Engagement in Practice: Partnering with Honors Students to Build a Sustainable Service-Learning Ecosystem

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I am currently the Associate Director of Assessment and Research team at the Siebel Center for Design (SCD) at the University of Illinois at Urbana-Champaign. I work with a group of wonderful and talented people at SCD's Assessment and Research Laboratory to conduct research that informs and evaluates our practice of teaching and learning human-centered design in formal and informal learning environments.

My Research focuses on studying students' collaborative problem solving processes and the role of the teacher in facilitating these processes in STEM classrooms.

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Introduction

Service-learning is an experiential pedagogy that integrates academic content with structured community engagement to achieve mutually beneficial outcomes, distinguished by intentional design, reciprocity, and guided reflection rather than ad-hoc volunteerism [1]. In engineering, it supports the integration of technical learning with professional competencies such as communication, ethics, and societal impact [2]–[3]. Service learning has been maturing within engineering education, showing steady growth, broader geographic reach, and rising emphasis on human-centered design, sustainability, and student experience [4]. Delaine *et al*. found that reciprocity varies widely across engineering service-learning programs and highlighted the need to intentionally center it within evolving campus community partnerships to avoid unintended harm or marginalization [5]. When service learning takes the form of STEM Education outreach, particularly when working with historically marginalized populations, there is a risk of reinforcing biases and stereotypes if outreach providers use poor pedagogical practices or neglect to address systemic biases in representation and access [6]. This paper examines the development of and lessons learned from an evolving service-learning ecosystem at the University of Illinois Urbana-Champaign (UIUC) that intentionally seeks to strengthen instructional and inclusive practices to the benefit of both campus and community partners by engaging College of Education (CoEd) students in partnership with engineering students to develop and implement STEM education activities in formal and informal K–12 settings.

Creation and development of the service-learning ecosystem

The development of this initiative had its beginnings in 2020 with a course for hundreds of graduate teaching assistants (GTAs) in the college of engineering focused on learning teaching skills as transferable skills that will benefit them even if they intend to pursue a career in industry rather than academia [7]. In the remote learning environment that many schools adopted during the fall of 2020, students in this course showed an interest in service-learning to impact the local K–12 educational system. Instructors reached out to local schools and found that the interest was mutual. Science teachers from one of the local middle schools provided topics for the graduate teaching assistants to develop supplementary teaching modules. The middle school teachers were overwhelmingly positive about the content and asked that we repeat the exercise in Spring 2021.

Since then, this model has continued to develop and expand. In 2021, we added "Teaching Catalysts" (TCs) to the model, who were pre-service students recruited from the CoEd to be expert feedback partners for the engineering GTAs. The CoEd students reviewed and offered guidance in effective lesson planning in K–12 education. This role not only increases the quality of the lessons provided to community partners, but the TCs gain valuable experience practicing curriculum and instruction skills as they mentor the engineering students and further develop their confidence in teaching STEM topics. Levels of confidence and self-efficacy with math and science are factors that can impact teacher effectiveness [8]. This became the tri-cornered reciprocal relationship of stakeholders that remains at the core of these efforts (see inset).

This model has been in active development since 2021 [9]. The work has been evaluated through the lens of the TPACK evaluation framework [10], as well as Entrepreneurial Mindset (EM) and Human Centered Design (HCD) principles [11]. New developments this year included the expansion of the provider base from the graduate TA Training course to an implementation for undergraduate students focused on developing career readiness skills and civic mindedness. The undergraduate engineering participants were either enrolled in a first-year experience leadership course in engineering (FX) or selected this STEM education option as their undergraduate honors project.

In Fall 2025, 22 undergraduate students enrolled in the FX Leadership seminar. This semester-long course focused on the development of leadership skills and included a capstone project of preparing and implementing a STEM activity at a local K–8 school. Additionally, through a partnership with the new Center for Family and Community Engaged STEAMM (FACES), focused on community engagement and the Engineering Honors program, the authors developed a series of activities that the honors students could implement as a means of gaining honors credit for the semester. Six honors students signed up for the Community-Engaged Engineering Students (CEES) Honors implementation, but two decided to drop their enrollment early in the semester. Required activities for credit included participation in three 90-minute workshops on topics of:

- **Best practices for lesson design** for an introduction to Universal Design for Learning and alignment to standards frameworks like the *Next Generation Science Standards*;
- **EM and HCD informed lesson design** to introduce these two frameworks for empathetic and entrepreneurial design practices that can inform lesson design or can be embedded in the STEM activities themselves; and
- **Safe and welcoming learning environments** about classroom practices that protect minors, motivate participation, and build connections.

The TCs also participated in these workshops and provided 2–3 feedback conferences to support Honors students in developing and implementing publishable lesson plans with local K–12 partners. An open-enrollment Canvas course centralized resources and tracked progress throughout the semester.

A call for applicants also went to CoEd juniors and seniors for an hourly position supporting STEM education in the community. Two elementary education majors, two mathematics secondary education majors, and a special education major were hired by FACES Center to be the TCs for this program. They served as lesson plan feedback partners to the engineering students throughout the planning process and managed the Canvas space as TAs, helping to develop the lesson feedback rubrics, reminding Honors students of deadlines, and responding to content posted in the LMS. The TCs also gained additional time in classrooms, serving as co-teachers for STEM enrichment courses provided by FACES partners on Saturdays for community students and families.

The FACES Center for community engagement became an active partner this year as well, which provided assistance with matching STEM education activities to community organizations serving

youth of various ages. The Center was formed recently to serve as a community engagement hub for community members to more easily find campus partners for STEM-related initiatives. This fills an expressed need in our community for a centralized source for STEM education resources and events. Additionally, by working across campus units, the Center is better able to sustain partnerships over time (e.g., as one unit's initiative ends, another can be identified to fill the gap).

Assessment Methods

At the end of the semester, we examined the implementation to understand participants' experiences and the perceived quality of reciprocity in the ecosystem. We conducted an end-of-semester survey after students completed their community-engaged activities. The survey consisted of Likert-type items measuring perceived development across multiple domains and open-ended questions used to contextualize each stakeholder group's experiences.

The service-learning outcomes for the GTAs focused on developing stronger pedagogical skills and practices. For engineering undergraduates, we aim for them to develop career-ready competencies (e.g., communication, critical thinking, leadership, etc.), as well as civic-mindedness and a sense of agency to impact local and broader communities. In addition, by incorporating the EM and HCD concepts into lesson design, our undergraduate students receive an early introduction to concepts applicable to engineering design projects as well [11].

Participants

In Fall 2025, we had two groups of undergraduate engineering students engaged in service-learning projects: 22 from the first-year experience course, and 4 honors students from various engineering courses. We also hired 5 TCs to guide engineering students in designing and creating their lesson plans. Community partners included two local K-12 schools, a homeschool cohort, and two afterschool programs.

Data Collection & Analysis Procedures

Surveys were developed to assess undergraduate experiences with community, as well as the quality of the campus-community partnership. These surveys were administered after the undergraduate students completed their semester activities. The survey tools included Likert scale satisfaction ratings and scaled questions to assess STEM identity, civic-mindedness, career competencies, and community partner reciprocity. Open-response questions were also included to gain more details about individual experiences. This same tool was administered to the TCs to understand their experiences during the semester. A separate survey tool was developed to measure satisfaction and assess the quality of the campus-community partnership.

Results

Community Partner Surveys

Four partner organizations responded to the post-semester survey, including a K–8, homeschool, and two K–12 afterschool programs. Experience working with the College ranged from first time

partner to a partner with more than three years of collaboration. This is a key difference among the partners that impacted survey responses. Two of the partners only work with this CEES initiative, while the two after school programs have a multi-faceted partnership with the College that includes a variety of programming in addition to the CEES initiative. Of the four partners, one reported never engaging with the university, one engaged 1–2 times in the semester, and two reported engaging with the university partner weekly.

All four organizations agreed that the collaboration advanced their organization's mission or objectives, that communications were inclusive and respectful, and that they were satisfied with the university partner's responsiveness and the experience overall. While the mean remained high (4.5/5), there was more variance among the organizations in how well they felt their perspectives were valued during planning and implementation, the extent to which the organization felt they had an equal voice in the program design, and that their feedback influenced the program's design and improvements. While we do not have enough data to draw relational conclusions, we did notice that higher ratings came from the organizations that engaged more frequently with the University. When asked how this partnership has contributed to the public good, three of the four organizations described increased access to STEM learning opportunities for youth and families. One of these partners added that their teen participants had never considered STEM as a career option for them until this partnership began. Now, several of their program participants have decided to pursue STEM fields. When partners were asked what they find most valuable about this campus-community partnership, schools valued the exposure to new content and different learning environments. After-school programs discussed the value of seeing relationships develop between their students and university volunteers, a value for students in both institutions.

TCs and Engineering Students Surveys

Table 1 summarizes post-test survey scores across a set of learning and development domains for TCs, Engineering Honors, and FX students. While we are unable to draw statistically significant conclusions from these results, we do see a pattern in this first year of implementation with the Honors cohort that their ratings were lower than those of the TCs and the FX participants in multiple categories. We also noticed that Honors students who did not interact with the Canvas site or with the TCs had lower pedagogy ratings than other students.

The open-ended survey responses provide insights into some of these differences. TCs reported that they most valued opportunities to support students through direct mentoring and feedback. They described helping students move from initial uncertainty to more developed ideas and increased confidence. TCs valued learning about peers' projects and observing how ideas evolved

Table 1. Seven Learning and Development Domains (N_{TC} = 4, N_{Honors} = 4, N_{FX} = 11)

Domains	TCs Post-test Mean (SD)	Honors Post-test Mean (SD)	FX Post-test Mean (SD)
Pedagogical skills	4.50 (0.00)	3.83 (0.12)	4.33 (0.15)
Career-ready skills	4.25 (0.35)	3.75 (0.20)	4.09 (0.07)
Civic engagement	4.58 (0.12)	3.89 (0.68)	4.00 (0.13)
Satisfaction	4.46 (0.51)	4.39 (0.23)	4.65 (0.26)

over time. Challenges are primarily related to logistical timing and the difficulty of tailoring lessons to foreign disciplines.

Honors students described the experience as enjoyable and engaging, where they specifically valued the opportunities to interact with young learners and observe their excitement during hands-on STEM activities. Honors students identified challenges related to instructional management and program structure. These challenges included ensuring students followed instructions, getting started without clear guidance, and adapting lesson plans to unexpected age groups or resource constraints (e.g., limited software access).

FX students reported that they most valued collaborative teamwork and opportunities to engage directly with youth during instructional activities. They were specifically happy during the final lessons and their interactive activities. At the same time, FX students stated that challenges related to instructional planning and logistics were a barrier. It was difficult for them to address diverse learners' needs, navigate unexpected constraints, and manage student behavior or participation. Some also noted difficulties with scheduling and finding a time to meet outside of class.

Lessons Learned

From these experiences, and especially from this most recent expansion of this service-learning ecosystem, we have learned some key lessons. Overall, we have a value-added ecosystem for all participants. We especially want to strengthen the experience for the Honors students. Of all groups in this ecosystem, the Honors students had the least interaction with others. We need to be more purposeful about opportunities for collaboration and interaction. We find that the TCs have been a vital part of this ecosystem. Both Honors and FX students reported similar challenges related to teaching, such as adjusting lessons to appropriate age levels and managing students, these are components that the TCs have expertise in, but these challenges arise more in the implementation phase than in the lesson planning phase. We are thinking about how the TCs role in providing guidance, feedback, and scaffolding can support implementation strategies as much as they are already supporting lesson design.

Additionally, Honors and FX students reported some differences in how they experienced the program. Honors students valued direct interactions with K-12 learners and the emotional rewards of teaching. They entered the program with more externally motivated goals, such as the course credit. In contrast, FX students were more internally motivated and valued a team learning context. Despite these differences in motivation and experience, both groups reported positive learning outcomes across all domains, with post-test scores exceeding the median.

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