Integrating Palm Hand-held Technology into the Web-based Inquiry Science Environment (WISE)

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ABSTRACT

We describe a program of research to explore how Palm Pilot technology can facilitate inquiry activities in K-12 science and mathematics curriculum. This research was conducted within the context of the Web-based Inquiry Science Environment (WISE) project, which addresses fundamental questions concerning the role of inquiry and technology in science education. Working in close collaboration with two large school districts, we developed new approaches for integrating Palm applications into existing WISE curriculum. We developed a sophisticated and generalized solution to enable hand held survey and observation forms that can be uploaded into a class data set.

Keywords

Inquiry, Palm Pilots, Learning Environment, Handheld, Curriculum, Science Education, Internet, Web

WISE: THE WEB-BASED INQUIRY SCIENCE ENVIRONMENT

This paper will present an innovative application of hand held technology for science education. For the past seven years, the Web-based Inquiry Science Environment (WISE) project, funded by the National Science Foundation, has explored the most effective designs for inquiry activities that draw upon the wealth of available Web resources. The designs of the WISE learning environment, inquiry curriculum and assessments are based on a pedagogical framework called Scaffolded Knowledge Integration. This framework, developed by Dr. Marcia Linn and her colleagues (Linn and Hsi, 2000), has been developed through twenty years of classroom research with technology and inquiry (Linn and Songer, 1982, Bell, Davis and Linn, 1995; Slotta and Linn, 2000).

WISE offers a powerful browser-based learning environment for middle and high school inquiry science projects. Students work collaboratively in these projects, actively using materials and software from the World Wide Web. In one project, students evaluate the health of a local creek, modeling the factors that contribute to pollution. In another, they compare two competing theories about why deformed frogs are appearing in American waterways. On the left-hand side of the student's Web browser window, WISE provides an "inquiry map" that coordinates all project activities. Students click on steps within this map, resulting in Web materials, pop-up notes or hints, or any of a variety of other tools and features, such as online discussions, journals , causal maps, data visualizations, and an argument editor. Throughout the WISE project, students are scaffolded by the Inquiry Map as they work collaboratively to perform carefully designed inquiry projects

This learning environment technology is accompanied by teacher support tools that enable classroom management, student assessment, monitoring of student work and formative feedback during a project run. Teachers choose from a library of projects, each accompanied by a lesson plan, assessments, scoring rubrics, connections to standards, and opportunities to customize the project to local issues and curriculum topics. The reader is invited to go to our project Web site (*http://wise.berkeley.edu*) where s/he will find rich descriptions of the WISE learning environment, the project library, teacher supports, and an html slide show. Many projects are available, in all science topics for students in grades 4-12. More than 2000 teachers have run WISE projects in their classrooms.

We have researched the effectiveness of WISE activities for student understanding in a wide range of classroom studies. All WISE activities are assessed by pre-post and embedded assessments of students' understanding of the science content. WISE fosters lifelong science learning skills related to critique of evidence, debate of arguments, and design of personally relevant solutions (Linn and Slotta, 2000). We have also begun to research the challenges faced by science teachers as they adopt our innovative technology and inquiry methods. Working in close partnership with two large school districts -- Denver Public Schools (Colorado), and Desert Sands Unified School District (California), we have helped science teachers integrate WISE activities with their courses, and developed networks of WISE mentors within the districts to help offer support

In conjunction with these school district partnerships, we were recently awarded a grant of 500 Palm IIIc devices from *The SRI Palm Education Partnership*. In researching effective uses for hand held technology in education. we proposed to develop Palm activities that would benefit from the scaffolding of the WISE technology and inquiry curriculum. We sought to enable new kinds of activities like data collection, surveys and field observations. The resulting student-collected data could then be uploaded for subsequent use within the WISE activities.

WISE USE OF HAND HELD TECHNOLOGIES

We seek to leverage the strength of the WISE technology and curriculum to provide powerful new applications for hand held technologies. The scaffolding of the learning environment, and the instructional context of WISE inquiry projects will allow meaningful new possibilities for the use of these hand held computers in meaningful ways. For example, working in the *WISE Genetically Modified Foods* project, students download a carefully designed survey into their Palm Pilots, then

interview their friends and family between classes or after school (e.g., collecting age, gender, dietary habits, and beliefs about GM Foods). The survey data from all students is then be uploaded into WISE, providing a collaborative data set for the students to use as they debate whether GM foods are dangerous. Alternatively, Palm Pilots could be used for field survey and data collection in the *WISE Healthy Creeks* project, or to help guide students as they visit the aquarium in conjunction with the WISE *Aquarium Conspiracy* project. Such activities put the hand held computer to good use in service to a broader curriculum context.

We identified four "distinctive features" of Palm Pilot computers that expand the functionality of WISE: (a) *portability* for remote functions like surveys and data collection; (b)*beaming* to enable students to share information or receive supplemental information while performing observations, (c) *touch screen functionality*, to enable ease of data input, and (d) *synching capability* to allow data upload and download from a PC and even from the Web. We sought to develop a system that would enable diverse educational applications, capitalizing on these four distinctive features. We therefore sought a general solution that would support diverse form data input into Palms for subsequent use within a WISE project . We were challenged to develop a solution for downloading information from our Web server to the student's Palm Pilot cradle, and a corresponding upload process where students "hot synch" their Palm Pilots, to transfer data from the Palm to their PC, and then on to our Web server.

WISE-PALM INTEGRATION: HOW WE SOLVED THESE PROBLEMS

We began our design process by articulating detailed user scenarios and system requirements. Based on these functional specifications, we articulated four main technology functions that would be required. (1) Palm data entry: some means of enabling students to input form data into a hand held computer was necessary. (2) Authoring of data entry forms: some generalized means of form authoring, to enable a wide range of Palm activities. (3) Interfacing Palm and WISE platforms: some means of downloading the blank input forms from the WISE project to the Palm application, and then returning the data back to WISE. (4) Data display and manipulation: some way of assembling and presenting the data into a meaningful format for students to use within their WISE browser window.

The result of our efforts is the WISE-Palm *Survey Your Surroundings* application. For any WISE project, a survey or set of observation forms are defined, each accommodating one Palm screen with a set of controls (e.g., check boxes, radio buttons, text entry fields) that are generally configurable. One item at a time is displayed, enabling the student to progress step-wise through the interview or observations. The software saves all of the form entries until the student "submits" his or her observations through the AvantGo custom Hotsync and ultimately into the collaborative database. Once loaded into WISE, the data can be viewed by students in aggregate form. Using data visualizing tools developed at Berkeley and elsewhere, students look at graphs, and plots of different categories of their data in an accompanying WISE project, scaffolded by hints and reflection notes.

This hand-held survey tool provides a perfect application for Palms within the broader context of a WISE inquiry project. Students are able to ask questions of their personal environments, then upload the data to be observed in aggregated form--providing a powerful source of inquiry content. In the process, students learn to evaluate information sources, to develop syntheses and clarity on issues that are confounding to others, to use data for knowledge development, interviewing skills, assessment practices, and self-monitoring opportunities.

REFERENCES

Bell, P., Davis, E. A., & Linn, M. C. (1995). The Knowledge Integration Environment: Theory and design. In J. L. Schnase & E. L. Cunnius (Eds.), Proceedings of CSCL '95, Bloomington, IN (pp. 14–21). Mahwah: Erlbaum.

Linn, M. C., & Hsi, S. (2000). Computers, Teachers, Peers: Science Learning Partners. Mahwah: Erlbaum.

Linn, M.C. & Slotta, J.D. (2000). WISE Science. Educational Leadership. Alexandria: Association for Supervision and Curriculum Development

Slotta, J., & Linn, M. C. (2000). How do students make sense of Internet resources in the science classroom? In M. In Jacobson, M. J. & Kozma, R. (Ed.), Learning the Sciences of the 21st Century. Hilldale, NJ:LEA