# BOARD # 227: Building Engineering Leaders: Pairing Leadership Coursework with Service Learning - NSF DUE #2012339

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## Introduction

This paper describes the experiences and outcomes of undergraduates enrolled in the new curriculum of an Honors program with many students from underrepresented groups in a variety of STEM backgrounds. The project was initiated by external funding and has now been established as critically important and replicated at other units in the institution. As we look to build the engineering workforce of the future, industry input about skills for success is critical. Technical skills are important for newly minted engineering graduates, yet there is a growing need for what are sometimes referred to as soft skills, such as communication, interpersonal, and teamwork [1]. This project, supported by NSF DUE #2012339, aimed to incorporate soft skills training and experiential learning into a required curriculum for an engineering honors program at a research intensive university.

Employers of college graduates consistently rate communication skills and teamwork as critical in the candidate selection process [1] and look for problem solving skills and group projects on resumes [2]. To address these needs, we designed two courses to prepare future leaders of the STEM workforce: *Service Learning in STEM* and *Leadership in STEM*. Class sizes are small, with 20-35 students per section, to ensure that students have every opportunity to have a voice in class, and be open about their experiences, especially for those who are underrepresented in STEM. Research has shown that science meritocracy myths cause declines in self-esteem, increases in dropout rates, and substantial psycho-logical costs, such as self-blame and imposter syndrome [3].

The approach we took was unique; rather than the traditional approach of faculty revising curriculum exclusively, our approach was broader. We created a partnership between the faculty director of the Honors program and the university's career service, a centralized unit within the division of student affairs. The Career Center's extensive industry and alumni connections helped inform the creation of two one-credit courses focused on the development of those soft, or essential skills, through experiential learning and intensive self-reflection [4]. These two courses: *Service Learning in STEM* and *Leadership in STEM*, are required in the new curriculum of this honors program. Both are offered exclusively and purposefully in a face-to-face format to promote interpersonal exchanges and build a strong peer network. They also allow students to fulfill general education requirements, and therefore, do not burden the students' schedules.

## Course Content

*Service Learning in STEM* pairs student teams with community partners for a service project. Students work with community leaders to identify a problem, design and implement solutions, and present their work. The course requires regular communication between the student teams and community partners, as well as investigation of the societal and personal challenges these non profit organizations are seeking to address. Reflection prompts cultivate empathy, ethical awareness, and a personal connection to service. Example questions: Should community service be a requirement for college students? Why or why not? What insights have you gained about yourself during this service project? How might you approach this project differently if you had to do it again? And lastly, an existential question: Because of my service learning class, I am….[5]

*Leadership in STEM* structures in-depth self reflection on leadership and followership styles and strengths, and brings alumni from industry to share stories of leadership challenges and successes. Students create vision boards and an individual leadership action plan, which they present to their peers. Individual and group mentoring is offered to students as an option through the Career Center's Industry Connections program. The text, *Dare to Lead,*[6] is a popular book for women in the workplace and very well received by the students. Industry professionals share their career paths briefly and spend time discussing leadership - philosophy, challenges, successes. Students are actively engaged in Q&A, feeling validated when an industry leader expresses having similar concerns, such as imposter moments and difficult situations. Inspired is a word that comes up often in class and in course evaluations.

A recent addition to the leadership course was prompted by feedback from previous year students who asked for more support as they navigated their leadership roles on campus. A dedicated day for peer consulting using the triad approach, is popular in teacher preparation [7] and assigns three roles: coachee, coach, and observer. The coachee, or client, presents their challenge with context, history, and detail. The coach listens and shares ideas for potential solutions to the problems presented. The observer provides feedback to both client and coach. Students loved this exercise; it provided practical ideas, peer support, and instilled confidence.

## Methods

Critical reflection [8,9] is embedded in both courses. A thematic analysis approach [10] is utilized to systematically examine student reflection papers and identify patterns. In addition to reflection papers and continuous feedback loops in classes, formal assessment data are collected through surveys and focus groups each semester, leading to adjustments to readings, assignments, and in-class activities. As the *Service Learning in STEM* course involves community partners, a separate partner evaluation was distributed to gauge their perceptions of the value of the project to their agency as well as their evaluation of the students on the project. Findings were discussed with students and non profit partners through meetings to challenge interpretations and minimize bias. In *Leadership in STEM*, the analysis was conducted separately by each section instructor. The instructors met to discuss their understanding, then reviewed themes with students during class as a form of member checking.

## Outcomes

Key areas of impact for both courses were increased self-awareness and self-confidence. These impacts are especially important for students in *Leadership in STEM*, as this course is not an experiential course and there is a range of previous leadership experience.

> *"Everything we discussed and read will stay with me long after I graduate. I'd say this was the perfect class to end my four years here, and I feel a little less scared moving on to new things. I hope to continue leading when I start as a field engineer, but for now, I'll do my part as a follower."* - L.C.

> *"You definitely come out of the class learning more about yourself and how to be a confident leader than at the beginning of the semester."* - Anon

Professional skills were honed. Most commonly cited skills by students in *Service Learning in STEM* were the soft, or essential skills: communication, interpersonal skills, problem solving, teamwork, and leadership. They also reported a deeper understanding of community issues and the tangible impact their contributions had on those communities. These outcomes are consistent with previous research as to the benefits of service learning for STEM students [11]. Moreover, this project experience may prompt students to keep humanity and ethics in mind while they pursue more technical courses and job roles [12].

> *"In addition to the STEM related skills I improved throughout this project, I also became more confident in professional communication, especially as I chose to be a group leader for this project, which is what I normally would avoid, as I tend to get anxious over organizing larger projects. This was a chance to get comfortable with professional emails, organizing meetings, and overall being the talkative one in group meetings."* - R.H.

> *"This project not only challenged me but also showed the impact that thoughtful service can have on both personal and community levels." - M.V.*

As this was the fourth year of the course offerings, we have integrated lessons learned over time from the students' experiences and refined the courses to better provide active engagement with content, solutions-oriented class discussions, practice having difficult conversations, vision board design, connections to industry and alumni mentors, deconstruction of their experiences working with community partners and/or student organization leadership roles, and significant self-reflection. Strategies to overcome discriminatory or biased behavior, a framework for having difficult conversations, language to help them articulate their leadership vision, philosophy, and skills, and a support network of peers and alumni mentors from industry equips students with the skills and confidence they need to thrive in their future career as STEM leaders.

This initiative, however, is more than a course sequence for engineers. The partnership between the Honors program and the Career Center ensures that students have access to industry professionals and community partners, which provides a level of professional engagement that does not typically occur in traditional STEM coursework. The effort can be easily replicable at other universities. A long history of strong industry relationships also means that the feedback

loops are stronger, leading to improved projects for the students, and reciprocal impacts on community initiatives.

## Limitations

A limitation of the project is the challenge of gathering post-graduate outcomes. To address this, long-term plans include implementation of more targeted alumni outreach strategies, maintenance of updated contact information, leveraging social media, and collaborations with alumni career services. We will also explore existing partnerships with industry and use surveys to collect long-term career data from alumni.

## Future Research

Future research could examine differences in experiences and outcomes based on sequence. Meaning, are there differences in the student experience and outcomes between students who enrolled in the service learning course before the leadership course, or vice versa? Overall we believe that this unique academic-student affairs partnership is a model for other institutions and welcome requests for consultation by interested faculty and staff.

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