Innovation in Engineering Education: An exploration of academic programs, gender, and self-efficacy

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**What is the Engineering Majors Survey?**

The Engineering Majors Survey is a longitudinal research project looking at which educational environments/experiences influence engineering students’ innovation and entrepreneurial interests, abilities, and achievements.

**7,197 ENGINEERING STUDENTS**

UNIVERSITIES

36% of respondents indicated pursuing a concentration or topical track within their primary or second major. Our analyses suggest some concentrations are officially declared within the academic major, while others are self reported as a clarification for field of study.

**Focal Respondents**

Percentage of respondents pursuing a certificate, minor, or concentration

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Certificates</td>
<td>9%</td>
</tr>
<tr>
<td>Minors</td>
<td>27%</td>
</tr>
<tr>
<td>Concentrations</td>
<td>39%</td>
</tr>
</tbody>
</table>

**Methodology**

- **Data Cleaning**
  - Resolved responses for
    - minor and concentration duplicates
    - certificate and concentration duplicates
  - Created flags for
    - programs in human factors and design
    - programs in business, management, leadership and entrepreneurship

- **Data Coding**
  - Developed a coding scheme linking respondents’ major to concentration
    - 39 unique engineering majors + 10 non engineering majors
    - 2,591 total concentrations

**What is “innovation”?**

Innovation has been described as both a process and result. Creativity and design exist in the product development process, considered inputs, whereas business, entrepreneurship, and leadership lie in the commercialization and dissemination end of the continuum, considered outputs. In reality, these often overlap and are part of an iterative process.

The Duval-Couët & Dyrenfurth Innovation Education Continuum Framework (2012)

- Creativity and techniques
- Innovation Product and process development
- Entrepreneurship New venture development
- Management Technology and business development

**Process and Outcomes**

Concentrations, minors, and certificates were categorized based on a keyword search of topics and competencies addressed in existing innovation courses.

- The most popular innovation process programs are fields in design, human factors, and product and process engineering.

- The most popular innovation outcomes programs are in business, economics, and management.

**Percentage of academic programs in fields of innovation**

<table>
<thead>
<tr>
<th>Category</th>
<th>Innovative Process</th>
<th>Innovative Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>concentrations</td>
<td>5.4%</td>
<td>6.7%</td>
</tr>
<tr>
<td>minors</td>
<td>1.6%</td>
<td>15.7%</td>
</tr>
<tr>
<td>certificates</td>
<td>0.3%</td>
<td>14.6%</td>
</tr>
</tbody>
</table>

**Participation rates by gender**

Of n=7,197 engineering student respondents, 31% are female and 69% are male.

- Of students awarded engineering degrees in the U.S., 18% are female and 82% are male.

**Self-efficacy by program participation**

Is there a relationship between participation in academic programs and students’ innovation self-efficacy? Is there a difference in the types of self-efficacy exhibited by participants of “innovation process” and “innovation outcome” programs?

Students were asked how confident they were in their ability to:

- Contact an entrepreneur, have a prototype, or conduct systematic research to develop or evaluate a design
- Develop a new product or process to meet specified requirements
- Generate new ideas by observing the world
- Learn a lot of people
- Take the steps needed to place a financial value on a new business venture

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