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GIFTS: Intro to Civil & Environmental Engineering - First-year Engineering Course designed for Student Engagement and Belonging

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Introduction

This GIFTS (Great Ideas For Teaching (and Talking With) Students) paper examines the design and implementation of a 1-credit Intro to Civil & Environmental Engineering course (CEE 101), and its impact on student engagement, belonging, and retention. I joined Juniata College in the Fall of 2022 as the college launched its Environmental Engineering program. As a faculty member in the new program, I dedicated significant time to developing and teaching this introductory course. However, the initial student evaluations were below expectations, with average scores lower than my typical average of 4.7/5.0. Student feedback highlighted two major challenges: the lack of sense of community and belonging as the first engineering cohort, and an overwhelming final assessment. In response, I implemented substantial revisions in Fall 2023, focusing on three key changes: 1) the inclusion of guest speakers, 2) the introduction of an "Engineering Passport," and 3) the redesigned final assessment.

Background

CEE 101 is a seminar-based class open to any first-year student on campus. This course introduces students to the interdisciplinary field of Civil & Environmental Engineering while helping them navigate college life, connect with the campus community, and make informed decisions about their academic paths. Upon completion of the course, students will be able to:

1. Make informed decisions about their Program of Emphasis (POE) – determining their suitability for an engineering-focused academic path.
2. Define Engineers' role in identifying and addressing societal challenges.

Implementation

Although the primary focus of the class remained unchanged, the curriculum underwent significant revisions to address workload concerns and enhance student engagement. Key activities implemented to achieve these outcomes included – 1) guest speakers, 2) engineering passport, and 3) redesigned semester project. The grading structure was revised with activities spread throughout the semester. Table 1 below presents the grading components for Fall 2024.

Table 1: Grading components for CEE 101

Graded Component	Points
Class Participation & Online Forums	200
Engineering Passport (50 each)	200
Speakers Reflection (100 each)	300
Final Assessment – Poster	300
Total	**1000**

1) Guest speakers

Over the course of 15 weeks, students engaged with a group of guest speakers from academia, industry, state and federal agencies. The aim was to expose students to various career paths and provide role models within the field. For example: in the Fall 2023, there were five speakers (2 female, 3 male) representing academia, private industry, city government, and the EPA; and in Fall 2024, we had 3 speakers (2 female, 1 male) representing academia, a private firm and a state employee. After each session, students were required to submit a one-page reflection guided by five specific prompts as outlined below.

1. Briefly introduce the speaker in 2-3 sentences. [10 points]
2. What did the speaker share about? Provide a one-sentence summary to reflect the speaker's lecture. [10 points]
3. Summarize the guest session in 3 paragraphs **(**1 paragraph for each prompt below**):**
    a) Provide 1 paragraph summary of the guest speaker's lecture. [20 points]
    b) What is the most interesting thing that guest speaker shared? Explain why? [20 points]
    c) What is one way in which the guest speaker helped to improve your understanding of the roles of a Civil/Environmental Engineer? [20 points]
4) On a scale of 1-5 (with 5 being the most beneficial), how beneficial was the guest lecture? Provide a reason for your rating. [10 points]
5) What suggestions do you have for future guest speakers? [10 points]

2) Engineering Passport

Another key element in enhancing the student experience was the inclusion of the "Engineering Passport" as part of their grade. The engineering passport encouraged students to participate in activities that fostered connections with the academic community and campus resources. Each student was required to complete and submit their passport by the end of the semester. While they had flexibility in choosing events or activities, students were expected to fulfill tasks aligned with four objectives: 1) University/College Study, 2) Academic Community, 3) Tools & Resources, and 4) Relationships. Students provided evidence and reflections for each activity, describing how these experiences enriched their academic journey. Table 2 details objectives, examples of activities, and reflection prompts.

3) Final Assessment – Poster design and presentation

The final assessment required students to collaborate on group poster design. Teams of engineering and non-engineering students selected topics of interest, developed posters over the semester, and presented their work during the final week. The project is introduced around the 5^{th} week of class where students have been introduced to some topics in engineering and had at least one speaker for the class. The project was scaffolded into milestones to ensure steady progress as shown in Table 3.

Table 2: Engineering Passport: Objectives, examples and reflection prompts

Objective	**Examples of relevant activities**	**Reflection**
University/College Study	a. Attend a public speech or presentation b. Attend a campus cultural event c. Volunteer at a service event	Describe how this event has enriched your educational experience?
Academic Community	a. Attend the Career Fair b. Meet with an existing engineering student on campus c. Use the link and explore some career opportunities in engineering d. Choose one of the engineering society and learn about their goals	What have you learned about majors or minors, or the careers they prepare you to pursue?
Tools & Resources	a. Visit the Writing Center b. Tour a Library, Labs or Career Services c. Visit Raystown Field Station, EcoHouse d. Visit SPOT or Unity House	What have you learned about the resources available to you to assist you in meeting your academic or professional goals?
Relationships	a. Meet with an academic advisor to discuss your progress or an academic goal. b. Meet a faculty member (outside of your current courses) c. Attend a university student organization meeting	What have you learned about relationships and your ability to form personal, academic and professional connections?

Table 3: Final Assessment Deliverables with deadlines

Milestones	**Deliverables**	**% of total grade**	**Due date**
Milestone 1: Project Outline & Planning	Title of the project and a summary (2-3 paragraphs) explaining the project and plans	5 (50 points)	Oct 17
Milestone 2: Poster Layout & Presentation	Structure (Layout) for your poster and a brief presentation to your peers during the class	2.5 (25 Points)	Oct 31
Milestone 3: Draft Poster	Submit the first draft of your poster with all required sections	5 (50 points)	Nov 21
Milestone 4: Final poster & Presentation	Final poster submission and class presentation	15 (150 Points)	Dec 5
Milestone 5: Peer Evaluation	Complete a peer-evaluation feedback form	2.5 (25 points)	Dec 7

Assessment & Outcomes

This study primarily was an effort to enhance students' learning experiences. Positive student feedback motivated the dissemination of these insights to the broader community. The inferences presented in this paper are thus based on preliminary assessment methods. Students were asked to complete a survey at the beginning, and end of the course with identical questions to track changes in students' perceptions over time. Key survey questions informing the inferences in this study are listed below. The first three questions assessed the guest speaker engagement, the next four evaluated the engineering passport, and the final two informed the assessment of the redesign project.

1. Rate your level of understanding of engineering (1 = very little, 5 = well aware).
2. List as many possible career pathways with an engineering degree as you can.
3. Have you met professional engineers before?

4. Are you involved in or aware of any student chapters on campus?
5. Have you made friends with someone outside of your class?
6. List any student resources on campus that you are aware of.
7. Rate your comfort level being on campus (1 = struggling, 5 = enjoyable).
8. Have you worked in teams before? If so, share one memorable experience.
9. Rate yourself as a team player (1 = not a team player, 5 = enjoy working in teams).

The other major assessment tool in this study is the student submissions for course activities. Key insights from specific components include:

Guest Speakers: Student reflections highlighted the value of guest sessions in exposing them to numerous career opportunities and expanding their understanding of engineering roles. A follow-up survey underscored students' strong appreciation for this activity.

Engineering Passport: Reflections revealed that the passport activity fostered a sense of belonging and new relationships. Many students reported discovering campus resources they would not have explored otherwise. This initiative also spurred the creation of a student chapter of the AAEES (American Academy of Environmental Engineers and Scientists), reflecting increased interest in engineering-focused organizations.

Final Assessment: Peer evaluations were key in assessing teamwork and project experience. Additionally, students shared that it provided them with a sense of accomplishment and belonging seeing their work displayed on campus hallways and classrooms. This experience appeared to boost students' confidence, as many went on to present their work at the Liberal Arts Symposium the following spring.

In addition to assessment of individual activities, and pre- and post-assessment survey, multiple other surveys were administered throughout the semester to assess the impact of the course structure and activities. Early surveys, such as the welcome and mathematical confidence surveys, helped identify student needs and tailor support. End-of-semester surveys emphasized self-reflection through activities like the "Course Train" and "Letter to Future Students," which yielded positive feedback with over 90% participation. Most of these surveys were focused on course improvements and were not targeted for assessment. Yet they provided meaningful and valuable information to support the inferences made in this paper.

Conclusion

Though no formal longitudinal assessment has been conducted, student feedback and survey responses indicate that the course modifications enhanced engagement and belonging. The revised approach helped students connect with real-world applications of engineering, fostered a sense of community, and played a crucial role in recruiting non-engineering students into the program. Of the 19 students in the Fall 2023 cohort (9 engineering and 10 non-engineering), 6 non-engineering students switched to engineering by the end of the semester. Likewise, multiple non-engineering students in the Fall 2024 cohort have expressed interest in pursuing engineering as their area of study. Students reported greater comfort in deciding to pursue engineering after taking this class.