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Designing Learning Environments for Systems Engineering and Professional Skills Development in a 2nd-Year CEE Course

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Designing Learning Environments for Engineering Systems and Professional Skills Development in a 2nd-year CEE Course

Abstract

As part of a broader multi-year curriculum and cultural change initiative in a research-intensive department of Civil and Environmental Engineering (CEE), multiple teaching-and-learning environments were designed in a 2nd-year engineering systems course. The overall change initiative aimed to develop more holistic engineers with entrepreneurial mindset. This was accomplished using a common learning experience in a spine of interactive courses. The vertically-integrated courses aim to facilitate the development of problem solving and definition skills, professional skills (computation, teaming, communication, stakeholder engagement), and professional identity development at growing levels of technical maturity. This paper discusses four teaching-and-learning environments designed and implemented in the 2nd-year course, as well as the rationale for creating them. Also, it presents evidence of pedagogy effectiveness from the literature as well as initial anecdotal data to shed some light on how students are experiencing and valuing these learning environments. These learning environments are part of a broader curriculum change initiative to engage CEE undergraduate students early and more consistently in their major. A summative and formative assessment framework and plan is under development to assess and continue to strengthen the spine course sequence.

Keywords: designing learning environments, engineering, professional skills

Background and Motivation

In 2018, the Associate Chair for Undergraduate Programs conducted a Sankey Diagram analysis that showed approximately half of the 1st-year students who declared civil engineering or environmental engineering as their major were leaving for other disciplines – mostly engineering – within their first two years in the program [1]. While roughly the same number of students transferred into civil engineering and environmental engineering (CEE) from other engineering programs during the same time frame, the school's leadership viewed these changes in major as an opportunity to engage their undergraduate students earlier and more consistently in the major and the profession [2]. The school's leadership started work to engage undergraduates early and more consistently during the program - an effort that began with the development of a first-year course: Introduction to Civil and Environmental Engineering. The effort later garnered support from the National Science Foundation and the Kern Entrepreneurial Engineering Network (KEEN) to implement a professional formation experience (PFE) aimed at graduating more holistic engineers with entrepreneurial mindset. Graduates with entrepreneurial mindset know how to create societal, economic and personal value, and have the culture of creating value wherever they go [3]. The PFE would engage undergraduate students earlier in the CEE program via a spine of interactive problem-based learning courses.

The overarching objectives of the CEEatGT curriculum and culture change initiative were to develop more holistic engineers with entrepreneurial mindset. The approach involved creating a

spine of four cohort-based courses aiming to cultivate the following capabilities at growing levels of maturity: (1) problem identification and solving; (2) computational development, (3) communication, (4) teaming, (5) stakeholder awareness and engagement, and (6) professional identity development [4]. These courses are required for all CEE students.

The first year of the change initiative involved broad outreach to the School's stakeholders – undergraduate and graduate students, faculty, staff and alumni via an external advisory board – to present the initiative, explain the underlying rationale and obtain input to refine the objectives. The project leaders also hired a learning scientist who would oversee the faculty development necessary to enable delivery of the initiative objectives. A series of faculty development workshops were conducted in the second and third years as faculty began to design new courses or redesign selected courses in the curriculum. Table 1 lists the workshops that were offered to the faculty. The fourth year was dedicated primarily to formal curriculum change where two new courses (first-year and third-year) were adopted permanently into the curriculum and required for all students. Preceding a formal vote by the general faculty on the curriculum, an extensive outreach was conducted across the school's six academic affinity groups (faculty administrative groups in structural engineering mechanics and materials, environmental engineering, transportation engineering, geosystems engineering, water resources engineering, and construction and infrastructure systems engineering) to co-develop curriculum change proposals that were responsive both to the school's needs as well as to the affinity groups' respective curriculum priorities and constraints [5].

Table 1: Faculty Development Seminars/Workshops for the Curriculum/Cultural Change Initiative

Dates	**Topics**
Spring 2021 Seminar/Workshop Series (monthly)	Curriculum Change: The BME (Biomedical Engineering) Experience
	Integrating Technical and Professional Skills in Real-World Problem-Based Curriculum: The Clemson Experience
	Intro to Interactive and Problem-Based Learning
	Developing Team Effectiveness
	Leading and Managing Change
Fall 2021	Value Sensitive Design and Applications in Transportation
Spring 2022	Future World Vision – Infrastructure Re-Imagined
	Asset-Based Community Development

After approximately four years of working on this initiative, the school's faculty (consisting of 55 full time equivalent faculty members) voted almost unanimously to approve and require two new courses in the curriculum: (1) a first-year course: *Exploring Civil and Environmental Engineering*, and (2) a third-year course: *Data Analytics for Civil and Environmental Engineers*. These two new courses together with the second-year *Civil and Environmental Engineering Systems* course and the fourth-year *Capstone Design* course constitute an integrated spine of

interactive problem-based learning courses (Figure 1). This spine of courses aims to boost the sense of belonging of CEE students to their major and the profession, and to increase retention. More specifically, the spine aims to enhance the students' problem definition and solving, computational, communication and teaming skills, strengthen their professional identity, increase their awareness of the role of stakeholders in the project development process and equip them with stakeholder engagement capabilities. This experience is expected to augment entrepreneurial mindset - boosting the quality of the civil engineering and environmental engineering graduate.

This paper discusses four learning environments designed as part of the curriculum change aimed to foster the development of more holistic graduates with entrepreneurial mindset. Learning environment is used in constructivist terms here to refer to a set of experiences that shape learning [6]. Constructivism is a philosophical view on how we come to understand or know. Within a constructivist framework, we cannot talk about what is learned separately from how it is learned; rather, what we understand is a function of the content, the context, the activity, and the goals of the learner. In what follows, we describe the course and the four new learning environments designed and implemented as well as the rationale for creating them. We then present evidence of pedagogy effectiveness from the literature, limited and initial anecdotal information on how students are experiencing these changes, as well as ongoing efforts to implement a summative and formative assessment framework. The paper is potentially useful to engineering educators interested in engaging students early and consistently in undergraduate engineering programs. It is also potentially useful to engineering instructors interested in embedding professional identity and skills development in engineering courses to augment the quality of the undergraduate experience and the graduates from their programs.

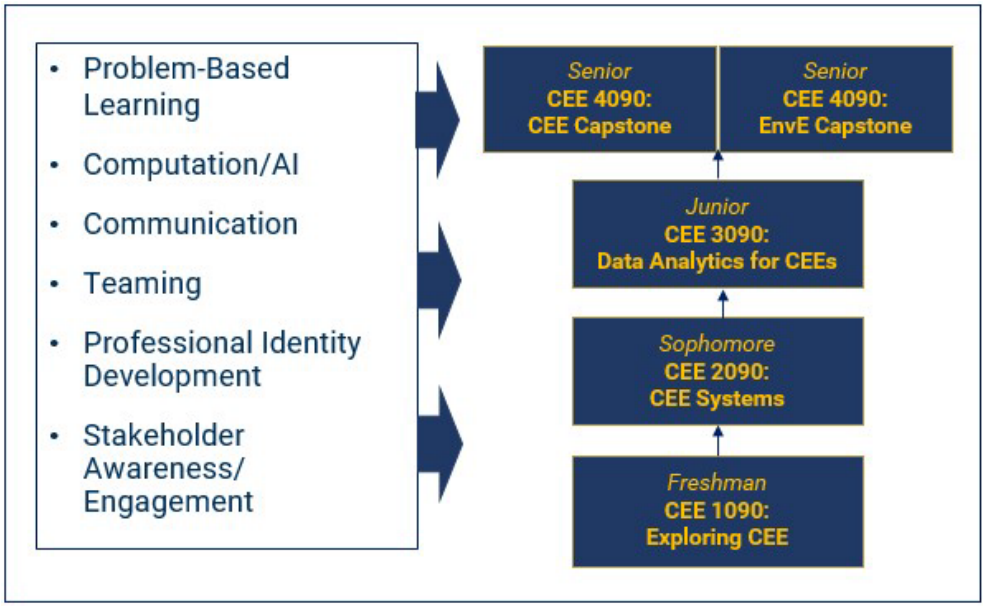

Figure 1: CEE Vertically Integrated Course Sequence (Spine Courses)

The Civil and Environmental Engineering Systems Course

History of the Course: In the 1999/2000 academic year, the Civil Engineering Sytems course was created, introduced and required in the curriculum as part of a broader curriculum revision involving an emphasis on civil engineering systems, technical communications, sustainability, and computer-aided analysis and design [7]. The overarching objective of the course was to introduce students to systems and sustainability principles and applications in civil engineering. A 3-credit course that meets twice a week, Civil Engineering Systems was introduced as a third-year course required for all students in the undergraduate program. Today the course meets for 75 minutes twice per week in four sections spread across two semesters - each section consisting of up to 50 students. The course is focused on systems thinking, planning, design and evaluation to create highly performing and sustainable facilities. The curriculum revision also introduced embedded communications instruction in an engineering course by a subject matter expert.

In 2020, the core topics in the syllabus included engineering sustainable systems; system analysis, sustainability planning and assessment models, environmental impact assessment, social impact assessment, math optimization (calculus, linear and integer programming and multiple citeria decision making), engineering economics, and integrated systems assessment with sustainable design recommendations – with the overarching goal of creating a higher performing and more sustainable built environment that improves quality of life for all. Additional course objectives aimed to hone professional skills, instructed by subject matter experts: communication skills (the students were instructed on written, visual and oral communication); team skills (the students were instructed on psychological safety, team structuring, health and assessment), and research skills (the students were instructed on how to identify good quality information and data when conducting research). The students worked together in teams to complete a semester-long project during which they practice and develop these skills.

The School hired a communications subject matter expert with a Ph.D. in English in 1998, and a teams subject matter expert with a Ph.D. in leadership in 2019. In the 2nd-year course, the communication expert instructed the students in written, visual and oral communication through the end of the 2024/25 academic year when she retired. The leadership development professional instructed students on teaming (team effectiveness and structuring, psychological safety and shared values, team health assessment and feedback) through 2024. Their replacements adopted and are adapting the existing communication and teaming curriculum for the course; the full extent of these efforts will be reported elsehwere. Basic research skills are instructed by the Institute's subject librarian for Civil and Environmental Engineering.

As part of the change intiative (2020-2025), the name of the course was changed from Civil Engineering Systems to Civil and Environmental Engineering Systems (CEE Systems) to reflect the broader audience of students in civil engineering and environmental engineering majors. Also, the course was moved from the third year to the second year to bridge the required 1st-year *Exploring CEE* course with the required 3rd-year *Data Analytics* course. Figure 2 presents the objectives and outcomes of the current *Civil and Environmental Engineering Sytems* course.

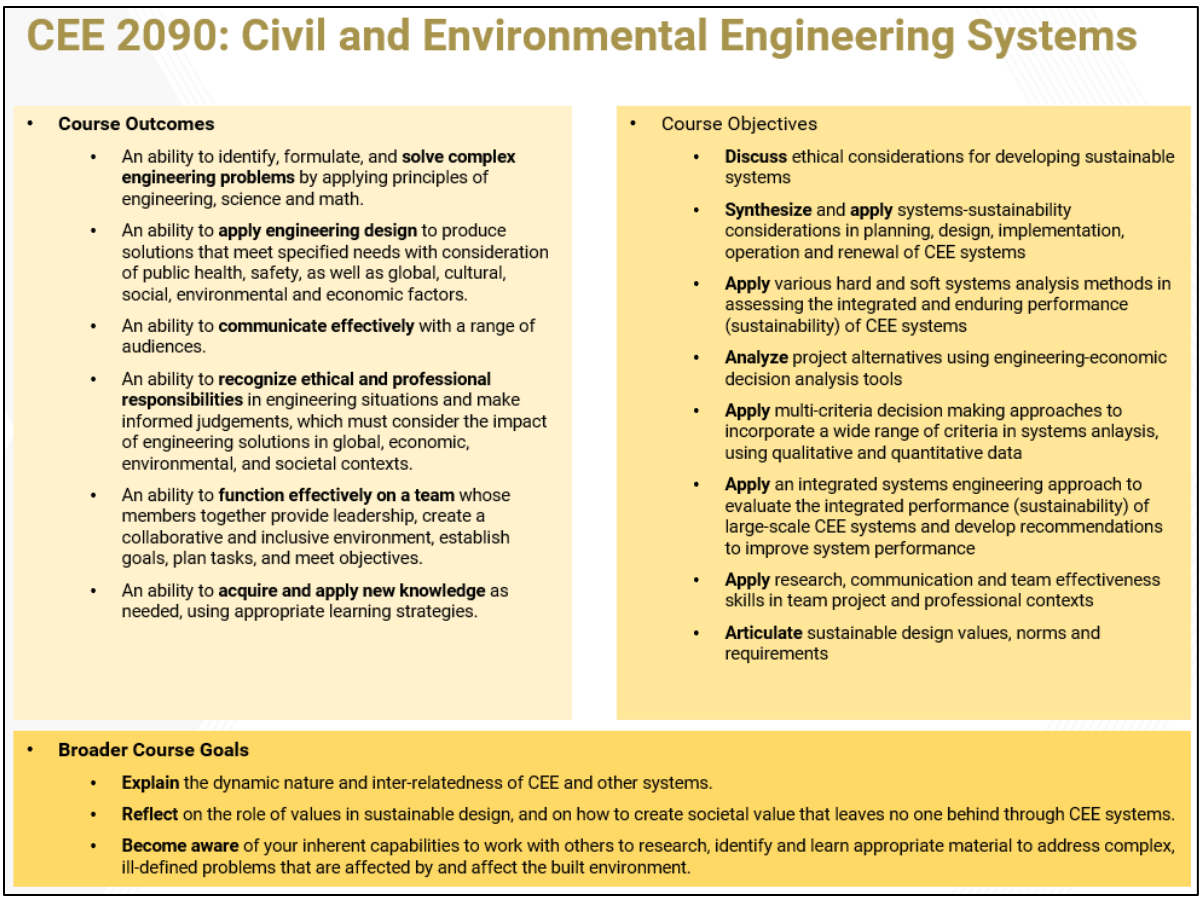

Figure 2: Objectives and Outcomes for Civil and Environmental Engineering Systems Course

Course Structure: The 2024-2025 course was presented in four modules: (1) Engineering Sustainable Systems; (2) Math Optimization Tools; (3) Engineering Economic Analysis Tools; and (4) Application (Oral Presentations, Written Report and Class Reflections). In Module 1 the students were introduced to grand challenges associated with engineering high-performing and sustainable systems, systems analysis, resilience and sustainability principles, and infrastructure asset management. The students were also instructed on team structuring, written communications and basic research skills. In Module 2, the students focused on applications of calculus, linear and integer programming, and multiple criteria decision making to optimize civil and environmental systems. They were also introduced to how uncertainty affects the development of highly performing and sustainable systems, and exposed to practitioner perspectives on sustainable systems via an in-class panel on the sustainable performance of a local large-scale system. The students were aksi instructed on team health and provided with tools to assess the health of their teams and set objectives for any mid-course corrections needed. In Module 3, the students study and apply engineering economic analysis tools and are instructed in visual and oral communications, as well as the application of story telling to their project presentations. In Module 4, the students gave team presentations on their semester-long projects and practiced asking good questions, using this opportuity to apply and futher develop their communication and teaming skills. Figure 3 summarizes how the key elements of the course came together.

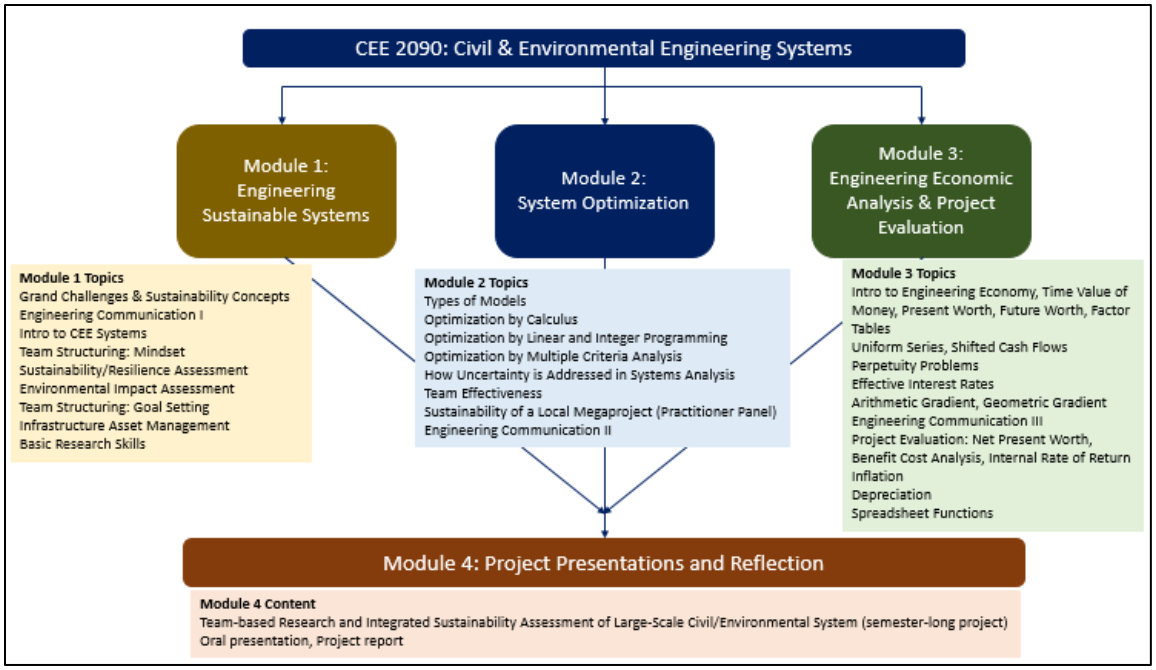

Figure 3: Key Topics and Content in the Civil & Environmental Engineering Systems Course

Course Pedagogy: The pedagogy applied in this course originally included traditional lectures, group work, practitioner-led discussion and project-based learning. The PFE introduced problem-based learning (PBL), story driven learning (SDL) and value sensitive design (VSD) and established formal team instruction by a subject matter expert. Value Sensitive Design (VSD) is an interactional theory that focuses on including human values systematically throughout the design process [8]. Story Driven Learning (SDL) encourages students to be reflective of their learning experiences [9]. SDL uses narrative of story telling to influence a student's concept of (i.e., collected beliefs about) themselves as value creators, an affective-focused pedagogy [10].

This paper discusses four learning environments created and introduced in the course as part of the PFE. In these learning environments, students are given the opportunity to participate in reflective learning activities, using SDL and VSD to develop their professional identity and entrepreneurial mindset. SDL was used in an individual reflection at the beginning of the semester for professional identity development. SDL was also used subsequently in team-based work to hone communication, team and persuasion skills, as well as to cultivate awareness of entrepreneurial mindset. Toward the end of the semester, SDL and VSD were combined in a class reflection exercise to foster further development of entrepreneurial mindset. Also, the students were exposed to an early problem-based learning exercise that began with an essay assigned during the first week of the semester and continuing with learning from pracitioners via a panel as well as team-based research to develop a project report and oral presentation on a large-scale project of choice. While the semester-long project has been a key feature of the course from its inception, the practitioner panel and early essay assignment were introduced more recently to create a problem-based learning thread in the course in conjunction with the semester-long term project.

Table 2 below summarizes how the course aimed to advance the themes presented in Figure 1.

Table 2: How the 2nd-Year Course Advances the Vertically-Integrated Themes (Figure 1)

Theme	Theme Advancement in Course
Problem-Based Learning	Semester-long team-based project; student teams selected and conducted research to study a megaproject of choice, conducted sustainability assessment of the system and offer recommendations to improve system performance.
Computational/AI Development	Integration of quantitative and qualitative tools for sustainability asssessment of large-scale built system
Communication	Instruction on Written, Oral and Visual Communication Instruction (1998-2025); instruction on Written, Oral, Visual, Electronic (i.e., Digital) and Non-Verbal Comunication (beginning in 2025); communication practice and assessment in term project report, PPT presentation development, and oral presentation.
Teaming	Instruction on Team Effectiveness and Structuring; Psychological Safety and Shared Values; and Assessing Team Health and Feedback (2019-2024); Instruction on Team Structuring: Psychological Safety; Team Structuring: Team Composition and Charter; Team Effectiveness and Accountability (Beginning in 2024); instructed in class with practice and assessment in project team development.
Professional Identity Development	Instruction on Ethics in Civil and Environmental Engineering Professional Societies (American Society of Civil Engineers, National Association of Environmental Professionals, and American Academy of Environmental Engineers and Scientists) with emphasis on ethical principles associated with built environment sustainability. Video-based self-relection on choice of major, grand challenges, course objectives, and self objectives for course. Practitioner panel on sustainability of real-world local system.
Stakeholder Awareness/Engagement	Instruction on stakeholders in megaproject development with opportunity for application in semeseter-long project development.

The term project fostered curiosity about civil and environmental engineering megaprojects, and required students to make connections between the built project and the natural, social and economic environments. The students developed a better understanding of how projects create or fail to create enduring value for their stakeholders through their research and end-of-semester project presentations. In these ways, the project fostered awareness and development of entrepreneurial mindset.

In the following sections, four learning environments created to support the development of holistic engineers with entrepreneurial mindset are discussed. Also, evidence of effectiveness of the pedagogy is presented from the literature, limited and initial anecdotal data (associated with these learning environments) from the students are shared, and information is presented on a formative and summative assessment approach under development.

Learning Environments (LEs) Created as part of the PFE

As part of a professional formation experience (2020-2025) supported by a Revolutionizing Engineering Departments (RED) project from the National Science Foundation and a Story-Driven Learning project from the Kern Entrepreneurial Engineering Network (KEEN), four learning environments were created in the CEE Systems course. First, an individual reflection links the reasons students chose to major in Civil Engineering or Environmental Engineering to the course objectives and at least one articulated grand challenge related to built environment performance. Second, a team-based reflection aims to foster the development of collaboration, communication and persuasion skills, and entrepreneurial mindset awareness - when the students identify three megaprojects for study and record a video to make a case for studying them, also reflecting their priority preferences. Megaprojects are projects valued at a billion dollars or more; we study megaprojects in this course to emphasize the significant environmental, social and economic impacts civil and environmental engineers can have on communities through their project design and development activities. Third, a joint class reflection applies SDL and VSD to characterize how stakeholder and design values influence value creation in the built environment. This exercise creates an environment that fosters entrepreneurial mindset development focused on creating enduring value in the built environment. The fourth learning environment revolves around problem-based learning and includes an early homework assignment in which students have to self-direct their learning to answer an ill-defined problem (they obtain instruction on research basics simultaneously). The students continue to develop their knowledge on the same topic of megaproject performance and sustainability via a practitioner panel and a semester-long term project. Below we describe the four learning environments and the rationales for creating them.

LE #1: Professional Identity Development through Video-Recorded Individual Reflection: One of the first assignments the students encountered in CEE 2090 (Civil and Environmental Engineering Systems) was an individual reflection linking their rationale for choice of major with one or more prevailing grand challenges associated with the course objectives. The students were asked to post a link to a short individual video on their CEE story. Figure 3 shows the assignment prompts.

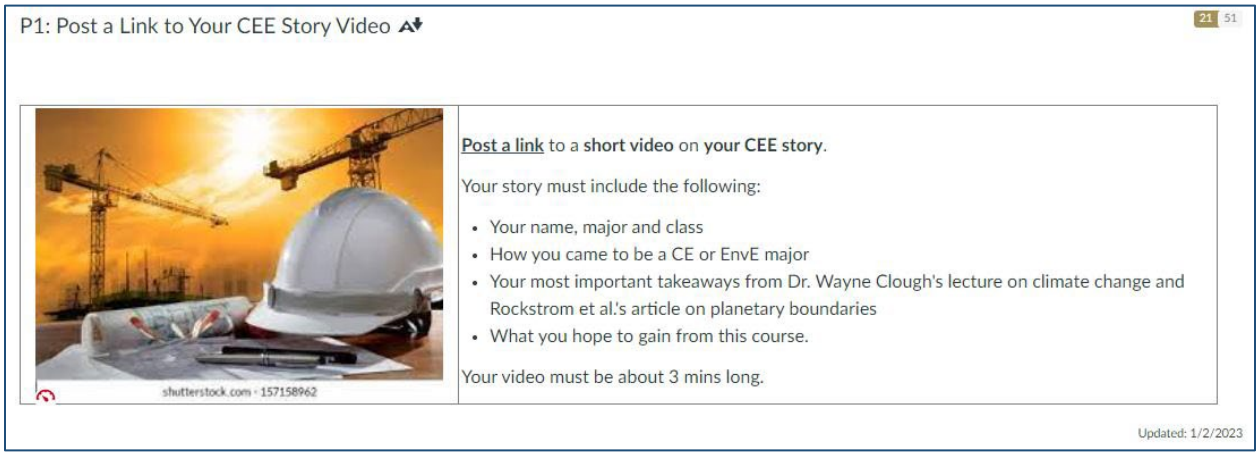

Figure 3: Professional Identity Development Exercise

The videos recorded by students were authentic reflections on where they have come from in their pursuit of Civil Engineering or Environmental Engineering, and where they hoped to go with respect to their future professions. The reflections were typically self-revealing and insightful, even thought-provoking. The students ended up tying their personal interests to the course objectives and self-identifying reasons why the course matters to them – thus personalizing the course objectives and making more explicit links to the profession via one or more grand challenges. Based on the speaking and visual communication requirements in this assignment, the students began to think about how to communicate orally and visually, at the individual level, in a low-stakes environment. A hardhat or some other artefact was included in this assignment to foster association with the Civil Engineering or Environmental Engineering profession via symbology. This assignment aims to enhance a sense of belonging to the class, the major and the profession. Not long after this assignment was introduced, the course instructor received the following unsolicited email (Excerpt 1) from a student acknowleding professional identity development even though no formal references had been made to professional identity development in the course.

In spring 2023, a student wrote the following in an unsolicited email to the primary instructor: *"I hope you are doing well! I just finished a scholarship essay about my interest in civil and environmental engineering, and I wanted to share it with you. I really enjoyed the first module, and I found that I drew from the things I learned in your class quite a bit for this essay, including some of the content from Dr. Cough and Dr. Bonaparte's lectures. I have found that I am better able to articulate what I want to do after just a few weeks in your class, and I am very grateful for that. I am attaching the essay in case you have any interest, it's about 350 words long." – CEE 2090 Student, Spring 2023*

Excerpt 1: Unsolicited Email from CEE 2090 Student Acknowledging Professional Identity Development

LE #2: Team Skills Development via Video-Recorded Group Presentation: The semester-long term project begian with identification of a megaproject for study by project groups of four. The first project assignment required the students to identify and make a case for studying a project of interest. The groups were required to record a short video (3 minutes or less) explaining their choice of projects (three projects), making a case for studying each of them, and ranking them in order of group preference. This assignment gave the students an opportunity to practice persuading each other and their instructors on the value of studying their preferred project. In this assignment, they had the opportunity to develop persuasion and consensus-building skills. They also had the opportunity for entrepreneurial mindset development as they considered the value of the project of study for the community it serves. They also considered how to communicate all of this effectively – orally and visually – as they recorded their short videos. And when projects were awarded, if a group did receive their first choice of project, this appeared to create some fulfilment from the recognition that they had been successful in making a case for their most preferred project. The students appeared to have a stronger stake in their

term project as a result, and a stronger relationship to the project - a sentiment they appeared to carry throughout the semester.

LE#3: Entrepreneurial Mindset (EM) Development Via Joint Class Reflection: The class received an introductory VSD lecture that cast project development as a value creation exercise - emphasizing curiousity, connections and creating value as tools for enhancing Entrepreneurial Mindset [8] [9]. After each team presentation discussing the impact of a megaproject on its community and assessing the performance of the system, the students were asked to reflect on the presentation and identify three dominant values (stakeholder and/or design) they found in the project. Students reflections using Mentimeter or some other tool appropriate for classroom reflection depicted the distribution of project values (e.g., as word clouds) unique to the particular project being studied.

Figure 4 shows examples of word clouds generated by the class reflecting on the dominant values of the systems studied by the various teams (the project groups generally develop into teams over the course of the semester) in the course. These values word clouds enabled the students to draw linkages between stakeholder/design values adopted for a project and the actual value the project created and propagated in a community and the built environment at large - highlighting the importance of intentionality in stakeholder engagement and project design, and the value of entrepreneurial mindset.

Also, the instructor emphasized the link between the values word coulds generated in the classroom exercise and the hierarchy for desired outcomes of civil engineering systems (Figure 5) in the students' textbook, reflecting on the importance of stakeholder and design values in project outcomes [11]. Thus, this joint class reflection exercise brought to life via selected real-world civil and environmental systems concepts on stakeholder/design values and system performance that the students had studied earlier in Module 1 of the course when they studied systems and system analysis. The intent of the word cloud development was to reinforce the students' understanding of how project values shape project impacts, and hence the importance of reflecting stakeholder values in the project values and design. The fact that the visuals showed different dominant values for the projects was intended to provoke reflection about how to achieve more sustainable project outcomes. The instructor drew the students' attention to these linkages to instill curiosity and encourage further reflection, aiming to further enhance entrepreneurial mindset.

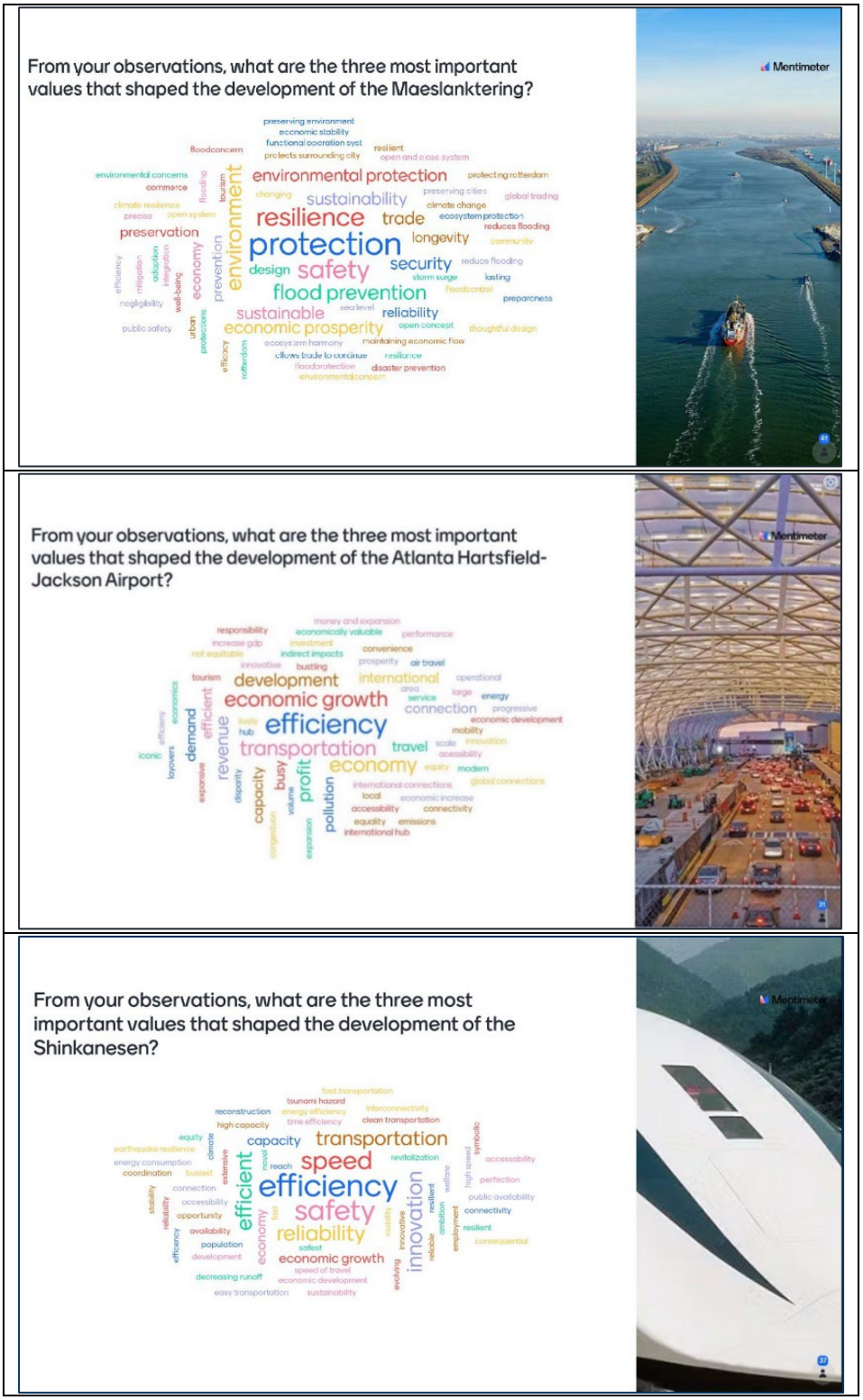

Figure 4: Word Cloud Outputs from Joint Class Reflection on Project Values

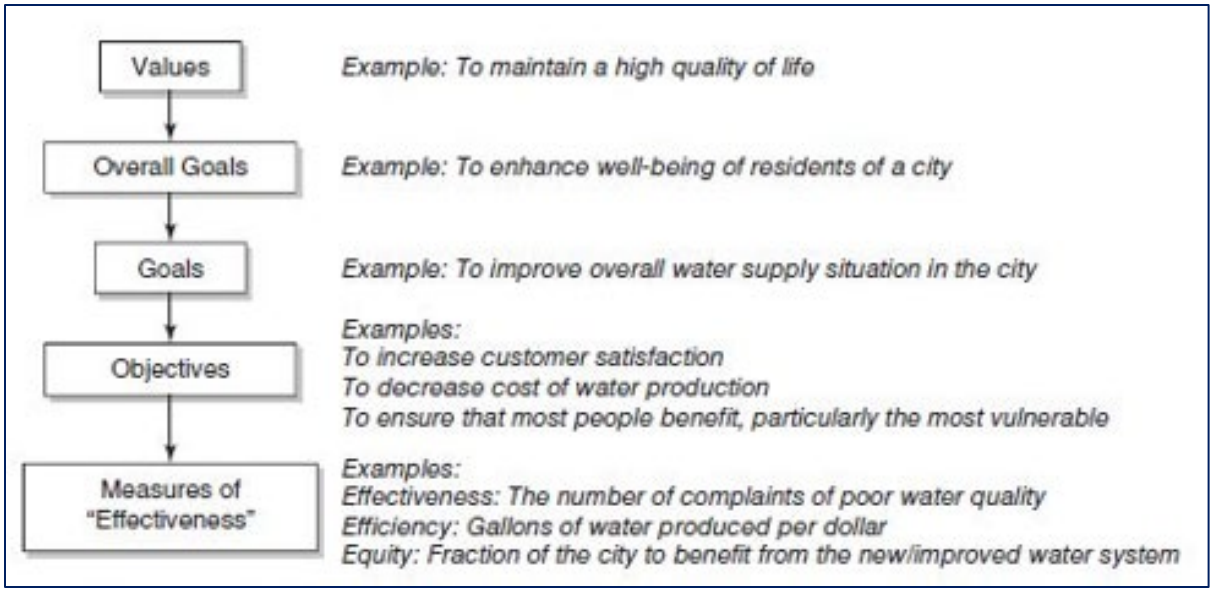

Figure 5: Heirarchy of Desired Outcomes of Civil Engineering Systems [11]

LE #4: Learning How to Learn via Problem-Based Learning and Research: One of the course outcomes is lifelong learning: "an ability to acquire and apply new knowledge as needed, using appropriate learning strategies" (Figure 2). The CEE 2090 students were exposed to problem-based learning and simultaneously received basic instruction on how to do research. Problem-based learning is an approach to problem solving that is primarily student-driven and rooted in real-world scenarios [12] [13] [14]. In the first week of the class, the students received their first homework assignment: an essay prompt requiring them to conduct a sustainability assessment of a real world megaproject or to conduct a comparative assessment of two megaprojects. While the students were yet to develop the requisite set of skills to conduct this assessment or comparative assessment properly, they were intentionally given this question to create a need for independent study to develop an acceptable response to the question in the time allotted for the assignment. At the same time, they were equipped with some basic research capabilities to support their problem-based learning to complete their first assignment in a satisfactory manner at their current knowledge-and-skills level. Some of the information they may use in this assignments were provided to them via traditional lectures.

This design was crafted using problem-based learning pedagogy where the problem drives the learning for this assignment. The students worked in groups of four for this assignment and were forced to extend their learning beyond what they know using in-class and beyond-the-classroom materials to: (1) frame and scope the ill-defined problem to be soluble within the allotted time, and (2) answer the question satisfactorily. The intent of this approach was to help the students develop or enhance their independent learning skills related to the lifelong learning course outcome. The students would see a similar but expanded problem again in the form of their semester-long term project prompt and were able to solve the problem progressively and more effectively over the course of the semester as their knowledge, skills, and entrepreneurial mindset matured. The term project culminated in the delivery of an oral presentation and final project report, and a joint reflection on the value-added of this and other projects presented in the

course (Figure 4). Toward the end of Module 1 or early in Module 2, the students attended a panel on the sustainability and performance of a local megaproject exposing them to practitioner perspectives on system sustainability to complement their learning in the course.

Excerpt 2 below, an unsolicited note from a student in Fall 2024, aligns with the aim of this course to be a contributor to enhanced sense of belonging to the major and profession.

In Fall 2024, another student wrote the following in an unsolicited note to the primary instructor:

"I would like to thank you for a lovely semester in CEE 3000 ... CEE 3000 has been by far the most important class I've taken at Tech and I will carry the skills I've learned in your class with me for the rest of my life. I've really fallen in love with civil engineering this semester. ..." – CEE 3000 student, Fall 2024*

Excerpt 2: Unsolicited Email from Student Reflecting Enhanced Sense of Belonging to the Profession

*Some students are completing the older curriculum in which the new CEE 2090 (Civil and Environmental Engineering Systems course) was CEE 3000 (Civil Engineering Systems course). Administratively, students were enrolled in two sections of the same course as the older curriculum was sunset and replaced by the newer one.

Course Assessment: There is an ongoing collaboration with the Center of Teaching and Learning to develop a formal assessment framework and plan for the spine courses. The plan is to report formally on the outcomes of these and other changes after a few years when data has been gathered through the formal assessment process. At the same time, the pedagogies that were implemented in this change initiative were intentionally selected because they have some evidence of effectiveness in the peer-reviewed literature. There is evidence in the peer-reviewed literature that problem-based learning can be superior to traditional lecture-based learning. Hsieh and Knight [15] provide empirical evidence that supports the use of PBL as an effective teaching method; the authors conclude that PBL leads to better outcomes for the learning styles of engineering students. Manuaba et al. [16] discuss the effectiveness of PBL in improving critical thinking, problem solving and self-directed learning in first-year medical students. And, a scoping review conducted by Trullas et al. [17] found PBL methodology obtained a high level of satisfaction among students and was found to be more effective than traditional lecture-based methods at improving problem-solving and self-learning skills, and social and communication skills. Story-driven learning has also been shown to be effective in developing self-concept clarity, and was thus perceived as a good tool for professional identity development in this change initiative. Turner et al's [18] review of 37 articles centered on story-driven learning in higher education identifies outcomes that tend to involve at least one of the following six areas: (1) leadership and career skills, (2) well-being, (3) empowerment among marginalized groups, (4) self-concept clarity, (5) empathy and sense of belonging, and 6) learning skills and engagement. With regard to Value Sensitive Design, a basic function of VSD methodology is to integrate stakeholder values into design decisions [8].

Summary, Future Work and Concluding Remarks

The overarching objectives of the CEEatGT curriculum change initiative (2020-2025) were to develop more holistic engineers with entrepreneurial mindset. The approach involved creating a spine of interactive and vertically-integrated courses – common learning experiences to engage students early in cohort-based learning and to keep them engaged. These courses aim to cultivate problem-solving and identification skills, computational development, communication and team skills, stakeholder awareness and engagement skills, and professional identity development. The common learning experience is expected to augment entrepreneurial mindset and enhance the students' sense of belonging to the profession, their major and the school. This paper presents four learning environments and the rationales for creating them in the 2nd-year course *Civil and Environmental Engineering Systems* (CEE 2090). These learning environments were developed while working to ensure that engineering rigor in the courses was maintained or strengthened. Ongoing efforts to develop a formal assessment framework aim to apply evidence-based instruments for both summative and formative assessment.

Acknowledgements

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