

WIP: Early outcomes from a leadership development program for women and non-binary engineering students

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Abstract

This work-in-progress practice paper presents findings from the first three years of an engineering leadership program. Our program, launched in Spring 2023, is a leadership development initiative dedicated to empowering upper-division and graduate-level women and non-binary engineering students. Rooted in equity and inclusion, the program is designed to encourage leadership identity development, foster a supportive community, and provide resources for academic persistence.

During the program, students engage in weekly two-hour training sessions co-facilitated by staff, faculty, and industry professionals, complete written reflections, and participate in activities such as off-site industry visits, team building exercises, and mentoring with faculty and professional engineers, culminating with a final team presentation. These engagements address a variety of topics tailored to women and non-binary engineers, including navigating implicit bias, resume and interview preparation, elements of negotiation, communication, and leadership identity development.

To assess program impact, we collected and analyzed post-program survey data from our first three cohorts containing both quantitative and qualitative questions. Preliminary results show gains in participants' self-reported leadership attributes and competencies, including interpersonal communication, conflict navigation, and confidence. Participants also more clearly articulated their definition of a leader, identifying key traits such as inspiring, empowering, goal-oriented, and trustworthy. Participants also found it particularly valuable to have professional women engineers as instructors and mentors throughout the program.

Each year, we refine the program based on participant feedback. Looking ahead, we plan to lengthen the program beyond the one term to deepen mentoring relationships and strengthen community connections. We also aim to broaden access to first- and second-year students. Future directions include longitudinal tracking of alumni and the long-term impact of the program on participants' leadership development.

Keywords: leadership development, women in engineering, non-binary engineers, industry mentorship

Introduction

Despite their potential and capabilities, women in engineering often face a lack of encouragement and support in pursuing leadership roles and sustaining long-term careers in the profession [1]. Social and cultural conditioning has perpetuated gender stereotyping in engineering workplaces, contributing to implicit biases and systemic barriers that shape how leadership potential is perceived and rewarded [2]. Even though women bring valuable interpersonal and collaborative strengths to engineering, they often report entering the engineering workforce with lower confidence than their male counterparts, shaped in part by gendered norms in engineering environments [3], [4]. These challenges can be further magnified for women from marginalized backgrounds, who frequently encounter intersectional biases and structural inequities within engineering cultures [5]. While leadership development can help address these gaps, gender-neutral leadership programs often overlook the distinct experiences, expectations, and leadership styles of women, particularly in male-dominated areas [6]. As a result, many women become discouraged or leave engineering when they perceived limited advancement opportunities or insufficient organizational support [1], [7]. These realities underscore the need for leadership programs intentionally designed to address gender-specific barriers, build confidence, and foster community among women engineers.

The college years are a critical time for emerging women engineering leaders to cultivate their leadership skills and develop their leadership identity to persist in the profession. Evidence suggests that leadership development initiatives tailored to the culture of engineering contexts can help strengthen self-efficacy, counter the effects of gender underrepresentation, and prepare students to navigate culturally embedded barriers within technical fields [8], [9], [10]. These programs contribute to creating more inclusive and equitable campus and educational environments by challenging inequitable norms and supporting peer and mentor networks that enhance persistence and professional growth. Furthermore, leadership development builds human capital through enhancing an individual's knowledge, skills, and values, and social capital through fostering relationships among individuals that enhance collaboration and resource sharing [11]. Engineering-focused leadership development can help shift perceptions of women's leadership capability and strengthen the leadership pipeline across engineering disciplines.

To address this need for engineering- and gender-specific leadership development, we recently launched a leadership program specifically for women and non-binary engineering students within our college of engineering. The purpose of this paper is to describe the design and implementation of our program and to present preliminary findings from the first three cohorts. We highlight early evidence of the program's impact on participants' leadership development and identify opportunities for continued refinement and expansion.

Background on the Program

The Women Engineers Rise (WE Rise) Leadership Academy (WLA), launched in Spring 2023 at the University of Washington (a large, public university in the western United States), is a leadership development initiative for upper-division (junior and senior) and graduate-level women and non-binary engineering students [12]. It is a dynamic, cohort-based, and interactive experience that combines mentorship, leadership development, and community building. The program aims to empower participants to build strong leadership identities and thrive as community leaders through weekly in-person sessions facilitated by volunteer professionals from industry and academia. Supported by curated online resources, the WLA provides tailored experiences that help students develop foundational leadership skills, gain confidence, and access mentorship. By equipping participants with the knowledge, skills, and strategies to lead in academic, professional, and personal settings, the academy fosters growth in communication, decision-making, and inclusive leadership practices. The learning objectives of the program are:

1. **Analyze and Address Issues:** Identify and critically examine challenges affecting women and non-binary leaders in engineering and related fields.
2. **Apply Holistic Leadership Strategies:** Utilize tools, resources, and approaches to build confidence and strengthen leadership identity.
3. **Demonstrate Professional Development Skills:** Practice and refine skills such as communication, networking, and self-advocacy for career advancement.
4. **Recognize and Create Opportunities:** Develop strategies to identify, pursue, and create pathways for promotion and leadership roles.
5. **Enhance Personal Leadership Style:** Articulate and adapt personal leadership approaches to align with professional goals and organizational culture.
6. **Navigate Transitions Effectively:** Understand and manage the shift from academic environments to professional workplaces, including changes in climate and culture.

The WLA is delivered during the spring academic quarter, meeting weekly for two-hour sessions over eight weeks. Designed to prepare women and non-binary engineering students for leadership in technical fields, the program combines expert-led instruction, interactive learning, and mentorship. Program components are intentionally selected to equip students with tools and strategies for navigating leadership challenges in technical fields. Each session features engineering professionals from academia and industry who share insights, lead discussions, and provide guidance. Topics span core leadership themes such as authentic leadership, innovation, negotiation, communication, and strategies for addressing bias and stereotype threat. Participants engage in hands-on activities, networking, and reflective exercises to apply concepts and build confidence. A weekend retreat hosted by an industry sponsor deepens community building and offers real-world exposure to organizational culture. The program concludes with a celebratory

event where participants present their learning to sponsors, instructors, and peers, share reflections, and receive certificates of completion. This integrated approach of connecting students with experienced leaders, fostering inclusive practices, and creating a supportive environment has proven effective in promoting professional growth and leadership identity development. Key components of the program are described in Table 1.

Table 1: Program Component Descriptions

Program Component	Description
Expert-Led Sessions	Each session features engineering professionals from academia and industry who volunteer their time to share insights, lead discussions, and provide mentorship.
Leadership-Focused Topics	Every session covers two core leadership themes, offering practical strategies and tools for personal and professional growth. Topics include, but are not limited to, Authentic Leadership, Leadership Theories, Innovation and Entrepreneurship, Cultural Stereotyping, Implicit Bias and Stereotype Threat, Negotiating Mindset, Imposter Syndrome, Communication and Compassion, and Understanding Gender Schemas.
Interactive Learning	Participants engage in activities, discussions, and networking opportunities to apply concepts and build confidence.
Networking and Real-World Application	Opportunity to gain practical insights into professional office environments. Incorporates a weekend retreat to foster community building, understand organizational culture, and engage in one-on-one networking with professionals. Hosted by one of our industry sponsors.
Mentorship & Coaching	Direct access to professional women engineers who offer guidance and share real-world experiences.
Community Building	Opportunities to connect with peers and mentors, fostering a supportive and inclusive environment.

Methods

Program participants are recruited from across the College of Engineering, through various flyers and email advertisements. Because the program is open to all students in the College of Engineering, students must apply to join the program. In the application, students respond to questions about their interest in leadership, what they value in an effective leader, their current leadership strengths, and what they hope to gain from the experience. Students are carefully selected based on their thoughtfulness and articulation of their goals and desire to participate.

To assess the impact of our women's leadership program on participants' leadership development, we have collected participant data from across each of the three cohorts. At the conclusion of each program, participants completed an online survey designed to

capture their experiences, perceived outcomes, and recommendations for improvement. The survey included both quantitative Likert-scale items, such as “Were your expectations met?”, “Rate your understanding of behaviors that promote an inclusive and supportive engineering environment,” and qualitative short-response questions, such as “How would you define a leader?”, “How do you think your leadership skills were heightened and/or strengthened?”, “What additional success strategies for preparing women for leadership would you like to learn more about?”. In addition to the survey, participants also submitted weekly written reflections on session topics throughout the program. While reflections are used as a pedagogical tool to enhance students’ learning, they are also of interest to the instructional and program staff to gauge students’ growth and understanding of the topic presented.

This paper reports preliminary findings from the end-of-program surveys only. Responses from all three cohorts were aggregated for analysis. Quantitative data were summarized descriptively, while qualitative responses were analyzed thematically to identify recurring patterns and representative themes [13]. Short-response questions were analyzed using an inductive thematic approach. Responses were first reviewed to identify recurring ideas, which were then grouped into preliminary codes. Codes were iteratively refined and consolidated into broader themes to capture patterns across participants. For example, responses to “How would you define a leader?” were coded for concepts such as inspiration, integrity, empowerment, and collaboration. Counts of participants per theme were recorded to indicate prevalence, and representative quotes were selected to illustrate each theme. This process was conducted manually by the authors to ensure alignment with the study’s focus on leadership identity development.

Preliminary Results

Across the three cohorts to-date, a total of 33 students participated in the leadership development program. Of these 33, we received 23 responses to the end-of-program survey, for a 70% survey response rate. Participants and survey responses by cohort are shown in Table 2, along with other cohort characteristics. Participants represented a broad range of engineering disciplines: each cohort included students from 6-7 of the 10 engineering majors offered by the college, and across all three years, all 10 majors were represented. This diversity reflects the program’s reach across the entire College of Engineering, enhancing its potential impact by engaging students from multiple technical fields and fostering interdisciplinary leadership development.

Table 2: Cohort Characteristics

Cohort	# Participants	Engineering Majors Represented	# Survey Responses
Spring 2023	12	Aeronautical & Astronautical, Chemical Engineering, Computer Science, Electrical & Computer, Industrial & Systems, Bioengineering, Mechanical	10
Spring 2024	10	Aeronautical & Astronautical, Civil & Environmental, Electrical & Computer, Human Centered Design, Materials Science & Engineering, Mechanical	5
Spring 2025	11	Aeronautical & Astronautical, Bioengineering, Electrical & Computer, Human Centered Design, Materials Science & Engineering, Mechanical	8
Total	33	10	23

When asked whether their expectations for the program were met, 17 of the 23 responses indicated “Yes,” while 5 indicated “Somewhat,” and only 1 reported “No” (see Table 3). The participant who responded with “No,” gives the following reason for their response:

“I appreciate the effort made however I think the program was mostly surface level and didn’t dive deep into the challenges or leadership skills in a high-level real-world environment. I think if more actionable skills were introduced rather than explaining the terms of different topics could have been helpful. As grad students, we are already familiar with most of the topics but can learn more about communication techniques or decision-making skills in critical situations in a reasonable and practical way considering the hierarchy in industry environments. Another skill that can help students a lot is networking skills.”

While overall, participants found the program aligned with their goals and delivered a positive experience, there is room for improvement to dive deeper into various topics, particularly to engage with graduate students who may have more experience than undergraduate students.

Table 3: Whether Participant Expectations Were Met

Cohort	Yes	Somewhat	No
Spring 2023	6	4	0
Spring 2024	4	1	0
Spring 2025	7	0	1
Total	17	5	1

To further assess the impact of the program on students' leadership development, we asked students to provide their agreement (on a 5-point scale, with 5 indicating strongly agree) to the following question: "The Academy helped me to identify and develop my leadership attributes and competencies." The responses by cohort are shown in Table 4.

Table 4: Agreement with "The Academy helped me to identify and develop my leadership attributes and competencies."

Cohort	Strongly Agree	Agree	Neither Agree nor Disagree
Spring 2023	4	6	0
Spring 2024	2	3	0
Spring 2025	6	1	1
Total	12	10	1

Overwhelmingly, 22 of the 23 responses indicated "strongly agree" or "agree", with only 1 has "neither agree nor disagree," for an average score of 4.48. No responses were received for the ratings of "strongly disagree" or "disagree." These results indicate consistent perceived gains in leadership development, which is one of the main learning outcomes of the program.

We followed up on this question and asked students, "How would you define a leader?" to provide additional context to their responses. Their responses revealed 5 themes, with the most common theme being Inspiration & Motivation (10 participants), emphasizing a leader's ability to inspire and uplift others. Vision & Goal Orientation (9 participants) highlighted guiding teams toward shared objectives, while Collaboration & Inclusivity (7 participants) reflected the importance of fostering community and common purpose. Similarly, Support & Empowerment (7 participants) underscored providing guidance and enabling others' success. Finally, Integrity & Trustworthiness (6 participants) emphasized ethical behavior and reliability as core leadership qualities. To be noted, no responses indicated that a leader must have strong technical acumen in an engineering career, but instead focused on interpersonal skills. These findings suggest that participants view leadership as both relational and aspirational, combining inspiration and integrity with practical strategies for team success. Themes and representative quotes are shown in Table 5.

Table 5: Themes for Defining a Leader

Theme	Count	Representative Quotes
Inspiration & Motivation	10	“A leader is someone who can inspire and uplift others.”
Vision & Goal Orientation	9	“A leader is a person who drives the team into achieving the collective vision through guidance, charisma and handholding if required.”
Collaboration & Inclusivity	7	“Someone who creates community and cultivates common purpose within an inclusive team environment.”
Support & Empowerment	7	“Someone who is knowledgeable and who others can rely on as a source of support. Someone who makes an effort to ensure the success of others.”
Integrity & Trustworthiness	6	“An individual who has confidence, integrity, trustworthy of leading.”

One participant was able to clearly articulate their definition, such that it encompassed all themes in their response. This participant’s quote is highlighted below, demonstrating the broad impact the program had on their understanding of what it means to be a leader:

“A leader is someone who inspires and guides others toward a shared vision by demonstrating integrity, empathy, and decisiveness. A leader empowers their team, fosters collaboration, and adapts to challenges while maintaining clear communication and accountability.”

Lastly, we asked students to articulate, “How do you think your leadership skills were heightened and/or strengthened?” Through our thematic analysis, we identified four themes: interpersonal communication and conflict negotiation (11 participants); practice, reflection, and team building (9 participants), self-awareness, strengths, and confidence (8 participants), and exposure to women leaders & role models (4 participants). These findings suggest that participants experienced leadership development through a combination of skill-building, experiential learning, and identity formation, supported by mentorship and networking opportunities. The themes and representative quotes are provided in Table 6.

Table 6: Themes for how participants' leadership skills strengthened

Theme	#	Representative Quotes
Interpersonal Communication & Conflict Navigation	11	"Communication, practicing how to pitch myself, and navigating difficult conversations helped me feel more prepared to advocate for my ideas."
Practice, Reflection & Team Building	9	"Attending the regular sessions and completing the reflections helped strengthen my leadership skills by giving me the chance to process and apply what I was learning."
Self-awareness, Strengths & Confidence	8	"Communication, personify yourself with a stronger front, approach issues and how to maintain a strong and confident personality."
Exposure to Women Leaders & Role Models	4	"I think it was great to be exposed to industry leaders who were women to give insight into how what we were learning would be effective on the job."

Conclusions and Next Steps

Preliminary results from three cohorts of the Women Engineers Rise Leadership Academy indicate that the program is meeting participants' expectations and fostering growth in leadership identity, communication skills, and confidence. Qualitative feedback highlights the program's strengths, such as mentorship, exposure to women leaders, and opportunities for reflection, while also suggesting areas for improvement, particularly the desire for deeper, more advanced content.

To address these recommendations, our next steps include analyzing weekly reflection data to identify opportunities to strengthen and expand program content. Based on these insights, we plan to extend the program beyond a single academic quarter to a year-long format, providing sustained engagement and skill development. Additionally, we aim to introduce an introductory leadership program for first- and second-year students, creating an early pipeline for leadership growth.

We are encouraged by the program's initial impact and remain committed to expanding its reach across the College of Engineering. By deepening content, broadening participation, and offering tiered programming, we seek to amplify the academy's role in preparing all women and non-binary engineering students to lead confidently in technical fields.

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