Engineering Connections for Middle School Science Teachers

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Program Overview

This program is designed to:

- Strengthen science content knowledge
- Develop engineering design process (EDP) experience and skills
- Enhance pedagogy by preparing participating teachers to use online, award-winning curriculum resources developed by CIESE
Program Description

Teachers participate in a week-long summer workshop which is comprised of

• Hands-on science investigations
• Team-based engineering design activities
• Topical areas of Life, Earth, and Physical Science
Examples of the Online Projects

- **International Boiling Point Project** – a global, collaborative experiment to determine which variable has the greatest impact on the temperature at which water boils

- **Human Genetics Project** – a collaborative data collection and analysis activity to understand dominant and recessive genetic traits and their prevalence in the population
Examples of the Online Projects

- **Musical Plates** – an exploration of the relationship among earthquakes, volcanoes, and plate tectonics using real-time earthquake and volcano data from dynamic databases such as the U.S. Geological Survey.

- **Weather Scope** – an activity involving the design and construction of instruments that meteorologists use and creation of a weather learning log to record weather observations.
Engineering Application

• **Musical Plates: What Can I Build On?**
  - Students go through the engineering design process to develop building design strategies capable of withstanding liquefaction.
Program Description

Additional aspects of the program

• Preparation to incorporate workshop activities
  – Implementation plan
  – Action research plan

• Provision of materials
  – Equipment and supplies valued at $250

• Follow-up support
  – At least one classroom visit to support implementation

• Student Innovation Day
Impact of Professional Development

Measured by Internet-based survey
• Pre- and post-workshop
• Focused on:
  – Teachers’ sense of self-efficacy
  – Teacher and student activities in the classroom
  – Value of specific workshop activities
  – Effect on knowledge of content and pedagogy
More than 80% of teachers reported that their knowledge in 8 areas increased either considerably or moderately.

*Figure 4:* Percent of teachers who responded that the summer workshop increased their knowledge of the listed topics a considerable or moderate amount.

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• More than half of the activities were perceived to be very valuable to 90% of teachers.

• All activities were considered to be very valuable to at least half of the teachers.

**Figure 5:** Percent of teachers who stated that each of the listed workshop activities was very valuable. (N=31)
Measurement of Teachers’ Self-Efficacy

Scale score of self-efficacy is constructed
- Based on teachers’ responses to 14 statements
- Three focal areas contribute to scale score
  • Content knowledge (6 statements)
  • Engineering (4 statements)
  • Technology/computers (4 statements)

• Three administrations: Pre-workshop, Post-workshop, End of academic year
• Almost all teachers’ self-efficacy score increased in at least one area.

• Statistically significant increase in teachers’ self-efficacy with respect to engineering based on a comparison of pre/post scores \((t = 3.915; p = .001)\).

Figure 6: Teachers with increased self-efficacy in each of three focal areas based on a composite score. (N=28)
Follow-up Work on Program Impact

- Survey teachers at end of academic year
  - Classroom practices
  - Perceptions of student impact
  - Self-efficacy
- Qualitative and quantitative data from action research studies
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