The importance of keeping it real

A technology teacher explains how he keeps his students engaged

by Dave Peins

Whenever people ask what subject I teach, I always tell them that I am a shop teacher. I have always enjoyed making things with my hands. I derive great satisfaction from completing a project that results in a functional object. I am proud to say that I have taught many children how to work with their hands in many different shop areas. I think that what I enjoy most about what I do is that it is real—it is what it is. I am not pretending to make something or making a model of something. I am making something real, like a clay vessel to hold flowers (something our art teacher introduced me to recently) or a shelf to store my books. These things are real and it feels great. That's why I strive to provide my students with the same experience.

"But I'm not a shop teacher!"

If you are still reading, you may be thinking, "How does this apply to me?" There are many opportunities in academic areas to add realism and accomplish your objectives. Students in an English class could write letters to the editor or offer their services to a local business to write advertising copy for a persuasive writing piece. Social studies assignments could involve students in local politics. Opportunities to keep it real abound in the sciences as well.

For example, a friend of mine who teaches in Pennsylvania had his physics class build a water monitoring station for the Neshaminy Creek. They went to the local building supply store and bought several sizes of PVC pipe, end caps, and some miscellaneous hardware. They made their own salinity, turbidity, temperature, and flow sensors, attached them to a microcontroller, sealed them in tubes, placed them in the creek, and logged data for a week. Students then made spreadsheets to present their data.

Two years ago, another group of students from the same class devised inertial sensors and placed their project on a NASA Spirit rocket that went into space. The inertial switches turned the project on during lift-off and other student-made sensors recorded the second and third stages of the rocket, logging the data to a microcontroller. You can see the results of their experiments on the Web at *www.robodyssey.com/gallery*.

Both of these projects demonstrate my belief that students need to feel that what they are doing while in the process of learning is worth doing now, not some day.

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What is reality?

Ironically, many of my ideas for keeping it real in the classroom come from the fertile minds of science fiction writers like Arthur C. Clark, Orson Scott Card, Greg Bear, Neal Stephenson, and others. In 1978 Isaac Asimov delivered the commencement address at my graduation from Trenton State College. One statement that Asimov made that day has stayed with me all these years. Asimov told us that when asked how he was able to predict the future so accurately, his response was that he and other science fiction authors did not predict the future, they wrote the future. He said that they were the dreamers that wrote about the future so that technologists could make these dreams into reality. With creative new approaches to complex problems, scientists and technologists can find creative new solutions.

Perhaps the only difference between fantasy and reality is in the attitude of the teacher. By not believing that a project could someday become a reality and asking students to "pretend," we doom our projects from the start. Why not look for a real world problem, explore past research on the subject, discuss the state of the art, formulate new proposals, and start working toward a new approach.

How to justify teaching material that is ahead of the curve

I am fortunate to be working in a comprehensive high school with a learning center that recruits student applicants from a large regional district. My students amaze me every day with their energy and sense of purpose. They have incredible focus and constantly push me to work harder.

To build on this enthusiasm, every year I select a topic for the final project in my electronics classes that will cover the material in a way that no one has ever done before—anywhere. Finding topics that no one has addressed yet is not difficult to do. Rehashing the same old experiments becomes boring for both my students and me, and it is too easy for students to find and reproduce prior results. Don't get me wrong, the basics must be covered before attempting the "impossible," but having a lofty goal gives students an incentive for mastering the less exciting content.

I confess it is a little unnerving for me, not knowing what the outcome will be. How will I measure my students' success when I do not even know if we will succeed? But there is another way of looking at the problem. How can you fail if you learn from

your mistakes? There is an old machine shop axiom that says a toolmaker's apprentice is allowed to make every mistake in the book—once. I apply this philosophy to my lessons and my classroom.

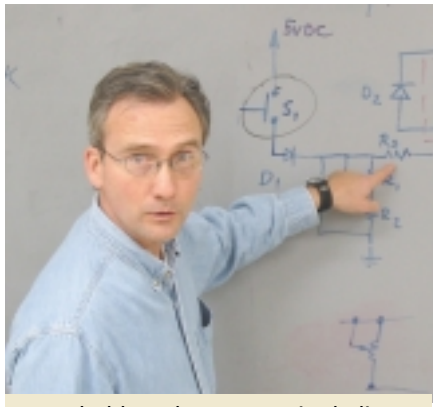
Social robotics in high school?

Let me give you an example of how I keep it real in my classroom. Two years ago, students created digital pheromones so that social robots could recognize and interact with each other. The students worked with four Robodyssey ESRA Expressive Robots. ESRA is a humanoid robotic head that is clearly not human. It is a non-threatening, mechanical robot with its gears showing, but it is recognizable at all levels of human interaction as a face—familiar, intentionally comical, and friendly.

To model a communication scheme for transmitters and receivers, students decided to use pheromones and started researching cockroaches, ants, and bees. They concluded that humans also have the ability to communicate with complex chemical transmitters and receivers, but they decided that real pheromones would be too complex to create within the time limit they had for the project. Face-recognition was another possible approach that they explored. Humans learn to recognize and interpret facial expressions at a very early age. However, this would mean that the robots would need vision and complex software to recognize facial expressions—also too difficult for the time allowed. If the robots could communicate at a simple, invisible level without actually seeing the expression on the other robot by using digital signals, then the human users could observe the expressions and gain a greater level of interaction with their robots.

Students used infrared transmitters and receivers and coded the communications algorithm in software written in a language related to Visual Basic. Students assigned a familiar role to each robot, and assigned an emotional reaction for each interaction, characterized by a series of facial expressions. Students assigned an age and gender to each—an "Old Male," a "Young Male," an "Old Female," and a "Young Female." The class discussed what facial expressions they might observe in each of the 16 possible interactions. They then observed humans in those interactions and recorded examples of possible expressions for those interactions.

With 16 stereotypical responses agreed upon, students redefined the problem as how to make ESRA mimic those expressions so that an outside observer will be able to recognize to which age and gender group each ESRA belongs. After learning how to control the servos on the robots to



Freehold teacher Dave Peins believes that having his students create something "real" keeps them interested.

produce the desired expressions, students wrote code that would cause the desired reaction when each robot was face to face with another robot.

Last year, my students made digital infrared pheromones using transmitters and receivers to create swarms of mobile robots. The students involved in that project are now writing about their experiment for *Servo* magazine and hope to see the article in print some time next year. This year students are going to invent an electronic nose for smelling chemical robot pheromones so that the mobile robot's behaviors can more closely mimic nature.

All of these projects allow students to create something real for immediate use and therefore, generates interest in the subject matter.

It is worth the effort!

The beauty of keeping it real is that teachers become as involved in the project as their students, and there is a greater opportunity to involve all subject areas. Students will seek advice from English teachers on writing and presenting their reports, from science teachers on scientific methods, and from mathematics teachers in organizing and presenting data. By keeping it real, you show your students that you believe in what you are doing—that you love what you are doing, and that you are excited about it. You demonstrate to your students that they too can make a difference in the world now, not some day after they finish school. It takes work and dedication to find and implement the kinds of projects I described, but besides the obvious benefit to the students, there is a hidden dividend for the teacher as well. When you are learning along with your students, teaching becomes an exciting research project and not just a job.

In his book, *The End of Education*, Neil Postman describes reasons that we, as teachers, could cite for supporting public education. My favorite is "Saving the Planet," in which he states that a reason for education is that students will be empowered to save the world by learning and practicing real skills in our classrooms. When that bell rings in the morning, my real life begins. I walk into my laboratory and collaborate with today's hope for tomorrow—our kids.

*David Peins, M.Ed, teaches Electronics at The Learning Center for Science and Engineering, Manalapan High School, Freehold Regional High School District in Englishtown. He currently sits on the Executive Committee of the Monmouth Junior Science Symposium and is the founder and president of Central Jersey Robotics Group amateur robotics users club (*www.cjrobotics.org*). He is the founder and president of Robodyssey Systems, LLC (*www. robodyssey.com*), a manufacturer of robotics platforms; and is a Registered New Jersey Professional Development Provider, providing in-school teacher training in computer programming and robotics and after school and summer youth programs. He has authored numerous articles and made many presentations on topics related to starting robotics clubs and using robotics to teach the sciences. Peins is completing a classroom manual titled,* Basic Electronics for Robotics Hobbyists. *You can reach Peins at* dpein@robodyssey.com.