Creative, Contextual and Engaged: Are Women the Engineers of 2020?

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## Some Findings from the Academic Pathways Study (APS)

<table>
<thead>
<tr>
<th>Findings</th>
<th>Longitudinal survey</th>
<th>2nd year structured interviews</th>
<th>Longitudinal unstructured interviews</th>
<th>1st year engineering performance task</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of (dis)engagement in liberal arts courses</td>
<td>√</td>
<td></td>
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<tr>
<td>Nature of participation in extracurricular activities</td>
<td>√</td>
<td>√</td>
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<tr>
<td>Social motivation to pursue engineering</td>
<td>√</td>
<td>√</td>
<td>√</td>
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<tr>
<td>Ways of knowing engineering</td>
<td></td>
<td>√</td>
<td>√</td>
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<tr>
<td>Ways of doing engineering</td>
<td></td>
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</tbody>
</table>
Women and men define & delimit engineering differently

Students were asked: “In your own words, would you please define engineering?”

<table>
<thead>
<tr>
<th>Highest Response Areas</th>
<th>% of all Responses</th>
<th>Men</th>
<th>%</th>
<th>Women</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Solving</td>
<td>48.4</td>
<td>29</td>
<td>44.0</td>
<td>15</td>
<td>60.0</td>
</tr>
<tr>
<td>Math and Science Application</td>
<td>37.4</td>
<td>28</td>
<td>42.4</td>
<td>6</td>
<td>24.0</td>
</tr>
<tr>
<td>Designing/Creating/Building</td>
<td>37.4</td>
<td>22</td>
<td>33.3</td>
<td>12</td>
<td>48.0</td>
</tr>
<tr>
<td>Improving Humankind</td>
<td>28.6</td>
<td>21</td>
<td>31.8</td>
<td>5</td>
<td>20.0</td>
</tr>
</tbody>
</table>
Discussion of data

► Both men and women saw *problem solving* as a major component of engineering
► Men more often included *improving humankind* in their definitions of engineering
► Women more often defined engineering beyond its traditional technical foundations in math, science, and efficiency
Discussion of data (continued)

Women and men conceptualize engineering differently

- Men’s answers tended to be more linear direct, and technically based

One male respondent defined engineering as “coming up with a solution to a problem in an economical way.”

- Women tended to define engineering more broadly

A female respondent defined engineering as being “like the middle man between the inventor and the manufacturer, so [it’s] the person that gets an idea and makes it possible.”
“I’d have to say there isn’t an average engineering [student]; they’re very ah-, they’re all unique, let’s put it that way….I was really surprised when I came up here at the female population because I think that is really diverse, just as far as interests and what people are like. Just, I don’t know; the guys kinda come out cookie-cutter…. [The guys] want to do math, sit and play on their computers, and video games afterwards; but the girls have more, very diverse interests…

- Michelle, MT
Women and men frame engineering problems differently

Over the summer the Midwest experienced massive flooding of the Mississippi River. What factors would you take into account in designing a retaining wall system for the Mississippi?
Examples of Detail and Context

Design detail
- “cost of materials”
- “check the budget available for the operation”
- “how to contain the river water that has flooded out”

Design context
- “aesthetic appeal – is it going to draw local complaint?”
- “the surrounding habitat – make sure little or no damage is done to the environment”
- “would wall impact use of the river by industry?”
### Detail vs. Context focus of ideas, overall and by gender

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Avg. # segments</th>
<th>% Detail</th>
<th>% Context</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>124</td>
<td>11.5</td>
<td>50.0%</td>
<td>50.0%</td>
</tr>
<tr>
<td>Women</td>
<td>43</td>
<td>13.0</td>
<td>44.6%</td>
<td>55.4%</td>
</tr>
<tr>
<td>Men</td>
<td>81</td>
<td>10.7</td>
<td>52.9%</td>
<td>47.1%</td>
</tr>
</tbody>
</table>
Women and men are differentially engaged in engineering education: Survey Data

- Longitudinal survey to study development of engineering skills and identity
- Administered to $\approx 160$ students at four institutions, from first to senior year
- Full details in Abstract AC 2007-2392
Women and men are differentially engaged in engineering education

Diseng. in lib arts courses

Men

Women

Administration (academic years)

FR1 FR2 SO1 SO2 JR1 JR2
Real People, Real Stories of Engagement

- Ethnography adds richness & depth to other methods
- Case studies of 2 participants
- Extremes of different female & male engagement demonstrate poles of experience at MT
- Starkest example of male disengagement; reasonably typical example of female engagement
Hilary & Max: Common Threads

- Family & social connections to engineering
- Strong interest in math & science
- Majors with application in oil and gas industry
- Recognition of need to work hard at MT
- Internships (targeted across field)
Divergent Experiences

Hilary
► Student Athlete (Varsity & IM)
► Interdisciplinary minor
► Campus leadership activities
► Professional society through field
► Friends across campus
► Sanguine about hard work
► Satisfied with undergraduate experience

Max
► Opted not to pursue sports
► No minor
► No leadership activities
► Professional society through field
► Friends in major/from HS
► Resentful of hard work
► Deeply dissatisfied with undergraduate experience
Discussion

- Women defined engineering more broadly
- Women’s approach to an engineering problem was more contextual
- Women were more engaged in their overall education
  - Preliminary survey evidence of less disengagement in liberal arts courses
  - Ethnographic evidence of greater engagement