Panel: Beyond First Impressions and Fine Farewells: Electronic Tangibles Throughout the Curriculum

Jennifer S. Kay (Moderator)
Computer Science Department
Rowan University
Glassboro, NJ 08028
kay@rowan.edu

Frank Klassner
Computing Sciences Department
Villanova University
Villanova, PA 19085
frank.klassner@villanova.edu

Fred G. Martin
Department of Computer Science
University of Massachusetts Lowell
Lowell, MA 01854
fredm@cs.uml.edu

David P. Miller
School of Aerospace & Mechanical Engineering
University of Oklahoma
Norman, OK 73019
dpmiller@ou.edu

Keith J. O'Hara
Computer Science Program
Bard College
Annandale-on-Hudson, NY 12504
kohara@bard.edu

Summary

Electronic Tangibles are being used routinely throughout the K-20 education system to teach everything from basic technology to advanced computer science courses; however, there is often a gap between the senior year in high school or freshman year of college and the senior year in college. This panel will discuss if it possible and desirable to integrate electronic tangibles throughout the curriculum, and if so, how?

As educators, we have high hopes for Electronic Tangibles (ETs), we expect ETs to:

- Interest more students in the study of computing
- Broaden students' views of computing
- Invite non-majors to learn something about the computing
- Attract students to computer science as a major
- Help students learn about particular ETs
- Attract students to our classes by incorporating a flashy ET in the course material
- Improve student understanding of some difficult topics
- Maintain student interest throughout the class

However some important questions arise: Can we and should we extend these benefits throughout the K-20 curriculum? And if we can't, are we guilty of bait-and-switch?

This is a somewhat atypical panel proposal. We propose to use only a few minutes of our allotted time to present short (provocative) position statements. The remaining time would be used as an opportunity for all of the participants at the symposium to discuss the topic with some guidance and reactions from the panelists.

We believe that the topic would be best served by a time slot of 45 minutes to an hour, but understand that such a long period of time might not be available, and think that given at least 30 minutes we could initiate a valuable discussion.

Jennifer S. Kay

Rowan University began experimenting with the use of Electronic Tangibles in introductory classes with the development of the homegrown MIPPET (Module for Input/Output Programming Projects Enhancing Teaching) board in the late 1990's. The goal was to teach object oriented programming in our Computer Science (CS) 1 course using real objects.

I teach Robotics as an advanced elective and more recently, I have begun using IPRE robots to teach an introductory programming course for non-CS majors. Preliminary data suggest that students seem to find this approach more engaging than our traditional introductory programming course and that they may be more likely to take additional CS courses in the future than their counterparts in the traditional class.

I am torn about the way we use ETs in our classes. On the one hand, I am an enthusiastic proponent of the use of robots in introductory programming courses as both a way to attract students who might not otherwise consider taking a computer science course, and a means to effectively teach programming. But I don't believe that it is feasible or appropriate to use robots throughout the curriculum, and I am very cognizant of the fact that the presentation of materials in subsequent courses is very different from my own.

Frank Klassner

I first worked with Lego Mindstorms in 1999 to enhance an Artificial Intelligence course that had been redesigned around Russell and Norvig's agents paradigm. Since then I have explored the integration of NXT and RCXMindstorms across the computing science curriculum at Villanova University in CS1 courses, operating systems courses, computer architecture courses, and, of course, AI courses. The Mindstorms platform has commonly been perceived as an introductory robotics platform. My work has shown that it more broadly qualifies as an Electronic Tangible in that it can be configured for instructional use on a continuum between "roving robot" and "handheld device."

It is my position that the effort to incorporate Electronic Tangibles, robotic or otherwise, at either end of a curriculum should be complemented with similar efforts across the curriculum. Clearly, incorporation can range from single new projects to complete course redesigns. Regardless of the degree, cross-curriculum incorporation should be considered not only for increasing the cost-effectiveness of acquiring an ET platform, not only for amortizing the pedagogical overhead of learning use an ET platform, but also for delivering on (often unspoken) promises to introductory students about the relevance of an ET platform to their field of study. This last point is especially crucial when the ET platform plays a significant role in convincing a student to major in a computing field.

Fred G. Martin

I am the co-developer of the MIT Handy Board, and in my graduate studies I developed "programmable bricks" and collaborations with teachers that helped launch the LEGO Mindstorms product. Recently, I am collaborating with artists who are also technophiles, and I have co-developed two undergraduate general education courses, Artbotics and Tangible Interaction Design. In both of these courses, students from across majors and class years use Electronic Tangibles (Crickets and the MIT Scratch/PicoBoard system) to develop interactive, engaging displays.

In these courses, students in technical majors work alongside of English, Psychology, and other liberal arts students. It is striking to me how much each group has desire (and fear) to learn about the strengths of the others. The non-technical students often feel clumsy as they learn to use ET in expressive ways, but when they push through these challenges, they have immense pride and satisfaction. Similarly, technical students find great rewards in being able to apply their disciplinary knowledge in humanistic ways.

David P. Miller

I teach a variety of computing/robotics related courses at the undergrad and graduate level at the University of Oklahoma. This includes the engineering computing class for Mechanical and Aerospace majors. In addition, I am the lead instructor for KIPR's Botball and Robots in Residence programs which brings robotics and computer programming into hundreds of elementary, middle and high schools around the world.

There are a wide variety of electronic tangibles, and associated outreach programs that are used at the high school level. They span the range of inspirational to educational. One significant source of disaffected college students are those that have gone through these programs without gaining an understanding of the underlying technologies and the skills needed to be able to exploit them. When they get to college they find that engineering is not a slap dash activity of doing stuff until something seems to work, nor is computer science a bunch of drag and drop steps to get something to move through a maze. Worse yet, the feelings of deification that they got from their high school robot projects are usually put off till their senior year.

It is not clear that anyone is well served from outreach activities that give the impression that everyone can program or be an engineer by disguising what programming and engineering actually are. Similarly, academic programs and society do not benefit by retaining students in engineering programs who are lacking the ability or temperament to do well in such careers. We need to make the tangibles reflect reality, and at the same time distribute them appropriately throughout the academic career so that theory and practice are well integrated.

Keith J. O'Hara

As of Spring 2010, I have taught introductory computing using robotics (the IPRE robots) as a context for three semesters: once at Georgia Tech and twice at Bard College. At Bard College, I have also taught an upper-level robotics class using real robots and simulation, and a non-majors introductory class that explores graphics (Processing) as well as physical computation (Arduino).

Electronic tangibles (ET), while often simple from an operational point of view, provide a rich context for motivation. The programs the students write, as simple as they might be, interact with the richness of the real-world. The relevance gained by using ET in the classroom transcends introductory material and can be advantageous across the curriculum (e.g. operating systems, computer architecture, algorithms). Moreover, the physical platforms are becoming more inexpensive, standard and user-friendly. We are at a point where we can integrate ET throughout the curriculum.