Transforming Engineering Education
based on
Educational Research and Scholarship

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Inspiring Future Engineers @ Purdue

We want to be engineers like you, Mr. Armstrong
A Proud History of Innovation

✓ 1st Department of Freshman Engineering – 1953
✓ 1st Women in Engineering Program – 1969
✓ National Society of Black Engineers (NSBE) founded – 1975
✓ Engineering Projects in Community Service (EPICS), winner of 2005 NAE’s Gordon Prize – 1995
✓ 1st Department of Engineering Education – 2004
✓ 23 astronauts; first & most recent person to walk on moon.
College of Engineering at Purdue

11 Schools

- Aeronautical and Astronautics
- Agricultural & Biological Engineering
- Biomedical Engineering
- Chemical Engineering
- Civil Engineering
- Electrical & Computer Engineering
- Engineering Education
- Industrial Engineering
- Materials Engineering
- Mechanical Engineering
- Nuclear Engineering

3 Divisions

- Construction Engineering Management
- Ecological and Environmental Engineering
- Engineering Professional Education

College of Engineering

- 7500 undergraduates
- 2500 graduate students

359 faculty growing to 460 by 2016
Mission of School of Engineering Education

Transforming engineering education based on scholarship and research

- Re-imagine Engineering and Engineering Education
  - Diversify engineering
  - Embed creativity, innovation & social responsibility
  - Enrich the student experience

- Create field-shaping Knowledge

- Empower Agents of Change
School of Engineering Education

- FYE Program
- Student Advising
- BS in MDE and IDE Studies
- Learning Labs
- BS Engineering Education
- INSPIRE P-12 Research Institute
- Research Labs
- PhD Program
- MS Engineering Education

- 20 Academic Staff (11 female)
- 20 A/P Staff
- 4 Admin
- 4 Secretary
- 8 Post-Docs
- ~2500 FYE students
- ~80 Multidisciplinary Engineering Students
- 70 PhD students in Engineering Education
- 23 PhD graduates
Domain of Engineering Education Research

how do people
learn about,
learn to and
create improved practices
in relation to engineering;
across all life and career stages
in formal and informal learning environments
Emergent Research Areas in Engr Education

Knowing our students
• diversity: race/ethnicity, class, and gender
• large-scale data analysis
• motivation and careers in STEM
• P-12 engineering education
• recruitment, retention, and student success
• self-efficacy and career identity building

Engineering thinking, knowing, and doing
• engineering epistemologies
• adaptive expertise in engineering context
• design thinking and engineering decision-making
• global engineering competencies
• mathematical thinking
• thinking & working in interdisciplinary ways

Supporting & assessing learning
• conceptual change and concept inventories
• modeling & model eliciting activities
• cyber-learning and cyber-environments
• design of learning environments
• instrument design and survey development
• learning in informal environments
• service and experiential learning
• teaming & collaborative learning
• meta-analysis of emergent literature

Transforming education systems
• critical analysis of policy
• theories of change for engineering education
• history and nature of engineering
• evolution of the EER community
• faculty and graduate student professional development

As yet there are no established sub-disciplines in EER

https://engineering.purdue.edu/ENE/Research/ResearchReport
Virtuous R&D Cycle in Engineering Education

R&D cycle

- Rigorous Educational Research
  - which lead to
  - Questions Ideas
  - which identifies and motivates
  - Innovative Educational Practice
    - which help improve
    - Answers Insights
      - that result in
Ideas-to-Innovation (i2i) Learning Lab

“We shape our buildings.... after that our buildings shape us”
Sir Winston Churchill
Educating A Broader Base of Engineers

**engineer as specialist**
recognizes the continued need for engineering graduates who are technical experts of world-class.

**engineer as integrator**
reflects the need for graduates who can operate and manage across boundaries, be they technical or organizational, in a complex business environment.

**engineer as change agent**
highlights the critical role engineering graduates must play in providing the creativity, innovation, and leadership needed to guide the industry to a successful future.

Next BIG Transformation in Engr. Education

Eras in Engineering Education

Mann Report

Practice-oriented

1900

Industrial
Local & National

1950

Technological
International

2000

Changing the Culture
Engineer 2020

Engineering Science centered

2050

Historical Trends in Engineering Industry

Post-Industrial
Global

Sustainable
Global & Local

Practice-oriented
Technical Innovation as a Learning Process
Global Challenges for a New Generation

Water
Food
Energy
Security
Urbanisation
Sustainable Futures

Blue Marble” December 7, 1972
Looking Forward - Looking Back
Our Engineering Future is in Good Hands

...... but HOW we educate and innovate must CHANGE