHHC training. Other technology training included:

- Software applications - Dreamweaver, Inspiration, PowerPoint
- Online course management software – WebCT
- Other internet training – software and website development
- Workshops/Training on how to use technology for instruction

Five respondents had extensive technology backgrounds due to the nature of their educational background or their work experience. Three respondents stated they had not participated in other technology or PHHC training.

*Basic Technology Users.* Thirty-two had participated in other technology training, including use of software applications (EXCEL, PowerPoint); online course management software (WebCT), web-based tools (TaskStream), and other digital media devices (digital cameras, scanners). About one-third had not had any previous PHHC or other technology training.

*Question A3: Who conducted it or provided it?*

*Advanced Technology Users.* Most participants were provided training through:

- Technology Vendors: Apple or IBM
- National Professional Organizations
- Computer Technology Conferences
- University or community college sponsored training through WebCT or face-to-face workshops

Others received training through programs at their specific universities:

- Wright State University's Center for Teaching & Learning
- Cedarville College
- University of Dayton
- Miami University
- Walsh University

*Question A5G: Before you participated in the PHHC Project, how would you rate your use of computers and peripheral devices?*

Both Advanced and Basic Technology Users reported using computers and peripheral devices (before the PHHC project) for instruction and for presentations or demonstrations.

Most Advanced Technology Users had extensive experience using technology for instruction. They teach their students how to use computers and other peripherals (digital cameras, scanners, digital video cameras, and digital microscopes), use a variety of software applications (Word, EXCEL, PowerPoint, FrontPage) and have other technology related skills (video editing, creation of DVDs, website development). They also conduct online courses via WebCT and Blackboard.

One participant stated,

“...technology allows one to compress the teaching-learning process within a Constructivist pedagogical environment.”

Only one Basic Technology User indicated how he/she used technology for teaching and learning in the classroom.

"I engage in CBL (Calculator-Based Learning) activities. I plug in light probes, sound probes and students identify patterns. ...students use EXCEL to record all data from experiments in biology content courses. Students produce PowerPoint presentations in both content and methods classes."

*Advanced Technology Users.* Participants also indicated extensive use of technology for teacher- and student-led presentations. Through the use of the LCD projectors, participants stated that they:

- Conducted lessons and formal presentations using PowerPoint
- Shared Internet websites and resources with students
- Demonstrated use of WebCT

*Basic Technology Users.* Almost all Basic technology respondents stated using LCD projectors and overhead projectors in the classroom for presentations and demonstrations. (Although they use PowerPoint/LCD projectors to deliver instruction, the participants did not state how their students were using the technology for learning).

*Question A6: Since you participated in the PHHC Project, how have you used the PHHC? If you have NOT been using the PHHC, please explain what the barriers have been to its use.*

Both Advanced and Basic Technology Users reported using the PHHC as a personal and professional organizer and as a data collection tool for use in the classroom by the instructor and students.

*Advanced Technology Users.* Fourteen participants use their PHHCs in the classroom or developed assignments/projects in which students use PHHCs. These included:

- Use of software useful in science education (Pico Map, Cooties and Sketchy) and use of probes for demonstrations in science classes and science courses for teachers
- "All students had PHHCs. The software is the mini version of the diagnostic manual, so students can use the system to talk to their clients and very quickly be able to work through the decisions with the PHHCs."

At least seven respondents use the PHHC to observe student teachers in the field. They developed their own forms for observations or used other standardized forms downloaded to their PHHCs via Documents to Go.

"I have used the PHHC to do my field visits for observation of teacher candidates. I use the keyboard and Palm to take my notes, the camera to record the classroom and school and then sync with Word to produce the final observation sheet."

*Basic Technology Users.* Most respondents also use the PHHC in their classrooms. The most common use for classroom management of student grades, attendance, and participation). The PHHC were also used:

- In presentations: "I learned to use the Margi with the PHHC and presented at a state conference. I showed others how to use the technology..."
- For note-taking during meetings (used along with the portable keyboard)
- As a data collection tool (classroom management, classroom observations)

In relation to obstacles encountered while using the PHHC, Advanced Technology Users reported having difficulty hot syncing the Veo camera software with the m130 PHHC, having difficulty using the PHHC with the Mac platform and connecting the PHHC to the Internet. At least two respondents had issues while using probes with the PHHC.

One participant stated that the PHHC would be helpful for note taking but not for replacing the TI calculators used in the math classroom. Other barriers to using the PHHC included PHHC probe maintenance and reliability; poor focus and resolution of detachable PHHC digital camera. The high learning curve related to the new technology was also a barrier:

“You have to do special writing on the writing area of the screen called graffiti; all the letters aren’t exactly the letters we write the way we write them in the alphabet. ...It was easier for me to take out my paper and pencil calendars. Instead of making less work, for me, it seemed to be making more work.”

*Question A7: Since you participated in the PHHC Project, are you interested in using emerging technologies (or upgrading the PHHC and software)? Please describe.*

*Advanced Technology Users.* All respondents were interested in using emerging technologies. The following is a list of their technology interests:

- Upgrade existing PHHC (from m130 to Zire or Treo)
- Additional software for the PHHC: GPS/mapping, Directions to Go, FileMaker Mobile, Bluetooth, e-Books, dictionary and thesaurus
- Digital Cameras
- Margi presenter
- Upgrade existing software: Documents to Go
- Ability to use Internet to access email via the PHHC
- More information on freeware
- Voice-recognition technology
- Electronic portfolios and how they can be posted on the WWW
- iPod
- Digital Imaging
- Probes for the PHHC
- Use of PHHC for data collection and information management

*Basic Technology Users.* All respondents were interested in using emerging technologies. The following is a list of their technological interests:

- Upgrading existing PHHC (from m130 to Zire, PHHC with wireless internet connection)
- New software for PHHC: FileMaker Pro
- Online courses, how to use WebCT
- Science Probes and their use with PHHCs
- Visualization and simulation software for PHHC
- Use Vernier Software and use the PHHC camera and video to collect data
- How to use Documents to Go PHHC software in the classroom
- Vernier data logger and how it can be used for data collection

*Question B1: How did you learn about the Ohio PHHC Project?*

*Advanced and Basic Technology Users.* There were three different notification methods identified; word of mouth, notification through faculty-based communication and conferences, and notification by e-mail targeted to specific individuals.

Just over half of all the participants heard about the PHHC training by word-of-mouth communication. When divided into groups, all respondents from the technical group and the non-technical group had learned about the PHHC training directly from the trainer or colleagues who new about it.

*Question B2: Why did you want to get involved in the PHHC Project?*

Both respondent groups had two themes in common. The majority of the combined respondent groups were interested in new technology with a subset of both groups whose primary incentive was obtaining the free PHHC. Beyond the interest in new technology and a free PHHC, the themes for each group differ in that the reasons for non-technical group were more personal and the reasons for the technical group included extending their knowledge to their students.

The largest group respondents from the Advanced Technology User group was interested in learning new technology with a small subset interested in getting the free PHHC. Another group was interested in increasing their technology skills and a fourth group got involved so that they could have an impact in improving student learning.

The majority of the Basic Technology Users were interested in getting involved in the PHHC Project due to their interest in making their skills more current and becoming better organized, personally and professionally. A small subset of that group was interested in the PHHC Project primarily because they would receive a free PHHC. There were two small groups that got involved due to encouragement from colleagues and/or family or because of their personal knowledge of the trainer.

*Advanced Technology Users*

- Interested in new technology (21 of 37)
- Interested in learning new technology and wanted the free PHHC (8 of 37)
- Interested in increasing PHHC skills and knowledge (4 of 37)
- Interested in new technology to improve student learning (4 of 37)

*Basic Technology Users*

- Interest in new PHHC technology, be better organized, and perform better: (23 of 48)

“The idea of finding new technology to use and it sounded like they had some great things I could do, it would be neat to learn how to do them...and it worked very well with where I was going” [in her work and research].

- Interested in learning new technology and wanted the free PHHC (9 of 45)
- Encouraged by colleagues and/or family (2 of 47)
- Personal knowledge of the trainer and interest in new technology (14 of 48)

*Question C1: Please describe the training you received?*

*Advanced Technology Users.* Most participants described the sessions as three, three-hour sessions that built one upon the other. The first session was a demonstration of the PHHC and its functions. A step-by-step introduction of the PHHC and how to do the basic functions of operation was given. This included beaming documents and resetting the PHHC. The second training session involved presenting real-life examples. The third session was “show and tell” presentations. Participants explained what projects they were planning to do or projects they had actually done.

Several participants mentioned that it was very motivating as each technology tool was introduced and passed out and they were shown how to use them. Each day felt productive and useful because so much was covered with time to explore and internalize what was learned.

Some participants thought that the training was like an overview but felt the training was very helpful and informative, organized, and covered a lot of information in a short amount of time.

*Basic Technology Users.* During the first session of each of the five rounds, participants learned about the features and personal uses of the PHHCs. The second rounds focused on the educational usages of the PHHC, the Margi Presenter-to-Go adapter and the Vernier scientific probes' usage. The third session allowed the participants to demonstrate how they would use the PHHC in their personal and professional lives. All workshop sessions were video recorded by a graduate assistant. As an incentive for completing the three required workshop training sessions, the participants were allowed to keep the PHHC, the camera, and the portable keyboard. In general, the activities were basic but moving into more complex tasks.

"The training covered the basics...this is what it is, this is what it does, and here are the limitations."

Other recurring comments were about the structure and delivery of the presentation. Participants thought the presentation were well organized and that the trainer communicated and shared the content effectively and efficiently.

"I think the trainer did a very good job telling us how to use it and how to set it up. Within the first day they helped us to set up documents..."

Participants thought the interactive aspect of the sessions gave them the time and opportunity to experiment and work at their own pace.

- "There was plenty of open time to give participants time to experiment before going to the next level, which allowed participants to work at their own pace."
- "One thing that I really liked about it is that I felt like everybody in the room was just like me. We were all people in academia who didn't know a lot about computers."

*Question C2: Did the number of pacing of the training sessions meet your needs?*

*Advanced Technology Users.* Most believed the pacing of the sessions was just right and these sessions met their needs. The sessions covered a lot of ground in a short time but it wasn't too much. There was also time allotted between each session, which helped to contribute to the internalization of the skills learned through the sessions.

"There was a good balance and there were not too many details, it was enough for people who want to know and who are curious to learn."

A few participants, however, felt more training would have been helpful. One participant wanted to have more advanced training as an additional session.

Only two of the participants thought the pacing was too slow. These were participants who had prior knowledge of PHHCs and because others were not as technologically advanced, they thought the pacing was necessary and couldn't be changed. None of the participants thought the pacing was too fast.

Other recurring comments:

- Pacing good but more support needed

"The only thing was only having one instructor and there was nobody else to help out and deal with people who weren't clear about the instruction. That is the only thing."

- Distractions

“Training would have been just right if faculty participants had been more respectful. A lot of distractions/misbehaviors interfered – participants going off on own, talking about unrelated things. The instructor’s pacing and planning were just right.”

*Basic Technology Users.* Most participants reported that the number and pacing of sessions met their needs. They liked the pacing of the sessions because it allowed them to experiment and play and then move to the next level at their own pace. The time of exploration and experimentation gave them an opportunity to learn the process and application of the tools. Participants also commented on the “good training techniques” used by the presenter to effectively communicate the content so that it was clear to them.

“The workshop situation seemed to work well. There were not a lot of different levels of users and it didn’t turn into the knowledgeable vs. the new users. The pacing was good and they were creating/doing things during the process that helped them proceed to the next level.”

Three of the participants commented on the presenter’s delivery of the content.

Participants commented that the presenter always remained calm and patient as she answered questions and provided assistance. They also liked working in small groups, which allowed the trainer to closely monitor their progress and give them more attention and support. This helped to create a very comfortable environment for learning.

*Question C3: What were the most positive aspects of the training?*

*Advanced Technology Users.* The expertise of the trainer was cited as the most positive aspect of the training. Many believed the trainer was knowledgeable and skilled in communicating effectively how and what to do with the technology tools presented. The presentations were comprehensive, fun, and engaging. The training sessions included lectures and time for “hands-on” activities – a very effective aspect of the training. One participant found the initial instruction so helpful that she was able to learn more complex applications before the second session. Participants also mentioned the accessibility of the consultant as an important part of the training. During each session there was frequent checking for understanding and monitoring progress.

Some participants believed that just learning the technology was the most positive aspect for them. They enjoyed learning various strategies and techniques for utilizing the technology to its fullest potential. Participants enjoyed the step-by- step instruction and time to explore and learn on your own.

Additionally, the workshops provided time for the participants to share ideas and skills learned through the sessions. Interacting with colleagues – hearing what other people were thinking and how they were considering using the PHHC – was enjoyable for many of the participants.

And finally, receiving a free Palm was the most positive aspect of the training for several participants.

*Basic Technology Users.* These participants commented that the trainer maintained an upbeat, informal, and relaxed atmosphere, which created a feeling of camaraderie and an eagerness to learn. They also felt the trainer’s knowledge, skills, and experience gave her a lot of credibility with the group and enabled her to assist everyone no matter what level they were own. The process for teaching the content consisted of instruction, followed by a demonstration, and then the opportunity to apply what was taught and demonstrated. The process enabled participants to start at a basic level and move to more complex tasks. The incorporation of a “hands-on” approach with time to experiment with the technology tools and share ideas and information with other colleagues was also effective. Most participants enjoyed

mastering skills, like being able to input personal data, and then use graffiti to write directly on the PHHC. They also enjoyed beaming these items to others.

- “The hands-on approach was the most positive aspect of the training. “
- “...learning some of the tricks, accessing information or using the PHHC to store information---or even to spread information.”
- “I think that the idea that I got to try something new and I got to see how it works.”

The participants also commented on the trainer’s good use of time and the value they held for the teacher’s time. Other comments included, “No time was wasted and a lot was accomplished. This was due in large part to the sessions being so well organized.”

*Question C4: What aspects could have been improved?*

#### *Advanced Technology Users*

- Smaller groups: Some participants thought a smaller group would have been more helpful to the learning process although the large group was divided into subgroups.
- Handouts: Many ideas were verbally shared but few or no handouts were given to participants to review what was presented.
- Too many different computer skill levels: Participant suggested that different levels of training could be provided to the people at different levels of expertise.
- Other Issues – Participants shared other aspects of PHHC use they had difficulty with:

“It seems really handy for student teacher supervision, but if I’m trying to use it in an instructor mode, the students all with Palms – 15 to 20 Palms – is problematic. ...you can’t quickly charge or hot sync all the units at one time - the technology’s just not there, yet.

*Basic Technology Users.* Most participants felt that the sessions could be improved. Twenty-six made suggestions which were grouped in the following categories:

- Orientation Session: Use this session to determine the learning level of the participants rather than waiting until the first session.
- Specific Software: Some participants had specific interest and wished they could have had more time exploring what most interested them.
- Manuals: It was difficult to keep up with instructions. A reference manual would have been useful.
- Time: Participants felt they needed more training time
- Technology Glitches: When things go wrong, how to troubleshoot the problem or have a plan B so that your presentation can proceed.

Two participants thought the training was too fast, but for different reasons. One thought the training was too fast for novice users while the other wanted to have more time learn and talk about products. The remaining participants saw no need for improvement.

*Question C5: Did you consult with your trainer outside the scope of the prescribed training sessions?*

*Advanced Technology Users.* Most participants consulted the trainer outside the scope of the training sessions. Often it involved specific questions related to technology tool they were working on. Some of the reasons given for consulting the trainer were to fix a problem with the PHHC, or obtain software to use the PHHC in the classroom or to get a software upgrade. Some emailed or phoned the trainer about questions or problems with using the PHHC.

A few of the participants never contacted the trainer for help. The reasons given was they were either able to sort things out themselves, had other resource people to help them, or there was just no need.

*Basic Technology Users.* The majority of participants did consult with the trainer outside the scope of the prescribed training sessions. The purpose of the consultations ranged from asking the trainer for resources for the palm to resolving technical problems related to the technology tools the participant was using. These consultations usually took place face to face. The trainer was contacted many times.

- “The participant consulted the trainer numerous times outside the scope of the training sessions. The participant had initial problems with synching the PHHC with the computer and had to ask the trainer for help. Every time the participant had a question he/she asked the trainer.”
- “Yes... the trainer is always there if I have questions.”

Four of the participants contacted the trainer via email. This was usually done to get an answer to a specific question. Eleven of the participants never contacted the trainer. They did not feel a need to contact the trainer or there was a time issue with their own schedule. One participant felt that the trainer was busy and didn't want to disturb her. She tried to resolve her own problems or challenges. However, all participants agreed that the trainer was readily available to assist them. None of the participants had trouble getting assistance if they needed it or requested it.

*Question D1: How have you used the skills/ tools you developed as a result of the training?*

*Advanced and Basic Technology Users.* A majority of all respondents indicated developing skills and tools on the PHHC for personal organization, professional use and instructional/educational. Of those identified as Basic Technology Users, three respondents had used the skills and tools since taking the PHHC training. Almost half of all respondents report using their PHHCs for more than one of the following skills/areas:

- Personal organization

Use it to organize personal information: calendar, addresses, phone numbers, to-do lists, etc

“Personal planning/calendar/organization skills have improved as a result of having everything in one place...”

- Professional use

Use it to organize work-related information: contact information, appointments, take notes during meetings, organize account information and passwords, financial records, phone call logs, etc.

“Use the camera regularly to take pictures at conferences and meetings; use the addresses and calendar feature to schedule meetings; take notes on Microsoft Word”

- Instructional/Educational use

Respondents used the PHHC to collect and manage student teacher field observation data; design professional development experiences for teachers; for grading purposes using EXCEL, to take pictures to enhance lecture notes and presentations; to conduct PowerPoint Presentations; and to use with probes in science classes.

“I use the Palm daily and it has become a vital part of my field observations. I also use the photos to create a file of the schools I visit for others to use when they have to visit the same school. I

record the teaching of the teacher candidates with the camera and my observations with the keyboard.”

“I’ve used the camera for creating documents about various art processes. Students took the pictures and I imported them into a word-processing document. I added text explaining the processes and students use the collections as a reference tool...”

“Instructional enhancement as previously described (experimentation with/use of scientific probes in methods classes, notes log on all classes).”

*Question D2: Are there any artifacts or examples of your work with the PHHC that you can share with us?*

*Advanced Users and Basic Technology Users.* Seventy-seven of the respondents had examples that they could share as an example while eight did not.

*Question D3: How do you plan to use PHHC technology in the future? What new strategies or software related to the PHHC do you think you might use? Please describe.*

Both Advanced and Basic Technology Users described plans for future PHHC use in four major areas:

- Personal organization
- Professional use – (presentations, spreadsheets, note taking)
- Educational purposes – instruction
- Education purposes – field observations, classroom management
- Upgrade or acquire new software/hardware

More than half of all respondents cited having more than one strategy or plan for their use of PHHC technology in the future. For their professional use, respondents indicated that they

- “Will continue using PHHC to take notes at meetings, use calendar. Wants to learn how to use Margi for PowerPoint presentation, use PHHC in place of laptop.”
- “Would like to be able to present at conferences and other events using PHHC.”
- “Wants to use the Internet on PHHC for research purposes to and lectures.”

#### *Educational Purposes – Instruction*

- “...hope to use the probes to instruct my Science and Math courses...”
- “...interested in expanded student use of the Zire 71 in the classroom. Students could use the camera feature to enhance their projects...”
- “Introduce PHHC (to teachers) as a data collection and information management device...”

#### *Educational Purposes – field observations, classroom management*

- “I will probably use it to keep track of student grades and homework assignments...”
- “...will use a grade book program available for Palm to make observations during class discussions...”

#### *Upgrade or Acquire New Software/Hardware*

- “Interested in Bluetooth technology – wireless login to the network through PHHC.”

- "...would also like the following software: File Maker Pro, creating student handbooks into e-books and wireless capabilities."
- "Different memory cards to increase memory and Internet access..."

*E1. What factors have helped you in using the PHHC?*

*Advanced Technology Users.* The following factors helped Advanced and Basic Technology Users to use the PHHC:

- Training support and guidance - Participants stated that the training and the free PHHC propelled them to start using the PHHC.
- Informal support networks - Several respondents formed informal support networks that helped them troubleshoot technical issues and share tips and tricks. These networks helped some participants become more comfortable with using the PHHC.
- Previous experience with PHHCs
- High level of comfort with technology
- Portability – The PHHCs compact size made it easy for participants to use it for a variety of purposes and in a variety of settings.
- Ease of use – Participants stated having an easy time transitioning to the PHHC from paper-pencil tasks.

*Basic Technology Users.* These users cited the training they received as one the major factors that helped them to use the PHHC. Participants indicated several key characteristics of the training they found most helpful:

- High level of support from Trainer and other Project participants
- Carefully designed initial training program
- Pacing of the training and extensive guided practice
- Trainer's use of motivation and encouragement
- PHHC experience of other participants – Their ability to demonstrate the potential of the PHHC for classroom applications.

*Question E2: What factors have hindered your use of the PHHC?*

*Advanced Technology Users.* The following factors related to hardware or software hindered participants from using the PHHC:

- Hardware limitations with older PHHC models – older m130 has limited capabilities and it's difficult to find software, camera attachments are difficult to use.
- Battery life/recharging issues – PHHC has only one charger. A portable charger would be helpful. Newer PHHC models have flash memory that help alleviate the problem of losing data when batteries run low.
- Issues with Mac platform and the lack of support – third party programs have to be purchased to fully use additional software.
- Inability to "sync" to multiple computers
- Insufficient number of PHHCs for students to use in classrooms at one time
- Instability of communication between probes and the PHHC

Several respondents identified time as a hindrance to using the PHHC. The participants would like more time to find more ways of using the PHHC. Also, some participants stated they spend a lot of time troubleshooting technical issues.

Some participants also had difficulty using the stylus and were troubled by the size of the PHHC screen.

*Basic Technology Users.* Technical issues were a major hindrance. Many lacked the technical expertise to troubleshoot problems. The following factors hindered participants from using the PHHC (many of these are similar to the Advanced Technology Users group):

- Battery life is too short.
- PHHC screen is too small and resolution is poor.
- Older PHHC models - limited capacity (memory and speed)
- PHHC compatibility with Mac platform and university portals
- Synchronization – Perhaps due to participants limited technology skills, synchronizing the PHHC to a computer was a major issue.
- Difficulty with peripherals and software: keyboard malfunctioned often, software kept crashing, computer continued to freeze during syncing.

Several respondents stated that they were unsure whether they will use the PHHCs with students or for instruction. And a few others cited a lack of time as hindrance as well.

*Question E3: Would you have started to use a PHHC without participating in this project?*

*Advanced Technology Users.* Twenty-three out of 37 respondents would have started to use a PHHC without participating in this project for the following reasons:

- Had previous PHHC training
- Owned a PHHC before the project
- Had an interest in PHHCs and the opportunity to be trained pushed them to use it.

Fourteen of the 37 respondents would not have started to use a PHHC without participating in this project.

*Basic Technology Users.* A majority of respondents would not have started using the PHHC had it not been for the training and support they received. Many indicated that they needed an extra incentive to get them started using something new, the free PHHC and training pushed to start using the PHHC.

The participant's technology knowledge and skills also was a factor. A few respondents reported not having sufficient technology skills or time to learn a new technology.

- "I'm not into technology, so I don't know the latest and newest things. ...until something is actually brought to my attention and demonstrated for me—show me how it can be used in my world, and what the benefits to me are..."
- "Would I be doing what I'm doing on the PHHC without the project, no—I don't think so. I think that part of it is hearing what's available and once you start hearing some of the things that people were doing, it sparked other ideas for what I could use it for."

Eight respondents had already been using a PHHC or had previous experience using PHHCs.

*Question F1: What benefits have you experienced from the PHHC project?*

*Advanced Technology Users.* A large majority (30 of 37) of the participants benefited from the training with only 8 of 30 reporting that the benefit was limited to their personal productivity. Two participants indicated they did not benefit from the PHHC training. Participants underlined that "being in the project made things, like taking notes, more convenient, but it has not increased her personal and professional activity."

*Basic Technology Users.* A large majority (29 of 48) of participants indicated that they had experienced a benefited from the training, with only four of those limiting it to either increased personal or professional use. Three respondents indicated they did not benefit from the training.

“Just more awareness of the broadness of use. I don’t think it increases my personally and professional productivity.”

The following are benefits both groups have experienced as a result of their participation in the PHHC study.

- Time efficiency: scheduling appointments and keeping track of contacts is easier using the PHHC.
- PHHC project at some extent decreased her fear of technology.
- Organization: Easy to organize and track information for meetings, classes, students, etc.
- Notes taken during meetings can be shared quickly with others
- Portability and ease of use for student teacher field observations, research, data collection

*Question F2: What benefits have your students experienced from your being in the PHHC Project?*

*Advanced Technology Users.* Twenty-three of the participants indicated that the students benefited from their participation in the PHHC project.

“My students have benefited from my participation...They get their field notes in a readable form and more timely. They have also begun using Palms in classes and, in some cases, have bought their own, because they use them to take notes, and beam assignments...”

Thirteen participants were unsure or did not indicate whether the students benefited from their participation in the PHHC project. Only one Advanced Technology Users indicated that the students did not benefit from his/her participation in the PHHC project.

“Participant declared that his students did not have PHHCs, therefore it was not beneficial to his students.”

*Basic Technology Users.* Seventeen of the participants indicated that the students benefited from their participation in the PHHC project.

“Both methods and content students have been exposed to and used the PHHC for data collection purposes. Students also benefit from participant’s increased level of organization as their professor.”

The remaining participants were unsure or did not indicate whether the students benefited from their participation in the PHHC project. The following are benefits listed as experienced from both user groups.

- Students are familiar with the basic functions of the PHHC as a result of the participant sharing their knowledge with students in class
- Personal organization for classes (grades, participation) has helped participant provide timely information to students
- Student receive instant feedback from participant
- Students see the potential of using hand-held technology to enhance learning
- Students see the portability and ease of use of PHHC as a data collection tool

"It helps students to ask questions and design their own experiments because they can see instantaneous results. They collect the data, and then can conduct the experiment multiple times..."

- Immediate access and sharing of class/course resources (via beaming)
- Modeling the use of PHHC for presentations (using Margi and PowerPoint)

*Question F3: What benefits have others (such as colleagues) experienced from your being in the PHHC Project?*

*Advanced Technology Users.* Fifteen indicated colleagues/others benefited from their participation in the PHHC project

*Basic Technology Users.* Seventeen indicated that colleagues/others had benefited from their participation in the PHHC project.

The following are benefits others have experienced as a result of both user groups' participation in the PHHC study.

- Generated interest in the use of PHHCs by discussing PHHC applications with colleagues

"We have gotten some others interested about the use of PHHCs...in a math classroom...some have looked at it and started to think about the use of it for their personal use..."

- Participant has helped colleagues use/troubleshoot the PHHC

"I help other faculty in using the PHHC and by answering their questions about the PHHC."

- Participant and colleagues can quickly share information, dictations and meetings notes with each other

"His colleague benefited from the forms [student-teacher observation] he developed by using the PHHC."

- Discussed other uses of PHHCs with colleagues

*Question F4: Has your institution benefited from your participation?*

*Advanced Technology Users.* Half of the respondents felt that their institution had benefited from their participation.

*Basic Technology Users.* Almost half of respondents felt that their institution had benefited from their participation. Overall, a majority of respondents felt that their institutions benefited from their personal and professional increases in productivity. The following are examples:

- Quick access to and distribution of information to students

"I think it has been a big benefit to my students because having that instant feedback, as opposed to waiting three days for me to find the time to write it up."

- Quick access to and sharing of information with colleagues;

- Increased productivity by decreasing the amount of time it takes to plan and organize lessons, observations and meetings; better organization and retrieval of information

“Being in the project expanded the range of things that I would do. I’ve been able to extend things that I would typically be limited to doing in a laboratory setting to field settings.”

“The primary benefit has been in personal productivity. Instead of writing out my field observations by hand and then retyping them into word or writing them on the department field forms...I merely sync the Palm with my computer and use Documents to Go.”

- Calendar and reminder features have assisted with schedules and priorities.

*Question G3. Have you purchased any accessories for your PHHC?*

*Advanced Technology Users.* Thirty-six have purchased additional hardware, software, and other accessory purchases with personal funds.

*Basic Technology Users.* Almost half of respondents felt that their institution had benefited from their participation. Ten respondents also purchased additional hardware, and software purchases with personal funds. Their institution has been supportive in purchasing additional software (expansion cards, Margi presenters, keyboards, PHHCs for other faculty or department-wide use). A total of 5 respondents reported that professional development or department money was used for these purchases.

*Question H1: Can the handheld computer be used as an effective tool to bridge the digital divide? (This question category was available for the fifth cohort group.)*

The respondents agreed that the PHHC is a powerful tool that can bridge the digital divide and make technology accessible to all students.

*Question H2: Do you think the PHHC could assist pre-kindergarten through 12 grade classroom teachers?*

The faculty and staff agreed that the PHHC can assist pre-kindergarten students in mastering concepts and facilitating learning.

*Question H3: Did the participants view the handheld computers as an equitable tool to bridge the digital divide?*

Citing the free educational software and comparing the cost of the PHHC's as a major factor in making computer technology available to low income school, the participants viewed the handheld computer as an equitable tool to bridging the digital divide.

*Question H4: Do you view the handheld computers as an equitable tool to bridge the digital divide?*

The participants viewed the handheld as an equitable tool to bridge the digital divide and warned that classroom teachers will experience similar learning experiences as PHHC participants.

## **Discussion**

The survey questions focused on investigating and discovering (a) who benefited from the faculty and staff learning to use the PHHC, (b) factors that helped or hindered their PHHC use, (c) overall skill levels and handheld and computer technology and peripherals usage, and (d) future directions.

### *Learning to use the PHHC*

The trainer was interested in discovering to what extent will the participants benefit from Palm handheld computer training, and more specifically, will the participants learn to use the handheld computers? All of the teacher educators learned to use the PHHC at varying rates; some quickly becoming advanced users while others used the PHHC primarily for its calendar and contact applications. A majority of the faculty and staff said participation in the PHHC workshops assisted them in learning, gaining and refining their computer skills, and in becoming more organized. The graduate student interviewers reported similar results. All participants say they were the primary beneficiaries of the training and seven used the Palm handheld computers and Margi Presenter-to-Go adapters at conferences to present their PowerPoint slides.

### *University Personnel Embraces the Palm Computer*

Over approximately three years, eighty five university teacher educators participated in an OBR PHHC study in which they were taught to use the Palm handheld computer. They were taught the practical, personal, professional and educational uses of the Palm m130, Zire 71 or Zire 72 computer. Participants in the first and second workshop cohort received a Palm m130 handheld computer, the *Palm handheld computer: A complete resource for classroom teacher* book by the International Society for Technology Education (ISTE), a portable keyboard and Veo camera as incentives for participating in the study. The third cohort received the Zire 71 handheld computer with built-in cameras while the fourth and fifth cohort groups received the Zire 72 with peripherals.

The Palm handheld participants attended three 3-hour workshops in which they learned and demonstrated the basic and educational uses/operations of the Palm computer. First and second workshop participants were required to read Part I of the *Palm handheld computers: A complete resource for classroom teachers* book before the first session and Part II before the second session. By the time the third training round began, the PHHC technology had improved and the changes in hardware and software made the resource book obsolete and necessitated changes in the training. The rapid evolution of the PHHC technology was a primary factor in making changes to the training throughout the almost 3 years of the project.

During the first session, participants learned about the features of the Palm and desktop software. The second was a trouble shooting session in which participants learned how to use educational software applications, freeware games, scientific probes, and accessories available for the PHHC. The third session provided a forum to discuss and/or demonstrated how the participants will use Palm handheld computer, software and technology in their professional lives. Participants were amazed at the vast amount of educational and curricular resources in the "palms of their hands."

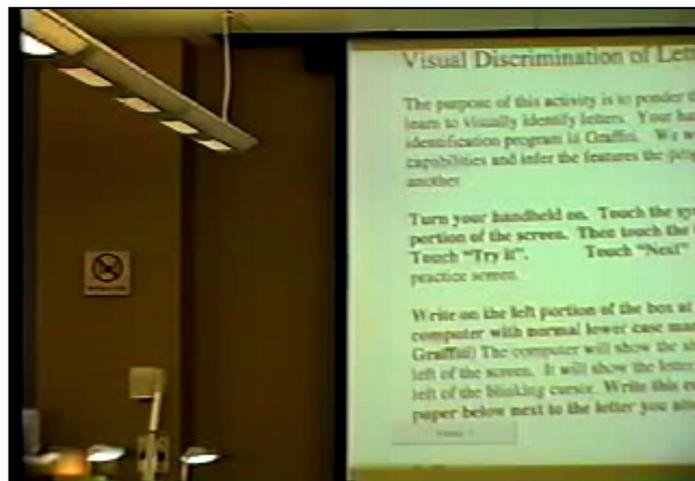
Most participants enthusiastically learned to use the basic Palm applications and created a mirror image of their Palm applications through hot syncing or transferring their Palms to the desktop software. The sessions were interactive and fun. Some participants "were caught" beaming notes to each other during the lunch break. The participants appeared to enjoy learning to use the Graffiti, the notepad and contact applications more than some of the other applications. The fact that they could import addresses into their contact application was a timesaver. The participants also enjoyed taking pictures with the camera.

### *Implications for Handheld Computer Use*

The teacher educators demonstrated creative ways to use the PHHCs during the show and tell presentations. Most explored using the PHHC with their students whether teaching, supervising or observing students at their field placement sites while some demonstrated using Dataviz's Document to Go to manage their students' grades and attendance. Ten of the cohort one and two participants demonstrated how they would use the educational software applications from HICE or GoKnow that were included in *Palm Handheld Computers: A Complete Resource for Classroom Teachers* with their classes

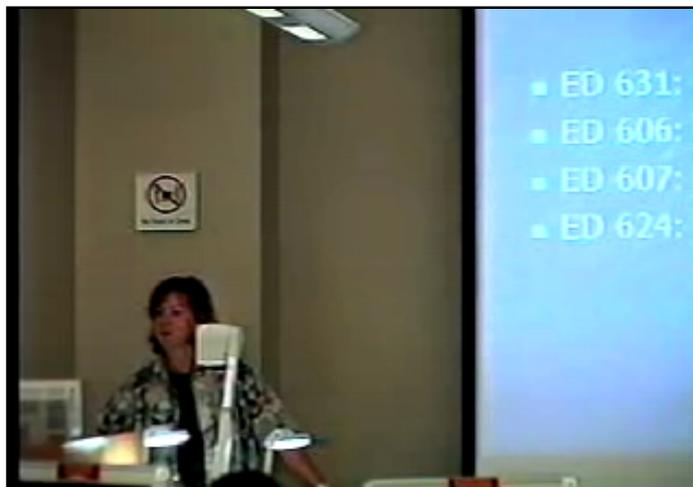
while other participants created templates for evaluating their students.

The participants created a template or activity that will be used either in the classroom with pre-service teachers or to assist in the delivery of service to the student. A literary professor demonstrated the use of the handheld computer for visual discrimination of letters. The professor asked the participants to go to the graffiti icon and touch "try it." Next, they wrote on the left portion of the box at the bottom of their handheld computers with normal lowercase manuscript letters. They were to answer the question, "What letter does the lower case 'a' make? An 'e' or what letter did you get? a = e b = \_\_\_\_\_." This leads to a discussion of how students learn literacy skills (Video 1).



Video 1: Handheld Use for Visual Discrimination of Letters (4:26; 19.3 MB)

Another literary faculty member showed "The Many Uses of a Palm Hand-Held Computer (PHHC)" for her pre-service reading teachers. **(Insert the O'Connor QuickTime movie here)** In this activity elementary students guess the meaning of unknown word by using or not using context clues. After displaying their answers on the PHHC, the teacher tabulates scores quickly and posts them on the Elmo projector. The students then use Bubble Blasters to reinforce grammar concepts.

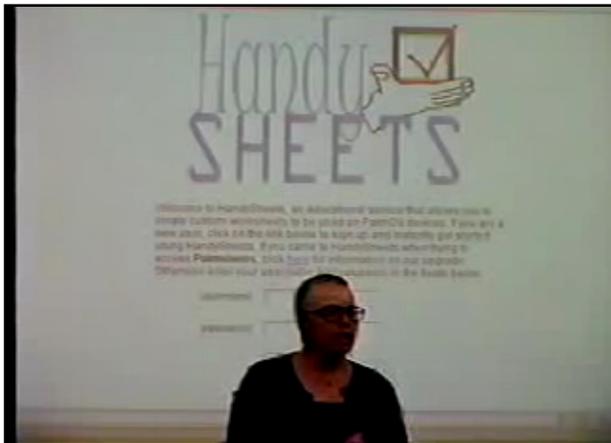


Video 2: Handheld Uses for Pre-Service Reading Teachers (2:01; 9.0 MB)

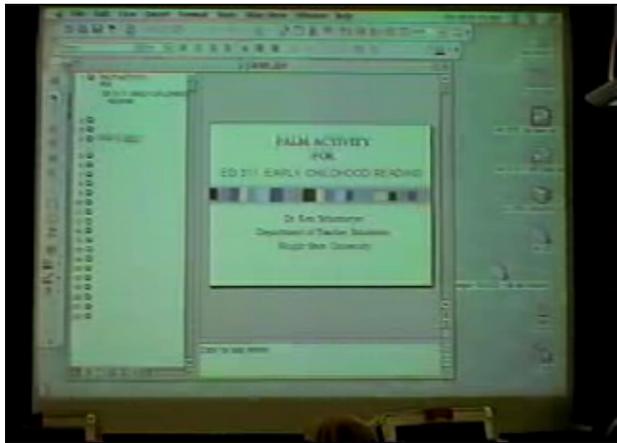
An educational leadership faculty member from cohort 4 demonstrated Palm Converter software, which converts angles, area, clothing, fuel consumption length, numbers, shoes, speed, temperature, time

volume and weight. He told the Palm participants that a value is placed in the blank and the software converts this number to short or full value. The participants followed along during the demonstration. Some resources developed and demonstrated by the university's faculty and staff included

- Developing a supervision template based upon the 19 Pathwise criteria to observe student teachers;
- Using the handheld computer for visual discrimination of letters. This activity was designed to have participants ponder the ways in which children might learn to visually identify letters and learn to read;
- Playing vocabulary games by using Pico Map;
- Using Dictionary to go to reinforce grammar concepts;
- Writing Predictions using Freewrite;
- Using the keyboard to practice summarizing skills;
- Learning propaganda techniques and culturally responsive teaching techniques by using Handy Sheets (Video 3);
- Creating Spreadsheets and PowerPoint Slides by using Dataviz's Sheets To Go and Slideshow to Go (Video 4);
- Using MVal and Learner's Profile to evaluate students and preservice teachers;
- Using the tape recorder for note taking;
- Using the still camera and video camera to evaluate preservice teachers;
- Using the handheld for recordkeeping (Video 5).



Video 3: Propaganda Techniques (1:31; 6.0 MB)



Video 4: Spreadsheets & PowerPoint (1:31; 6.1 MB)



Video 5: Recordkeeping (2:33; 11.2 MB)

## Troubleshooting

The International Society for Technology Education's (ISTE) *Palm handheld computers: A complete resource for classroom teacher* book was found to be an invaluable resource during the first two series of workshops. Since the PHHC technology has developed at a rapid pace, the software included in the book was incompatible with the Palm Zire 71 and 72 and should no longer be included with the book. The Palm educational software and Vernier's software and technology were great tools for demonstrating and linking the real world to the academy, but incompatible with the Palm Zire 71 and 72. Other problems were encountered and resolved included

1. Making sure the computers' security software is completely disabled. When using the College of Education's computer lab, the administrative and security software became engaged upon restarting the computers after installing the Palm Desktop software. Laptop computers are the better choice for demonstrating desktop software installations.
2. Checking the PalmOne website under the software application's frequently asked questions (FAQs) link and reading through the questions to discover possible problems or conflicts with the software before – installing to the Palm handheld. Some participants created questions, worksheets, activities and spent time searching websites, have products that are useless because incompatible programs cannot be hot synced to the Palm handheld.
3. Installing desktop software on the participant's home or office computer before the second session. When participants have different operating systems, the time needed to install various applications will vary. In some cases, the software was installed in minutes; in other cases, hours were spent installing software on the various computers.

Although these challenges occurred, the majority of the participants remained optimistic and proud of their creations and newly developed handheld computer skills.

## Future Directions

The participants learned about the features, personal, professional and educational usages of the PHHC, the Margi Presenter-to-Go adapter, the Vernier scientific probes' usage and demonstrated how they'd use the PHHC with their pre-service and in-service teachers. Continuous and ongoing professional development in handheld computer technology can yield high results as educators become lifelong learners by gaining successful and lasting skills. Future directions and projected PHHC uses include

1. Participants' continuing use of the Palm handheld computers in their personal and professional lives and with students in their classes.
2. Participants' planning to assist in-service teachers in using the handheld at the university's local partnership schools.
3. Consultant's training of articulation agreement pre-service teachers to use the PHHC.

Since the PHHC's is relatively inexpensive, many participants say upgrading their PHHC is more likely to occur. In comparing the PHHC's advantages and replacement cost to the desktop computer, the PHHC is portable and the cost is minimal (Education at PalmOne, n.d.). As the participants become more comfortable with using the PHHC, they will discover more innovative uses for the Palm computer in and outside of their classrooms.

## Bridging the Digital Divide

Can the handheld computer be used as an effective tool to bridge the digital divide? Did the participants view the handheld computers as an equitable tool to bridge the digital divide? The participants agreed that the PHHC is a powerful tool that can bridge the digital divide and make technology accessible to all students. Since access to technology should be about the effective use and careful integration of technology into the curriculum, the PHHC is an equitable, cost effective choice.

In comparing the PHHC's advantages and replacement cost to the desktop computer, the PHHC is portable and the cost is minimal (Education at PalmOne, n.d.). The participants said they are planning to continue using the Palm Handheld computers in their personal and professional lives and with students in their classes. The participants will continue to assist the college's pre-service and in-service teachers in using the handheld at our local pre-kindergarten through twelfth grade partnership schools.

## **Conclusions**

All students, especially those living in low-income neighborhoods, must be afforded the opportunity to gain the computer skills that will be needed to participate fully in local and national economies (Bitter & Pierson, 2002; Costello & Stone, 2001; McBride-Stetson, 2004). Students should have an opportunity to use computer and information technology to add value to their lives and to achieve their goals. Educators must become skilled and proficient computer and information technology users who advocate and provide occasions for all students to develop high level cognitive skills.

Gender and multicultural education research consistently report that there are inequities relating to technology resources available to members of these groups (Costello & Stone, 2001; McBride-Stetson, 2004; Parkins, 2004). Initially male students tend to be more involved with and exhibit high level of confidence while using computers; however, these tendencies can be ameliorated by involving females, minority and low income student groups with computers at an early age and maintaining that involvement throughout the school curriculum at each grade level. Teachers, as reflective practitioners, must examine themselves for possible biases and encourage all students to participate fully in their classrooms.

Using different sections of the NCLB law – Title I, Title II and Title V – teachers can bridge the digital divide by purchasing and using handheld computers with their students. As demonstrated in the Ohio Palm Handheld computer study, educators must forge ahead and become those reflective practitioners that gain appropriate computer technology skills. The study clearly illustrates that learning to use the Palm handheld computer can lead to successful and continued use.

As educators become more confident of their computer skills, they must plan their curricula so that all students have equitable access and equal opportunities to be involved with instructional technology, whether desktop, laptop or handheld computers throughout their schooling (Forcier & Descy, 2002). When faced with the dilemma of having to choose versatile, yet cost effective technology for classrooms, consideration must be given to using school funds wisely for technology purchases such as the pocket computer and handheld computer. Continuous and ongoing professional development in information and computer technology can yield high results as educators become lifelong learners by successfully gaining computer literacy and handheld computer skills. Educators must ensure that all students have access to computer technology regardless of gender, ethnicity, socioeconomic background, and disability as NCLB makes this success possible.

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