The second Pervasive Computing Education Workshop (PerEd 09; http://cseweb.ucsd.edu/~wgg/PerEd2009) was held in conjunction with the 11th International Conference on Ubiquitous Computing (Ubicomp 09) in Orlando, Florida. It had been five years since the first PerEd workshop in 2004 (http://doi.ieeecomputersociety.org/10.1109/PERCOMW.2004.10008) and six years since the formative Ubicomp Education Workshop at Ubicomp 03 (http://doi.ieeecomputersociety.org/10.1109/PERCOMW.2004.1276936). So PerEd 09 was an important opportunity to get an update on the state of ubiquitous computing education.

I was one of the workshop’s organizers, together with Scott Midkiff and Gregory Abowd. We hoped to see a lot of progress since the earlier workshops, and we did. Ubicomp education has, in a word, arrived.

THE INVITATION AND FORMAT

We invited papers describing both early and mature results across a broad range of topics, including course content, pedagogy, teaching materials, case studies, class projects, toolkits, and educational tools. We also invited two speakers whose work in ubiquitous computing education had caught our attention.

Originally, we planned to include panels and discussions, but we received such a wide range of papers that we limited ourselves to a closing discussion on the state of ubicomp education. Instead, we allocated a half-hour to each of five accepted papers (http://cseweb.ucsd.edu/~wgg/PerEd2009/PerEd-2009-Proceedings.pdf), and gave half this time to a discussion led by a workshop program committee member, who read the paper prior to the workshop and prepared a statement to kick off the discussion. We wanted to raise the level of discussion by basing it on a carefully considered, fully articulated response, rather than off-the-cuff remarks. I thought this was a big success, as the discussants’ commentaries were uniquely substantive, and the ensuing discussions were constructive and deep.

PROGRAM HIGHLIGHTS

Leah Buechley of the MIT Media Lab opened the workshop with a keynote about her work with computational textiles and paper sketchbooks in early computer science education.

Figure 1. The LilyPad Arduino e-textile main board. Leah Buechley developed the technology and designed it in cooperation with Sparkfun Electronics. (Photo used by permission from Sparkfun Electronics.)

Buechley invented the LilyPad Arduino (http://web.media.mit.edu/~leah/LilyPad), a derivative of the open source Arduino embedded-computing platform (www.arduino.cc).

The LilyPad Arduino (see Figure 1) lets designers incorporate computing into clothing in the form of actuated lights, sounds, and the like. Buechley has successfully used this platform to introduce young teens, notably women, to computing. She demonstrated the device, showing some clothing designed with it, as well as a prototype paper sketchbook that translates the LilyPad Arduino’s features to paper constructs. Attendees were inspired by the platform’s possibilities in terms of both expression and inspiration. However,
some aspects—for example, a C-like programming language—seemed to be a limitation for many students. Buechley acknowledged this issue, but she said the programming required was often quite elementary, and students could be walked through the process.

The Arduino also figured in a paper from Mike Richards and John Woodthorpe of the UK’s Open University. They described a new introductory programming class, My Digital Life (TU 100), designed around ubiquitous computing. Open University is a nonresident campus, and distance learning is a mainstay of its curriculum delivery. The authors created a one-piece Arduino unit for first-time programming students. In addition to an Arduino board, the unit has a few sensors and actuators. The all-in-one packaging eases deployment and avoids points of failure such as stress on connectors. Richards and Woodthorpe also designed a Scratch-based visual programming language for the class, which is compiled down to Arduino’s C-like language. The attendees noted that such a language could make the LilyPad Arduino more accessible. At the time of the workshop, the course hadn’t run yet, so we eagerly await the results.

Gregory Abowd was the discussant for the Richards and Woodthorpe paper. He noted that there had always been a tension between including ubiquity in a topical course like operating systems and teaching it in a separate course. Indeed, ubiquitous computing touches on virtually all aspects of computing, and when it eventually becomes the computing norm rather than the exception, all topical courses could have a ubiquitous flavor. Then, teaching it as a separate course would no longer be necessary. Richards and Woodthorpe signaled that this time might be closer than we once thought.

Another paper, presented by Roshni Malani, described three projects addressing digital note-taking in classroom lectures. All three projects use the Ubiquitous Presenter (UP) platform (http://up.ucsd.edu), which lets an instructor write on slides and lets students view the results online, both during and after class.

NoteBlogger, the first project, is a Web tool that lets students “look over the shoulder” of a few selected note takers for the class. The note taker uses a TabletPC application to make notes on top of the instructor’s slides, while other students use any Web-capable wireless device to view the results. The second project, IntegrativeNotes, is like NoteBlogger, but the note taker uses Livescribe pens (www.livescribe.com), based on the Anoto digital pen-and-paper platform (www.anoto.com). The note takers upload these notes after class, which UP then attaches to the instructor’s slides.

The third project, SearchNotes, treats students’ in-class Web searches like notes and shares them out to the class live, attached to the instructor slide that prompted the search. Experiments have shown that public notes are a valuable resource for both the note takers and the other students, but some students didn’t like SearchNotes so much because it didn’t allow for expressing analyses or conclusions—the information was too raw.

As the discussant for this presentation, Abowd noted that he had envisioned these types of applications years ago when working on Classroom 2000, and was happy to see them come to fruition.

The workshop featured three other presentations. Gerrit Kahl and his colleagues described a shopping-cart-based learning system for toddlers that engaged them by using the parent’s shopping activities as part of the input. I described a prototyping infrastructure that my students developed for mobile context-aware computing on smart phones, and Sebastian Bader and his colleagues presented their design for a ubicomp course at University of Rostock, Germany.

To close the workshop, John Krumm talked about his new textbook, Ubiquitous Computing Fundamentals, a volume of tutorials he edited with contributions from many authors. Krumm focused on the process of putting such a book together—the challenges of scoping it, recruiting authors, and pulling all the pieces together in a timely manner. Alan Apt, the publisher’s representative, was present for the discussion, which addressed the book’s content.

A question arose about the book’s lack of a section dedicated to hardware. Krumm observed that the shelf life of such a chapter would have been very short, given how fast ubicomp hardware has evolved. The Arduino platform is a case in point; it didn’t exist at the book’s inception but was a major force by the time of its publication. Another example is the pen-and-screen-based TabletPC: after many years on its own, it now has partners in the Anoto digital pen-and-paper technology and the touch-based Apple iPad. This spurred a short discussion on the affordances of a traditional textbook versus a live, digital “text” maintained on the Web.

Just six years after the first Pervasive Computing Education Workshop, ubicomp has hit education’s mainstream. We have a textbook. We have great, affordable tools in the open Arduino platform, several smart phone platforms, various Anoto pen platforms, and TabletPCs—just to name the tools that showed up in this workshop. These tools aren’t being used just in ubicomp classes. They’re being used in general introductions to computing. In other words, these tools work.

PerEd will be held again at Ubicomp 2010 this September in Denmark.

William G. Griswold is a professor in the Computer Science and Engineering Department at the University of California, San Diego. Contact him at wgg@cs.ucsd.edu.