Reflections on the Integration of Social Justice Concepts into an Introductory Control Systems Course
Kathryn E. Johnson, Jon A. Leydens, and Barbara M. Moskal

Introduction

- Real engineering problems are solved within social contexts
- Engineering practice demands sociotechnical thinking (learning to define and solve problems not in exclusive technical or social terms but acknowledging their interplays).
- Technical engineering courses often focus exclusively on the technical; Humanities and Social Science courses often focus exclusively on the social.
- Project goal: *Integrate sociotechnical thinking* within Introduction to Feedback Control Systems (IFCS).

Context & Background

- Colorado School of Mines is a public research university devoted to engineering and applied science.
- Social justice in engineering is: “engineering practices that strive to enhance human capabilities (goal) through an equitable distribution of opportunities and resources while reducing imposed risks and harms (means) among agentic citizens of a specific community.” [10, p. 4]
- In Fall 2014 & Fall 2015, students in one IFCS section were given:
  - o examples of social justice in IFCS (prosthetics, wind energy systems)

Who benefits? Who suffers? Who is not even at the table?

- o opportunities to apply the social justice definition and six criteria in class discussions and active learning, homework, and a final project

Iterative Interventions

<table>
<thead>
<tr>
<th>Iteration #1 (Fall 2014): summary of key problems with social justice interventions:</th>
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<tbody>
<tr>
<td>Students question social justice as a disconnected add-on</td>
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<tr>
<td>Students are concerned about missing “content” when discussing social justice</td>
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<tr>
<td>Students question the relevance of social justice</td>
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<tr>
<td>Social justice is only spottily integrated</td>
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<td>Students are missing real-life connections</td>
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Iteration #1: biggest takeaways

I think my biggest takeaways from this initial integration are (1) that it is more time-consuming than I ever expected, and (2) that I am more bothered by a small number of naysayers than I would like to admit.

Iteration #2 (Fall 2015): epiphany on active and applied learning:

I had the sudden inspiration that *of course* the students [in the focus groups and individual interviews] talked to you more about the water-related examples than the wind and prosthetic ones were largely used as in-class examples and discussions – times when the students could be more passive. This seems so obvious to me after the fact that I can’t believe I didn’t think of it ahead of time.

Iteration #2: Content, the bane of the engineering classroom

“Content is the bane of my CSESJ [control systems engineering and social justice] activity.”

Iteration #2: Success! Social justice as the problem motivator

The requirement to *motivate* the project by SJ [social justice] was a real brainstorm since it kept the students thinking about the bigger picture from the start; I had no actual complaints about this one, and more teams talked about SJ elements beyond just safety (anecdotally, though I haven’t done the formal analysis, “enhancing human capabilities” and “increasing opportunities and resources”).

Conclusions

- Key barriers to sociotechnical integration: faculty knowledge, student pushback, time and content constraints
- Most students desire to see some sociotechnical interplays when learning highly technical content like IFCS; the challenge is finding the most effective methods to help them learn how the technical works and how the social can shape technical design choices
- Using social justice as a catalyst for problem definition resulted in the most successful iteration of the research to date.

Social Justice Catalysts

Catalysts related to social structural conditions, distribution of opportunities, resources, risks, and harms, and ways to enhance human capacities, etc.

References