# Connecting with first-year engineering students' interest in social responsibility issues through ethics lessons

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Katie is an undergraduate student researcher at the University of Colorado, Boulder. She is interested in why students choose to study engineering and what retention methods are successful for universities, particularly in underrepresented communities. She is a Senior in Mechanical Engineering and plans to work in renewable energy when she graduates in December.

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Janet Y. Tsai is a researcher and instructor in the College of Engineering and Applied Science at the University of Colorado Boulder. Her research focuses on ways to encourage more students, especially women and those from nontraditional demographic groups, to pursue interests in the eld of engineering. Janet assists in recruitment and retention efforts locally, nationally, and internationally, hoping to broaden the image of engineering, science, and technology to include new forms of communication and problem solving for emerging grand challenges. A second vein of Janet's research seeks to identify the social and cultural impacts of technological choices made by engineers in the process of designing and creating new devices and systems. Her work considers the intentional and unintentional consequences of durable structures, products, architectures, and standards in engineering education, to pinpoint areas for transformative change.

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Malinda Zarske is a faculty member with the Engineering Plus program at the University of Colorado Boulder. She teaches undergraduate product design and core courses through Engineering Plus as well as STEM education courses for pre-service teachers through the CU Teach Engineering program. Her primary research interests include the impacts of project-based service-learning on student identity - especially women and nontraditional demographic groups in engineering - as well as pathways and retention to and through K-12 and undergraduate engineering, teacher education, and curriculum development. She is passionate about hands-on engineering design for every student, at every age level.

College of Engineering & Applied Science
UNIVERSITY OF COLORADO BOULDER

# *Connecting with first-year engineering students' interest through ethics lessons*

Katie Waugaman – Dr. Janet Tsai – Dr. Mindy Zarske, Engineering Plus

Engineering Plus
UNIVERSITY OF COLORADO BOULDER

## OBJECTIVE

The goal of this study is to identify and analyze engagement strategies. Ethics lessons from five instructors in first-year engineering projects courses (GEEN 1400) will be observed and analyzed.

## RESEARCH QUESTIONS

1. What are successful engagement strategies instructors and what ethical teaching outcomes does each produce?
2. How can these strategies begin to achieve Triggered-Feeling SI in students?
3. How do these engineering ethics lessons affect students' perspectives of an engineer's role in ethical decision-making?

## BACKGROUND

### *First-year Engineering Student Retention*

- Attrition rates for first and second year engineering students is unusually high: 82% of Engineering students return for a second year of Engineering and only 62% of Engineering students return for a third year of Engineering.
- "A primary reason for the attrition of students from engineering is their perception of a learning environment that **fails to motivate them and is unwelcoming.**"

### *Triggered Situational Interest*

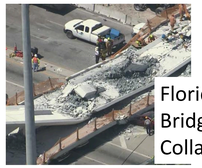
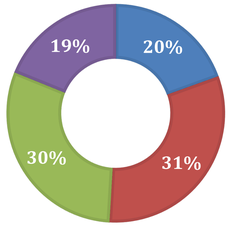
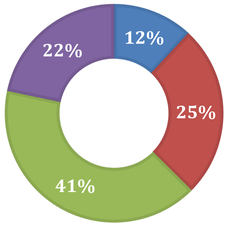
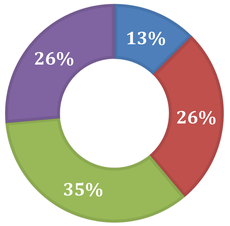
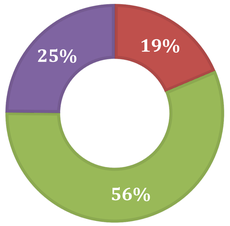
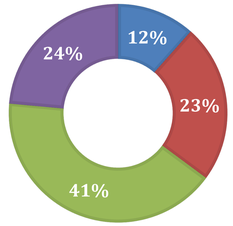
Situational interest defines how students connect to lesson content and how they retain this content over time. *Triggered SI* is the first step towards *Value SI*, where students retain concepts and apply them in other aspects of life and topics in school.

**Triggered SI** → Maintained SI → Value SI

## METHODS

- ***Presurvey:*** Asked about the course overall; seeking insight on how students want to **master material** and **avoid work** (n = 73 responses)
- ***TDOP Observation Method:*** **Observational software** in which observers record student and teacher actions/interactions during a 50-minute GEEN 1400 course session (5 courses, 2-3 observers each)
- ***Postsurvey:*** Asked questions about GEEN 1400 **ethics lecture**; examples include what students remembered, what they liked and didn't like, etc. (n = 79 responses)

## FINDINGS: CLASS PROFILES

| | C1 | C2 | C3 | C4 | C5 |
|---|---|---|---|---|---|
| **Class Case Study** |  Challenger Space Shuttle |   |  Challenger Space Shuttle |  Challenger Space Shuttle |  Florida Bridge Collapse |
| **Class Style** (TDOP Observation) |   |   |   |   |   |

Student Focused Instruction · Student Led Instruction · Teacher Focused Discussion · Teacher Led Discussion

| | Class Activity | Interesting & Thought Provoking | Practical Examples | Practical Examples | Practical Examples |
|---|---|---|---|---|---|
| **Top Strength** (Postsurvey) | | | | | |
| **Top 3 Student Outcomes** (Postsurvey) | **#1:** Decision Making: 61% | Ethics vs. Law/Employer: 36% | Class Case Study: 44% | Class Case Study: 38% | Class Case Study: 38% |
| | **#2:** Class Case Study: 39% | Ethics Codes & Morals: 21% | An Engineer's Role in Ethics: 21% | Ethics vs. Law/Employer: 33% | An Engineer's Role in Ethics: 31% |
| | **#3:** (none) | Class Case Study: 14% | Ethics vs. Law/Employer: 13% | Ethics Codes & Morals: 22% | Decision Making: 13% |

**61%** of students liked the Ethics lecture the best of all the lectures

**11.8%** growth in "Ethics importance" from presurvey to postsurvey

## FINDINGS: KEY TAKEAWAYS

**Case studies are a powerful way to teach engineering ethics.**

Case studies that are *particularly* applicable to students convey messages more than the "narrative" of the case study (i.e. C2 and The Flint Water Crisis).

**Content can be tactfully incorporated with a teaching method.**

Instructor 1 "taught" decision-making practices through the Challenger case study and small group work.

**The way that an instructor structures a lesson may have little impact on student content takeaway.**

C3-C5 had different Class Style, yet students had similar outcomes.

**Overall, ethics lessons are effective.**

Popular with students and instill Triggered SI in the area of Engineering Ethics.

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