Teaching the Socially-Situated Nature of Climate Change Science in Technical STEM Courses: A Hurricane Katrina Case Study #0853

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Background

STEM practices are socially embedded[1,2,3]

- Historically taught as technical, no social context
- Usually centered on dominant culture's knowledge, practices, and needs
- Disproportionately harms marginalized people
- Inclusive professional identities include technical and social skills and inclusive practices and embrace social responsibility[4]

Lack of curriculum is a barrier to integrate social content into technical curriculum

- Case studies effectively contextualize content[5]
- Contextualized content supports all students, particularly those underrepresented in STEM[4,5]
- Important to embed social context in STEM curriculum for inclusive practices[4]
- Social justice cases integrate professional social responsibility and marginalized situations[6]

Research Questions:

- How students' products demonstrate the interconnected nature of engineering and social factors?
- Do students perceive the socially-embedded nature of their work as valuable?

Course Context

- Introductory Civil Engineering course at a large, R1 university in the Inter-Mountain West of the United States
- Taught by Civil Engineering professor who has taught introductory engineering courses for >20 years.
- 50 minute lecture twice weekly, weekly lab
- Total enrollment: 74 students, 32 consented
  - In class for activity: 62 students, 25 consented
    - 20 first-year, 5 second-year
    - Majors: 1 Engineering Science, 1 Engineering Open Option, 23 Civil Engineering
    - Mean age: 18
    - 36% students of color, 64% white
    - 52% men, 48% women, 0% gender diverse (e.g. transgender, intersex, non-binary).
    - 80% heterosexual, 16% LGB+, 4% prefer not to respond

Methods

Intervention

- Pre-class homework: Read case study, watch a video about integrating local community into problem-solving, and answer reflective questions
- In class activity: group work developing a system model of case study, answer questions using their system model, and develop a system model of different situation of their choice
- Post-class: reflection questions

Data and Analysis

- Data: All written responses from the above activities. Prior to this activity we obtained student consent and collected demographic data, as part of our larger study
- Analysis: Qualitative Content Analysis, which distills responses into categories and themes that characterize both similarities and differences – in progress

Results (in progress)

96% of students responded positively to the activity. Major themes included social and system-focused skills and concepts.

Student-reported learning (n=25)

- 52% - social context and engineering connectivity

"Social impacts and systemic oppression play a much larger role in engineering than I first thought."

- 26% - complexity of systems

"There are an infinite number of solutions to a problem. It just depends on how you think about it."

- 26% - system modeling skills,
- 17% - Group-work skills

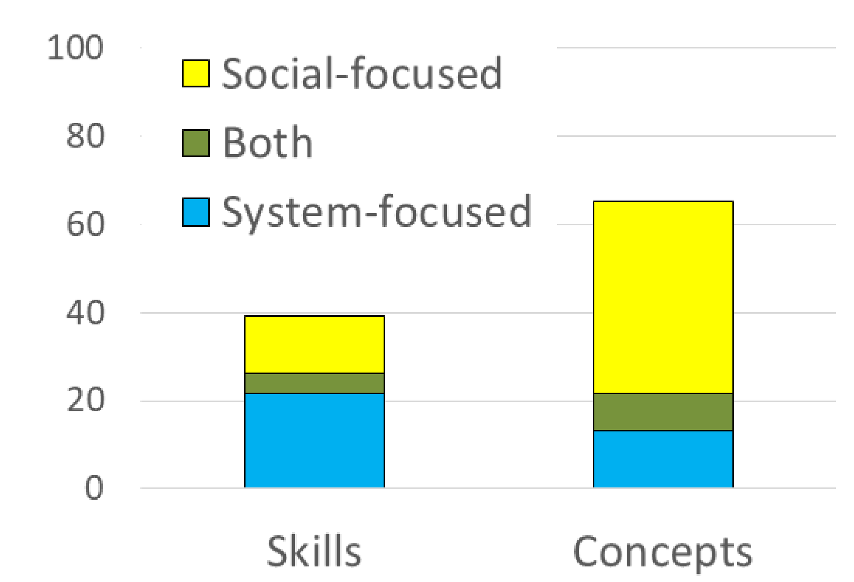


Figure 1: Students reported learning about both social and system skills and concepts. Social skills – group and communication. System skills – building a system model. Social concepts – integration of social and engineering. System concepts – complexity

Transfer to future group work (n=25)

- Group collaboration (46%), broader/social impacts of engineering (33%), and concept mapping (8%), not ready to use new skills (8%), nothing new (8%)

"It will make me consider who is advantaged by anything I work on."

Liked about assignment (n=25)

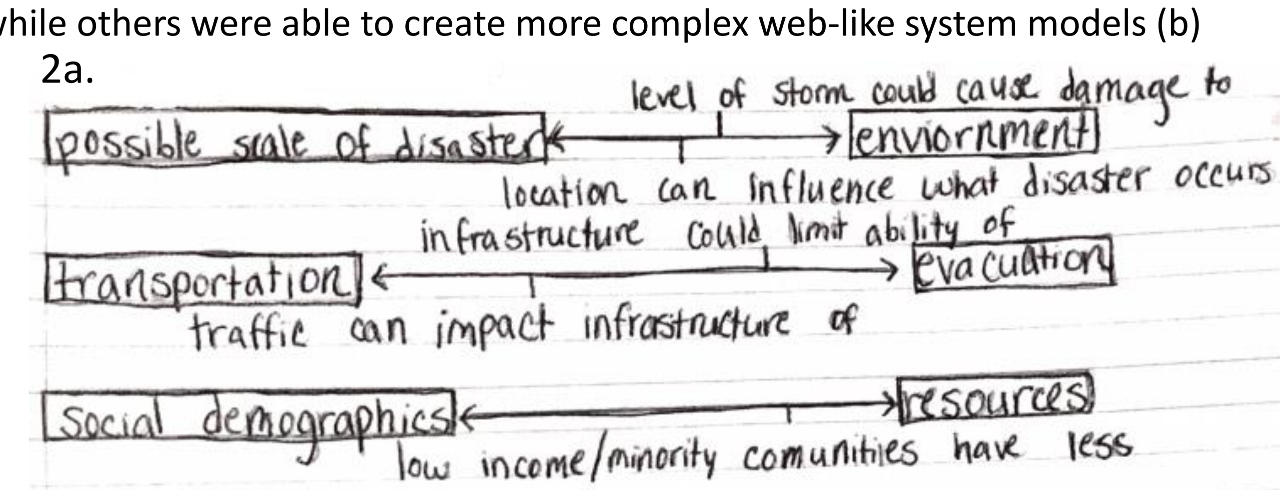
- Innovative (56%), student centered 28(%), social context (28%), real issues (20%), disliked (4%)
- *"I liked the innovative thinking. Not just saying **this** is the solution but what **could** be a solution."*

Group System models (n=4)

- All interconnected social and physical characteristics, only half (2/4) created interconnected webs

Figure 2: Some student groups created simple, disconnected models (a), while others were able to create more complex web-like system models (b)

2a.



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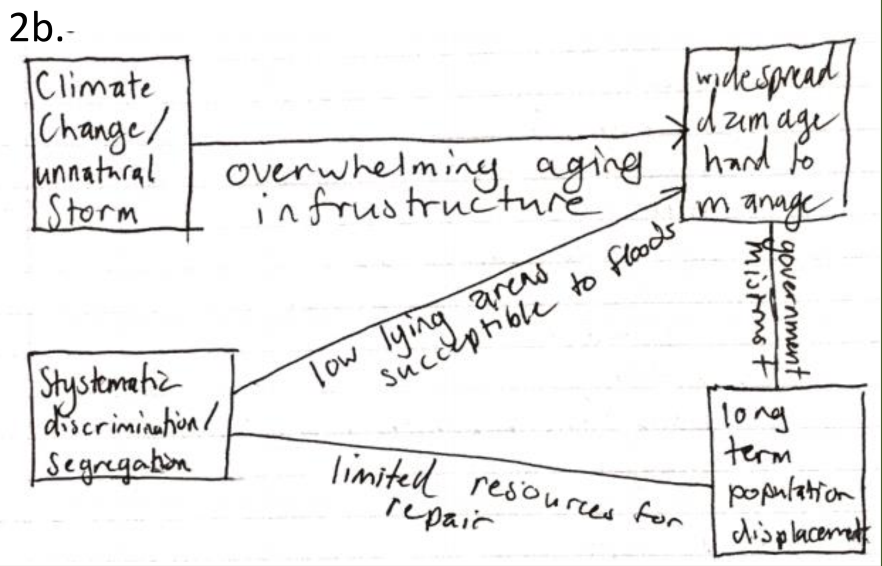

Discussion

Preliminary results indicate that the case successfully taught students about the importance of the broader social context of engineering and that students valued this social context.

- Student analyzed connections between engineering and social factors in the case study
- More than half of the students reported learning about the connectivity of engineering and social systems

Since contextualized learning supports underrepresented students[5], social-justice rooted cases may serve multiple roles by supporting student persistence, bring real-world material into the classroom, create a space to explicitly discuss the socially-situated nature of STEM, and step beyond the dominant perspectives that often dominate STEM curriculum[6].

Future work

- Implement case across broader context
- Develop and test additional cases
- Evaluate persistence of student learning
- Evaluate student persistence in engineering, since cases can increase underrepresented student persistence in engineering

Selected References and Acknowledgements

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