"Engineers as Teachers", Technology Pilot Project Report

Project funded by the USC Fund for Innovative Undergraduate Teaching

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Final-Year Report

Screening

The screening process in Fall 2009 involved candidates submitting a one page statement of purpose describing why they are interested in teaching underserved children and their specific skills that will support their involvement. Candidates also needed to submit a letter of recommendation. Surprisingly this method of screening wasn't very effective.

In Spring 2010 we modified the screening process by sending out a general email informing graduate students about a fellowship opportunity. We offered a stipend of $1000 each for four fellowship positions. We received roughly 45 interested applications. We then asked each interested candidate to submit an outline of four lessons that would together tell a story about an electrical engineering/computer science concept through hands-on experiments.

We received 8 such stories. Following this screening, we conducted phone interviews and chose a final four instructors.

Training

The four graduate students were required to come to our "Engineers as Teachers" training program. Each graduate student was paired with an undergraduate student who had already taught one, four-session course. During training, the graduate students developed four lesson plans each based on fundamental electrical engineering concepts. Lesson plans included interactive visual aids, videos, analogies for concepts of electricity and magnetism and hands-on experiments that aligned with the learning objectives.

Graduate students worked with undergraduate students and developed four lesson plans each on the following topics: Electricity and Magnetism, Computer Architecture, Integrated Circuits and Sensors, How TVs work and Wireless Energy.

Implementation

We tested the lesson plans with a total of 59 K-12 students and 13 parents from five schools. Each of the lessons had some hands-on, experimental components that helped students connect the concepts to the real-world.

Course Topic	Course Type	School	No. of participants
Electricity & Magnetism	In-class	Garfield High School	15
Computer Architecture	Family Science	Western Elementary	17 (12 students, 5 parents)
Integrated Circuits and Sensors	Family Science	Woodcrest Elementary	25 (17 students, 8 parents)
How TVs work	In-class	Camino Nuevo Charter School	27
Wireless Energy	In-class	Gompers Middle School	15

Each lesson addresses at least two of the Science Content Standards for California state public schools grades 3-7[1]. In addition to these standards, the inquiry- based nature of all lessons addresses the Investigation and Experimentation standard strand present in California Science Content Standards grades K-12 which reads:

Investigation and Experimentation:
Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.[1]
In all lessons, the majority (45%) of the lesson time was spent inquiring about the content matter and performing experiments in order to investigate these questions.

Name of Course	**Topics covered**	**Relevant California Science Standards**
Computer Architecture	The Computer Architecture curriculum covers the basics of Digital Code, Logic Gates, Single Cycle System, and Efficiency. The goal is to help	Grade 4: Physical Science 1: Electricity and magnetism are related effects that have many useful applications in everyday life. Grade 3: Physical Science 1: Energy and matter have multiple forms and can be changed from one form to another.

[1] Science Content Standards for California Public Schools Kindergarten Through Grade Twelve. Adopted by the California State Board of Education October, 1998, revised 2003.

	participants understand how a computer and computer programming works.	
Integrated Circuits: Sensors	In the Sensors Course, participants learn about the parts of a circuit and how it works. Participants then use this knowledge to create a circuit that can be tested using a sensor.	Grade 4: Physical Science 1: Electricity and magnetism are related effects that have many useful applications in everyday life. Grade 3: Physical Science 1: Energy and matter have multiple forms and can be changed from one form to another.
Wireless Energy	This course explores transformers, how magnetism can create electric fields, and how we can use these fields to our advantage and create electricity.	Grade 4: Physical Science 1: Electricity and magnetism are related effects that have many useful applications in everyday life. Grade 3: Physical Science 1: Energy and matter have multiple forms and can be changed from one form to another.
How a TV Works	This examines the scientific concepts integral to the functioning of a Cathode Ray Tube (CRT). Students learn how and why they see what they do on TV, and create and display images in a similar manner.	Grade 4: Physical Science 1: Electricity and magnetism are related effects that have many useful applications in everyday life. Grade 3: Physical Science 2: Light has a source and travels in a direction. Grade 3: Physical Science 1: Energy and matter have multiple forms and can be changed from one form to another.

Pictures and videos from the courses can be seen here:

How TVs work:
http://picasaweb.google.com/IridescentLearning/HowTVWorksCaminoNuevoCharterSchool?feat=directlink

Integrated Circuits:
http://picasaweb.google.com/IridescentLearning/IntegratedCircuitsWoodcrestElementary?feat=directlink

A video of an interview with a teacher from Western Ave Elementary School about the Family Science Course experience can be accessed here: http://www.youtube.com/watch?v=7jivbSFojFo

Support
We worked with the class teachers and school administrators and provided feedback to the graduate students on methods of instruction, student engagement and effectiveness of the lesson. We also reviewed the lesson plans and presentations online and provided feedback.

Evaluation
We developed an initial pre and post assessment for each course. Results from each were shared in a Final Report. A report from the Wireless Energy course is given at the end of this document.

Dissemination
The graduate students shared curriculum and lessons learned from the experience at the Engineers as Teachers Final Presentation on May, 2010 in front of senior USC faculty and project stakeholders.

Next Steps
We will improve and implement these lesson plans in Family Science Courses in Los Angeles and New York City in Fall 2010.

BUDGET SUMMARY

Materials and supplies for 6 experiments for 15 students = $244
Stipend for five graduate students to develop 25 hands-on lesson plans and five reports = $4756
Total = $5000
Iridescent, the partnering science education nonprofit covered expenses for materials and supplies for four courses reaching 120 K-12 students and their parents.