Revolutionizing Engineering Diversity

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Origin of Formal Education
Philosophy of Education

469 - 399 B.C.  
Socrates

427-347 B.C.  
Plato

384-322 B.C.  
Aristotle

Discourse

Inquiry

Reflection

Learning Science

Al-Hazani

965 C.E.
Technological Revolution
fMRI Evidence

Passive

Active

Vannest et al.,
Electrodermal Evidence
Change in Practice

Need for Change
Today
NSF RED Program
Revolutionizing Engineering and Computer Science Departments

The Problem
- Educational innovations have not found their way to the middle years of the curriculum
- Core courses lack emphasis on workplace-relevant engineering skills

NSF RED Program
- $38 million total over three years (2015, 2016, 2017)
- 19 Awards to Engineering Departments
- Goal is to effect cultural and organizational change to address a wide array of enduring challenges in engineering education
NSF RED Program
Revolutionizing Engineering and Computer Science Departments

• “Radically, Suddenly or Completely New”
• Producing fundamental, structural change
• Going outside or beyond existing norms or principles

Change rooted in:
• Engineering Education research
• Social science understanding of organizations
• Theoretical change framework to move research to practice
RED Projects

Additive Innovation: An Educational Ecosystem of Making & Risk Taking (Engineering)

Revolutionizing Roles to Reimagine Integrated Systems of Engineering Formation (Electrical and Computer Engineering)

REDCON: Consortium-level support for scaling and adoption of knowledge concerning sustainable change

Lord et al., ASEE 2018
Revolutionizing Engineering Diversity

Civil and Environmental Engineering

• Expand the conception of diversity to include groups not served by traditional efforts to broaden participation
• Develop a collective intentionality of inclusiveness among students, faculty and administrators
• Build an inclusive environment for all students
• Increase underrepresented student population to 50%
Diversity and inclusion

Diversity - counting heads
Inclusion - making heads count

- Women
- Racial and ethnic minorities
- LGBTQ
- Low Income and First Generation to College
- Differently abled

http://www.theinclusionsolution.me/
Rowan Student Demographics

- Non-Eng: 2565
- ENG: 317
Why are there differences in representation?

Tokyo medical school admits changing results to exclude women

University manipulated test scores for more than a decade to ensure more men became doctors

<table>
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</table>
A systematic approach to building inclusion

Institutional Commitment
Access & Success
Inclusive Pedagogy
Affirming Climate

A multidimensional framework

Shorter-Gooden, p. 451
Access and Success

- Change CEE Admissions Process to reduce the dependence on SAT scores
- Establish mentoring groups
- Spatial skills training in fall of year 1


Brookings Institution Report

Race gaps in SAT scores highlight inequality and hinder upward mobility

Richard V. Reeves and Dimitrios Halikias

01 Feb 2017
Access and Success

• First year enrollment: 29% women, 15% racial/ethnic minority (up from 19.5% and 9.5%)

• Mentoring groups for lower level students and for transfer students

• Spatial skills improvement
Inclusive Pedagogy

- Inclusive curriculum
  - Redesigned several CEE courses (content, teaching methods, assessment)
  - CEE students participated in the course redesign
  - RevED team mentors faculty in the redesign process

Syllabus and introduction

Socially Relevant Examples

Engineering role models

Asset-based model of diversity

Diverse Assessment Methods

Classroom Interaction
Affirming Climate

Social, psychological, structural dimensions

Connections between personal identities & academic domains

Effort and achievement

“beyond predictions based on socioeconomic or academic indicators”

Source: NAE (2016)
Affirming Climate

- Link diversity and inclusion with disciplinary engineering work
  - CEE alumni professional panel
  - Women of Color in STEM event

- Expand understanding of character traits and education of a successful engineer
  - Workshops for faculty
  - Seminar and Discussion on Low-income and first-generation to college students

Google search: successful engineer
Institutional Commitment

• Rethink the reward system
  • Make diversity and inclusion an element in rewards for faculty

• Write diversity and inclusion into tenure, recontracting and promotion Criteria for CEE and ExEEd

Scale-up

Efforts to apply model campus wide

• Rowan Inclusive Pedagogy Certification Program

• Faculty seed funding
  • PIPER
  • REDI
Challenges

• Engineering students are less likely than their peers to believe that topics related to D&I belong in the curriculum
  • Depoliticization and technical-social dualism (Cech)

• Unconscious bias around engineering values (Mejia, Smith)

• Deficit-based view of diversity (Valencia; Svilha)
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University manipulated test scores for more than a decade to ensure more men became doctors

Acknowledgement

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References

References (Con’t)