Embedded Computing and Authentic Inquiry in Middle School Science

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It's a temperature sensor, or is it...
a refrigerator performance sensor
a heated fluid lipid detector
a thermal diffusion detector
a breath rate detector
a heating pad efficacy sensor
a wet suit performance sensor
[etc]

It's a light sensor, or is it...
a football rotation sensor
an automobile sensor (headlights)
a persons-entering-the-room sensor
a human/animal leg gait sensor
a solar energy and cloud detector
a late-night snack detector
[etc]

It's a touch sensor, or is it...
a reaction time sensor
an event marker trigger

A rotating football w/light sensor—graph shows release, rise, rotation, fall, catch, and 60 Hz. florescent light flicker.

Teachers’ questions...
These sensors are uncalibrated!
How can I trust anything about them?
How can I make sense of this data—(what version of reality does it represent?)
Why is there noise in my data? How can I get rid of it?

Research questions...
How do teachers’ ideas of inquiry change as they discover the messiness of their own experiments?
As teachers’ notions of inquiry change, how does that of their classroom practice?
How does student learning change as a result of teachers’ changing practice?

Concurrently, the use of classroom robotics has become prevalent across the K-12 grade levels. Much of this robotics work exhibits the characteristics of inquiry-based science: students are highly engaged as they frame problems, experiment, debug problems, and pursue solutions. Why is classroom robotics successful in inspiring students to take charge of their work, while classroom science has trouble getting students' attention?

The key is that agency is in the hands of students. Providing capable, extensible and inviting technology to teachers and students is also important. This project will use and extend research technology—the Handy Cricket microcontroller—with the goal of characterizing and then providing materials that can be readily assimilated into authentic inquiry-based work by teachers and students.

The project includes research and development components. The PI is investigating how beginning and practicing middle school science teachers perform their own inquiry-based science experiments, reflect on and make sense of their own experiences, and then bring these approaches to their students. Subsequently, how these teachers’ students practice science inquiry using Crickets and what they learn will be studied, and compared with the practices and learning of students in control classrooms. The project will create deep linkages between computing science and middle school science content, and develop improved technology for widespread classroom use.

The PI is collaborating closely with faculty and staff of his university's graduate school of education, and is co-teaching sections of science methods courses required of the student-teachers in its program. These individuals and other teachers who participate in professional development workshops will be invited to be involved in classroom trials using project materials and approaches. The development plan includes an international component, extending the PI's previous collaborations with leading educator/researchers in Ireland and Germany.