I’m Sheri

October 25, 2018

2018 Tetelman Lecture
Jonathan Edwards College
Yale University
New Haven, Connecticut

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Selected References at End
Please imagine an engineer...

Now sketch that engineer, and add 3 adjectives that describe that engineer

OR
Please imagine an engineer...

Now sketch that engineer, and add 3 adjectives that describe that engineer

Now turn to the person next to you, introduce yourself, and compare sketches and adjectives.

How much alignment is there? (mark on the scale from 1-100)
Please imagine an engineer...alignment debrief

Sketch Here

Adjective 1

Adjective 2

Adjective 3

0 50 100

0-30

40-60

90-100
5 words used to describe engineers
(sophomore prospective engineering majors, Sept 2018)

Among the least mentioned

- accurate
- adept
- adventurous
- applied
- approximate
- artistic
- authentic
- aware
- big-picture
- boundless
- builder
- calculated
- calm
- cautious
- clear
- clever
- collaborators
- compassionate
- courageous
5 words that do NOT describe engineers

Among the not so mentioned

- accessible
- adventurous
- approachable
- aware
- big-thinkers
- calm
- close
- creative
- eloquent
- free-flowing
- freeform
- fun
- loved
- many
- philosophical
- poetic
- political
- right-brained
- robotic
- sentimental
- social
- sympathetic
- tactless
- thoughtful
- well-versed
- whimsical
How do we make a better engineer?

How do we make a better engineer?

How do we make a better engineer?

How do we make a better engineer?

How do we make a better engineer?
Five Ideas.
Idea 5.
Engineering Enables Many Possibilities

3,900,000 is (approximately):

A. Number of babies born in the U.S. in 2017

B. Number of individuals in the U.S. with a U.S. engineering B.S. degree

C. Weight (in Newton) of 230 average automobiles on earth

D. All of the above
Idea 5.
Engineering Enables Many Possibilities

3,900,000 is (approximately) the number of individuals in the U.S. with an engineering B.S. degree

3,600,000 is (approximately) the number of individuals in the U.S. with a B.S. who are in the workforce
The U.S. Engineering Workforce (2013)

3.6x10^6

1.55x10^6 Working in Engineering Occupations
FIGURE 1-10: The engineering workforce in 2013: Degreed engineers in engineering and non-engineering occupations, and workers without an engineering degree in engineering occupations (NSCG data).
Engineering Enables Many Possibilities


https://www.census.gov/dataviz/visualizations/stem/stem-html/
Engineering Enables Many Possibilities
Idea 4.
What is engineering work?

“Dimensions”* present in Innovation Incidents of 35 Early-Career Engineers

Action
Cognitive
Contextual
Emotional
Social


[T. Björklund, M. Klenk, S. Gilmartin, P. Simon, etc ]
Idea 4.

What is engineering work?

Action: “When I first started at the beginning of the year, I developed a training manual for a software that we used, or use now, that is used by the company to train new hires.” - action segment from Elton

Cognitive: “[The code wasn’t working and] I didn’t know why. I looked at it in my set of circumstances and I couldn’t find anything wrong with it.” - cognitive segment from Noah

Contextual: “There are... have been some delays, just due to manufacturing issues and other things.” - contextual segment from Norris

Emotional: “And I was very, very nervous the whole time [worried] that I was doing a bad job.” - emotional segment from Elliot

Social: “[After producing a product video] I got some messages from people saying, you know, ‘You’re the new faces of [the product range]!’.” - social segment from Evelyn
Idea 4.
What is engineering work?

- Action: 33%
- Social: 33%
- Cognitive: 16%
- Contextual: 10%
- Emotional: 8%

“Dimensions” present in Innovation Incidents of 35 Early-Career Engineers

What is the ordering of these in terms of frequency of presence? Are they practiced the way they are taught/learned?

[T. Björklund, M. Klenk, S. Gilmartin, P. Simon, etc.]
What is Engineering Work?
Idea 3.
What things in school seem to matter?

**SELF-EFFICACY:**

an individual's belief in his or her innate ability to achieve goals. Albert Bandura defines it as a personal judgment of "how well one can execute courses of action required to deal with prospective situations".

We study Self-Efficacy in:

- Engineering Tasks
- Innovation
- Job Acquisition Skills
- Career Discovery Skills

We also study:

- Career Alignment
- Organizational Alignment
Examples of factors we have studied:

Table 3 - Regression Analysis Summary for the Top 15 FPM Activity and Experience Variables Predicting Engineering Task (ETSE) and Innovation Self-Efficacy (ISE.5)

<table>
<thead>
<tr>
<th>Predictor Variable</th>
<th>Activity</th>
<th>ETSE</th>
<th>ISE.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>%P</td>
<td></td>
<td>β</td>
<td>SE</td>
</tr>
<tr>
<td>Engineering Mastery Experiences</td>
<td></td>
<td>β</td>
<td>SE</td>
</tr>
<tr>
<td>Coursework: Designing and/or prototyping things or ideas</td>
<td>72%</td>
<td>.11</td>
<td>.01</td>
</tr>
<tr>
<td>UG: Worked in a professional engineering environment</td>
<td>56%</td>
<td>.10</td>
<td>.01</td>
</tr>
<tr>
<td>UG: Coursework: Theory of design</td>
<td>55%</td>
<td>.09</td>
<td>.01</td>
</tr>
<tr>
<td>UG: Made use of maker space/ prototyping lab</td>
<td>22%</td>
<td>.08</td>
<td>.01</td>
</tr>
<tr>
<td>UG: Conducted research with a faculty member</td>
<td>32%</td>
<td>.07</td>
<td>.01</td>
</tr>
<tr>
<td>UG: Coursework: Computer science</td>
<td>81%</td>
<td>.06</td>
<td>.01</td>
</tr>
<tr>
<td>HS: Learned computer programming</td>
<td>31%</td>
<td>.05</td>
<td>.01</td>
</tr>
<tr>
<td>HS: Took a shop class or engineering class</td>
<td>47%</td>
<td>.05</td>
<td>.01</td>
</tr>
<tr>
<td>Vicarious Engineering Experiences</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UG: Coursework: Leadership topics</td>
<td>47%</td>
<td>.06</td>
<td>.01</td>
</tr>
<tr>
<td>Coursework: Business or startup topics</td>
<td>35%</td>
<td>.05</td>
<td>.01</td>
</tr>
<tr>
<td>Participated in entrepreneurship</td>
<td>40%</td>
<td>.04</td>
<td>.01</td>
</tr>
<tr>
<td>Presented a new engineering technology</td>
<td>36%</td>
<td>.03</td>
<td>.01</td>
</tr>
<tr>
<td>HS: Learned about entrepreneurship</td>
<td>24%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participating in Supporting Engineering Self-Efficacy</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UG: Participated in a design or invention competition</td>
<td>13%</td>
<td>.07</td>
<td>.01</td>
</tr>
<tr>
<td>HS: Participated in a robotics competition</td>
<td>11%</td>
<td>.06</td>
<td>.01</td>
</tr>
<tr>
<td>UG: Started or co-founded a student club on campus</td>
<td>9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS: Started a club, organization, or company</td>
<td>16%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UG: Led a student organization</td>
<td>28%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive Physiological and Emotional States</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UG: Coursework: Interaction with students from non-engineering majors</td>
<td>85%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demographics (Inputs and Background)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender (1 = Male, 0 = Female)</td>
<td></td>
<td>.19</td>
<td>.01</td>
</tr>
</tbody>
</table>

How are we supporting our students in finding and reflecting on internships and other summer opportunities?

What things in School Seem to Matter?
Idea 2.
The Power of Belonging

“Belonging is the perception of being accepted, valued, and included. Belonging can help learning by increasing effort and decreasing negative distractive thoughts.”

[Greg Walton, Geoff Cohen]
Dear Colleagues,

The beginning of the school year is always exciting. But for many students it can also be accompanied by some nervousness and trepidation as they encounter new teachers and peers, and new classes, living environments and surroundings.

This is particularly so for the hundreds of students who come to Stanford Engineering but perhaps feel that they don't quite fit the perceived profile of what an engineer "should look like." Included among them may be students on the undergraduate and graduate level who are female, from an underrepresented minority or LGBT population, or one of the roughly 15% of Stanford's undergraduates who are the first in their family to attend college.

I have spoken in many venues and written to the school about why diversity is so important to the School of Engineering and outlined some of the ways we are working to increase diversity at all levels. These initiatives are proceeding, and I look forward to giving updates in subsequent communications. But as the school year begins, we also must ask ourselves a critical question: What are we doing to ensure that the Stanford Engineering environment and educational experience is as inclusive and welcoming as possible to all of our students regardless of their backgrounds and identity?
THE ABCs OF HOW WE LEARN

26 Scientifically Proven Approaches, How They Work, and When to Use Them

DANIEL L. SCHWARTZ, JESSICA M. TSANG, & KRISTEN P. BLAIR

Table of Contents

A is for Analogy
- Finding the general principle

B is for Belonging
- Silencing anxiety and boring in

C is for Contrasting Cases
- Discovering critical information

D is for Deliberate Practice
- Becoming an expert

E is for Elaboration
- Making memories meaningful

F is for Feedback
- Supporting self-improvement

G is for Generation
- Building lasting memories

H is for Hands On
- Recruit the body's intelligence

I is for Imaginative Play
- Developing cognitive control

J is for Just in Time Telling
- Making lectures and readings work

K is for Knowledge
- An essay on efficiency and innovation in knowledge

L is for Listening and Sharing
- Learning more together than alone.

M is for Making
- Producing interest and practical knowledge

N is for Norms
- Cultivating the roles of the game

O is for Observation
- Initiating feelings and procedures

P is for Participation
- Getting into the game

Q is for Question Driven
- Creating a reason to inquire

R is for Reward
- Motivating behavior

S is for Self-Explanation
- Going beyond the information given

T is for Teaching
- Learning on behalf of another

U is Underspecification
- Overcoming misconceptions and misplaced reasoning

V is for Visualization
- Inventing structure for complex information

W is for Worked examples
- Acquiring skills and procedures

X is for Excitement
- Turning up attention and arousal

Y is for Feedforward
- Increasing self-efficacy

Z is for Sleep
- Consolidating the memories of the day
In Fall of 2014, a group of students from Stanford’s student-run First-Generation and/or Low-Income Partnership (FLIP) created a program called “What I Wish My Professor Knew” to help Stanford faculty understand how their classroom practices and statements could contribute to First-Generation and/or Low-Income (FLI) students feeling alienated or welcomed at Stanford.

https://www.youtube.com/watch?v=8pmJNuxyvpA
Figure B1. Semester grade point averages during the first and last semesters of college. African Americans who participated in a brief exercise to help them appreciate that they do belong in college realized more of their academic potential over the four years than African Americans who did not receive the treatment. The European Americans did not exhibit any effects of the belonging treatment, because they already felt they belonged in college. Based on data from Walton and Cohen (2011).
Some things I have been trying...

The Teaching Team
Some things I have been trying...

**Intentional activities**...

for the teaching team and students to get to know one another and work together...
The room and the PODS....
The room....and activities
Activities tied to Action…

Mastan2

Buckling as a failure mode

West Point Bridge Designer

Bridge Testing
The Power of Belonging
Idea 1.
Expanding What We Teach

Engr117/217, FEMGEN117/217, CSRE117/217
Expanding Engineering Limits:
Culture, Diversity & Equity

Students Explore, as related to engineering:

Hazel Rose Markus, Ph.D., and Alana Conner, Ph.D.

[S. Gilmartin, C. Muller, S. Sheppard]
Sample Engr 117/217
Outcomes and Results

– Growing interest (years 1->3)
– Impressive attention & engagement of students (attendance is “required”)
– Deep appreciation; very positive course evaluations
– A great deal of data, much still to be analyzed

• “This course provides a learning and discussion forum for engineering students (and others that are interested) to expand their perspectives on the engineering profession. It is extremely important to have a safe space to for students to learn about gender and culture issues specific to engineering which is something that is desperately needed at Stanford. I think this course did a great job serving this purpose.”

• “...a great way to support positive change in campus engineering culture. I would love for people who don't get it or think it's silly to realize why this matters.”
How do we make a better engineer?

Idea 1. Expanding What We Teach

Idea 2. The Power of Belonging

Idea 3. What things in school seem to matter?

Idea 4. What is Engineering Work?

Idea 5. Engineering Enables Many Possibilities
Please imagine an engineer...

Now sketch that engineer, and add 3 adjectives that describe that engineer

How might our images be expanded?
LET'S TALK
Opening Triangle Exercise inspired by:

- D.W. Chambers, Stereotyptic images of the scientist: The draw-a-scientist test (April 1983)
- Meredith Knight, Christine Cunningham, Draw an Engineer Test (DAET): Development of a Tool to Investigate Students’ Ideas about Engineers and Engineering (ASEE 2004)
Idea 5. Engineering Enables Many Possibilities

Idea 4. What is Engineering Work?


Idea 3. What things in school seem to matter?

Idea 2. The Power of Belonging

Idea 1. Expanding What We Teach

