

# Revolutionizing Engineering Diversity

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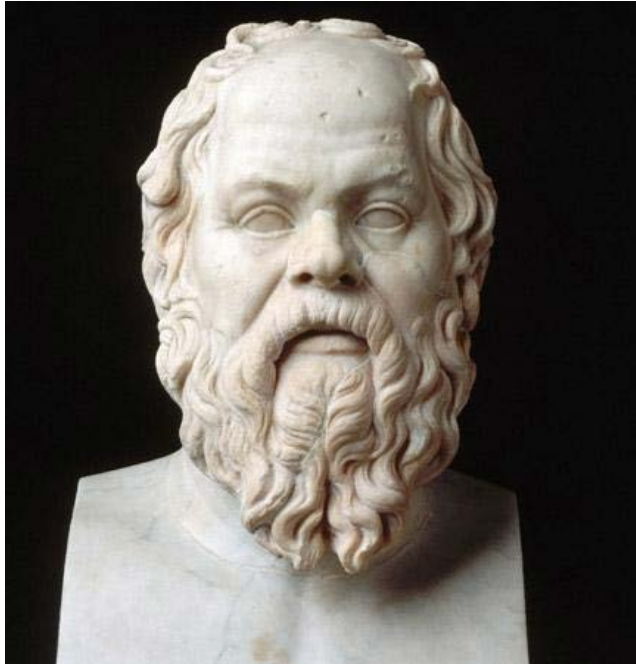


# Origin of Formal Education



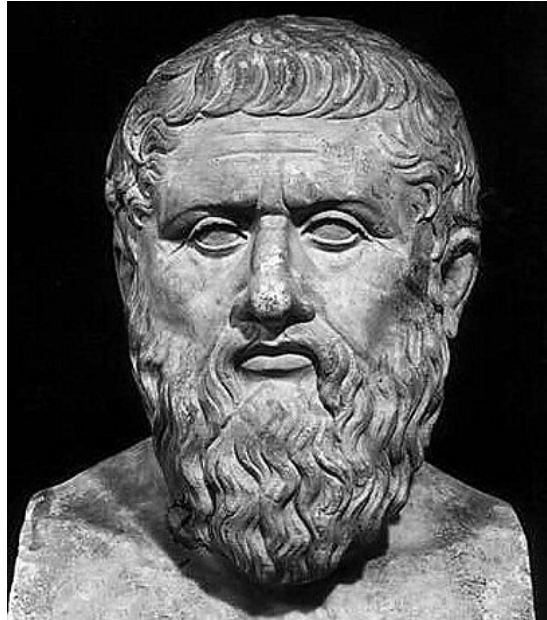


# Philosophy of Education



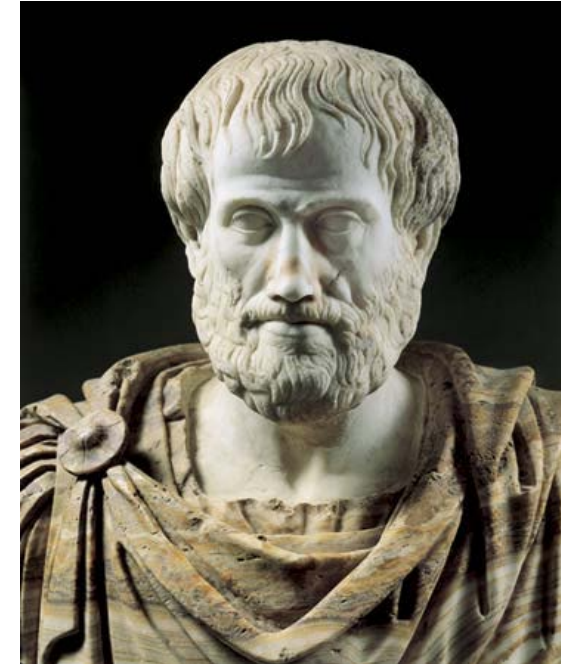
469 - 399 B.C.  
Socrates

*Discourse*



427-347 B.C.  
Plato

*Inquiry*



384-322 B.C.  
Aristotle

*Reflection*

# Learning Science

Al-Hazani

965 C.E.









# Technological Revolution





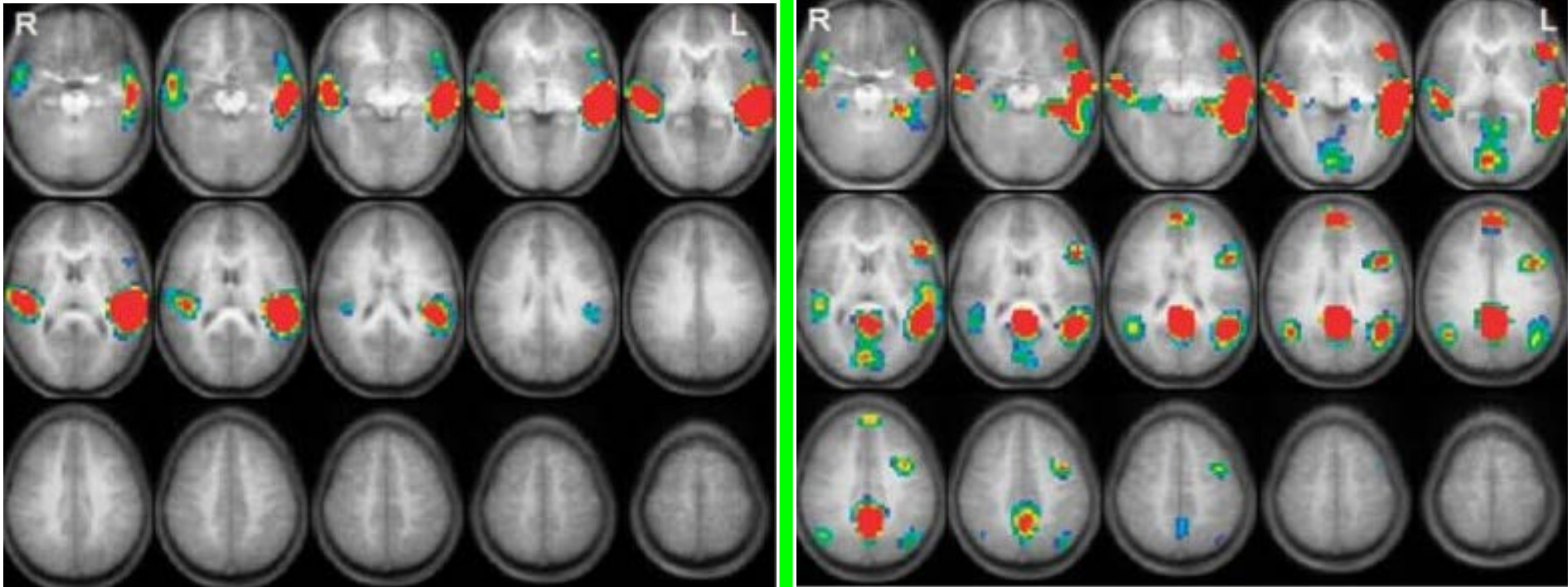




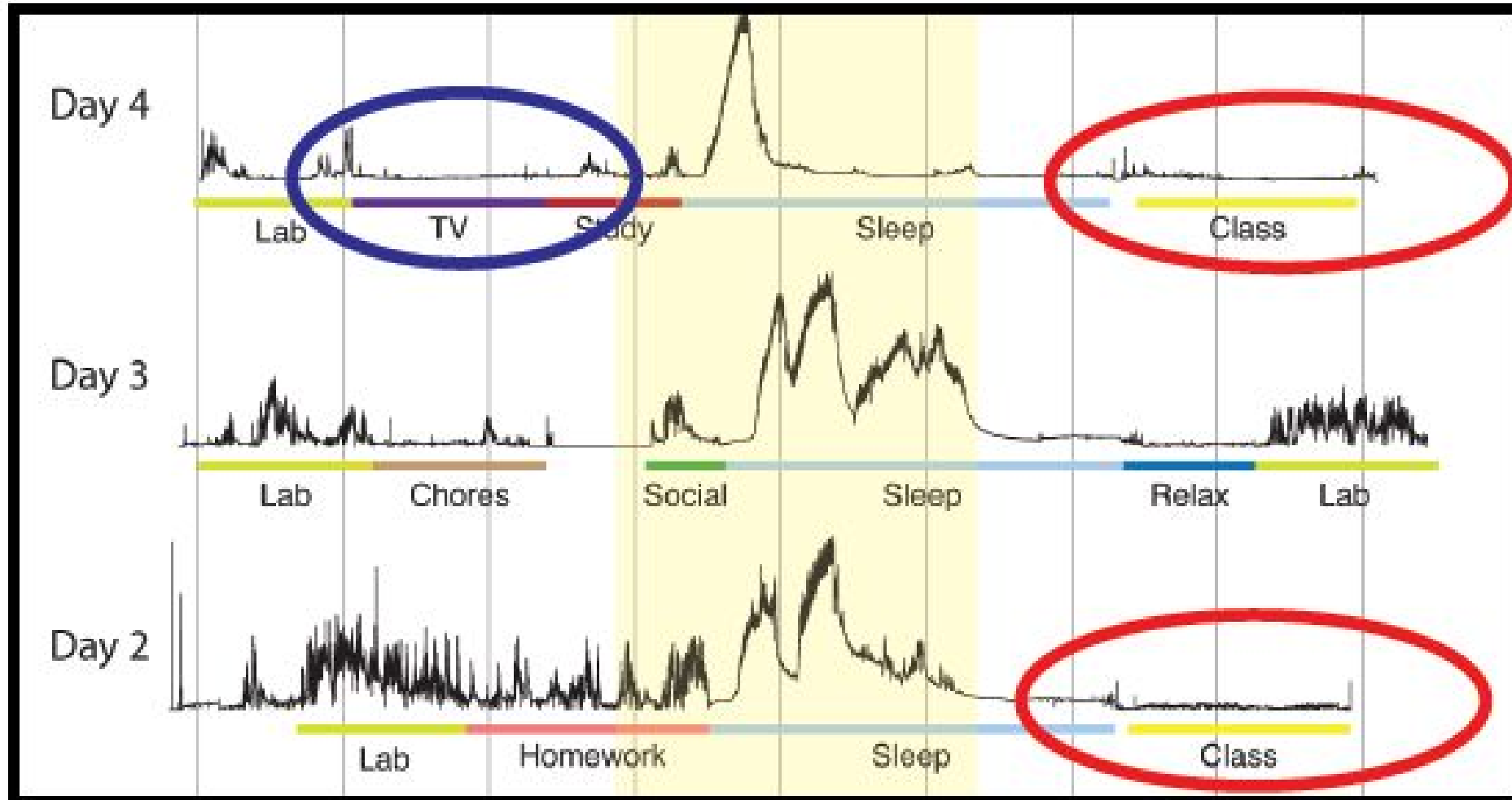
# fMRI Evidence

Passive

Active



# Electrodermal Evidence





# Change in Practice



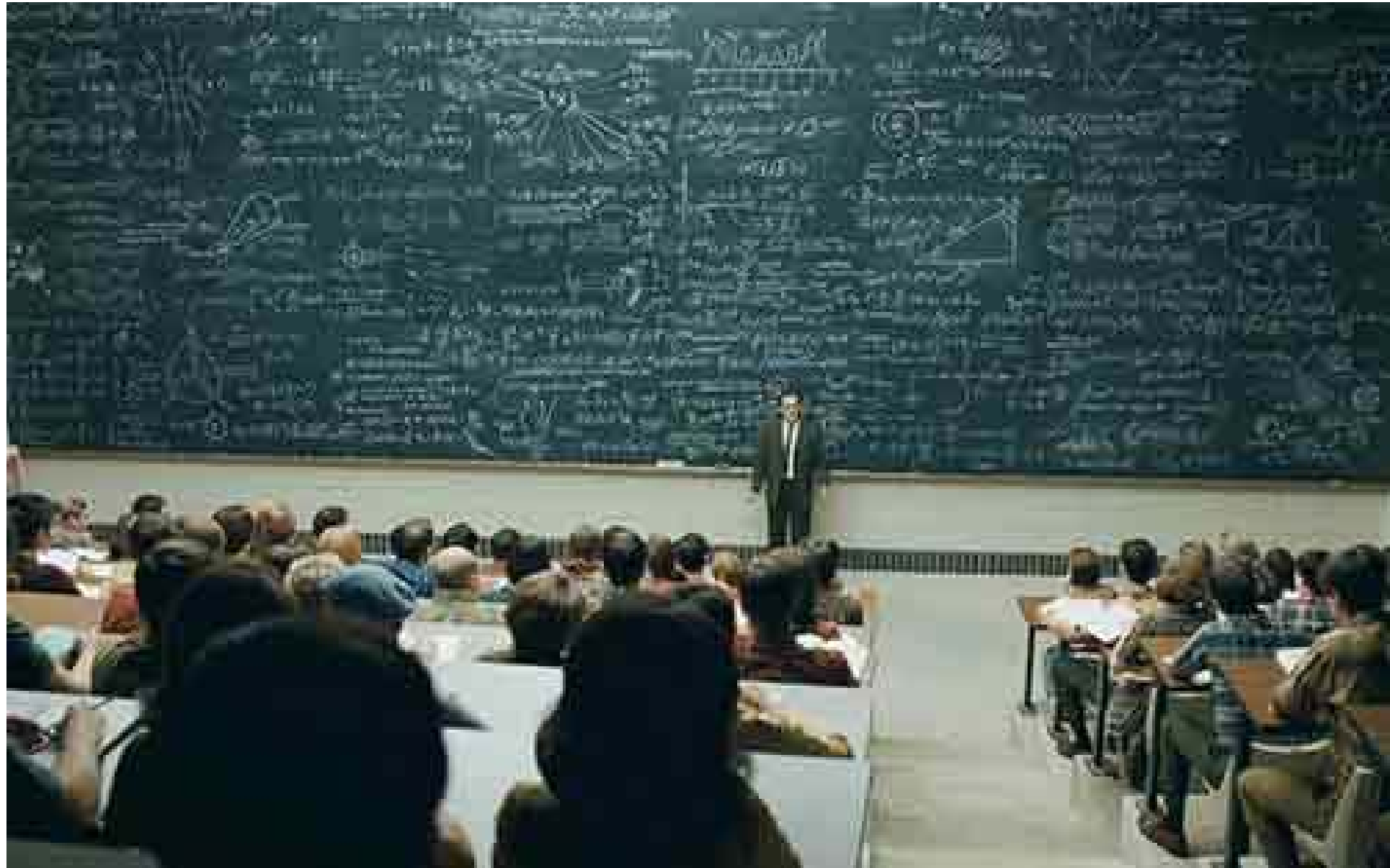
Theory

Technology

Evidence

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



# 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

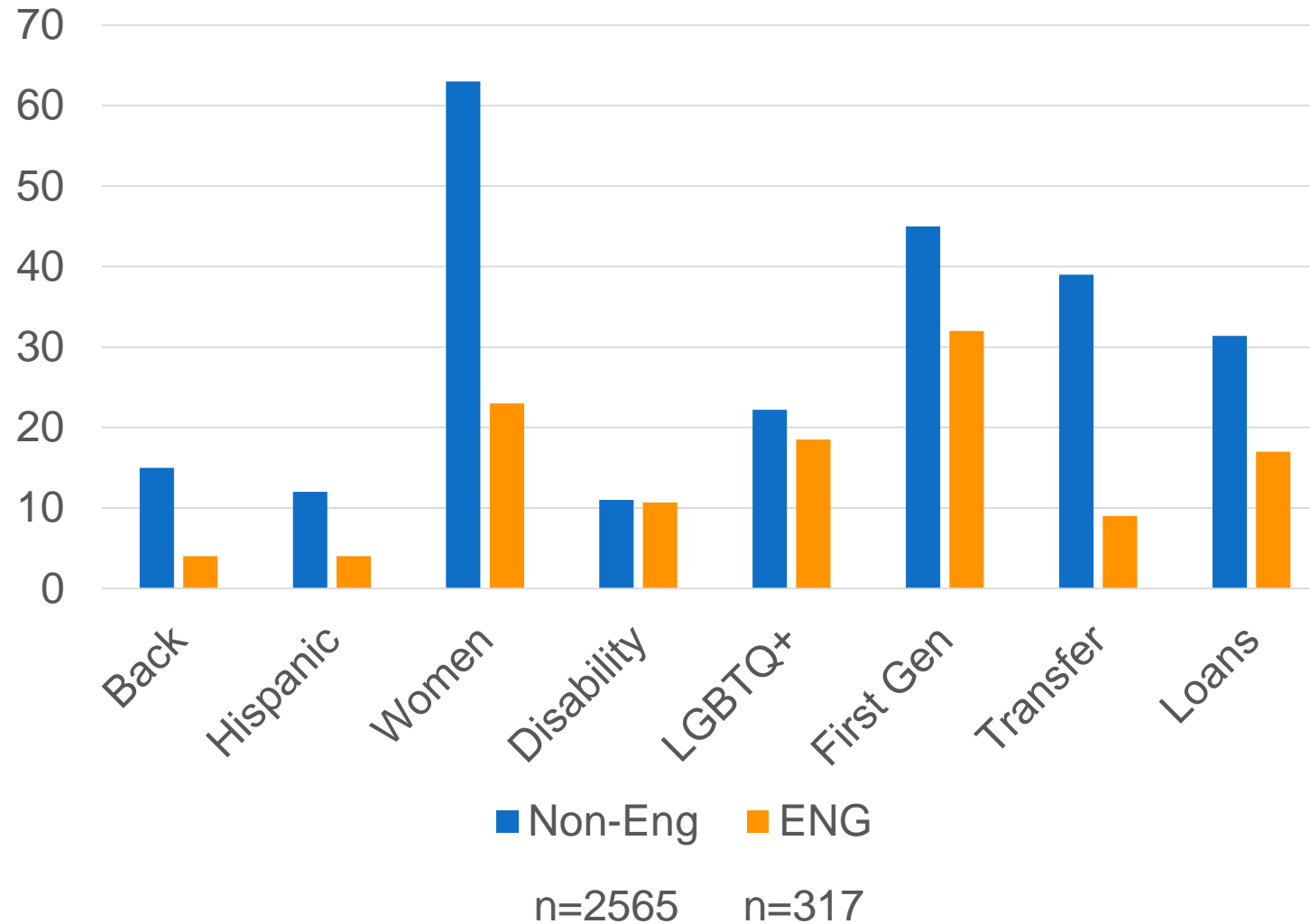
Diversity - counting heads

Inclusion - making heads count



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

# Rowan Student Demographics



# 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**



<https://www.theguardian.com/world/2018/aug/08/tokyo-medical-school-admits-changing-results-to-exclude-women>



# Different Experiences and Perceptions

	1 <sup>st</sup> Gen	Sexual minority	Women	Diff.abled	Non-White
Participation in Engr-related activities	Less	More	--	Less	Less
Inclusive Classroom Experiences	--	Less	Less	Less	Less
Educational Experiences	Less	Less	--	Less	Less
Experiences with discrimination	More	More	More	More	More
Diversity Climate	--	Less	Less	Less	Less

# A systematic approach to building inclusion



**A multidimensional framework**

# 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

Bowen, W. G., & Bok, D. (2016). *The shape of the river: Long-term consequences of considering race in college and university admissions* (Vol. 96). Princeton University Press



# 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

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graph TD; A[Social, psychological, structural dimensions] --> B[Connections between personal identities & academic domains]; B --> C[Effort and achievement  
"beyond predictions based on socioeconomic or academic indicators"]
```

Connections between personal identities & academic domains

Effort and achievement

*"beyond predictions based on socioeconomic or academic indicators"*



# 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



Slaton, A. E. (2010). *Race, rigor, and selectivity in US engineering: The history of an occupational color line*. Harvard University Press.

# 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)





# Tokyo medical school admits changing results to exclude women

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<https://www.theguardian.com/world/2018/aug/08/tokyo-medical-school-admits-changing-results-to-exclude-women>

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