2009 Teacher Quest Tampa Bay Pilot Program

Action Plan

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Lesson Title: Microcontroller Stamp Using Computer Hardware and Software
Grade Level: 9 - 12
Subject Area: Math, Science, Computer Science

Summer Work Experience:
Company: Raytheon Network Centric Systems

Position: Software Technical Support Specialist

My Teacher Quest job as Software Technical Support Specialist at Raytheon involved me in total computer systems infrastructure. I experienced a team environment in the corporate world and participated with project groups. I was well received by my co-workers. I toured the facility, viewing hardware such as a server farm (Windows/Linux), voice and video internet communications, PC support, satellite programming, Cisco router support, and java programming. The software aspect included custom integrations of web semantics, ontologies, and RDF stores using a variety of technologies. I found the experience to be enlightening, as the future is being developed now. I had the task of evaluating trade study document conversion systems. I tested commercial software, rating it according to our needs. Not only did I install potential software, but spent time on product programmability, determining how it would fit into our system architecture. I was able to participate in project demonstrations, which was a big deal with us. Unfortunately, the details of the project are classified and not to be discussed. However, I can say that Raytheon and other companies are in need of American (citizen) engineers.

Steve Park, the Teacher Quest Supervisor at Raytheon, discussed with me the need for more American engineers. Steve is involved in education programs such as Teacher Quest, promoting interest in engineering. While working at Raytheon as a Software Support Technical Specialist, I experienced many data technologies including web semantics, RDF stores and ontologies. Although extremely interesting to software engineers and myself, I could not think of a way to apply those technologies to drive engineering interest to the typical teenage high school student. I turned to discussing with my co-workers their reasons and experiences in becoming engineers. I found that tangible objects to build and program were key motivators. Adam Dennis, a co-worker, explained educational experiences with microprocessor stamping and its impact on his career decision. He emailed me information on microprocessor stamping. I will discuss many things that I learned in corporate environment, but Adam's experience is perfect to integrate into my computer science/math courses.

Lesson Plan/Unit of Study:

Objective(s): Students will learn about microcontroller programming using Visual Basic and the Parallax Basic Stamp Kit. The project introduces how electrical components work and how they are assembled using the Basic Stamp Kit. Students will measure the sensory components: LEDs, pushbuttons, potentiometer, photoresistor, piezospeaker using input/output between the computer and Basic Stamp Kit, while recording data of changes of sensory components. Students will learn elementary robotics by programming the operations of a servo motor.

Sunshine State Standards:

MA.912.A.2.1 - creates a graph to represent a real-world situation.

SC.912.P.10.15 - investigates and explains the relationships among current, voltage, resistance and power.

LA.B.2.2.4 - uses electronic technology, including word-processing software and electronic encyclopedias, to create, revise, retrieve and verify information.

MA.B.4.4.2 - selects and uses appropriate instruments, technology and techniques to measure quantities in order to achieve specified degrees of accuracy in a problem situation.

MA.D.1.4.1 - describes, analyzes and generalizes relationships, patterns and functions using words, symbols, variable, tables and graphs.

MA.E.1.4.1 - interprets data that has been collected, organized, and displayed in charts, tables and plots.

MA.E.3.4.1 - designs and performs real-world statistical experiments that involve more than one variable, then analyzes results and reports findings.

MA.B.4.3.2 - selects and uses appropriate instruments, technology and techniques to measure quantities in order to achieve specified degrees of accuracy in a problem situation.

LA.A.2.4.4 - locates, gathers, analyzes and evaluates written information for a variety of purposes, including research projects, real-world tasks and self-improvement.

LA.A.2.4.6 - selects and uses appropriate study and research skills and tools according to the type of information being gathered or organized, including almanacs, government publications, microfiche, news sources and information services.

LA.A.2.4.8 - synthesizes information from multiple sources to draw conclusions.

SC.H.3.3.6 - knows that no matter who does science and mathematics or invents things or when or where they do it, the knowledge and technology that result can eventually become available to everyone.

SC.H.3.3.7 - knows that computers speed up and extend people's ability to collect, sort and analyze data; prepares research reports and shares data and ideas with others.

Materials: PC with Visual Basic (VB) and spreadsheet software, internet connection for research, Parallax Basic Stamp Kit, which includes: Basic Stamp 2 module, Board of Education Serial Parallax USB to Serial Adapter with cable, Basic Stamp manual, CD-ROM software and documentation, serial cable, "What's a Microcontroller" text, "What's a Microcontroller" parts kit, and complete component listing.

Instructional Procedures: Project time 6 weeks. Student Organization: Group students according to how many stamp kits are available. Recommend 3-4 students per group. Students will work in groups to better facilitate learning and troubleshooting programs and component building.

Week 1 Objective: Introduction to the Basic Stamp and its components. Students learn about the Basic Stamp Kit and its programmability with the computer. Discuss safety and handling of electrical components with students. Using the provided text, teach students about microcontrollers and the electrical parts that interact with them. Students use VB on the computer to make a communication connection (comm port) to the Basic Stamp Kit.

Weeks 2-3 Objectives: Students use the Basic Stamp Kit and Visual Basic to program sensory components and collect data of sensory changes.

Building Unit 1: The Light Show (Programming LEDs): Students program the microcontroller to display different sequences of LEDs lighting on and off.

Building Unit 2: The Concert (Programming piezospeaker): Students program the microcontroller allowing the peizospeaker to produce sounds of various frequencies.

Building Unit 3: The Concert (Programming photoresistor): Students program the microcontroller to receive input from the photoresistor using various sources of light while VB records the change in ohms in VB storing to text file. Students import data into a spreadsheet and graph light data to make correlations between ohm readings.

Building Unit 4: Turn Up the Volume (Programming potentiometer): Students program the microcontroller to receive input from the potentiometer and record voltage output data using VB and a text file. Students import data into spreadsheet and graph voltage data to make correlations between voltage readings. Extension: Students use potentiomenter to dim lights.

Week 4 Objective: Students are introduced to elementary robotics using the Basic Stamp and servo motor. Students program the Basic Stamp using VB to operate a servo motor.

Weeks 5-6 Objectives: Students combine what they have learned in the previous lessons to create their own program using the Basic Stamp to perform a new function. Research using the internet, books, etc. to find three different careers that involve the mathematics, science, and engineering technologies used in their project to present in a PowerPoint slide show.

Integration of Summer Work Experience/Follow-up Activities: Keep in contact with co-workers and have one come as a guest speaker. Arrange a tour of the Raytheon facility.

Assessment Instrument: Teacher will inspect program and hardware configurations and assess level of functionality. Conduct an individual written assessment to verify unit tasks, vocabulary and relevance.
Final Project: Teacher will assess the final project by functionality, difficulty and creativity.
Final Research: Teacher will assess a PowerPoint slide show guided by an oral presentation from the group about three careers that utilize mathematics, science and engineering technologies used in their projects.