Considering life cycle during design: A longitudinal study of engineering undergraduates

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ABET outcomes
on sustainability and context

- "(c) an ability to design…within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and **sustainability**"
- "(h) …understand the impact of engineering solutions in a global, economic, environmental, and societal **context**"

Are students achieving these outcomes?

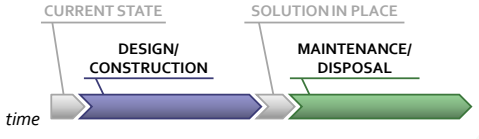
Considering context
in engineering design

- Extending past research on how engineering students and professionals approach open-ended design problems
- Now also considering dimension of time

Millennium Bridge and St. Paul's Cathedral, wallyg on Flickr

Life cycle
as an analysis framework

- Structured way of placing engineering design in broad temporal context



- Commonly used for comprehensive evaluation of project cost, environmental impact

Research questions

- How broadly do engineering undergraduates consider life cycle when evaluating design alternatives?
- Change during undergraduate years?
- Vary with gender?

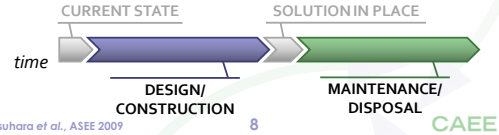
Data collection:
Street crossing design task

- Free-response questions about the design of a cost-effective way of safely getting pedestrians across a busy intersection
- 64 engineering majors at 4 institutions
- 2nd and 4th years of undergraduate study
- Part of CAEE's Academic Pathways Study

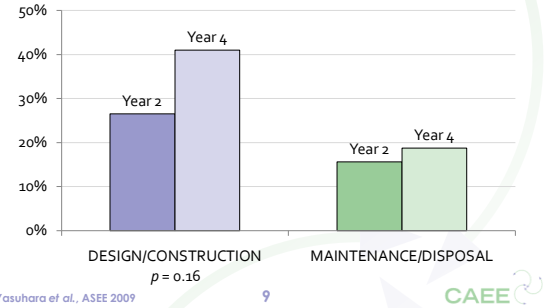
Special Session 2530 today at 2:15 and Booth #437

Data analysis:
Coding for life cycle stages

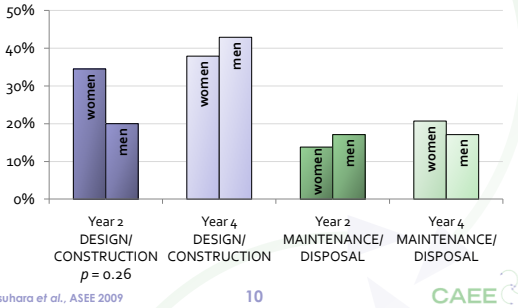
- Focus on generating and evaluating design alternatives
- Coding for consideration of life cycle stages
  - Independent coding by two researchers
  - Minimum of 80% agreement
  - Negotiation to consensus



Life cycle consideration:
Class standing



Life cycle consideration:
Gender



Toward implications

- What kinds of experiences/background are associated with broader consideration of context during engineering design?
- How can we encourage engineering students to consider life cycle?

A multi-method glimpse

- "Kara," who had a capstone course in sustainable development
- **From interview:** "not just how much it costs to produce but how much it costs to get rid of it"
- **From design task:**
  - DESIGN/CONSTRUCTION: study to better understand problem
  - MAINTENANCE/DISPOSAL: trial period with crosswalk signals, with option of adding overpass later

See also: Kilgore *et al.*, 2009 at Mudd Design Workshop

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