Impact of Attending a Research Experience for Teachers Program with International and Societally Relevant Components

We report evidence of impact on 23 in-service teachers from high-need, low-SES rural school districts in Appalachia across three annual iterations of a NSF-funded Research Experience for Teachers (RET) program. Novel elements of our program situated engineering research, educational experiences, and problem-based pedagogy in societally relevant energy and environment contexts in engineering laboratories and secondary schools in the eastern United States and in the United Kingdom.

Sample research programs teachers engaged:

1. Materials for Energy Efficiency: Investigation of process-structure-property relationships in developing highly insulating aerogel blanket materials and solar reflecting polymer films for energy efficient windows. This work included thermal measurements, surface characterization, optical measurements, and electron microscopy.

2. Energy Efficiency for Transportation: Investigation of energy wastage during vehicle operation and possibilities for energy recovery. This work included data logging, a vehicle-road load model, and experimentation with hybrid electric-drive systems.

The international component included:

1. Research in engineering labs in the United Kingdom to develop a global context for research and development in energy and the environment. These labs were coordinated around hydrogen as a fuel source, investigating multiple approaches to generation, storage, utilization, and scaling up.

2. Observation in UK secondary schools utilizing problem-based learning (PBL) with diverse student populations, followed by focus group discussions among participating teachers and faculty regarding similarities and differences across contexts.

We worked as a multidisciplinary team integrating skill sets and perspectives from a Department of Mechanical and Aerospace Engineering, a Department of Technology, Learning, and Culture, and a Program Evaluation and Research Center. This brought together expertise shaped through experience in engineering bench science, social and educational research, teaching and learning in secondary schools, and evaluation of externally funded education programs. Perspectives common across team members included the importance of hands-on experience in societally relevant contexts to drive learning and a commitment to utilizing mixed methodological evaluation for continuous quality improvement. The first of these drove the design of the RET to include hands-on research experience for teachers in engineering research labs in two nations and to include PBL as a pedagogical tool to bring teachers’ RET experiences into their classrooms. We chose energy and environment as a societally relevant theme through which teachers’ engineering research experiences and PBL lessons would motivate learners. Our program evaluation perspective kept us focused on key project outcomes to provide continuous quantitative and qualitative feedback from participating teachers and project personnel to improve the program as it unfolded.
In the full paper, we will describe significant and meaningful impact on teacher content knowledge and attitudes toward science and engineering, increased appreciation of relationships tying science fundamentals to technology applications and economic development, and the impact on teachers of the international component (UK research, school observation, and cultural experience). Quantitative and qualitative evidence for impact includes pre/post surveys (Likert-type and open-ended), teacher content knowledge tests (Force Concept Inventory, Calculus Readiness, AP Chemistry), school observation focus groups, exit interviews, written reflections on school observations, and evaluator field notes.
References


