

A Multidisciplinary Team-Based Approach to Addressing Climate Change in Fall River

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Anthropogenic climate change is already seriously impacting communities around the world through higher temperatures, stronger storms and more variable weather patterns. These impacts are predicted to increase especially in the coastal communities of New England. Solutions to the challenges will require civil engineers and designers to work with city officials to develop infrastructure resilient to climate extremes while providing economic development. Traditionally, engineering and interior architecture students have had little chance to work in multidisciplinary teams on real-life projects – a critical skill they will need to develop as they transition to the workforce. To address this need, we developed and co-taught two independent courses in fall 2023 which collaborated on a novel service-learning design project for the City of Fall River, Massachusetts.

The two courses were taught independently because of the different program requirements. The Civil Engineering (CEN) bachelor's degree at The University of Massachusetts Dartmouth (UMassD) requires students to take five technical electives during their senior year. These courses must be highly technical in nature and apply what they have learned in their previous courses. Historically they have not had a significant service-learning component. Interior Architecture + Design (IAD), students must take a Special Topics studio in their senior year that provides advanced exploration in current industry topics which change regularly and usually have a service-learning component. The learning objectives for both classes are listed in the table below.

CEN Learning Objectives	IAD Learning Objectives
<ul style="list-style-type: none"> • Describe how anthropomorphic emissions of greenhouse gases are altering the atmosphere and causing global climate change. • Explain how increasing temperatures are altering weather patterns around the world. • Describe how climate change is impacting civil engineering systems. • Evaluate different climate mitigation strategies to reduce greenhouse gas emissions. • Evaluate different climate adaptation strategies to reduce the impact of climate change. • Understand how municipalities in the northeastern US are planning for climate change. • Create novel solutions to increase the resiliency of civil engineering systems. 	<ul style="list-style-type: none"> • Students are able to understand the complexity of designing and programming a space for varying user profiles • Students are able to collaborate and participate in teams • Students are able to apply information from a variety of stakeholders and sources to develop design solutions that achieve community goals and promote resilience, sustainability, health and well being • Students are able to successfully communicate design solutions to various individuals through oral and visual presentation • Students are able to demonstrate a strong concept and cohesive design solutions for an extensive commercial design project • Students are able to document iterations using the design process and synthesize results

The IAD students met Monday and Wednesday for three hours at a time. The CEN and IAD students met in a combined class for one hour Monday and Wednesday and the CEN students met alone for an hour on Friday. The first half of the combined course focused on helping students from both CEN and IAD majors understand how greenhouse gases are causing global climate change. We then moved on to study how climate change will impact infrastructure and different climate mitigation and adaptation strategies that engineers, and interior architects can use in their designs. Throughout the semester, the Friday CEN-only class periods focused on the technical engineering design aspects. IAD students focused on their independent design projects for the Monday and Wednesday class periods.

Service-learning was a major focus of the class. Both instructors had extensive experience integrating service-learning into prior courses, and both participated in a Faculty Fellows program through the UMassD Leduc Center for Civic Engagement. In addition to helping nearby communities, service-learning projects effectively simulate the professional environment. As indicated by Zollinger, et. al. in the article, “Deconstructing Service-Learning: A Framework for Interior Design,” projects of this type improve students’ higher order thinking skills, increase their understanding of course-to-application knowledge and enhance their problem solving and decision making, all of which were key goals and objectives of the course. We vetted several community partners to find a suitable project. Key considerations were as follows: (1) a partner with a defined need in a marginalized community (2) a project

located in an area with high vulnerability to the effects of climate change (3) a project that can support learning for both IAD and CEN students and (4) a project large enough in scope to fill an entire semester for several teams.

The instructors chose to assist the City of Fall River on the Route 79-Davol Street Corridor Improvements project, a large-scale redevelopment project currently underway. Working alongside the City Engineer, students first toured the site and gathered socio-economic information about the surrounding area. Four multi-disciplinary teams of 4-5 students then completed research and developed a design plan for one section of the 19-acre site. We used an iterative approach, whereby students received weekly feedback about their designs from the instructors and periodic feedback from the City Engineer. Students incorporated such items as green infrastructure to adapt to higher precipitation amounts and solar panels to reduce their carbon footprint. The teams worked together to make their sites aesthetically appealing and conducive to low-impact, sustainable development while also serving as an economic boom to the city.

Key components of the class were team member evaluations and personal reflection essays. Students were required to evaluate themselves and their peers to assess the success of the teams. This helps students be accountable to their peers across disciplines. Additionally, reflection questions were posed to the students throughout the course to consider potential project challenges, evaluate successes, and propose alternative approaches for the future. The paper “Measuring the Impacts of Project-Based Service Learning” by Paterson, Swan, and Bielefeldt, notes that reflective essays “yield rich qualitative information beyond the student learning of technical topics and indicate changes in attitude and identity of the students.”

The culmination of the class was their formal presentations at the Fall River Government Center on December 13, 2023. Most of the city’s top planning officials were in attendance along with the Mayor and representatives from Stantec (the firm that was hired to make the master plans). Everyone present was impressed with the students’ professionalism and their ideas. It was clear that many of the concepts and designs presented by the student groups will be incorporated into Stantec’s final plans. As the mayor himself stated: "This is one of the biggest redevelopment projects in the SouthCoast region. We are pleased to know that our city can depend on [the university] as a partner."

There were several challenges related to the course including the following which will be discussed during the presentation:

- Keeping the course technical enough for the CEN students.
- The fact that the architectural design needed to be mostly finished before the engineers could begin their design.
- The logical progression of topics meant that we first needed to cover the science of climate change before we begin talking about climate mitigation and adaptation strategies.
- The IAD class had six contact hours a week while the CEN students only had three.
- Fully integrating the IAD and CEN components of the project.

Throughout the course, students from both majors gained a greater appreciation for their critical role in climate mitigation and adaptation strategies. They also had a much better understanding about how cities in New England are approaching the problem of climate adaptation while also encouraging economic development. Lastly, the students gained valuable skills in cross-disciplinary approaches which they will need in their careers. Project outcomes, successes and challenges, and feedback from student reflection essays will be shared during this presentation.

Sources:

Zollinger, Stephanie Watson, Denise Guerin, Tasoulla Hadjiyanni, and Caren S. Martin. “Deconstructing Service-Learning: A Framework for Interior Design.” *Journal of Interior Design* 34, no. 3 (2009): 31-45.

Paterson, Kurt, Chris Swan, and Angela Bielefeldt. “Measuring the Impacts of Project-Based Service Learning.” Paper presented at the American Society for Engineering Education Frontiers in Education Conference, San Antonio, Texas, October 18-21, 2009.