Feature

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Subject: Handhelds

Grades: 6–8 (Ages 11–13)

Standards: *NETS•S* 3; *NETS•T* II, IV; *NETS•A* II (http://www.iste.org/nets/). *NSES* Teaching Standard C (http://books.nap.edu/html/nses/html/).

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Implementing a Handheld Program

Lessons from a District-Level Initiative

The principal investigator of this handheld program shares the lessons his team learned about teacher professional development and integration of new technologies.

Excitement about handhelds must be tempered by an understanding of what is typically required when any new technology is introduced into classrooms. We know, for example, that to succeed, handheld initiatives will need clear educational objectives and a logical theory of action that guides implementation. We can anticipate that teachers will need opportunities to learn how to use handheld computers if they are to integrate them successfully into instruction. Teachers will also need ongoing technical and pedagogical support to sustain changes they make to their instruction over time.

Although these particular requirements are not unique to handheld computers, my group's work at SRI International to support and study a district-level initiative called Project WHIRL (Wireless Handhelds for Improving Reflection on Learning) has identified some ways these needs are shaped by the particular capabilities and limitations of these devices. This article explores what we have learned about the opportunities and challenges associated with implementing a district-level project with handheld computers.

Project WHIRL

Project WHIRL began with the formation of a partnership between researchers at SRI's Center for Technology in Learning and school administrators at the Beaufort County School District (BCSD) in South Carolina. In 2001, SRI and BCSD applied for and won a three-year grant from the National Science Foundation to investigate the potential of handheld computers to support more effective classroom assessment in middle-grade science classrooms. We hoped to take advantage of handheld computers' portability and their data capture and aggregation capabilities to make assessment easier for teachers to do frequently. We did not intend just to develop tests for handheld computers, however. Instead, we hoped to provide teachers with tools they could use in an everyday fashion that would allow students to be actively involved in monitoring their own learning and that would promote conversations about what students are mastering and struggling with in the classroom. We achieved this goal in part thanks to our design process: last year, teachers used tools in their science classes one out of every four days. The tools supported a variety of assessment purposes as well, helping teachers and students alike understand what students can know and do.

A key feature of Project WHIRL was the involvement of teachers in designing the software they would use for classroom assessment. We decided to include teachers in the design process from start to finish, in an effort to increase the likelihood that the software developed would be usable by them and adaptable to real-world classroom contexts. Each teacher belonged to one of three design teams, which consisted of a facilitator, two teachers, a software developer, and assessment researchers from SRI. Each team was responsible for developing one or more software programs for use in the classroom. The facilitators sought teachers' ideas first, as a matter of principle, before sharing their own ideas or suggesting activities to the team. The process proved very successful: by the end of the 2002–03 school year, teachers who had participated in design teams were fluent in the use of the software and became champions for their software because it met critical needs faced by science teachers in real classrooms. Some of this software is now available at the project Web site (http://www.projectwhirl.org/).

In the 2003–04 school year, the project conducted a field trial of the teacher-designed software with 18 teachers. All the teachers received classroom sets of handheld computers and training in how to use the project's software applications. They also participated in activities to show them ways to integrate the tools into their instruction. Activity designs were based in part on lessons learned from working with design team teachers. In addition to training, teachers had access to classroom-based assistance from a local technology coordinator and had the option of participating in a graduate-level course tied to the project.

Research and evaluation were part of the project in all three years of the grant. During the first year (2001–02), before designing the new assessment software, we interviewed teachers and visited their classrooms to learn what kinds of challenges they faced in science instruction and assessment. (For more on the results of these interviews, see my article—with D. Tatar and J. Roschelle—in 30[4] of the *Journal of Educational Computing Research*). During the second year (2002–03), we kept notes of the design teams' process, interviewed teachers, and observed classroom trials with the software to learn about their experience with the design process and to identify likely effects of introducing the software into classrooms. Finally, during the field trial year, we conducted a formal evaluation of the project's effects on teachers and students.

Lessons Learned

Each lesson presented below is offered not as a script for success, but rather as a critical element to consider in planning a handheld initiative.

Lesson 1: Set goals that address important educational problems. Many early 1:1 laptop initiatives focused more on increasing access to technology than on developing a clear theory for how increasing access would improve teaching and learning. In Project WHIRL, our advocacy for providing each student with a handheld computer was driven by a focus on improving classroom assessment. We saw from earlier studies that handheld computers helped improve student engagement and that, if used well, their appropriate use could provide students with opportunities for meaningful reflection.

Each design team started out with a charter document that specified an educational problem their tool would help solve, such as the need to support students' paying closer attention to measurements in science labs. The resulting software proved both engaging to students and helpful to teachers. Teachers reported that the software engaged students much more than their typical pencil-and-paper assessments and provided them with a better sense of what their students understood throughout different phases of instruction. They reported using the data to adjust instruction, either because most students understood the material or because students were having difficulties.

Lesson 2: Select uses that match the capabilities and limitations of handhelds. Handheld computers can perform many tasks that desktop and laptop computers can, but it is a mistake to treat them as if they are shrunken computers. Like bigger computers, handhelds are useful for gathering, storing, and transferring digital information. Many software applications have been developed for them that can perform the same functions that productivity tools for desktops do, such as word processing. But handheld computers have some

Software Development Planning Rubric

Foster a development process and environment in which your partner teachers' *experience, wisdom,* and *intuition* can guide, shape, and find expression in software applications that are:

- Important to your classrooms
- Supportive of learning goals
- Useful in an everyday sort of way
- Feasible to create and support

Ask yourselves the questions below to see how your software fulfills these requirements.

Important to Your Classrooms

- How well can you describe the issues the software should address?
- How important are these issues to you?
- How many teachers within your school district might share your concern over these issues?
- How many teachers outside of your school district might share your concern over these issues?

Supportive of Learning Goals

- Do the concepts supported by the software come up in many topics?
- How central are the supported ideas to student understanding in those topics?
- How difficult is it, currently, to test student understanding of these ideas?
- To which aspects of hands-on science activities would you apply the software?
- How confident are you that using this software would draw the class's attention to the underlying concepts of the activity (minds-on during the course of hands-on activities)?
- To what extent might the use of the software provide a new way of making students' thinking visible to you?

Useful in an Everyday Sort of Way

- How often might you use the software?
- How much prep work before class would be required to use the software?
- How much logistical support might be necessary to use the software in class?
- How many different steps and resources will students need to get started with a new software-supported activity?
- How many different setups or versions of the software will there be?

Feasible to Create and Support

- Do the specific features of handheld computing match the problem?
- How complicated is the software?
- How important is speed of using the software?
- How important are multimedia elements (audio, animations, video)?
- How important are communication elements?

capabilities and limitations that desktops do not. For example, handheld computers are much more portable, and the boot-up time is much shorter than for desktop computers. Handheld computers have an extremely small screen size compared to desktops, however, so it is difficult to portray complex graphical representations on them or to have several people look at the screen at the same time. When considering the goals of a handheld initiative, it is critical to consider both the capabilities and limitations of handheld computers, and to examine what combinations of devices and peripherals are likely to support those goals.

To guide decisions about what kinds of features to develop for our software, Project WHIRL developed a rubric for each design team to use in creating its charter document. Each team needed to identify for its educational problem how the specific features of handheld computing could help address the problem. In some cases, design teams backed off implementing features that would have worked better with larger screens. In other cases, teams took advantage of the portability of handhelds to create prompts for students working in different corners of a science lab that functioned like "teachers' assistants." For example, one team created software that gives students feedback when measurements they are taking are implausible. Teachers who used that software reported that it helped them be in many places at once in a laboratory, because students who got feedback about their data were prompted to take a second look at measurements and discuss the feedback with peers or their teacher.

Lesson 3: Select a diverse array of program partners. Large-scale educational innovations of any kind need the support of policy makers and administrators at different levels of a school system. For handheld initiatives, it is critical to have not just technology leaders but also curriculum leaders on board. In the case of this project, BCSD's Supervisor for Research, Program Evaluation, and Assessment was a critical partner, because she was directly involved in a wide array of assessment reform efforts in the district. We also developed relationships with two software vendors, GoKnow and Pocket Mobility, who provided us with discounted or free copies of their software programs for participants. These relationships helped us leverage the resources of the grant so that we were able to provide a broader suite of tools for teachers to use.

We learned some important lessons from groups with whom we did not develop strong partnerships. We learned—too late to ensure the project's sustainability beyond the grant period—that we also needed significant involvement from curriculum supervisors at the middle school level. Closer alignment of Project WHIRL with other major initiatives to promote data-based decision making could have ensured that the project would continue with more support from a wide array of stakeholders within BCSD's administration. We also might have benefited from a relationship with a hardware vendor. Although we were able to obtain bulk discounts on handheld devices from vendors, we encountered difficulties obtaining adequate support when we encountered problems with a batch of handhelds we purchased in the project's third year.

Lesson 4: Focus on the classroom context in teacher professional development. Teachers need opportunities to learn how to plan for the integration of handheld software into their instructional activities. At each teacher workshop, we engaged teachers in analyzing their own standards and curriculum for opportunities to integrate WHIRL software as assessment tools. We also asked teachers to bring in examples of student work generated within the software and engaged in discussions about what the work revealed about what their students knew and could do. Teachers reported that this aspect of their formal professional development was particularly valuable to them, because they got so many new ideas from their colleagues about how to integrate the use of the software into their instruction. They also reported that classroom-based assistance—provided by the local learning technology coordinator—was critical in helping them carry out the activities they had planned.

Teachers using handhelds with their students must also be prepared for the complex task of setting up handheld computers for use. Handheld devices must be recharged periodically; if the charge is lost, student data can be lost as well. One way to save student data is to sync the data

with a desktop computer; however, many classrooms have just a few computers they could use for this purpose. Teachers need opportunities to learn about and share strategies for charging, syncing, and storing handheld computers in the classroom. In Project WHIRL, we constructed special charging stations that allowed all handhelds in a classroom set to be charged all at once. Instead of syncing each device to a desktop, teachers designated one handheld as a *collector device*. This device served as a repository for student work that was to be saved.

Handheld computers also require planning for different kinds of classroom communication than are typical. For example, teacher-to-student communication was handled by using an infrared beam to send both software and student assessments with a "cascading" method. The teacher beamed an assessment to two students, who then each beamed it to two more students, and so forth, until the entire class had the assignment. Student-to-student communication was also supported by this peer beaming strategy, and student-to-teacher communication involved students' beaming their work to the collector device, which was then synced to the teacher's own desktop computer to preserve student work. Teacher-to-class communication was facilitated by document cameras attached to a video display; these allowed a teacher to show the entire class work from the collector device and then discuss the work of the entire class.

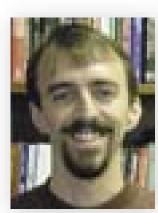
Lesson 5: Use data from early users to decide how to evaluate success. A critical task for researchers is to help initiative leaders decide how to evaluate their success. Although this task may seem straightforward, in fact handheld computers are so new that we understand very little about how they change instruction, alter communication patterns, or influence student learning.

A good strategy is to rely on classroom observations and interviews with teachers who are involved early in the project, and then to analyze the data collaboratively to identify the most visible effects of introducing handhelds to the classroom. SRI researchers worked closely with design team teachers in the second year of the project as they implemented prototypes of the software with their students, and then the design teams analyzed the results of those trials in group meetings. Those analyses helped inform the design of the software, and they also led us to form some hypotheses of specific effects on instruction we expected to see in the third year. We then designed interviews, observation protocols, and survey instruments to test those hypotheses. The advantage of adopting this approach was that our instruments proved sensitive to the kinds of effects the initiative had on teachers and students.

Expectations

Two of the preliminary outcomes we have observed from Project WHIRL are changes in teachers' thinking about assessment and increases in the level of teachers' technology integration into science teaching. Most of the teachers in the project were more likely to report that they used classroom assessment data to adjust their instruction. They also reported that they were able to assess students more frequently because the handheld software programs saved them time. The teachers who began the project in 2002–03 were, by and large, infrequent users of technology with their students. But by the end of Project WHIRL, technology use had become a frequent, integral part of instruction for most of the teachers.

This last outcome—better integration of technology in the curriculum—may be a secondary goal that is possible for many handheld initiatives to achieve, even if an initiative is not focused on improving classroom assessment. In this respect, one of the key promises of handheld computers—to increase dramatically students' access to technology—can be realized. But an even more important goal—increasing students' opportunity to learn with technology—may also be achieved, although the details will differ, depending on the educational focus of the handheld initiative. Success in achieving this final goal depends on the match of the initiative's focus with the capabilities and limitations of handheld computers and on the support given to teachers who must implement the program.



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