Revolutionizing engineering and computer science Departments (RED)

Elliot P. Douglas
Program Director
Engineering Education

ENG Advisory Comm
October 21, 2015
NSF Engineering Education History

“Reform”

Capacity building for “Rigorous Research”

Revolution!

1980
Reagan eliminates NSF Education programs

1985
Nam Stuh/Neal Report
Lab/curr reform

1990
Education Coalitions

1995
EC-2000 EGR of 2020

2000
Dept Level Reform

2005
Eng Ed CAREER

2010
EngEd PhDs, JEE

Engineering Education Research

2020
Bridging Research & Practice

RED
NSF Education Initiatives

• Professional Formation of Engineers (PFE)
  – The formal and informal processes and value systems by which people become engineers.
  – “To form is more ontological than to instruct or educate, for one’s entire being is at stake.”

• Improving Undergraduate STEM Education (IUSE)
  – The key guiding principle of IUSE is to ensure focused, strategic investments that address the greatest challenges in U.S. undergraduate STEM education.

Engineering Education at NSF

• EEC Programs
  – RED
  – Research in the Formation of Engineers
  – Research Initiation in Engineering Formation
  – Broadening Participation in Engineering
  – REU and RET
  – Workforce development component of ERC

• EHR programs
  – IUSE:EHR; Engaged Student Learning, Institutional and Community Transformation
  – EHR Core

• Crosscutting programs
  – Cyberlearning
  – Cultivating Cultures of Ethical STEM
Inputs to RED

• Engineering Coalitions
  – Reform of first year, senior capstone design
  – Key role of learning communities and faculty engagement with engineering education research
  – Scholarship of teaching not always valued in faculty reward structure

• Department Level Reform
  – Primarily pedagogical changes
  – Local reform, little systemic change

• EEC 2013 COV Report
  – Develop programs focused on implementation at test sites
  – Support larger scale projects to transform the academy
Cross-Directorate Activity

• RED Working Group members
  – Kamau Bobb, CISE/CNS
  – Glenn Larson, ENG/IIP
  – William Olbricht, ENG/CBET
  – Zhijian Pei, ENG/CMMI
  – Yvette Weatherton, EHR/DUE

• Other staff
  – Daphney Jean, AAAS Fellow
  – LaTanya Sanders-Peak, Program Specialist
  – Susan Watson, Program Specialist

• Funding
  – ENG: $5M
  – EHR: $5M
  – CISE: $2M
RED Goals

• Support student success in attaining professional formation
• Broaden participation through cultures of inclusion
• Disseminate successful change processes nationally
RED Outcomes

• Fund programs that can serve as exemplars of change
• Revolutionary change to middle two years of undergraduate curriculum
• Connect engineering education research and practice
• Contribute to the literature on change
RED “target point”: the Core

PhD Degree

MS Degree

Senior

“The Core”
Junior
Sophomore

First-Year

Industry

Community Colleges
Key Elements of RED

• Vision
• Department Chair as PI
• Appropriate Team
• Institutional Commitment
• Connection to Professional Practice
• Faculty Development Plan
• Potential for Success and Scalability
• Connection to Research on Engineering Education
• Scaling and Adaptation
RED Visions

- **Arizona State Poly:** Additive Innovation: An Educational Ecosystem of Making and Risk Taking
- **Colorado State ECE:** Revolutionizing Roles to Reimagine Integrated Systems of Engineering Formation
- **Oregon State Chem, Bio, and Env Eng:** Shifting Departmental Culture to Re-Situate Learning and Instruction
- **Purdue ME:** An Engineering Education Skunkworks to Spark Departmental Revolution
- **UNC Charlotte CS:** The Connected Learner: Design Patterns for Transforming Computing and Informatics Education
- **University of San Diego School of Engineering:** Developing Changemaking Engineers
Creating a Cohort

• EAGER award made to a team from Rose-Hulman and U. Washington
  – Rose-Hulman, Making Academic Change Happen (MACH)
    • Providing resources on change to assist the teams
    • Convening regular teleconferences to discuss challenges and successes
  – U. Washington, Center for Workforce Development
    • Conducting research on the change process across the projects
    • Will provide case studies on how to manage change effectively
Questions for Discussion

• What is the right role for NSF in the engineering education space?

• How can NSF help RED awardees transfer results to other institutions, and motivate other institutions to adopt the new knowledge/model?

• How can NSF sponsor the application and further development of RED-generated knowledge across a range of institutions?

• What metrics are most important to evaluate the progress of a RED-sponsored project and the RED program overall?