The Role of Liberal Arts in Undergraduate Engineering Education

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Education in Humanities and Social Sciences for American engineers has been considered important for more than a century.

Topic of constant debate and periodic change.

Many forces influenced the nature of engineering education.

Corporate needs are especially influential.

1900

- Social Status and Prestige
- Engineers considered themselves professionals and a "professional was expected…to be a 'gentleman.'" (Seely, 2005)
- Writing
- Economics
- History

1930's-1940's

- Heightened concern about social issues, in general, and the role of technology in particular

1936 Carnegie Plan

- Robert Doherty, President of Carnegie Mellon (then called Carnegie Institute of Technology)
- Required freshman course
  - Origin and development of the Technological Age

Today

- Further Broadening of engineering beginning in the 1960's.

2014 Accreditation Requirements

- Accreditation Board for Engineering and Technology (ABET).
- Richard Miller (2015) observed that of the 13 ABET requirements, six of them are "professional skills."
  - Multidisciplinary collaboration
  - Professional and ethical responsibility
  - Effective communication
  - Understanding engineering solutions in a global, economic, environmental and social context
  - Lifelong learning
  - Knowledge of contemporary issues

"It's in Apple's DNA that technology alone is not enough – it's technology married with liberal arts, married with humanities, that yields the results that make our hearts sing…"

Steve Jobs, 2011
(As reported by Miller, 2015)

"…one of the core insights that we try to apply to developing Facebook. …It's all about giving people the tools and controls that they need to be comfortable sharing the information that they want. If you do that, you create a very reliable service. It's as much psychology and sociology as it is technology."

Mark Zuckerberg, 2011
(as reported by Miller, 2015)

"How to Get a Job at Google"

Tom Friedman in New York Times
February, 2014
Senior VP for People Operations at Google:
Top Attributes

- Learning ability
- Emergent leadership
- Humility and ownership
- Expertise

Purdue Survey

- 5 years after graduation
  - More technical knowledge
- 10-15 years
  - More management expertise
- 25+ years
  - More about life

MIT Survey

- 10 years after graduation, mechanical engineering alumni reported that they used professional skills much more than science and engineering knowledge.

Professional Skills that Engineers should learn and acquire in college

(RK Miller, 2015)

- Ethical behavior and trustworthiness
- Employability skills, including self-confidence and positive outlook, accepting responsibility, perseverance, sincerity, respect for others, good judgment, etc.
- Effective communication, including advocacy and persuasion
- Effective collaboration including leadership, followership, and consensus building
- Resourcefulness and the capacity for independent learning
- Entrepreneurial mindset and associated business acumen
- Inter- and multi-disciplinary thinking
- Creativity, curiosity, and design
- Empathy, social responsibility
- Global awareness and perspective

It's hard to incorporate all that we would like to in an undergraduate engineering curriculum.

Perpetual issues

- Science vs. technology
- Technical expertise vs. design
- Breadth vs. depth
- Technical expertise vs. humanities and social sciences

Emerging Trends

- B.S. as pre-engineering degree and with broader disciplinary exposure
- M.S. as first professional degree

- General Education vs. Integrating Humanities and Social Sciences
- Carnegie Mellon
  - BXA degree
    - X=a science major, including computer science
    - A=a major in one of five arts schools
- Stanford
  - Joint major: computer science + English or music
- Florida International University
  - School of Integrated Science and Humanities
  - Human health focus

- National Academies Board on Higher Education and Workforce

  December 2, 2015 workshop

  "Incorporating Humanities into STEM Education"

References

- Richard K. Miller, "Why the Hard Science of Engineering is No Longer Enough to meet the 21st Century Challenges," white paper from Olin College of Engineering, May, 2015.
- Bruce Seely, "Patterns in the History of Engineering Education Reform: A Brief Essay," in Educating the Engineer of 2020, National Academy of Engineering, 2005.