Using A Wireless Pocket PC-based Classroom Response System

Dean A. Zollman[1], N. Sanjay Rebello[2]

*[1,2] Physics Department, Kansas State University,
116 Cardwell Hall, Manhattan, Kansas 66506-2601 U.S.A.*

Abstract

Research [1] has shown that students learn through active participation. However, in most large classes are not conducive to active learning. We have developed and implemented a classroom response system to address this need. Students use 40 wireless HP iPAQ Pocket PCs to communicate with the instructor in a classroom. Using a web-based interface the instructor poses questions to students who think, discuss with each other, respond the question, and receive feedback based on their answers. Our system keeps students actively involved during class, promotes student-student interaction, and provides real-time feedback about student learning. The use of Pocket PCs allows for various types of questions (textual, graphic, and video) which are not possible on "clicker" based systems. Our evaluation indicates that a majority of students believe that the systems have positively impacted their learning. Nearly two-thirds of the students also believe that their experience with this system has made it more likely for them to use it in their own classes when they become teachers. In this paper we describe our system and present results from student surveys.

Goals of the Project

The HP Pocket PC used in this projects model IPAQ550 that was obtained from a Technology for Teaching in Higher Education [2] grant from Hewlett Packard Corporation in summer 2004. The grant provided for 40 Pocket PCs, a cart to house and recharge the Pocket PCs, an instructor's tablet PC and other computer accessories. Figure 1 shows the Pocket PC that was used in this project.

Fig. 1. *The HP iPAQ 550 Pocket PC this project*

The overarching goal of our 2004 HP Technology for Teaching Grant was to enhance student learning through the use of a wireless classroom interaction system. The objectives were to:

(1) Deploy a state-of-the-art wireless system in physics classrooms that utilizes 40 HP iPAQ Pocket PCs for students to interact in real-time with the instructor.
(2) Develop and adapt software that allows the instructor to transmit questions and collect and analyze students' responses in real-time in the classroom.
(3) Implement the system in a large enrollment physics class for elementary education majors (future elementary teachers).
(4) Collect and analyze data on student use of the system in terms of user-friendliness and student learning.

Logistics

Several logistical issues needed to be considered in the implementation of this classroom response system. First, the room had to be prepared with wireless access. The University Information Technology services installed and tested the system prior to the start of the semester. Additionally, we needed to keep track of the rather expensive Pocket PCs. Just before class a student assistant placed the Pocket PCs into numbered holders so that we could keep track of which machines were being used. Each Pocket PC was marked and labelled. The classroom response system was used in a class with about 90 students. The Pocket PCs were stored in a dedicated cart that was plugged into an electrical outlet so that they could charge overnight. Very few of the students had used a PDA before taking this class, therefore on the first day of class the instructor spent significant time in going over the use of the systems, and providing assistance to the students to logon and navigate to the right page. However, the students were quick to learn and soon were able to use the system with few problems. For each class one or two student assistants walked around the lecture hall assisting students with using the systems. Students did not have any significant problems using the Pocket PC per se, however on several occasions there were problems because the systems would lose connections with the wireless network. During these times the assistants would help the students reconnect to the network. The instructor would typically transmit about 4-5 questions during each 50 minute class. The questions included multiple-choice, short answer, and ranking tasks.

Software

We experimented with at least two different kinds of software and finally settled on the software developed at Kansas State University called the 'K-State Survey System.' This software was originally designed for administering online surveys. However, it allowed for creation of different question types as well as dynamic display of student responses as the questions were being answered. Therefore, for the most part the 'Survey System' software met our needs. One important drawback however was that it was not possible to track individual student responses during a session and it was not possible to create questions on the fly. The latter is an important feature that can help the instructor conduct real-time formative assessment of student learning in the classroom whenever he/she senses that students are not understanding the material that is being discussed. Finally, the software did not allow for questions to be sequentially popped to the students. Rather the questions were always available to the student and she/he could always logon and answer the questions without really participating in the lecture. We are currently developing and testing a new version of the software that addresses some of the drawbacks of the previously used software.

Student Attitudes about Impact on Learning

Although we used the system in more than one class we focus here on our results of students in the large enrolment class taken by future elementary teachers. We surveyed these students to ascertain the impact of the system on their learning of the concepts presented in class as well as their attitudes toward this technology. The class enrolling a total about 90 students were surveyed using a 5-point Likert scale. Students' attitudes toward the impact of the system were measured along two dimensions: Conceptual learning and Technology Learning. Highlights of the results are shown in Table 1 and Table 2 below.

Table 1. *Student attitudes about impact on conceptual learning*

% Agree or Strongly Agree	
Responding to questions on iPAQs helped learn concepts.	**63%**
Interactions with students via iPAQs helped learn concepts.	**61%**
iPAQs provided useful feedback to instructor about our learning.	**70%**
iPAQs helped instructor address our misunderstandings.	**79%**

Table 2. *Student attitudes about impact on technology learning*

% Agree or Strongly Agree	
iPAQs are user-friendly with seldom any technical difficulties.	**50%**
iPAQ software is user-friendly and directions for use were clear.	**72%**
Recommend that other professors use iPAQs in their classes.	**57%**
Now more inclined than before to use iPAQs in their own teaching.	**79%**

Anecdotally, we also found that students tended to be more alert in class when using iPAQs. They also responded more frequently to instructor's questions because they had been given the time to think, discuss and respond to these questions on the iPAQ. Similarly, they were also more likely to raise questions of their own.

The key findings gleaned from the results above indicate an overall positive impact. Students…

- overwhelmingly liked the fact that the iPAQs provided feedback to the instructor who became more aware of and responsive to their lack of understanding during the lecture.
- mostly believed that responding to questions on iPAQs and interacting with other students in the process was beneficial to their learning.
- overwhelmingly were more likely, after this experience to use this technology in their future career roles – especially heartening since these students were future elementary teachers!
- mostly found the iPAQs and the software to be user-friendly.

Project Outcomes

The project has met its overarching goals described earlier in this paper. We have met each of the objectives as follows.

(1) The Office of Information Technology at K-State has provided wireless internet everywhere in the physics department building. Additional wireless access points were installed in a lecture hall seating up to 90 students.

(2) We have adapted the in-house K-State Online Survey System for real-time classroom communication. The system provides for easy creation and transmission of questions as well as data collection and display in real-time.

(3) We have implemented the system in two physics classes – one large-enrollment introductory class and one small-enrollment intermediate level physics class.

(4) We have conducted a feedback survey on student use of the system and identified specific issues that we plan to address in the proposed project.

Project Visibility

Our project has gained visibility locally, nationally and on the Web. In addition to our website (http://web.phys.ksu.edu/HP_project), our project was featured in an article on *Newswise* (http://www.newswise.com/articles/view/510080/) titled "Professor Examines Practical Ways to use PDAs in the Classroom." Our talk at the 130th National Meeting of the American Association of Physics Teachers in January 2005 described HP iPAQs and other response systems at KSU (http://www.aapt.org/AbstractSearch/FullAbstract.cfm?KeyID=10935). The meeting was attended by about 1000 physics educators. At the local level, use of the iPAQs was described in a KSU physics department colloquium in Fall 2004.

Future Challenges

Based on the results of our project, we have identified three challenges, each of which is will be addressed in the near future, and requires expansion of the current project in terms of obtaining more Pocket PCs:

(1) A large majority (~75%) believed that iPAQs aided real-time instructor feedback, however fewer (~60%) believed that responding on the iPAQs was helpful. A vast majority (~80%) is likely to use iPAQs as teachers, but fewer (~57%) would like more college professors using it. Anecdotal evidence revealed that these dichotomous views were due to difficulties in sharing iPAQs between 2-3 students in large classes

(2) A different challenge emerged for low-enrollment classes. In addition to the iPAQs these students needed other computers for running simulation software (e.g. LabVIEW™) and interfacing with instruments. They found it cumbersome to go back and forth between them. The use of wireless HP Tablet PCs for the low-enrollment classes that need the greater functionality of a computer, but still afford the mobility of a Pocket PC would be advisable. Therefore the solution for low-enrolment classes may lie in the use of a different technology – Tablet PCs instead of Pocket PCs.

(3) We found the K-State survey system to be the optimum software solution. However, as indicated earlier in this paper, this software needs some additional features, e.g. pop-up questions on demand, interface with university database, etc. We hope to develop a dedicate software to run the system. We have already developed a prototype version and are pilot-testing it in the classroom this semester.

Overall, the project has been successful. We have learned the issues pertaining to the development and deployment of such a system and hope to address some of the aforementioned challenges in the near future.

[1] R. R. Hake, " Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses", American Journal of Physics **66**, 64 (2005).

[2] This work is supported in part by the 2004 HP Technology for Teaching Grant.