The Consortium for Technology in the Preparation of Teachers:

Exploring the Potential of Handheld Technology for Preservice Education

Final Report to Atlantic Philanthropies

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Executive Summary

During the final year of the project, the EDC Center for Children and Technology, in collaboration with Wireless Generation and the Mamaroneck Public Schools, undertook two exploratory studies on using handheld technology to support teaching practices. We were most interested in considering the potential of handheld technologies for preservice teacher education and for supporting new teachers. Both studies were formative in design, and although small and exploratory, they furnished us with a glimpse of the possibilities handheld technologies hold for supporting preservice education.

The single most powerful affordance of these flexible and highly portable technologies is their ability to make certain aspects of teachers' thinking visible. It became clear that handhelds have the potential to support a broad range of teacher practices. They promise to facilitate some elements of both classroom management and assessment practices that have proved particularly difficult to master. Even in these two short studies, we can discern that by rendering the process of organizing or recording more visible, handhelds can support the following:

As tools for *organizing* work (by teachers and students), they can:

- Individualize instruction by allowing teachers to customize assignments and learning plans
- Facilitate accurate recording of assignments and work plans by students with organizational problems
- Help special education teachers keep track of their students' assignments in inclusive classrooms
- Help parents supervise homework and communicate with teachers
- Help students with organizational problems manage time by integrating work plans in the form of "To Do" lists with timed alerts in the calendar
- Allow students with special needs to take increased responsibility for their work and thus feel more autonomous.

As a tool for keeping *diagnostic records* of children's reading, they can:

- Standardize a method of data gathering
- Facilitate systematic diagnostic activities through specialized applications
- Support frequent informal record keeping through notes attached to individual student's records
- Encourage a more holistic approach to data gathering by supporting the collection of different types of information, from test results to impressions of student's frame of mind
- Provide analytic tools for comparing student performance over time and with other students
- Suggest instructional strategies in real time, based on an analysis of individual student performance and normative data or benchmarks.

Introduction

The Consortium for Technology in the Preparation of Teachers was originally established to undertake six goals:

- Convening institutions and individuals to discuss key problems, models, and innovative materials.
- Developing strategies for supporting institutions that are poised to integrate technologies, with particular attention to those that prepare large numbers of teachers
- Exchanging materials and considering joint development activities
- Collaborating on course design and co-teaching of experimental courses
- Stimulating national attention and interest in technology innovation in preservice education
- Encouraging schools of education to get involved in research and development.

The Consortium has devoted the bulk of its resources to accomplishing the first three goals. (Goals 5 and 6 are being substantially addressed by the Department of Education's Preparing Tomorrow's Teachers initiatives.) Five meetings of the Consortium have taken place, with member institutions sharing the responsibility for hosting these gatherings (hosting institutions include CCT, Bank Street, the University of Michigan, the University of Virginia, and one meeting was held at the 1999 AERA conference). We have discussed and debated issues, exchanged ideas and strategies, and shared examples of projects that make substantial use of technology in the preservice context. During 1999–2000 CCT staff also made extended visits to three preservice programs: the University of Missouri, the University of Virginia, and Iowa State. We reported on these visits and the similarities and differences in institutional strategies and practices at the 1999 AERA meeting.

One of the cross-institutional issues to emerge during meetings and site visits is that both new and practicing teachers have enormous difficulties linking classroom-based assessments to instructional practices in a way that helps them to think about *the developmental progress of each student*. Additionally, many new teachers have difficulties developing strategies to manage their classrooms effectively – strategies that enable them to concentrate on supporting students rather than discipline. Although faculty across institutions spoke about the importance of enabling educators to bring a more diagnostic perspective to their teaching, this approach is not s effectively supported

or sustained once teachers enter the classroom. Tools that preservice faculty can use with new teachers, and which practicing teachers benefit from as well, can conceivably help in supporting a more diagnostic orientation toward teaching.

A key area of work envisioned for the Consortium was the establishment of rich case studies to explore the ways in which technology tools can be used to address core educational challenges. As a result, in our final year of work we elected to undertake a 12-month research and development effort to experiment with creating handheld applications for both new and veteran teachers that support teachers in thinking diagnostically about their students' learning.

Supporting New Teachers

Supporting new teachers in their first few years of classroom practice is a widely recognized problem for both universities and schools. Mentoring projects, where new teachers are in steady communication with either university faculty or experienced master teachers in their schools, are an increasingly common way to bridge the gap between the pedagogical ideas encountered in teacher education courses and the reality of K-12 practice.

There are many ways to name the problem for new teachers. They are suddenly confronted with a classroom full of children whose needs are real, immediate, and varied. Issues of classroom management are among the first to become apparent even if there is a shared curriculum and a full supply of resources. Eventually, assessment issues loom for new teachers. They often lack the experience to recognize appropriate indicators of progress or of misconceptions that have impeded a student's understanding (or ability to demonstrate that understanding). Time — how to manage it, how to use it well, how to find more of it both for preparation and for reflection about practice — is the single most dramatic issue for most new teachers — and perhaps for all teachers.

University or school-based mentors can provide a supportive shoulder, can give good advice and useful ideas for practice, but they cannot supervise closely. They cannot be

there as new teachers attempt to organize their students' work or diagnose their progress on a regular basis. Recent progress in the development of new wireless handheld technology provides a potential opportunity for a richer and more concrete communication between mentors and new teachers. These new small, flexible, and easy-to-use computational devices permit a new kind of sharing of concrete, specific information about student work that can form the basis for more immediately useful conversations among educators about their daily practice.

During this last year, we have begun to experiment with the use of such devices both for assessment and for classroom management. We collaborated with a technology company, Wireless Generation, interested in developing new tools for teachers and a suburban school district, Mamaroneck, New York, which had the human and technological infrastructure to support such experimentation. We did not start this experiment with new teachers. Instead, we worked with experienced teachers in order to identify *potential* uses of the technology that fit realistically into daily classroom practice. It is our assumption that new teachers might eventually learn to use these devices during their training and then continue to use them both to organize their teaching and to communicate with their mentors during the early years of their practice. First, however, we had to investigate what makes sense with experienced teachers who could help us design appropriate programs.

In the course of collaborating with teachers and administrators in the district, we decided on two applications that addressed aspects of two major problems for new teachers: classroom management and diagnostic assessment.

Classroom Management

We worked with special education teachers about classroom management because the district has an inclusion policy and special education teachers follow their students to regular classrooms and help them organize their work in a way that is appropriate to the students' developmental level. Each teacher follows a group of students to different classrooms, which presents a serious organizational challenge. This challenge is not

identical to the one faced by new teachers in regular classrooms. It is, however, a new way of working for all of the special education teachers and we intended to investigate if the use of the handheld technology could support new ways of working and save teachers time. Teachers ended up using not special software, but the kinds of productivity tools built into the Palm Organizer to keep track of their students' assignments. The ability to beam customized assignments to their students and have students beam back their checklists made it much easier for teachers to keep track of their students' work. (See *Inclusion Palm Project* below for details.)

Diagnostic Assessment

The district uses a "balanced reading" approach in elementary school, which includes the keeping of "running records." In short, this technique involves regular one-to-one sessions during which a teacher keeps track of every word read by an individual student from a set of books that have been categorized according to established reading levels. As the student reads, the teacher uses a form (based on the Reading Recovery model prevalent in many schools) to monitor how the child is deciphering the text. Each incorrect word is noted and the nature of the misreading is charted according to a pre-determined code. Based on this diagnostic assessment, teachers then determine whether the child is ready to read a book on a higher level. Special software on the Palm Organizer makes these tasks much easier to accomplish and also summarizes and graphs each student's reading performance, allowing for easy comparisons so teachers can see at a glance how children are progressing. Teachers can also share that information instantly with other teachers, administrators, and potentially with parents. The teachers we observed found the running-record-keeping software easy to use and eagerly anticipate the next version, which will summarize achievement. (See *Running Records Project* below for details.)

Study I: Inclusion Palm Project

The Palm Pilot project in Hommocks Middle School (HMS) took place in the special education department, which has 175 students and teachers. Every special education teacher has a team of students who participate in the general education classes (inclusion students).

Until this academic year students with special learning needs[1] attended reinforcement groups with a special education teacher. This year the school started a new inclusion model. Instead of working with reinforcement groups, the special education teachers attended the general education classrooms in order to support their team of students.

The special education staff at HMS felt the experiment was very successful. In a recent survey they found that the general education students assume that the support teachers are there to support all the students, not only those with special learning needs.

Timeline

December 2000: The participating teachers receive 6 Palms (M100) from Wireless Generation, Inc.

February 2001: 5 Palm IIIc and 25 Palm IIIxe from the Palm Pilot grant arrive for distribution to students.[2]

March 2001: The teachers started to use the "To Do" list function of the Palm OS. They developed customized "To Do" lists in different subject matter categories. They used their Palms in the classrooms to record the homework assignments developed by the regular classroom teacher.

April 2001: Teachers receive keyboards from the district.

May-June 2001: 7 teachers and 20 students have Palm IIIxe's.

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[1] Students who receive special education support have been diagnosed as having various learning disabilities including: dyslexia or dysgraphics; attention difficulties; concentration loss; organizational issues; language-based issues; hearing impaired; dyscalculia; Aspberger's.

Student and Parent Responsibilities

On April 19 a meeting with the participating students and their parents was held to discuss the students' and teachers' responsibilities. Students were asked to sign a contract regarding their use of Palm in which they agreed to the following:

- To use the Palm only for school related activities during the school day.
- To use the Palm for entering all homework and assignments every day.
- To keep the Palm in a safe place.
- To not let other kids borrow it.
- To keep practicing the graffiti writing.
- To meet with your Palm Pilot teacher according to a system you have decided upon.
- To show your parents the information on your Palm Pilot.
- To check your battery status every day. Let Ed and Nora know when they are almost finished (the school replaces batteries).
- If you are having any problems with your Palm, to let a teacher know.

Parents were asked to sign a permission slip accepting their responsibility for the cost of a lost or damaged Palm. They were asked to agree to the following:

- To become familiar with the Palm Pilot ("a great way to practice using the Palm is to write a memo to the child's teacher").
- To check the Palm periodically.
- To encourage your child to use it responsibly.
- To remind your child to bring the Palm daily.
- To notify the school if you have concerns about the use of the Palm.

April 23 was declared "Palm's kick off day." Students received their Palms and the teachers showed them the basic functions and how to use the "To Do" list for homework recording. Students customized their Palms for this use. The students did not receive cradles and were not able to hot-sync their Palms.

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[2] In collaboration with Wireless Generation Mamaroneck submitted a proposal to Palm and received a "Palm Education Pioneers" enabling the purchase of devices for the special education students.

For the rest of the school year, students and teachers used the Palm Pilots for recording homework assignments.

Goals and Expectations

In the Palm inclusion project, handheld computers were viewed primarily as organizational tools. The project aimed to help students master organizational skills, keep track of their assignments, and make sure they knew what to bring to school. Since special education students have organizational problems, they find these skills difficult to master. They tend to forget what they have to do, to leave their assignments at home, to do half of their work, etc. Currently, students copy their homework assignments off the blackboard to a planner, and special education students who have difficulty with transcription or word order often copy down the wrong assignment. With Palm Pilots, teachers could beam assignments directly to students' calendars and "To Do" lists. Teachers could help students organize their work by breaking assignments down into short-term intermediary deadlines to meet longer-term goals.

Parents of students with special needs are often very involved in helping their child organize work. One goal of the project was to help students become more autonomous by organizing and taking responsibility for their own learning. The students in this study were at an age when most children are beginning to resent adult involvement but still need a good deal of steady support, a combination that is particularly true for students with learning disabilities. For these students, Palm Pilots had the additional advantage of being non-stigmatizing, even "cool."

The focus of the Palm Pilot project was communication between students and teachers. Teachers hoped that use of the technology would enable them to be more aware of the work progress of their special education students. They also hoped that technology-supported communication with each other would facilitate sharing information about their students, which is particularly important when students rotate among classes and work with more than one teacher.

Implementation

Students quickly mastered writing their homework assignments on their Palms. Occasionally they beamed assignments to each other. For the most part, it was unnecessary for teachers to beam assignments to students.

The teachers developed their own ways of using the Palms. One teacher wrote the assignments on her desktop, hot-synched them to her Palm, and beamed them to all of her students daily. Another teacher checked her students' Palms daily to make sure they had all their assignments written down, and in rare cases beamed them what they were missing. One teacher posted the assignments daily on her website.

Initially, the project aimed to use the Palm as an organizer and as a communication tool between teachers and students in order to make sure students recorded all of their assignments. This turned out to be unnecessary in most cases, since students mastered the device much more quickly and were more comfortable with it than their teachers so that the teachers' intervention was not required. Students, on the other hand, beamed each other notes and assignments when they were missing something.

Summary of Findings

Based on the preliminary findings of this formative study, the classroom management uses of technology have potential for preservice education. In this case, teachers used the technology to keep track of what their learning disabled students were doing in inclusive classrooms. Both teachers and students used the handheld computers to organize work. Even though handheld organizers are not yet considered essential in schools, the enormous growth of these tools in the business community is bound to have the usual ripple effect in the educational community. It is not entirely unrealistic to expect that both teachers and students will soon consider an electronic organizer a normal part of school equipment, especially as the price of such devices continues to drop. Attendance, assignments, assessments, and other forms of record keeping can be done more efficiently with small, flexible, genuinely portable devices. Cutting down on paperwork in this way by making record keeping easier and by permitting instant sharing of such

records with school administrators may have a positive effect on how new teachers use their time. The ability to share those records with mentors and administrators may alert them to developing problems that require extra attention and support.

Study II: Running Records Project

The district uses a "balanced reading" approach in its elementary schools that includes the keeping of "running records." In short, this technique involves regular one-to-one session during which a teacher keeps track of every word read by an individual student from a set of books that have been categorized according to established reading levels. As the student reads, the teacher uses a form (based on the Reading Recovery model prevalent in many schools) to monitor how the child is deciphering the text. Each incorrect word is noted and the nature of the misreading is charted according to a pre-determined code. Based on this diagnostic assessment, teachers then determine whether the child is ready to read a book on a higher level.

Wireless Generation, Inc. developed a software application for the Palm Pilot to support this running record process. The software permits teachers to keep their records on their Palms rather than on paper. The software (see Appendix A) accepts handwritten input and summarizes and graphs each student's reading performance, allowing for easy comparisons so that teachers can see at a glance how children are progressing. The technology allows teachers to share that information instantly with other teachers through infrared beaming and with administrators and potentially with parents, through synching their handheld computers with a desktop computer and sending the information to a shared website.

Timeline

November 2000: Initial meetings between district administrators, CCT, and Wireless Generation, Inc. to determine the feasibility of creating software to support the district's K-2 literacy initiative.

December 2000 – January 2001: Wireless Generation studies running records process to design software application. Classroom observations of teachers using the method.

There are several meetings with reading expert and the five participating teachers to discuss the initial design of a software template.
February 2001: First-grade teachers pilot-test initial draft of running records application.
March 2001: Follow-up interviews with teachers. Development of application by Wireless Generation continues.
June 2001: Final "walk-through" of new version of application with reading experts to get feedback on design and feasibility.

Goals and Expectations

The district focuses considerable effort on its early literacy program. They are persuaded that a balanced approach, combining techniques developed by the Reading Recovery process with those of other early literacy programs, best serves their community. They were hoping that the handheld computer version of the running records technique would facilitate and standardize the recording process. Administrators focused on the promise of making everyone's records more standardized and more easily available as well as on making more informed choices about instructional strategies in conversations between individual teachers and reading consultants. Teachers focused on the promise of saving time by making the recording easier to conduct, save, analyze, and share.

Implementation

This was a development project. The emphasis in the research was on gathering enough information about how the process being supported by technology works in real classrooms to make it possible for Wireless Generation to develop a small, powerful, flexible application that does exactly what teachers need. Since the process was not being invented by the participating teachers, there were many sources of information in addition to classroom observations and interviews with teachers and administrators, including the Reading Recovery movement literature and specialized conferences on early literacy. Wireless Generation staff attended conferences and read the background literature to make sure they understood the theory underlying the method as well as the practice.

In practice, individual teachers take records in different ways and interpret the results of their record keeping differently. Wireless Generation and CCT staff observed them, interviewed them, and went through an iterative process of showing them templates that reflect their practice.

In February, seven participating K-2 teachers used their Palms with a beta version of the running record application to conduct their student recordings. All seven successfully conducted several recordings. When the original software was updated at the end of the month, their original recordings were inadvertently lost. This discouraged them from continuing to use the application until a reliable synching and backup system was devised. The web-based database, which will eventually store the data from individual recordings, is still under development at this time.

The teachers we observed found the running–record-keeping software easy to use and eagerly anticipate the next version, which will summarize achievement. Meanwhile, however, they continue to make use of their Palms to organize their own work. Their personal uses range from storing contact information about their students in the address book, to writing notes, to using the calendar to schedule meetings and the "To Do" list to keep track of paperwork that must be done.

Summary of Findings

The software was still under development throughout this project and continues to be as of this writing. As a result, these observations are very preliminary, but they allow us to speculate about the potential of handheld technology for teacher preparation.

1. The single most powerful affordance of this flexible, highly portable technology is its ability to make certain aspects of teachers' thinking visible through easy and instant sharing.

2. Keeping track of student performance digitally saves time. It makes the recording process easier and, since the information is already in digital form, no additional time is required to make it available for sharing.

3. The portability of the handheld devices and the ability to enter information easily through simple clicks and handwritten notes make it possible to collect information about student performance easily, both during planned occasions and spontaneously as opportunities arise.

4. The ability to keep track of student performance this way provides a kind of process recording that can be shared with other teachers and university faculty and form the basis for far more concretely informed conversations between new teachers and their mentors.

5. It enables mentors to observe how teachers-in-training are learning to use the assessment tools at their disposal (in this case running reading records) and to adjust their professional development efforts accordingly.

6. Once a new teacher has mastered the recording process, the ease with which the process recordings can be shared provides mentors with an opportunity to observe what the students of new teachers are accomplishing.

7. The dual opportunity to assess the observation and recording skills of the new teachers, and the learning progress of their students, promises to be highly useful when teachers-in-training are sent out to do their student-teaching in diverse settings because it allows university faculty to augment site visits with a flow of process information, easily available because already in digital form.

8. The software itself provides tools for reflection. The ability to view student progress in charts and graphs and to compare students encourages reflection about student performance.

9. The software encourages reflection about teaching strategies by providing summaries, comparisons, and reminders about when students might be ready to move to a new level of challenge.

10. The portability of the information means that reflection about student performance and progress can take place at different times, when it is most convenient for the teacher. With the use of this new technology, teachers no longer have to go to the information they need in order to reflect; instead, the information can come with them wherever they go.

Other educational software packages help clarify student performance, but until the appearance of handheld computers, they have always required being near a desktop computer to take advantage of them. The school day is so full for most teachers, and particularly so for new teachers, that expecting them to spend a portion of their time in front of a computer terminal somewhere — even if at their desk — reflecting on student

progress, is unrealistic and unreasonable. What makes this portable technology genuinely interesting is not only that it can save a teacher time, but that the time it saves is more likely to be filled with reflection about the meaning of the collected data because the software itself supports and facilitates such reflection. We also expect that the conversations with mentors or university faculty can be focused more on reflection and interpretation than on reporting of information because the software's record keeping and comparison functions allow mentors to consider information about student performance ahead of time.

Conclusions

Handheld technologies are likely to prove very useful in supporting new teachers as they leave universities and encounter the increasingly complex challenge of being a teacher held accountable for preparing students for full citizenship in the information age. These technologies can help build a digital bridge over the gap between teacher preparation and entering the profession.

We have observed two distinctly different uses of the technology: as a tool for organizing the educational work-flow for teachers and students, and as a diagnostic assessment tool. There are many other potential uses, including a vast set of possible instructional uses, from data-gathering expeditions to analytic tools and simulations, to sharing notes, information, or ideas.

Portability, genuinely ubiquitous access, is the single most powerful feature of these new devices. Portability includes the access to wireless networks and infrared beaming among wireless devices. Without the capacity to share information stored on a device, these computers would still have enormous value for education, but the ability to share information so easily makes them particularly flexible and powerful.

The small size and light weight of these devices makes ubiquitous access a reality. Teachers (and students) really can carry them around everywhere.

The input accepted by these devices makes ubiquitous access possible because they:

- Recognize handwriting reasonably well (and will continue to improve)
- Digitize hand-drawn images as well as accept digital photos
- Have built-in touch screens which allow input with almost any pointer, including a finger
- Have a built-in soft keyboard which allows more standardized data entry
- Have a number of useful peripherals, including good, full-size, but lightweight and highly portable keyboards for extensive writing and modem cards for telecommunication.

These features make it possible to keep track of all kinds of information spontaneously and systematically. Teachers and students can jot down an impression in a few words or make a quick drawing and annotate it (they can even take a quick digital snapshot of a work in progress). All of these notes are permanently stored and easily retrievable for analysis and sharing. Making the "stuff" of observed experience more easily available supports reflection. It also provides the means of illustrating a student's record of achievement with examples of real work, teachers' reflections, as well as demographic data and test results, thus supporting a more holistic form of record keeping.

The running records application is an example of how this technology can be used to support more individualized assessment. In particular, the technology supports a more diagnostic approach to assessment because the built-in capacity to instantly compare student performance over time and with other students puts any single assessment into an appropriate and meaningful context. Running records is an early literacy assessment program. Undoubtedly, other, comparable uses for small, flexible applications will be developed that scaffold the process for new teachers and facilitate recording and sharing among all users of a technique.

In the area of preservice education, then, the promise of handheld technology is most likely to lie in helping to:

- Organize a new teacher's work

- Facilitate communication between teachers and students
- Facilitate information sharing between teachers and mentors
- Provide primary material for systematic analysis and reflection
- Scaffold particular instructional or assessment techniques through the use of customized recording templates.

Further research and development will be needed to determine other, perhaps more instructional, uses of these devices. Meanwhile, however, they can be used effectively both "as is," by helping to organize a new (and usually overwhelmed) teacher's work, and with customized, specific applications, to support and scaffold the use of particular instructional and assessment techniques.