Broadening Contexts to Broaden Participation in Engineering

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ENE Seminar
1997
Math & Science = Engineering
2001
Engineering Education?
2004
 Real Engineering?
2009
K-12 Engineering Education Expert?
2010
Post Doc?
2011
Research Faculty?
2013
Tufts University
Arizona State University
FACE lab
For All: a Chance to Engineer

Morgan
Cole
Chanel
Avneet
James
Broadening Contexts to Broaden Participation in Engineering
The Big Idea: Diversity
Disclaimer: My Privilege

• I am white.
• I am male.
• I am straight.
• I am able-bodied.
• I am educated.
• I am upper middle-class.
• I am tall.

I am left-handed.
Think: Why is diversity important?

Pair: Turn to your neighbor(s) and discuss your ideas.

Share: Share with the whole group.
Diversity: The Big Idea
1. Diversity of People
2. Diversity of Ideas/Solutions
3. Diversity within Engineering (\& STEM)
Perspective-taking
Who are engineers?

What do they do?
Not much diversity of people
Engineers can be MUCH more than this
MYTH: engineers fix cars or wear hard hats
MYTH: engineers sit at computers all day
MYTH: engineers have no people skills
MYTH: engineering is for boys
Where will you find engineer’s work?
MOVIES

Sound Engineering

Lighting Engineering

Special Effects Engineering

Ergonomics Engineering

Theater Engineering
FASHION ENGINEERING
SPORTS ENGINEERING
MULTI-DISCIPLINARY ENGINEERING
Video games
Toys
Skateboards
Rockets
Windmills
iPhone apps
Rollercoasters
Pizza
Self-driving cars
Candy bars
Medicine
Engineering is diverse &
Requires diverse solutions
So what’s the problem?
NSF-CAREER

Broadening Contexts to Motivate Engagement in Engineering

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Engaging, Interesting!
Psychology of Interests

**Personal interests** are the characteristics of a person that influence his or her engagement in interactions with the social or nonsocial environment.

**Situational interests** refer to the interestingness of the social or nonsocial environment that evoke or encourage interactions with people or objects.

Situationally Interesting!
Research Questions

Does broadening the context of engineering activities:

1. Appeal to more students’ personal interests;
2. Empower underrepresented groups (female and minority) to find personally meaningful connections;
3. Lead to more authentic engagement in engineering practices for all students; and
4. Improve students’ attitudes and perceptions of engineering?
Interest-based Engineering Challenge framework

• **v1** – based on lit. review, prior experience, and pilot interviews
  • **v2** – revised based on Phase I simulation lab and interview studies
    • **v3** – revised based on findings from Phase II school implementation
      • **v4/5** – revised based on Phase III broader implementation findings

  - Phase I simulation lab & interview studies (years 1-2)
  - Phase II New Community School implementation (years 2-4)
  - Phase III broader implementation (years 4-5)
Phase I: Interview Study
The Interview

• What are your personal interests? What do you do for fun? Extracurricular activities?
• What are your academic interests?
• What are your career interests?
• Are you interested in engineering?
• What is engineering? How would you describe engineering to a friend?
The students

<table>
<thead>
<tr>
<th>Category</th>
<th>Breakdown</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>12 female, 16 male</td>
</tr>
<tr>
<td>Race</td>
<td>10 African American, 4 Hispanic, and 14 white</td>
</tr>
<tr>
<td>Grade level</td>
<td>9 4&lt;sup&gt;th&lt;/sup&gt;-5&lt;sup&gt;th&lt;/sup&gt; grade, 12 6&lt;sup&gt;th&lt;/sup&gt;-8&lt;sup&gt;th&lt;/sup&gt; grade, 7 9&lt;sup&gt;th&lt;/sup&gt;-12&lt;sup&gt;th&lt;/sup&gt; grade</td>
</tr>
<tr>
<td>Engineering participation</td>
<td>19 participated in an engineering program, 9 did not</td>
</tr>
</tbody>
</table>
Holland’s Career Theory (RIASEC)

http://www.utsa.edu/careercenter/images/riasec/riasec.png
# Mechanical Engineers

**O*NET OnLine**

A proud partner of the [American Job Center](http://www.onetonline.org)

## Interests

<table>
<thead>
<tr>
<th>Occupational Interest</th>
<th>Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>95</td>
<td><strong>Investigative</strong> — Investigative occupations frequently involve working with ideas, and require an extensive amount of thinking. These occupations can involve searching for facts and figuring out problems mentally.</td>
</tr>
<tr>
<td>89</td>
<td><strong>Realistic</strong> — Realistic occupations frequently involve work activities that include practical, hands-on problems and solutions. They often deal with plants, animals, and real-world materials like wood, tools, and machinery. Many of the occupations require working outside, and do not involve a lot of paperwork or working closely with others.</td>
</tr>
<tr>
<td>50</td>
<td><strong>Conventional</strong> — Conventional occupations frequently involve following set procedures and routines. These occupations can include working with data and details more than with ideas. Usually there is a clear line of authority to follow.</td>
</tr>
<tr>
<td>28</td>
<td><strong>Artistic</strong> — Artistic occupations frequently involve working with forms, designs and patterns. They often require self-expression and the work can be done without following a clear set of rules.</td>
</tr>
<tr>
<td>17</td>
<td><strong>Social</strong> — Social occupations frequently involve working with, communicating with, and teaching people. These occupations often involve helping or providing service to others.</td>
</tr>
<tr>
<td>11</td>
<td><strong>Enterprising</strong> — Enterprising occupations frequently involve starting up and carrying out projects. These occupations can involve leading people and making many decisions. Sometimes they require risk taking and often deal with business.</td>
</tr>
</tbody>
</table>
Chemist

**Interests**

Interest code: IRC

- **Investigative** — Investigative occupations frequently involve working with ideas, and require an extensive amount of thinking. These occupations can involve searching for facts and figuring out problems mentally.

- **Realistic** — Realistic occupations frequently involve work activities that include practical, hands-on problems and solutions. They often deal with plants, animals, and real-world materials like wood, tools, and machinery. Many of the occupations require working outside, and do not involve a lot of paperwork or working closely with others.

- **Conventional** — Conventional occupations frequently involve following set procedures and routines. These occupations can include working with data and details more than with ideas. Usually there is a clear line of authority to follow.

Pediatrician

**Interests**

Interest code: IS

- **Investigative** — Investigative occupations frequently involve working with ideas, and require an extensive amount of thinking. These occupations can involve searching for facts and figuring out problems mentally.

- **Social** — Social occupations frequently involve working with, communicating with, and teaching people. These occupations often involve helping or providing service to others.
Results: Personal Interests

RIASEC totals across all students and all personal interest questions

- Investigative
- Realistic
- Artistic
- Social
- Enterprising
- Conventional

Combined Interests

Total responses
Results: Personal Interests

**Comparison of Participation (P) vs. Non-participation (NP) interests**

- **Realistic**
  - P: 59%
  - NP: 67%
- **Investigative**
  - P: 50%
  - NP: 67%
- **Artistic**
  - P: 64%
  - NP: 67%
- **Social**
  - P: 73%
  - NP: 83%

- **Enterprising**
  - P: 0%
  - NP: 17%

- **Conventional**
  - P: 0%
  - NP: 0%

**Percentage of responses**
Results: Understanding of Engineering

Comparison of Participation vs. Non-participation understanding of engineering

- **Realistic**: 64% P, 36% NP
- **Investigative**: 64% P, 36% NP
- **Artistic**: 14% P, 86% NP
- **Social**: 50% P, 50% NP
- **Enterprising**: 0% P, 100% NP
- **Conventional**: 0% P, 100% NP

Understanding of engineering by RIASEC codes
RIASEC Profiles for Student Interest Profile and Their Perception of Engineering

- Student perception
- Student profile
- Student perception revised
Students have diverse interests
BUT
Students may not see diversity of engineering
Think: How can engineering activities appeal to students’ personal interests?

Pair: Turn to your neighbor(s) and discuss your ideas.

Share: Share with the whole group.
Broad societal contexts
Work to do: How can you broaden the context of STEM to appeal to students’ personal interests?
Questions?

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