A Few Comments...

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100 years ago...
1907 – Joint Committee on Engineering Education (Cleveland . . . not Columbus)

- American Society of Civil Engineers
- American Society of Mechanical Engineers
- American Institute of Electrical Engineers
- American Chemical Society
- American Institute of Chemical Engineers
- American Institute of Mining Engineers
1907 – Joint Committee on Engineering Education (*Cleveland...not Columbus*)

- American Society of Civil Engineers
- American Society of Mechanical Engineers
- American Institute of Electrical Engineers
- American Chemical Society
- American Institute of Chemical Engineers
- American Institute of Mining Engineers
- Society for the Promotion of Engineering Education
The Mann Report (1918)
Graduation Rate (1918)
Graduation Rate (1918)

60%
Graduation Rate (2016 – avg. 5-yr)
Graduation Rate (2016 – avg. 5-yr)

50%
5 Year Graduation Rate Data (2016)

5 Year Graduation Rate in 2016 (%)

= 1.676 \times (1^{st} \text{ Year Retention Rate}) - 79.22

“Changes must be made from time to time to meet conditions as they arise, and any attempts to solve the problems of engineering education must be of so flexible a nature as to admit of improvements.”
“There probably never was a time when the minds of teachers were so intently alive and receptive to rapid changes, as at the present moment.”
1824
Over the past 50 years...

• Numerous reports have identified issues and concerns about declines in STEM comprehension, workforce capabilities, and national competitiveness – many have also suggested solutions...
For example . . .
We Know: Why Students Leave

- Lack of role models – particularly as women and underrepresented minority faculty
- Poor teaching
- Poor performance in the first math courses
- Poor advising
- Fear that jobs may disappear
We Know: Why Students Leave

- Perception that other majors have easier classes & more fun, feeling of isolation
- Coursework too restrictive for more varied interests
- Rising costs – disproportionate impact on students from low income families (*worse due to > 4yr degree completion*)
- Lack of connection between what is studied and exciting engineering practice
We Know: There’s a Dichotomy

• In school, problems almost always are clearly defined, confined to a single discipline, and typically have one right answer

• In the workplace, problems are usually ill-defined, multi-disciplinary, and have several possible answers (none of which are perfect)
## Creativity Definition (D. Pink)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Industry</th>
<th>Academia</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Problem identification or articulation</strong></td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Ability to identify patterns of behavior or new combination of actions</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Integration of knowledge across different disciplines</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Ability to originate new ideas</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Comfort with notion of “no right answer”</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>Fundamental curiosity</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Originality and inventiveness in work</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td><strong>Problem solving</strong></td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Ability to take risks</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Tolerance of ambiguity</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Ability to communicate new ideas to others</td>
<td>11</td>
<td>5</td>
</tr>
</tbody>
</table>
We Know: *from Research*

- Learning is highly dependent on **prior knowledge**
- **Motivation** is critical – it determines, directs, and sustains what students do
- How students **organize knowledge** influences how they learn and apply what they know
- Goal-directed practice, coupled with **targeted feedback**, enhances learning quality (vs. a grade)
We Know: from Research

• **Climate** *(intellectual, social, and emotional)* has significant impact on student perception and outcomes

• On average, online course-taking reduced student learning *(1/4 to 1/3 – Oct. 2015 DeVry study)*

• Active learning **trumps** passive methods, hands-down...**period**.
We Know: from Students

- Schools are paying insufficient attention to an array of KSAs needed to produce the desired T-shaped engineers.
- Students acquire most of the KSAs through extracurricular activities and student-driven projects, conferences/workshops, co-ops/internships, competitions, along with membership in student organizations and professional societies.
- Need to focus on real-world impact, show why what is being taught is important.
We Know: from Students

• Need to help professors learn how to teach
• Track whether courses fulfill the promise suggested in syllabi – require accountability
• Allow faculty members to teach subjects they’re passionate about or really skilled at teaching
• Connect the applications to engineering in first-year math and science courses – calculus, physics, and chemistry
So...

Why are we here?
Engage Academia, Societies, Industry and Government Representatives in:

Guiding, Develop, and Implementing a Plan that Transforms UG Engineering Education
A Plan to:

• Enable students to better acquire KSAs
• Employ engineering-specific learning theories/frameworks
• Diversify pathways to, and through, engineering education
• Understand how to scale engineering education innovations and do it!
A Plan to:

- Shift emphasis from how students learn engineering to **how engineers are formed**
- Build a deep understanding of how to enact change
- Increase focus on the effectiveness of pedagogy
- **Focus on inclusion (climate) vs. diversity (numbers)**
Broaden Participation

- Address educational inequalities
- Expand support systems and social networks
- Increase interest and sustain participation in engineering across underrepresented demographic groups

Yoder, Brian L.
Engineering by Numbers
ASEE 2015
For Example: Women in Engineering
For Example: Women in Engineering
A Challenge:

Double the % of women in Engineering
(20% → 40% in 5-10yrs)


NOTE: Engineering credentials include credentials at all education levels classified by IPEDS CIP codes 14.0000 (engineering) and 15.0000 (engineering technology).
A Potential Strategy – Collective Impact

Common Agenda
- Develop a technology-relevant, best-practices-based framework/approach to engineering education

Shared Measurement
- Collect learning data using common tools (e.g., TDOP)
- Shared accountability across courses, depts., schools

Mutually Reinforcing Activities
- Coordinated national curriculum/framework
- Regional/National industrial collaborations

Continuous Communications
- Professor training, web collaboration, mentoring
- Co-teaching, shared monitoring

Backbone Organization
- National Engineering Education Network
- Communication, data acquisition/integration/analysis

Source: www.collaborationforimpact.com
Suggestions

• Stay cognizant of the goals/objectives
• Don’t get caught repeating past efforts, build upon prior work (e.g., www.dia2.org)
• Ideas w/out actions ≠ change
• Be realistic, identify where each group can best contribute
• Form and sustain a community of practice
• Commit - one workshop won’t produce a transformation
Think, Share, and Enjoy the Workshop!
Thank you.

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We can change the world…
One life at a time.
http://tinyurl.com/m6xjq7c