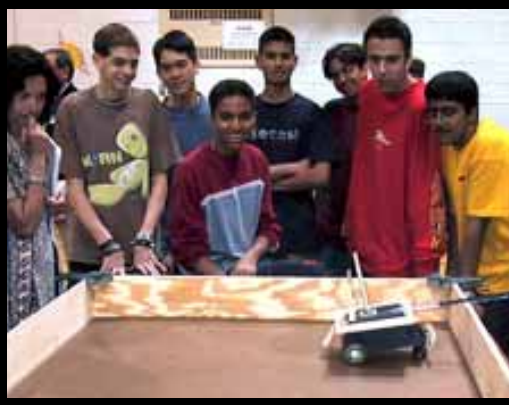

Robotics:

A successful Teaching Strategy

If you are taking the time to read this article, you have no doubt seen the images that accompany the text. The enthusiasm and interest generated by this event is evident on the faces of the participants. Students were on hand all day to compete in the "Robot Melee™," and to present the robots that they had made during the year. The United States Air Force brought the ordinance disposal robot, Andros VII, and allowed students to control the robot. Science teachers attended with their classes and parents, teachers, and representatives from industry were present. The question most often asked by teachers attending the open house was, "How were you able to generate this much interest in a class like Electronics?"

My answer is that the use of robotics as a teaching strategy is the best method I have found yet for generating excitement in my classroom. Technology has finally caught up with science and personal mobile robots that are capable of performing useful tasks are now commercially available. Students watch "Robot Battle" television shows and wear clothing depicting Japanese Animé cartoons that feature humanoid robots, indicating the popularity of robots with students today. Just a few short years ago, popular projects included machinist hammers, gun cabinets, and the "pump lamp". As a teacher of technology, I have continually searched for a strategy that would capture the students' interest and that would allow me to lead students to discover the course content. During the last 15 years I have tried many strategies including rocketry, balloons, kites, boomerangs, hot rods, nomadic furniture, third world technology, and adaptations for people with disabilities. Nothing has created the enthusiasm and participation that I have seen from all levels of students since I started using robotics as a strategy for teaching.

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Robotics:

A successful Teaching Strategy

By David Peins

There is, however, more to this strategy than robots. The game plan for gaining student participation comes from a strong commitment on the teacher's part and the use of reality and realism. Students pretending to make robots that may go to Mars are not as involved as they are if they are building robots that they will someday present to NASA. They will devote all of their spare time, lunches, and study halls to be in your class if what they are making is real. I begin by presenting films that show current state of the art of robotics, including “Robots Rising”. A visit early in the year from the Air Force Explosive Ordinance Disposal Unit helps to convey the complexity and reality of mobile robots in use today. My local Armed Forces' recruiters add to the authenticity by stopping by to see the students at work on their projects. I encourage members of the local engineering community to participate in our program by being available by email to answer student questions.

There is more to developing a successful program than robots and realism. How do you get all the students to buy into your idea? Do you need a special group of students and a teacher whose hobby is robotics? How can students produce mechanisms precise enough to work well without the use of a machine shop? Can technology teachers successfully adopt this method and see similar results?

Students do not always accept that the projects are real; teachers must believe in the project they choose and have a mental image of the story surrounding the project. If students do not accept one idea, try another–like a commercial product such as “The Insane Clowns” or the “Tiki Bar Animatrons”. Don’t underestimate the value of outside support. I have the good fortune of teaching in a high school district that is progressive and supports my efforts. My students receive parental support, and my school hosts a magnet school for Science and Engineering. My hobby is robotics and I have built many robotics circuits. The problem of building robotic platforms with enough precision to operate in a real environment arose early in the development of this program. The first robots my students built were slow, weak, and very unreliable. Over the past three years, the robots have improved by having third and fourth year students assist new students in their design of robot bodies. We began ordering gear head motors, dug through dumpsters, and ordered materials that would be useful for robot bodies. I machine precision hubs, wheels, and legs for robots at my own machine shop to student specifications. I now have a commercially available line of robotics platforms that are basic enough for students to create their own sensors, logic, and control, but are free from having to machine a precision chassis.

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As a technology teacher, you can use the area in which you are most knowledgeable to design your project. The strength of Applied Technology has always been that teachers have areas of expertise in which they are involved outside the classroom. The Web address for robotics platforms is www.robodyssey.com.
Examples of student work can be seen at
http://dpein.home.netcom.com

Here are some premises for design briefs:

The Project

A client, who wishes to remain anonymous, has commissioned the students of this obscure high school in the back-waters of New Jersey to find a solution to the problem of tracking a high intensity light source. Like the military establishment in the story "Ender's Game," by Orson Scott Card, the client realizes that the minds of children have not yet been influenced by existing technologies and have the potential for finding a unique solution to their problem. The only information provided to the students is what they need to know to construct the device. Students formulate questions for the instructor who, having some knowledge of the requirements, can answer directly or pass on the questions to the client for an answer.

Insane Clown Companions

A group of electronics nerds come to grips with the reality that, to be real nerds, they will have to spend hundreds of hours studying. They realize that they may have to literally make their own companions. Coming home from a long day at the lab, it would be great to have a low maintenance friend to turn and greet them with eyes flashing. But what would trigger the robot's response? A sound? A TV remote? Neophyte electrical engineering students, having only light sensors under their belts, must make their "Insane Clown Companions" react to light. The companions have to ignore ambient light and not be easily distracted from light through a window. Using several motor control circuits and a variety of light and dark sensing circuits, each team will devise their own "Clown."

David Peins is a technology teacher at Manalapan High School, Englishtown, NJ and the founder of Robodyssey Systems LLC.

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Tiki Bar Animatrons

In the past few years, there has been a resurgence of the desire to retreat to the tropical islands of the South Pacific. "Tiki Culture" is a state of mind reflected in the whimsical nature of all things "Tiki." After a difficult day at the office, it would be nice to relax at the "Animatronic Tiki Bar", complete with cricket replicants, electronic tiki torches, and parrots. While not true "Robots", the "Animatrons" have sensors, logic, motor controllers, and some form of output. Mastering these methods helps students develop smarter, more mobile robots.

Robot Melee

The object of the Robot Melee is to build a two-wheeled independent drive, autonomous vehicle that will disable other vehicles in the arena by knocking over the other vehicles' antennae. The antenna is a 3/8" diameter dowel with a brass washer making contact at two points so that knocking over the antenna stops the vehicle. The arena is a 4'x 8' surface framed by two by fours and set on a tabletop. Students use identical DC gear motors but may construct bodies from cigar boxes, aluminum channel, or other suitable material. Six cars compete under guidelines developed by the students. The winner is the last vehicle running.

Walking Robots

The task for students is to research alternative means of propulsion for robots. Students may build a Stiquito robot using muscle wire (Shape Memory Alloy [SMA]) or follow the Stiquito model and make piano wire legged walkers. Henry Arnold's "Cricket" can inspire tripod gate cricket-like robots from scratch (The "Ambassador" was made by the instructor using only machinery available in the school shop as an example for the students). Most legged robots will be microprocessor controlled by the Parallax Basic Stamp.