Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025 ASEE
Paper ID #49455

Teaching Teachers to Integrate Sustainability into Engineering Education: Lessons Learned from UTA's EOP Institutionization Program

Erick C. Jones Jr., The University of Texas at Arlington

Erick C. Jones Jr., an assistant professor of Industrial, Manufacturing, and Systems Engineering and Resource and Energy Engineering at the University of Texas at Arlington, combines analytics and prototyping to develop (or improve) technological systems and accompanying decision-making tools, so organizations can allocate their limited resources to maximize desired outcomes sustainably, efficiently, and resiliently.

His lab, the SEAR lab, focuses on three major areas: 1) Energy Systems and Technology; 2) Buildings, Transportation, and Infrastructure; 3) Critical Supply Chains; with ancillary work in Operations Management, Logistics, RFID, and Health.

The lab specializes (analytically) in Mathematical Optimization, Simulation, AI / ML, and specialized analytics (GIS, LCA, TEA). They develop prototypes and pilots informed by Mechanical, Electrical, and Chemical Experiments guided by Systems Engineering principles conducted in interdisciplinary teams.

Jones has a Chemical Engineering undergraduate degree and Petroleum Engineering minor from Texas A&M University, an Operations Research and Industrial Engineering doctoral degree from the University of Texas at Austin, and was an NSF NRT, DOE FACES, GEM, and Mickey Leland Energy Fellow.

In between degrees, he worked in the oil and gas and engineering design industries contributing to his unique perspective on the opportunities and challenges in various sectors. He is a native Texan who has traveled 6 continents with only a backpack.

Kendra Lee Wallis, The University of Texas at Arlington
Mengqi Monica Zhan

MONICA ZHAN Dr. Zhan serves as an Associate Professor for the Department of Communication at the University of Texas at Arlington. Her research interests include employee communication and corporate communication. Recently, she has developed growing interests in underrepresented minority student and employee experiences.

Na-Li Kim, The University of Texas at Arlington
Ann M.L. Cavallo, The University of Texas at Arlington
Andrew Clark, The University of Texas at Arlington

Abstract

Sustainability, as a topic, has increased in importance due to resource scarcity and the growing impact of climate-related disasters. Students and faculty are showing interest in sustainability but frequently do not know how to define sustainability or identify how they can contribute. Given engineering's critical role in infrastructure and technology, bridging this knowledge gap is imperative. Therefore, the Engineering for One Planet (EOP) Institutionalization program at the University of Texas at Arlington (UTA) aims to train instructors on how to define sustainability, introduce the EOP framework and its resources to instructors for application in the classroom, and provide reproducible examples of how to integrate sustainability concepts into the courses while still meeting the course's core learning objectives. To achieve these goals, we created two programs. One is a two-day bootcamp, held between late Spring and early Summer, which introduces key concepts including sustainability principles, the EOP framework, and the UTA's initiatives. Participants learn how to integrate and combine these approaches in their classroom teaching. The second program is a two-semester long Sustainability Professional Learning Community where faculty meet in a small group led by a faculty facilitator. The faculty meet every two weeks and share knowledge of how they are implementing sustainability concepts into the classroom. They also learn from guest speakers, and at the end of the two semesters they develop a poster presentation that illustrates how they are implementing sustainability in their course(s). The pilot year of the program (the 2024-25 school year) had over 30 participants who taught over 100 classes that reached an estimated 2000 unique students. Our findings indicate that the bootcamp's shorter duration and project-based approach attracted more faculty participation. In contrast, the SPLC facilitated deeper engagement but had lower enrollment. In this paper, we share our challenges, successes, and planned improvements to enhance faculty engagement and program effectiveness.

Introduction

The EOP framework and institutionalization grant perfectly aligns with one of the five strategic themes at UTA: Sustainable Communities. To advance sustainability efforts, UTA has launched a concentrated effort to promote sustainability by developing committees for staff, research, and teaching on sustainability, converting the Faculty Advisory Network for Sustainability (FANS) into a formal Professional Learning Community (PLC) for sustainability, and introduced new certificates, programs, and majors with a strong sustainable focus. Additionally, UTA has been modernizing its approach to meet ABET criteria by developing new rubrics to assess compliance and ensuring Student Learning Outcomes are educationally sound, measurable, and aligned with ABET goals.

The EOP framework is described as "A curated list of core and advanced sustainability-focused student learning outcomes that all engineering students should acquire" and "that addresses the seven ABET student outcomes, as outlined in the ABET Criteria for Accrediting Engineering Programs (ABET 2021) and aligns with the 17 United Nations (UN) Sustainable Development Goals (SDGs; United Nations 2015)." Thus, the EOP framework is a perfect resource for meeting both ABET and sustainability curriculum goals. In fact, part of the literature review that informed the EOP framework are past UTA initiatives that implemented sustainability in engineering education (Pearson Weatherton et al., 2012, 2015; Sattler et al., 2012). The fact that

the EOP framework builds on that foundation enables UTA to work toward its sustainability initiatives without having to build an instructional foundation from the bottom up; the EOP framework provides a base to build on.

UTA has an established system, called Maverick Advantage, for highlighting courses that incorporate five different high-impact distinguishing activities into the curriculum (AAC&U, 2008): Research, Community Engagement, Global Engagement, Leadership Development, and Career Development. The Maverick Advantage courses are designed to be educationally transformational, and students who engage in these courses are eligible to earn a certificate and graduate with a distinction. These high-impact practices have been found to support student retention and promote self-efficacy and student success. Courses receiving the Maverick Advantage designation indicate that faculty have been trained in incorporating these activities, and a publicly available website lists designated courses along with the names of faculty members teaching them (Table 1).

As part of the institutionalization grant, we aim to expand this system by adding sustainability as a distinguishing activity. This addition will enable students to identify courses that integrate sustainability concepts alongside the existing five distinguishing activities. Faculty informed us that this ability to distinguish their courses to make them more attractive to the students was a key motivator for their participation in the bootcamp.

Table 1: Maverick Advantage Distinguished Course Designation Website Table Example

Faculty First Name	Faculty Last Name	Course Name	Course Abbrev	Course #	Community Engagement	Global Connections	Leadership Development	Research	Career Development
Bob	Silas	Eng Proj Mgmt	IE	4340	X		X		
Margo	Reed	Fluids	ME	3416				X	X

Observations on Integrating Sustainability into University Curriculums

The Maverick Advantage distinguished program and the Sustainability Professional Learning Community (SPLC) exemplify an integrated horizontal approach to adding sustainability into the curriculum. According to the literature review by (Reyante, 2022), the horizontal integrated approach is a more effective method to incorporate sustainability into university curriculums than other approaches like vertical integration and the rebuild approaches.

In addition to the horizontal integration, UTA has also implemented vertical approaches, including new sustainability courses, culminating in a Sustainable Engineering minor and an entirely new major in Resource and Energy Engineering with core courses focusing on sustainability. According to the EOP framework's literature review (Reyante, 2022), the Sustainable Engineering minor at the university is an exemplary integrated program. However, faculty interviews revealed roadblocks and challenges that the institutionalization program aims to address.

Previous efforts aimed to incorporate sustainability into existing courses often relied on stand-alone module additions. The approach has two major limitations. First, sustainability modules are peripheral content in courses primarily focused on other topics, such as courses on probability modeling or economics. Second, different faculty teaching the same course often have different approaches for teaching the fundamental content, leading to inconsistencies in teaching sustainability related content or dropping the sustainability modules.

The Sustainable Engineering minor is more successful because its courses are focused on sustainability ensuring faculty buy-in. Additionally, students who enroll in the minor actively choose to engage with sustainability content, reinforcing student buy-in. However, this program has also had challenges with aligning the timing of the required core classes for the minor and the integration of sustainability into the technical electives. These challenges highlight that student interest, faculty engagement, and training are critical to a sustainability curriculum initiative's success.

Programs Description

The UTA's EOP Institutionalization program's faculty training consisted of two programs: Sustainability Professional Learning Community (SPLC) and a 2-day Sustainability High Impact Practices (SHIP) Bootcamp. Both programs introduce the EOP framework to participants and share best practices for implementing the EOP framework into the respective faculty's courses. Each program imparts three main lessons: 1) sustainability is a broad but definable term and the SDGs are a useful reference for that goal; 2) faculty can incorporate sustainability efficiently into their course using existing course projects; 3) the EOP framework can help align existing learning objectives with sustainability concepts and provide additional resources. Both programs incentivized faculty participation with a $500 stipend faculty could use on materials or travel in addition to free lunch (and breakfast for the SHIP program) during program days.

The Sustainability Professional Learning Community (SPLC) was modeled after a previous program developed by UTA's Office of Sustainability, the Faculty Advisory Network on Sustainability (FANS). FANS was hosted by a center outside of engineering with support from the Office of the Provost and the Center for Research on Teaching and Learning Excellence (CRTLE). The Professional Learning Community program, which includes the SPLC and other learning communities, is a two semester (fall and spring) faculty fellows' program developed as part of another university initiative to provide a platform for faculty to learn from faculty facilitators and their peers about selected topics (e.g., teamwork, multimedia creation, and Open Educational Resources) and to develop different strategies to introduce these topics into their courses. In the SPLC, faculty shared their experiences implementing these practices, but also heard from speakers presenting on sustainability at the university, the EOP Framework, and Best Practices on Integrating Sustainability in the Curriculum. Therefore, SPLC provided faculty with sustainability training, taught them how to incorporate the EOP Learning objectives into their courses, and provided a platform to discuss challenges and successes with their peers.

The official SPLC description shared with faculty is included below:

SUSTAINABILITY IS THE ABILITY TO ENDURE AND THRIVE IN HARMONY

PLC for Sustainability – a group of faculty who have an interest through research, teaching, and/or service in at least one of the three pillars of sustainability – social, economic, and environmental aspects of sustainable systems. This PLC will replace the Faculty Advisory Network on Sustainability, previously a program in the Office of Sustainability at [the university]. The purpose is integrating sustainability in teaching, curriculum development, service learning, and faculty research by creating a network of faculty experts on campus in a collaborative environment. We will start by reviewing the United Nations Sustainable Development Goals (SDGs) https://sdgs.un.org/goals and then consider how we can advance sustainability goals at [the university] and how to prepare [the university] graduates to contribute to a more sustainable world.

Information on the Faculty Advisory Network on Sustainability in 2021 and 2022 can be found here: [link provided]

While the SPLC was built from existing programs, the 2-day Sustainability High Impact Practices (SHIP) Bootcamp was new and aimed to train faculty on sustainability and the EOP in a shorter time span. The goal of the bootcamp was to introduce faculty to the core principles of sustainability, the EOP framework, EOP resources, and high impact practices for taking that information and installing it into their classrooms through an intensive 2-day session.

The official SHIP bootcamp description and agenda are shown below:

As part of a grant from the Lemelson Foundation and the Engineering for One Planet initiative, the Center for Research on Teaching and Learning Excellence and the Office of Sustainability are sponsoring a two-day boot camp for faculty to learn about how to utilize the [distinguished program] to integrate sustainability into their courses. Faculty will receive $500 for completing the boot camp. The sessions will be held in Trinity Hall, Room 105 on Thursday, May 30, and Friday, May 31, from 9 a.m.-2 p.m. each day with lunch provided.

Day 1 (Trinity Hall 105)

Time	Session	Speaker
9 am – 10 am (Light Refreshment)	Introduction to [the distinguished program] and the Course Designation Process	Program Lead
10 am – 11 am	High-Impact Practices and the Distinguishing Activities; include campus connections	
11am – 12 pm	Working Session (Which activities can fit in the sustainability course?)	
12 pm – 1 pm (Lunch)	Panel of distinguished program Faculty	Fellows
1 pm – 2 pm	Developing and Incorporating Reflections	

Day 2 (Trinity Hall 105)

Time	Session	Speaker

9 am – 10:20 am (Light Refreshment)	Syllabus and Measuring the Values of High-Impact Practices	CRTLE
10:30 am – 12 pm	Working Session (Feedback on: Activity | Reflection | Syllabus Language)	
12 pm – 1 pm (Lunch)	Presentation of Sustainability Course with Activity	Grant PI
1 pm – 2 pm	Plans for Ongoing Collaboration and Support - Evaluation/Impact - Course Designation - Faculty Network - Publication/Conference	

Attendance and Feedback

In the first year, the Sustainability Professional Learning Community (SPLC) consisted of three faculty members, with none from engineering. Despite the lack of engineering faculty, we were able to develop discussion questions and identify effective discussion approaches.

The first Sustainability High Impact Practices (SHIP) Bootcamp session had 28 attendees with 12 from the College of Engineering. Following the SHIP bootcamp, we conducted a voluntary survey. Ten participants completed the survey. The overall reception of the event was very positive as faculty feedback indicated that they enjoyed the topics and appreciated the limited time commitment. Seven out of the ten respondents were satisfied or very satisfied with the workshop. Nine out of ten respondents, on a scale of 1 to 5 with 5 being the highest, graded the length, format, and organization a 4 or better. Many participants commented that they learned from the sustainability topics, found the project-based model to be useful, and enjoyed the structure that allowed them to discuss how they would aim to incorporate sustainability with the group. However, they found that aspects of the distinguished activity program were confusing.

In the survey, we also asked directly if the workshop increased their knowledge of sustainability, the distinguished program, the EOP initiative, and if the bootcamp increased their desire to add sustainability to their course, on a 1 -5 scale with 5 being the highest. Each of these questions received at least six 5 scores and two 4 scores. When asked what most helpful, multiple respondents was said “All of it” while others mentioned the SDGs, the introduction to the EOP, and two respondents mentioned distinguished activity. The biggest challenge was understanding how to get the Maverick Advantage distinguished activity designation and understanding how the sustainability designation worked with Maverick Advantage. Informal feedback echoed these findings as faculty told the grant team that they enjoyed the sustainability aspects of the SHIP bootcamp which expanded their view of sustainability and gave them a pathway to implement into their courses, but understanding how this was linked with the Maverick Advantage was unclear.

Based on this feedback the bootcamp was our most successful program and it achieved many of the stated goals namely: 1) providing baseline knowledge of sustainability to faculty; 2) introducing faculty to introducing sustainability to students via course projects; 3) Sharing the EOP framework; and 4) Introducing the new sustainability designation and its relationship with

distinguished activity. However, the confusion with distinguished and the lack of interest in the SPLC program has encouraged us to make changes which are explained in the discussion section.

Nonetheless, the 34 total participants (SHIP [28], SPLC [6]) taught over 100 classes that reached an estimated 2000 unique students over the course of the 2024-25 school year (Fall 2024 and Spring 2025). 13 of these participants are engineering faculty who taught nearly 30 classes that reached an estimated 800 unique students. Thus, the programs are succeeding in having a wide impact even as we work through the challenges.

Discussion

The SHIP bootcamp attracted significantly more faculty than the SPLC program. The bootcamp was shorter, taught participants how to integrate sustainability efficiently into existing curriculum, and how to get their course designated by the university as a Maverick Advantage course. Based on formal and informal participant feedback, the shorter time commitment, integration into existing university mechanisms, and easy to understand sustainability integration strategy made the bootcamp a better choice for most participants.

The SPLC program attracted relatively few faculty overall and an even smaller number of engineering faculty. The SPLC program is a once a month, two semester long program designed to stimulate intense peer to peer engagement. Our initial strategy was to have the SPLC program be the cornerstone of the Institutionalization program. However, most faculty were not interested in that much of a time commitment. Yet, some of the faculty who participated in the bootcamp and who wanted to go more in depth joined the following SPLC program implying that the SPLC program is a better supplement for the bootcamp than vice versa.

Based on our pilot-year experience, we identified several improvements to enhance program efficacy and increase faculty engagement. One, the sustainability information should be streamlined to incorporate into our existing mechanisms and avoid competing with other programs. We should attempt to integrate sustainability information / training into one of the university's well attended existing workshops to reach more people.

Another major finding from the pilot year experience is that faculty seem to have a relatively narrow view of sustainability, generally only considering energy and the environment, but are curious as to how they can integrate any aspect of sustainability into their courses. The EOP framework and the framing of the SDGs resonates with the faculty and opens their eyes into how sustainability goes beyond the stereotypical environmental, energy, and climate issues and has a broad range of definitions based on three pillars of environmental protection, economic viability, and social justice that fits into most faculty's work and their courses. Furthermore, the idea of integrating sustainability lessons into existing course projects resonates with faculty since it is flexible, requires the least amount of course modification, and does not take away from the main learning objectives of any course.

One of our main challenges to attracting faculty to the SPLC program is the competition for limited faculty time from other great faculty training programs and PLCs suppressing interest in our two-semester long SPLC program. Instead of focusing on the SPLC program as the main mechanism for delivering the sustainability and EOP content, we will instead work with faculty

in each of the other PLC groups to help build an understanding of sustainability and help faculty connect sustainability, not only with their course content, but to the PLC topic they are participating in. This effort could reach the more than 60 faculty who participate in the PLC program each year. This year in addition to the sustainability PLC, there is storytelling, open educational resources and AI, multimedia and AI, and study abroad. Furthermore, we will also create a mini module for the distinguished program trainings and continue the Sustainability High Impact Practices (SHIP) Bootcamp which has proven successful.

For even quicker dissemination and to raise awareness, we plan to create a short pamphlet that helps faculty see the connection between sustainability and their own work. The idea is that this method will help faculty to see that this is helpful to them and make them more receptive to participating in the programs. University Minutes, one- or two-line campaign messages disseminated through CRTLE newsletters, will explain how sustainability is broader than what most people initially think and that illustrate how it aligns with faculty's research and teaching to interest them in learning more at our programs.

Another UTA group also hosts sustainability sessions featuring faculty in sustainability that we can invite to speak or participate in the Institutionalization program. The sessions highlight that sustainability encompasses all 17 UN Sustainable Development Goals, extending beyond just environmental and energy concerns. We are also exploring more single seminar sessions in other PLCs and inviting the university president to keynote a large event on sustainability possibly in coordination with the annual faculty showcase. Lastly, we since the project-based integration resonated with a majority of the faculty, we are planning to integrate project-based learning pedagogical approaches into the bootcamp.

Conclusion

The pilot year of the university's EOP Institutionalization included the creation of two programs the SPLC and the SHIP bootcamp to mixed results. Both programs introduced faculty to the core concepts of sustainability, the EOP framework, illustrated strategies they could use to incorporate sustainability into their courses, and how this could leverage existing university distinguished activities. However, the SHIP bootcamp a two-day program proved to be more attractive to faculty than the two semester long, once a month SPLC which was sparsely attended. Furthermore, while faculty provided positive feedback for the sustainability lessons, they found the integration of sustainability with the university's existing distinguishing activities to be lacking.

Participants in the SHIP bootcamp and SPLC taught over 100 courses that reached over 2000 students over the course of the 2024-25 school year (Fall 2024 and Spring 2025). The findings in this report are preliminary and being continuously updated; however, this paper sets a baseline that will inform future work and help illustrate the effectiveness of the program going forward.

Future Work

While the survey provided useful insights about the program during the first year, the small sample size limits generalizability. To address this issue, we are currently conducting pedagogical assessments of the SHIP and SPLC trainings by surveying and interviewing faculty who participated in these programs in the pilot year. Our aim for both programs was to impart good pedagogical practices, and we are currently evaluating the effectiveness of that with self-

reflection being our main pedagogical assessment for the instructors. We will report what we find and incorporate the lessons into the next years programs. Furthermore, we also want to measure the impact on students of faculty introducing sustainability into their courses. We aim to perform pedagogical assessments on the classroom impacts on students as well and report those findings within a year. This will include evaluating student evaluations and interviewing a subset of students. Overall, we expect the lessons we learned from the pilot year and the results from the assessments we are conducting on participants from the pilot year will help improve the integration of sustainability into the engineering curriculum both at the university and every university worldwide.

References

1. Pearson-Weatherton, Y., Chen, V., Mattingly, S., Rogers, K., & Sattler, M. (2012). Sustainable engineering internships: Creation and assessment. ASEE Annual Conference & Exposition. https://peer.asee.org/sustainable-engineering-internships-creation-and-assessment
2. Pearson-Weatherton, Y., Sattler, M., Mattingly, S., Chen, V., Jamie Rogers, K., & Dennis, B. (2015). Multipronged approach for incorporating sustainability into an undergraduate civil engineering curriculum. Journal of Professional Issues in Engineering Education and Practice, 141(2), C5014003.
3. Sattler, M., Chen, V., & Dennis, B. (2012). Integrating sustainability across the curriculum: Engineering sustainable engineers. ASEE Annual Conference & Exposition.
4. Reynante, Brandon (2022). Engineering for One Planet Literature Review Report. ASEE.
5. Armstrong, P. (2010). Bloom's Taxonomy. Vanderbilt University Center for Teaching. Retrieved [July 10, 2022] from https://cft.vanderbilt.edu/guides-sub-pages/bloomstaxonomy/
6. ABET (2021). Criteria for Accrediting Engineering Programs, 2022-2023. Retrieved [July10, 2022] from https://www.abet.org/accreditation/accreditation-criteria/criteria-foraccrediting-engineering-programs-2022-2023/
7. United Nations (2015). Transforming Our World: The 2030 Agenda for Sustainable Development. Retrieved [July 10, 2022] from https://sdgs.un.org/publications/transforming-our-world-2030-agenda-sustainable-development-17981
8. Environmental Protection Agency (EPA). Environmental Justice. Retrieved [July 10, 2022] from https://www.epa.gov/environmentaljustice
9. High-Impact Educational Practices: What They Are, Who Has Access to Them, and Why They Matter*, by George D. Kuh (AAC&U, 2008). Visit AAC&U's resources page on high-impact practices*