The Environment Corps: Combining Classroom Instruction, Service-Learning, and Extension Outreach to Create a New Model of Community Engaged Scholarship at the University of Connecticut

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Abstract

An extensive faculty partnership at the University of Connecticut (UConn) that reaches across college and departmental lines is engaged in a project that seeks to enhance, expand, institutionalize, and study a new model for community engagement. The model, called the Environment Corps (E-Corps), combines the familiar elements of classroom instruction, service-learning, and extension outreach to create a method of engagement that aims to benefit students, faculty, surrounding communities, and the university community itself. This article describes the structure and history of E-Corps; details the institutional setting, faculty partnerships, and pedagogical strategies involved; and discusses early evidence of impacts and future prospects.

Keywords: engagement, environment, community, service-learning

Project Setting

Institutional Setting: A Rethinking of Public Engagement and a New Focus on the Environment

As the flagship university of the State of Connecticut and a land- and sea-grant university, the University of Connecticut (UConn) strives to meet the challenges set forth to state and land-grant universities in the seminal Kellogg Commission report *Returning to Our Roots: The Engaged Institution* (1999), which states:

It is time to go beyond outreach and service to what the Kellogg Commission defines as "engagement." By engagement, we refer to institutions that have redesigned their teaching, research, and extension and service functions to become even more sympathetically and productively involved with their communities, however community may be defined. (p. 9)

As we move beyond the 20-year anniversary of this report, few institutions would argue that the bar set by the Kellogg Commission has been reached. Whitmer et al. (2010) argued that the enormous potential for academia to assist with the world's complex problems is hindered by widespread, entrenched institutional systems of faculty performance review, reward, and funding. Irwin et al. (2018) echoed these sentiments but also expanded upon them:

New mechanisms, policies and tools . . . are required to bridge the barriers that currently limit the effectiveness of scholars and academic institutions. These bridges should foster deep integration of

disciplines (convergence), and collaboration between academic and non-academic stakeholders (transdisciplinary), that together enable the co-production, communication, and application of knowledge. (p. 325)

In search of these mechanisms, policies, and tools, UConn is in the early stages of reenvisioning its public engagement philosophy and strategy. As part of this effort, the university service-learning program has recently been relocated to the Center for Excellence in Teaching and Learning (CETL). CETL's objectives for their new charge include making service-learning more systematic in training faculty, providing resources, attracting students, and tracking results regarding students and the communities in which they work. This initiative was strengthened even further by a new emphasis at the university on Life Transformative Education, which, among other things, incorporates experiential learning and deeper connections between faculty and students to enable greater impact on students' well-being as they move through life (UConn Life-Transformative EducationTask Force, 2021). Thus, the timing is ideal for programs that help redefine public engagement at the university through the promotion of new service-learning models and the development of support and facilitation mechanisms to ensure their success.

The timing is also excellent for new models of engagement to be focused on the environment. In April 2018, the University Senate approved a general education ("GenEd") requirement for environmental literacy. This new requirement was implemented in fall semester 2019, with the added stipulation that qualifying courses needed to address not just environmental topics but human impacts on the environment. This is reflective of the strong environmental ethic at UConn, which has been ranked in the top 10 "green" schools nationally in the Sierra Club "Cool School" index for 6 of the last 7 years (*Sierra*, 2019). The new GenEd requirement is catalyzing examination of environmental curricula throughout the university and has created a need for sustainable offerings of courses that focus on the environment and result in a new generation of students who will have the background, motivation, and competencies to engage in environment-focused STEM initiatives.

Community Engagement Setting: Addressing the Capacity Gap

Before and during the shifting of these institutional factors at the university, a small team of faculty were developing a new transdisciplinary public engagement/service-learning model. The effort began as a pilot project proposed in 2016 to an internal grant program of the Provost's Office focused on supporting the university's Academic Plan. The team included members from both the Land Grant and Sea Grant arms of the university, programs that have a long history of public and community engagement. The remainder of the team consisted of the directors of the three environmental majors at UConn: Environmental Studies, Environmental Sciences, and Environmental Engineering. The proposal, to develop and conduct a new academic offering called the Climate Corps, was successful in obtaining a modest seed grant for a 3-year period.

In a "big picture" sense, the Climate Corps was a response to the longstanding contention of some faculty members that the land-grant system had room for improvement in assisting communities with non-agricultural land use issues (Arnold, 2000). More immediately, it was in response to two recent studies by team members focused on understanding the scope and nature of local (municipal) needs regarding planning for, and adapting to, climate change. In the first study, Hyde and Barrett (2017) interviewed municipal officials from 20 towns along the Connecticut coast, which was battered by Tropical Storm Irene in 2011 and Superstorm Sandy in 2012. The interviews had two main objectives. First, to identify high priority needs and concerns regarding climate change and resiliency, and second, to determine what standard of authority local officials were willing to accept in the context of incorporating climate information into their local planning and regulatory documents. Interviewees included both elected and appointed officials and were drawn from a range of departments, including public works, engineering, planning and zoning, conservation, emergency management, and health. The responses resulted in a list of about 55 priority informational needs that included a wide range of topics from flood inundation prediction to septic system failures to tax policy.

Boyer (2013) and Boyer et al. (2017) analyzed climate change policy development from all

169 municipalities in the state, creating an extensive quantifiable data set about what towns were doing (or not doing) regarding climate adaptation planning, and what constraints existed on policy action. To explore the motivations for, and constraints on, adaptation policy-making, they collected data through open-ended interviews about policy-makers' perceptions of the successes and failures of adaptation policy-making in their community.

A major finding of both efforts was that for most local officials, overall lack of resources and expertise, rather than lack of interest or desire, were the key elements in the lagging resiliency planning efforts across Connecticut. This is not surprising: As with communities in most areas of the country, Connecticut cities and towns are struggling to marshal sufficient resources to fulfill their responsibilities to their citizens and to state and federal governments. Connecticut does not have county government, and land use plans and policies are determined at the local (municipal) level. Many of the state's 169 municipalities do not have full-time professional staff to handle the assessment, mapping, engineering, and other tasks needed to comply with increasingly complex regulations, take advantage of state/federal governmental resources, or conduct proactive planning. The need for STEM-related skills and competencies is especially critical for tasks and programs related to environmental protection. The need to address this issue, referred to as the "capacity gap" by the team, forged a link between traditional academic and extension faculty on the team and became the focus for the Climate Corps experiment that, in turn, provided the foundation for the Environment Corps.

Environment Corps Overview

Formation and Partners

The Climate Corps is now in its 4th year and has inspired the creation of a second course (Brownfields Corps) and a third (Stormwater Corps), now collectively known as the Environment Corps, or E-Corps. Information on the individual courses is provided in the next section, but all share a common structure: a three-credit course focused on situated and practice-oriented instruction, followed in the next semester by a three-credit independent study/practicum where teams of students work directly with town officials on a range of projects

related to the topical theme of the particular course. The instructional model (to date) is that each course has two instructors, with one taking the lead during the classroom semester and one the lead during the practicum semester. The uniqueness of the E-Corps model is not in any one feature, but in the combination of innovative classroom instruction, service-learning, and community engagement supported by extension outreach. In effect, the model extends the land- and sea-grant ethic to the undergraduate student body, a vital and largely untapped source of university engagement with communities.

E-Corps was enabled by the collaboration of faculty across departmental and college lines. The project team includes five academic departments in four colleges/schools at UConn: the College of Agriculture, Health and Natural Resources, the College of Liberal Arts and Sciences, the Neag School of Education, and the School of Engineering. In addition, it includes four university-wide centers: the Center for Land Use Education and Research (CLEAR), the Institute of the Environment, the Connecticut Sea Grant Program, and the Center for Excellence in Teaching and Learning. Finally, it includes all three "environmental" major programs (Environmental Studies, Environmental Sciences, Environmental Engineering), and the Office of the Provost. Consolidation of this partnership, and the resources to add project components focused on research, evaluation, and institutional sustainability, were made possible by funding in 2019 from the Improving Undergraduate STEM Education (IUSE) program of the National Science Foundation (NSF).

Project Structure

E-Corps has three major aspects: instructional, integrational, and research and evaluation (Figure 1). The instructional aspect focuses on the enhancement of the E-Corps model through support and coordination of the three existing courses, as well as the exploration of additional courses. An instruction team was put in place, consisting of the instructors of all three courses and representatives from the Center for Excellence in Teaching and Learning (CETL). The institutional, or integrational, aspect of the project focuses on identifying, fostering, and understanding the institutional changes needed to ensure the long-term success and viability of E-Corps as a new

university public engagement model, set in the context of UConn but relevant to other universities. This aspect of the project is led by faculty from the Office of the Provost and CETL, and also includes the directors of several of the university centers involved. The research and evaluation aspect of the project focuses on investigation into the impact of the model on faculty, students, and administrators, and is led by faculty from the Neag School of Education. In addition, in response to the COVID-19 pandemic, grant resources were shifted to enable a modest parallel research effort that investigated the impact on student learning and instructional strategies of the transition to a virtual learning environment. All aspects of the project engage with the external evaluation team, which works in complementary fashion with the research team to evaluate the effectiveness of the instruction, the appropriateness of the research, and the success of ground-level impacts in Connecticut communities. More detail on each of these project components follows in the rest of the article.

Information on the number of students and projects involved in this effort, from the debut of the Climate Corps in 2017 through spring semester 2021, appears in Table 1. Because of their emphasis on discussion and small-team projects, E-Corps classes are limited to 24–30 students; the practicum semester enrollment is smaller both for practical (not all students enroll in the practicum) and pedagogical (the logistical complications of the practicum demand that only four or five student teams be assembled per semester) reasons. Although E-Corps classes are targeted primarily at the environmental majors, the courses have attracted students from 15 other majors. This includes other STEM majors (e.g., bio-logical sciences, chemical engineering, civil engineering) and non–STEM majors (e.g., economics, English, political science, urban and community studies).

There is no one template for an E-Corps classroom semester course. Each program has evolved in the context of the environmental issue upon which it is focused, and the way in which its instructors interact with communities on these issues. In the case of the Brownfields and Stormwater Corps, these factors were also influenced by the experience of its E-Corps predecessor(s). However, the courses share many common elements. On a conceptual level, these common elements can be captured as *high-leverage practices* and are a major focus of the project's research component. High-leverage practices (HLPs) can be understood as the instructional practices that aim to stimulate advancements in all student thinking, support students' participation in disciplinary pursuits, and be applied frequently across disciplinary topics and subject matter (Windschitl et al., 2009). HLPs are drawn from the field of teacher education and have been recently recognized for how they can support a community in their work of developing, refining, and sharing knowledge about teaching and learning (T. Campbell et al., 2019).

The HLPs for the E-Corps project were developed through the integration of previous literature about teaching and learning and an understanding of the practices already used by UConn E-Corps instructors. These HLPs are situated within community environmental challenges and iteratively negotiated with community members. They involve first (1) eliciting students' initial ideas; then dedicating considerable time to (2) informing approaches to problems by
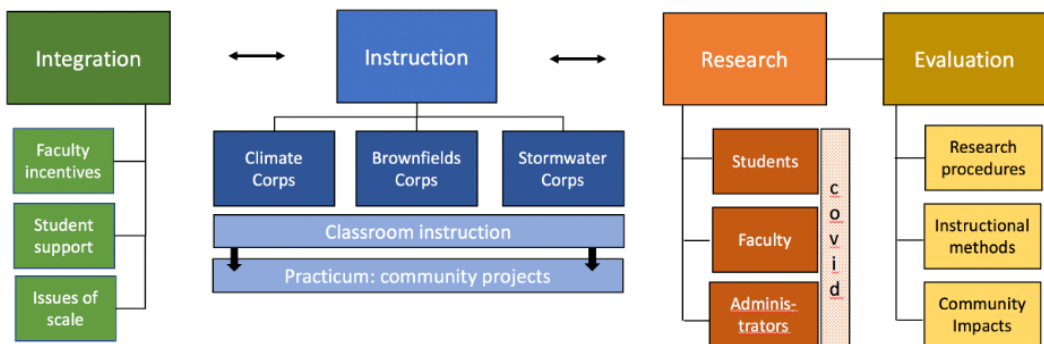

Figure 1. Major Elements of the E-Corps Project

Table 1. Summary Statistics for E–Corps Courses Through Spring 2021	
Total enrollment	281
Classroom students	186
Practicum students	95
Climate Corps students	133
Brownfields Corps students	117
Stormwater Corps students	31
Community projects	76

introducing disciplinary principles, practices, and frameworks; and culminating in (3) developing informed solutions to community problems. The HLPs are described in more detail in the article's Research and Evaluation section.

At the classroom level, the instruction team has compiled a list of instructional techniques that are used by at least two of the three courses:

- Discussion of a hypothetical community scenario both early and late in the semester

- Use of case studies

- Reading assignments using current events/media coverage

- Role–playing exercises

- Guest lectures from real–world practitioners

- In–class small–team exercises

- Small–team assignments/projects

- Field visits

- Critical reflection

- Peer evaluation

In addition, the use of real–world cross-cutting skills and/or competencies is explicitly emphasized. These skills include a working knowledge of the local land use decision–making process; the use of online mapping tools; verbal and written communication related to coordinating with a "client" (town) and relating the results of a project; and teamwork.

E–Corps Courses

Climate Corps

The Climate Corps was planned, developed, and approved during Academic Year (AY) 2016–2017 and debuted during the next AY, in fall 2017. The course Climate Resilience and Adaptation: Municipal Policy and Planning is cross–listed in three colleges/programs at the university. Students taking the class can choose to move on to an independent study in the spring semester, working in teams on climate–related projects with Connecticut towns. This model benefits the students by providing relevant real–world workforce training, benefits the towns by producing usable information/products, and benefits the university by demonstrating the commitment of UConn to the communities of the state. The Climate Corps is cotaught by two Department of Extension faculty: a land use planner who worked in municipal government for several decades as a director of economic development and an ecologist focusing on coastal habitat restoration and management. Both faculty members are involved with regional, state, and local municipal efforts on climate adaptation, resilience, and outreach.

The overall vision for the Climate Corps is for students to develop the ability to assess and analyze how large–scale environmental problems translate to the local level, particularly the world of local land use planning, and for Connecticut towns to gain much–needed assistance in adapting to a changing climate. Learning objectives for students in the class semester include gaining the ability to analyze and assess climate change impacts at a regional, state, and local scale; understand climate policy

and programs at the federal, state, and municipal levels; analyze and assess the relationship of land use to environmental health; conduct a vulnerability assessment through the use of maps, imagery, and land use information; analyze climate-related problems at the local level from interdisciplinary perspectives; and understand how local government functions and the many factors that come into play during the land use decision-making process.

Guest speakers are an important component of this class, with faculty as well as municipal and state officials sharing their experience and efforts with climate change adaptation. Class assignments include reflections based on readings of current newspaper articles, a role-playing exercise, and a cost of sea level rise exercise. In the role-playing exercise, students participate in a mock municipal hearing in a local community grappling with localized flooding due to sea level rise and its impacts on roads, residences, and commercial buildings. Students are randomly assigned roles that include community leaders, residents, climate experts/deniers, and reporters. Student reflections about this exercise include both the difficulty of, and revelations found in, taking on a belief or opinion that they do not personally hold. This exercise also raises awareness of the difficulty in trying to make long-term decisions while elected officials are working on a 2-year or 4-year election cycle.

The cost of sea level rise exercise is a semester-long team project in which students determine primary and secondary impacts of 4 feet of sea level rise to a given section of Miami Beach, Florida. Teams must consider population impacts, costs (including psychological) associated with demolition and relocation, where a new community will be established, what form it will take, and what the flooded Miami Beach waterfront will be used (or not used) for. Although frustrating and confusing at times due to the many decisions that have to be made, students generally feel that they gain a greater understanding of the complexity of climate change impacts and the potential costs to future generations of those decisions or nondecisions.

The second semester independent study focuses on community engagement, in which student teams work with Connecticut municipal and state officials, as well as nongovernmental organizations (NGOs), to conduct climate-related analyses; develop policy, plans, and/or ecological options in response to climate-related problems; and create outreach materials based on the specific needs of the community. From this experience, students gain knowledge of the opportunities for and barriers to climate adaptation at the local level while developing a climate-related report, analysis, or educational product to add to their résumé. Municipalities and NGOs gain much-needed tools and information that assist in their ability to adapt to a changing climate.

Developing a list of potential projects is a critical component of the Climate Corps. Through their extension appointments, the course instructors regularly work with local communities and organizations. Since 2015, they have collaborated on the Climate Adaptation Academy, an iterative series of statewide workshops for local officials and other sectors that explores issues related to local responses to climate change. This allows them to hear and understand local needs, from which independent study projects can be developed. The course instructors play a critical role in the student-community partner interface, helping both to develop realistic expectations for a one-semester project and to ensure that students obtain timely feedback. Because climate change is a socially and politically charged issue, difficulties often arise during the course of these projects. The instructors and students need to be prepared to pivot on projects, and on occasion have had to change course entirely (providing yet another valuable real-life experience for the student teams).

Application of knowledge through the independent study empowers students in moving forward, whether in careers or graduate school, and provides new windows into potential careers. Students have developed products that provide communities with meaningful analyses, reports, and outreach resources; examples of these projects are posted on the Climate Corps website, by year. Communities not only highly value Climate Corps student projects but actually implement and use them. For instance, the Town of Waterford is changing the maintenance regime of a coastal town park based on recommendations from a Climate Corps report, and the City of Norwich is using the data and analyses from a Climate Corps project in their stormwater management program. These documented albeit anec-

dotal impacts will be supplemented in the future with data from the evaluation team's interviews with community representatives, which began in late 2020 (see Research and Evaluation section).

Instructional techniques for the course have evolved over time, as each academic year provides input from formal student evaluations and informal feedback from students, Environment Corps instructor team peers, and pedagogical experts from CETL. Funded by the pilot project grant, a modest formative evaluation was performed for AY 2017–2018, the first year of Climate Corps implementation, by a colleague in the Department of Extension. The study consisted of an online survey of students soliciting feedback on the course semester, the practicum semester, and the overall experience. In addition, phone interviews with town officials from four communities were conducted. The report made recommendations for improvements that primarily focused on earlier communication with town officials in determining the focus of projects; these recommendations were adopted the following AY. The report concluded that the results

> demonstrate that the program has the capacity to grow and evolve, especially with regard to working with municipal partners. However, the students were enthusiastic about the Climate Corps program and found it to be a deeply valuable and useful educational experience, overall. (Kelly, 2018, p. 5)

Brownfields Corps

As the Climate Corps was beginning its second operational year in fall 2018, it was joined by the Brownfields Corps, developed by a member of the original Climate Corps faculty team from the Department of Civil and Environmental Engineering. The fall semester class, Brownfield Redevelopment, is also cross-listed between the three environmental programs and attracts students from diverse disciplines.

The Brownfield Corps is associated with the Connecticut Brownfields Initiative (CBI), a program supported by the State of Connecticut and philanthropic contributions from private sector partners who are actively engaged in brownfield remediation across the state. CBI provides training and technical assistance to Connecticut communities (including municipalities, regional planning organizations, and nonprofit entities) on several aspects of brownfield redevelopment, such as environmental investigation, remediation, and identification and pursuit of funding opportunities. CBI employs a full-time non-tenure-track faculty member with expertise in remediation who functions both as a liaison to the communities and as coinstructor for the Brownfields Corps, essentially replicating the role of Extension faculty in the Corps model.

Two essential features of CBI support the success of the Brownfields Corps. The first is that CBI serves communities year-round, outside the scope of the course, providing training opportunities to nonstudents, as well as workshops and individual consultation on specific projects. This feature ensures that relationships with communities are ongoing, building trust and creating a steady stream of meaningful projects for students. The second essential feature is CBI's relationships with the state and local industry. These stakeholders benefit from the creation of a skilled workforce and the opportunity to recruit students with knowledge in the field. At the same time, they contribute by providing reliable participation in the course, including student mentoring and consulting on brownfield projects and on issues that require practical knowledge that may be beyond the expertise of UConn faculty.

The Brownfield Corps is structured very similarly to the Climate Corps class, with a two-semester sequence. One difference is that both semesters involve a service-learning component. In the fall semester, students attend lectures provided by a combination of faculty and professionals in the field, on topics ranging from the legal framework and the finances of real estate development to the environmental issues and social aspects of brownfield redevelopment. At the same time, the students work in teams with a Connecticut community on developing a grant proposal to the U.S. Environmental Protection Agency (USEPA) brownfields program. The instructors assemble four-member teams using the CATME tool (Loughry et al.,2014), with an explicit criterion that teams should be interdisciplinary. The grant program has annual deadlines in December, so that proposal submission coincides with the end of the fall semester. The proposal is currently

a 10-page document with the following sections: description of the brownfields and the environmental issues associated with their presence; description of the community itself and the economic, social, and public health impacts of brownfields; and explanation of how the funding will be used to investigate or clean up the sites and the benefits that will arise from these actions. The class includes specific instruction on proposal development throughout the semester, as well as weekly group meetings and periodic meetings with the communities.

There are two final deliverables: a draft of the grant proposal, which is provided to the community, and an oral presentation delivered by each group to the class and a panel of external judges consisting of three professionals. The judges provide feedback in terms of the criteria used by USEPA, and select what they deem to be the most compelling presentation. The winning team has received a small scholarship in the past 2 years, provided by the Brownfields Coalition of the Northeast and CBI. Peer evaluation is also implemented at the end of the semester using CATME and is a portion of the grade. And for partner communities, this aspect of the fall semester has been remarkably successful: In the program's first two academic years, nine proposals were submitted by towns or regional councils of government to the EPA, of which four were funded for a total of $1.1 million.

The learning objectives of the class include technical as well as communication and management skills, and the importance of both is communicated to the students in the syllabus. Technical learning objectives include the ability to identify the status of a site as brownfield; articulate the relevant laws and regulations that govern the management of a brownfield site; describe how public (federal, state, municipal) and private partners are involved in the process of redeveloping brownfield sites; describe the basic concepts of real estate financing; list the different phases of a site investigation, the objectives of each phase, and the methodology to develop a plan for each phase; identify and describe different measures of cleanup and remediation procedures; articulate the elements of urban planning strategies and how brownfields fit into them; identify economic, ecological, and social factors that influence the redevelopment of brownfield sites; and develop commu-

nity engagement plans for the brownfield redevelopment process. Communication and management learning objectives include the ability to explain the elements of a compelling grant proposal; effectively synthesize technical information into a coherent and informative narrative; work together in multidisciplinary teams, meeting deadlines and providing constructive feedback to peers; communicate with government officials in a professional manner; and deliver oral presentations to diverse audiences in a timely and engaging manner.

The spring semester class is identical to the Climate Corps: It takes the form of an independent study (or internship credits depending on the major), with students working on a specific project in teams of two or three. The instructors have found that it is most productive to have larger teams in the fall semester, when students are still on a substantial learning curve, and smaller teams in the spring semester, when students are more experienced and know each other. There are no lectures, and students meet weekly with the instructors to discuss progress and the path forward; thus, a lot of the project work occurs independently. An important component of the spring projects is that the student teams visit the communities, accompanied by the instructors. The personal contact with the stakeholders and the firsthand experience of the brownfield sites and community are critical for project success, both in terms of promoting student understanding of the issues and building rapport between the community and the team.

Several types of projects are supported in the spring semester. These types of projects do not require site access and preclude any kind of exposure of students to contamination. Project types include partial Phase I investigations (background studies of site conditions and potential sources of contamination); preparing scopes of work for Phase II investigations (these are essentially sampling plans that provide communities with an idea of the cost to investigate a site with suspected contamination); brownfield inventories and lists that prioritize brownfields for redevelopment according to various criteria; evaluation of existing data and potential reuse plans for specific sites; and community outreach materials to promote brownfield development and raise awareness in the community.

The CBI team has found that early selection

and communication with the communities is critical to success of the course and the project. CBI issues a request for proposals twice a year, three months prior to the beginning of the semester. The communities are required to submit information on their project and assign a designated contact person. There is often a learning curve on the part of the community itself, as many towns do not have specialized staff or have limited knowledge of brownfield issues. This early communication ensures that the selected projects are appropriate for student work within the confines of a semester and that there is sufficient information available for the project to proceed successfully. Also critical is faculty's refinement of the student work: The instructors frequently spend a considerable amount of time refining and enhancing the student products, especially the grant proposals provided in the first semester. This ensures a consistent quality in the deliverables, again building trust from the community.

Stormwater Corps

A third course is completing its inaugural year in 2020. The Stormwater Corps, which has a "flipped" schedule, with the classroom course in the spring and the practicum in the fall, is led by three instructors, all from the Department of Extension and with a long history of working with communities on stormwater issues. The course, Green Stormwater Infrastructure Practices, is currently listed as a special topics course in the Department of Natural Resources and the Environment, but is seeking colisting in all three environmental majors next year, to join its sister programs. Again, as with the other programs, the Stormwater Corps relies heavily on class exercises, field trips, and practitioner guest speakers to focus on the local aspects of stormwater management. Certain instructional techniques found effective by its two predecessors have been incorporated into the new class. For instance, the instructors have included a role-playing exercise based on the one developed for the Climate Corps.

In the case of the Stormwater Corps, the class curriculum takes direct advantage of the many stormwater-focused projects and tools developed by the instructors in the course of their extension work. For instance, field trips are easily incorporated because the University of Connecticut campus has become a showcase for green stormwater practices (Dietz et al., 2015). Also featured are the smartphone application Rain Garden (Dietz & Dickson, 2013) and an online interactive "story map" detailing the progress of green stormwater implementation throughout Connecticut's towns (Dickson et al., 2018), both developed by the instructors, as well as online mapping sites developed by their colleagues at CLEAR (Rozum et al., 2005).

In fall 2020, independent study students were formed into teams that conducted impervious cover reduction plans for four communities. Each plan is an analysis that has both mapping and field components and is focused on identifying promising opportunities for installing green stormwater practices (also known as Low Impact Development practices). This type of analysis was piloted in summer 2018, via a partnership with Rutgers University and a grant to the team from the nonprofit National Fish and Wildlife Foundation. Such information is in great demand by Connecticut municipalities, most of which are struggling to meet the requirements of a newly strengthened general stormwater permit that began in 2017. As with the Climate and Brownfields Corps, the ongoing relationship of the instructors to the communities is critical, and in this case, the link is particularly robust. The instructors are principals of a longstanding outreach program focused on stormwater management that dates back to the early 1990s (Arnold et al., 2000) and currently lead a 5-year project to assist Connecticut towns with responding to the new stormwater permit.

Research and Evaluation

Research Approach, Questions, and Methods

The research aspect of the project seeks to iteratively refine high-leverage core practices for service-learning and understand how transformative institutional change can be effectively mediated across multiple levels within the university and beyond. Accordingly, we decided on a design-based implementation research (DBIR) methodological approach, which emphasizes systems-level improvement and theory development through design-focused partnerships, typically between researchers and practitioners (Penuel et al., 2011). More specifically, we are using a qualitative case study design (Yin, 2003) as the most ap-

propriate research method. The strength of qualitative methods research lies in its analytical approach, characterized by a coding process that draws simultaneously upon theory and data (Miles & Huberman, 1994). This approach allows the research team to focus on qualitative–naturalistic negotiations and scaffolds that (a) support the development of knowledge about teaching and learning and (b) transform institutions. All human–subjects research conducted as part of the E-Corps project has been approved by UConn's Institutional Review Board.

Specifically, the research focuses on the instructional and institutional or integrational aspects of the E-Corps project (see Figure 1). In relation to the instructional aspects of the project, the research aims to investigate the interactions among the tenets of the high–leverage practices (HLPs) selected to guide this work, the instructors' use of the HLPs (i.e., how they translate into courses and community–based experiences), and the tools that support their use (such as the instructional techniques listed earlier). For each iteration of the E-Corps model, the research team is collecting data that will inform project leaders' decision–making as the model is refined over time. Two questions guide this aspect of the research:

1. What is the nature of instructors' use of the high–leverage practices and the impact on students' service–learning experience?

2. What is the nature of instructors' use of tools, and how does this impact their use of the high–leverage practices?

Further, in relation to the institutional or integrational aspects of the project, the research investigates the process of institutional change needed to support the model, guided by the following questions:

3. How do policies, practices, and incentives (within the University and in the host communities) need to be aligned in order to foster and support the E-Corps model? What factors contribute to successful coordination and realignment?

To answer these questions, data is collected and thematically analyzed (Braun & Clarke, 2006) from interviews with students, instructors, and administrative faculty supporting the program; observations of project team meetings; and collection of project artifacts such as meeting agendas, course syllabi, and instructional rubrics. All interviews and meetings are recorded. Two to three members of the research team (those members involved in data collection) perform the coding and analysis of the data, consulting with other members of the research team to ensure codes and findings related to key concepts of the research questions are representative of data. Specifically, the researchers use a three–step process wherein they create a codebook and establish interrater reliability, discuss disagreements in coding to arrive at a consensus, and code the interviews and observations using the established codebook (Campbell et al., 2013).

High–Leverage Practices

As alluded to earlier, the HLPs represent a conceptual stance or set of principles about how learning and participation can be effectively fostered over time in community–level environmental problem–solving contexts. Table 2 gives a summary of our current version of the HLPs.

As can be seen in Table 2, our HLPs are linked and intricately connected so that the identified real–world scenarios or environmental challenges (e.g., the development of an EPA grant proposal for brownfields cleanup in a Connecticut community) that set the problem space for learning are revisited and refined based on negotiation and engagement with community members, and on what students learn about the real–world scenarios or environmental challenges over time (e.g., relevant science and engineering principles, practices, frameworks, and problem–solving approaches). Through a commitment to focusing on HLPs across the E-Corps courses, a common language and instructor-developed set of instructional techniques connected to supporting learners engaged in the HLPs is being assembled and refined (the current list is included in the previous section) so that a sharable knowledge base about E-Corps teaching and learning embodied in the HLPs will emerge over time.

The project team, like others (e.g., Aleven & Koedinger, 2002; Means & Harris, 2013), recognizes the difficulty that can come from efforts to bring educational innovations to scale. Accordingly, in addition to our study of HLPs, our research also focuses on institutional change, in particular understanding and supporting the interactions and alignment between educational innovation (e.g., E-Corps model) and the policies, people,

Table 2. E–Corps High–Leverage Practices			
Planning the Course	**Identify a community environmental challenge** (stormwater, climate, or brownfield related) that sets the goal or establishes the focal problem (the "Big Idea") for learn-ing and meeting our professional responsibility to the communities that we serve long-term. This focus is identified by faculty in partnership with communities during course development. It provides a real-world context to elicit ideas in the **Initial Phase: Eliciting initial ideas**, a guide for identifying the topics and instructional techniques used in the **Middle Phase: Informing approaches to problems**, and the focus of the development of informed solutions in **Final Phase: Developing informed solutions**.		
Initiating the Course	**Orient** students and the community to the pursuit of E-Corps focused work (e.g., community assessments, grant proposals) at the outset and throughout the course. This orientation entails acknowledging that resolutions will be developed within contexts of uncertainty—important for students entering professions that address environ-mental community concerns. Help students and communities understand what they will be doing and begin to see HLPs as essential for achieving their identified pursuit. Make it explicit that the pursuit (**the community environmental challenge**) is their important focus that sets the stage for how solutions are proposed (**Eliciting initial ideas**), informed (**Informing approaches to problems**), finalized (**Developing informed solutions**), and continually negotiated with community (**Involvement and interactive negotiation of solutions with community members**).		
Throughout the Course	**Involve and negotiate solutions with community members iteratively**. This process begins early, as instructors work with local stakeholders to identify the community challenge of consequence. It continues through instruction as more information about the local community is shared, such as through in-class guest lectures by community members. Finally, community members are invited to help conceptualize and negoti-ate developing solutions, particularly as part of the practicum semester. This process becomes iterative as each year's group of student-community collaborative projects adds to the Corps collective experience, shedding more light on the types of outcomes that can be achieved.		
Engaging: High Leverage Practices in the Course	1. **Intial Phase: Eliciting initial ideas** for ad-dressing the community environmental chal-lenge. Ideally, these initial ideas would be captured so that they could be revisited and improved overtime. This will also help students see how their ideas have evolved as connections between their ideas and newly introduced ideas are made as they engage with their peers and the instructor(s) around the challenge.	2. **Middle Phase: Informing approaches to problems**. Here, instructors help in-troduce important science and engineering principles, practices, frameworks, and approaches informed by community needs. These will build upon students' initial ideas for addressing the environmental chal-lenge in context. These are the things that students learn in the course that they may not have consid-ered otherwise.	3. **Final Phase: Developing informed solutions** for address-ing the community environmental challenge. Building upon intial ideas, this is where stu-dents revisit their initial proposals and strengthen them with what they learned about engaging in previous 'informing solutions problems' mid-instruction experiences with peers and instruc-tors.

and places where our E-Corps model is being tried (Honig, 2006; Means & Penuel, 2005), both at UConn and, potentially, other universities. This is accomplished through negotiated joint work at the institutional level that happens as project researchers and stakeholders within (e.g., professors, administrators) and beyond UConn (e.g., community partners) cooperatively plan and investigate efforts to refine, sustain, and scale our innovative public engagement model (Campbell-Montalvo et al., 2020).

Adaptation to Remote Learning

The onset of the COVID-19 pandemic in spring 2020 forced E-Corps, along with almost every other course at UConn, to adapt to remote learning as students did not return to campus after the spring break. This had effects both on the practicum proj-ects of the Climate and Brownfields Corps, and the inaugural classroom semester of the Stormwater Corps. In fall 2020, with instructors given a little more latitude on teaching modes, the Climate Corps class was taught completely in remote learning mode

and the Brownfields Corps was taught in hybrid mode. In recognition of these drastic changes—particularly in the context of a program founded on small-team projects, fieldwork, and engagement—and the opportunity to learn from this situation, a modest amount of funds from the NSF grant has been redirected to study the COVID-19-related impacts on E-Corps instructors and students.

Evaluation

The external evaluation provides an independent perspective on the project's research, contributions, and quality of outcomes. All three aspects of the project (instruction, research, integration) are undergoing evaluation of some type, as can be seen in the following list of evaluation questions:

1. What are the strengths and limitations of the research design for (a) expanding and refining the E-Corps model and (b) examining the process of institutional change needed to support this model?

2. How well are data collection processes and instruments aligned to the project's research questions?

3. How well are the project's research findings supported by evidence?

4. What is the quality of the training provided to faculty who are implementing the E-Corps model?

5. What is the quality of the tools intended to support the use of the high-leverage practices by faculty and students?

6. To what extent does the project use findings from its own research to inform revisions to the E-Corps model and the policies, practices, and tools needed to support its implementation?

7. To what extent do E-Corps projects meet the real-world needs of community partners and result in community organizations shifting toward more evidence-based practices?

To date, early into the 2nd year of the 5-year project, the emphasis has been on the formative elements of the evaluation plan. Members of the evaluation team attend all project meetings, and their first-year report focused on the effectiveness of the organizational structure and internal communication and planning of the project. In addition, the team meets regularly with the research team and principal investigator to ensure close coordination and avoid overlap or confusion between the research and evaluation efforts. During the 2nd year of the project, a major focus will be on interviews with representatives of E-Corps partner communities, in order to determine what is working, and not working, from the towns' perspectives, thus providing guidance for the instructors to improve the design of the practicum semesters (and likely influencing the content of the classroom semesters as well).

Integration: Sustainability Challenges and Opportunities

Key to the E-Corps initiative is the examination of mechanisms for sustaining this type of instructional model in the face of a number of challenges. All three aspects of the project are involved with this endeavor: the instructor team identifies these challenges, the integration team focuses on administrative responses, and the research team documents and explores those responses. Challenges are many, but for the most part they can be distilled into several major issues. These are summarized briefly here, with the acknowledgment that these issues are, at this point of the project, based almost completely on the experiences of the instructor team and are not yet supported or refined by research or ev;aluation results.

First, the model demands a higher commitment of instructional time and effort than most traditional classes. In addition to the many tasks involved in implementing a course that makes use of multiple interactive instructional techniques, there is the solicitation and coordination work with towns, and the logistical work involved with sustaining multiple field projects at the same time. All E-Corps instructors are in agreement that to implement an E-Corps course as a single faculty member would be extremely difficult. To add to this, the current system of faculty incentives and rewards is not designed to encourage this type of commitment, despite the model's many rewards to students and communities. One small step in this direction, funded by the NSF grant, is that each E-Corps class has been assigned a graduate assistant to help with some of these tasks. This has been an enormous help, but has not, to date, obviated the need for a two-instructor system.

Second, the model depends heavily on the participation of extension faculty (or their equivalents), not only for their knowledge of, and relationships with, the communities of the state, but as instructors that have a true feeling for the way environmental issues play out at the local level. Extension administration support of this involvement has two aspects, financial and philosophical. In our case, the critical issue is financial: Most of the extension faculty involved in E-Corps are primarily dependent on grant funds. This is an obvious and major challenge to sustainability of this model at UConn, and there is no getting around the fact that a greater commitment to supporting these faculty is needed for the model to survive. Perhaps a more widely applicable potential problem (although this has not been our experience at UConn) is that extension administrators may not be supportive of this modification of the role of an extension professional; faculty with 100% "extension" appointments and no "teaching" appointments might be seen as inappropriate instructors. Our answer to this is that the E-Corps model harnesses the enormous power of energetic and committed undergraduates to, in effect, multiply the impact of ongoing extension work within the community—and as such is not only a viable extension model but a desirable one. In our view, new pedagogical models like this more fully realize the land-grant/sea-grant ethos of the integration of research, teaching, and outreach.

The third major challenge revolves around working across administrative boundaries. For instance, one of the first challenges for the Climate Corps course was cross-listing it at three different schools/colleges across the university. In this case, the directors of the three environmental majors played a key role within their school/college Course and Curriculum Committees in explaining the Climate Corps with committee chairs prior to a presentation of the Climate Corps course to the committees and subsequent vote. But it was an uphill battle that took over a year. More telling, perhaps, is that even with the Climate Corps leading the way, it also took the Brownfields Corps over a year to perform the same feat. This served to remind the team that working across college and departmental lines, while theoretically encouraged by various levels of administration, is rarely simple in reality and that new procedures are needed to facilitate such efforts.

Taking Stock and Future Plans

The collective experience of the E-Corps team dates back to the AY 2017–2018 debut of the Climate Corps, although the NSF project, with its addition of research and evaluation, is only entering its 2nd year. As we await the results from those efforts, it is still possible to make some general observations about our experience to date, looking through the lens of its goal to simultaneously benefit four constituencies: faculty, students, communities, and the university. The seven instructors have found the experience of teaching these courses to be enormously gratifying but somewhat exhausting. Perhaps in the future these courses could be offered every other year rather than annually, but the student demand, and our desire to keep up the momentum of the model in its early stages, currently argues against that. It is also clear that the model as constituted at UConn is built on the long-term relationships that extension faculty (or, in the case of the Brownfields Corps, CBI faculty) have with the communities of the state. Although a deep pool of this type of experience and expertise exists across the country, particularly in the land- and sea-grant networks, prospects for adapting this model remain unclear. We hope to develop at least one more E-Corps offering during the course of the NSF project (a Mapping Corps based on a partnership between the Department of Geography and CLEAR), and beyond that perhaps facilitate the creation of non-STEM adaptations in the years to come. For instance, E-Corps principals have had preliminary discussions with both the School of Social Work on a collaboration focusing on environmental justice, and with the Department of Agricultural and Resource Economics on a master's-level effort that would develop economic analyses for towns. With each new version of the model will come more understanding of the ways in which faculty can use different approaches to reach our common goals.

In the absence of research and evaluation results to date, gauging student reaction is limited to formal teaching evaluation scores (which have been very high, above departmental averages) and informal student comments, both solicited and impromptu. One theme that has emerged in student feedback is the workforce preparation benefits of this approach, as seen in the following:

I was struggling to find an area of

interest that I could legitimately see myself pursuing for an extended period of time at some point in the future and, likewise, actively making a difference while doing so. My struggles ceased after taking the Climate Resilience and Adaptation/Municipal Policy and Planning course . . . for the first time ever, I was able to envision myself in a position in which I would be working in this field in the future/post-graduation.

This course was my favorite one I've taken in my undergrad career. I think I've learned so much more in these past two semesters than I have in any other class. It has prepared me for the professional world and gave me the feedback to improve my skills along the way. A lot of topics related to brownfields, assessments, and remediation was taught in this class that was not taught anywhere else in my undergrad career. I'm very excited to watch all of the incredible things to come from this class.

Impact at the municipal level is also anecdotal. There are certainly many positive stories, including communities that have used E-Corps reports as the basis to change their policies, apply for grants, or educate their citizens. And of course, there is the $1.1 million dollars in grants to communities obtained for brownfields work. Challenges remain, however, and to date many of them relate to the difference between the compressed timeline of a university semester and the extended time frame under which most municipal operations and decisions take place. In the earliest years, student teams would be left waiting for feedback or information from town officials as the semester clock ticked away. The addition of the graduate assistants to help facilitate communication and logistics has greatly helped in this regard. Impact at the local level is intimately connected with the benefits to the university, since this goal refers to an increase in awareness of, and appreciation for, the university for the application of its resources to help to solve community problems. Although it has been temporarily suspended due to COVID-19, the team has also implemented a recognition system in the form of an E-Corps plaque for each town, expressing appreciation and noting the town's partnership with UConn.

Four years is a relatively short time, from the perspective of the authors, to move from an interesting idea to a pilot project bootstrapped by a seed grant to a full-blown (if not yet fully realized) academic initiative with a big cast of partners and many moving parts. As the E-Corps continues to evolve and mature, we intend to relate our experiences—win, lose, or draw—to our peers in the hope that they will be of value.

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Acknowledgments

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