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Launching the Engineering Ambassador Program: First Year of an NSF ITYC Project

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Abstract

This paper reports on the first year of an NSF ITYC project that launched an Engineering Ambassador Program. Designed to address ongoing barriers to engagement and persistence in engineering at two-year institutions, this program integrates faculty and industry mentoring, technical and professional skill development, student-led outreach, and a summer immersive undergraduate research experience at a partnering four-year institution. Using a mixed-methods research design alongside an independent external evaluation, this paper reports on implementation and student experiences during Year 1. Preliminary findings suggest that participation supported students' understanding of engineering practice and its real-world applications and encouraged exploration of engineering-related academic and professional opportunities. These early results inform ongoing program refinement and contribute evidence toward scalable, experiential strategies for engineering pathways at two-year institutions.

Introduction

Improving persistence, engagement, and success in engineering remains a national challenge, particularly at two-year colleges. Early engineering coursework at community colleges often emphasizes mathematics and physics, which can limit students' ability to connect coursework to engineering practice or envision future career pathways (Meyer & Marx, 2014). Limited access to authentic engineering experiences, mentoring, undergraduate research, and outreach further constrains engagement with real-world applications, however research demonstrates that undergraduate research, mentoring, and collaborative outreach support student engagement and academic development (Carpi, Ronan, Falconer, & Lents, 2017; Hunter, Laursen, & Seymour, 2007; Fitzallen & Ruth Brown, 2017). Persistent challenges related to community formation and student well-being in early engineering education further highlight the importance of structured experiences that support early engagement with engineering practice (Jensen & Cross, 2021).

These challenges are especially significant at Fresno City College (FCC), a designated Hispanic-Serving Institution (HSI) and Asian American and Native American Pacific Islander-Serving Institution (AANAPISI) located in California's Central Valley. FCC serves a student population characterized by significant economic and educational barriers. Fresno, California has a poverty rate substantially higher than the national average, and FCC enrolls a high proportion of low-income students (United States Census Bureau, 2022; FCC Institutional Research, 2023) in Fall 2023, 63.6% of FCC engineering majors were considered as low-income students (FCC Institutional Research, 2023). Institutional data reinforces the need for approaches that address both structural and experiential barriers to persistence in engineering.

In response to this national and institutional context, the Engineering Ambassador Program (EAP) was developed as a comprehensive, experiential model designed to foster belonging, engagement, and persistence among engineering students at FCC. Funded by the National Science Foundation Innovation in Two Year College STEM Education (ITYC) program (NSF Award #2412926/2412927), this program integrates mentoring, undergraduate research, technical and professional skill development, and outreach within a coordinated, year-long structure. The program leverages a partnership between FCC and California Polytechnic State University, San Luis Obispo (Cal Poly) to expand access to undergraduate research opportunities that are typically unavailable to community college students and to strengthen pathways between two-year and four-year engineering programs. Through immersive research experiences at Cal Poly, complemented by preparatory and follow-up activities at FCC, students engage in authentic work while developing technical and professional skills relevant to engineering practice.

Engineering Ambassador Program Design

The Engineering Ambassador Program (EAP) was designed to strengthen FCC engineering students' self-confidence, engagement, and persistence through a coordinated, year-long model. The program is guided by three overarching goals: (1) building an in-person engineering community, (2) increasing participation in the engineering program, and (3) supporting students' academic and professional success, operationalized through measurable objectives (**Table 1**).

Table 1. FCC Engineering Ambassador Program Goals and Objectives

Program Goal	Description	Associated Objectives
Goal 1	Create an engaging and supportive in-person community for FCC engineering students.	Increase community engagement and student self-efficacy, reflected in participation in FCC STEM-related student organizations, presentations, events, and workshops.
Goal 2	Increase participation in the FCC engineering program.	Increase enrollment in FCC engineering classes.
Goal 3	Provide FCC engineering students with the support and skills needed to succeed in their engineering academic pathways, undergraduate research, and internship opportunities.	Increase retention and persistence in the FCC engineering program; increase student awareness of and application to external STEM opportunities such as internships, undergraduate research programs, summer experiences, and scholarships.

To achieve these goals and objectives, the program incorporated four integrated components: seminars and workshops, student-led outreach activities, faculty and industry mentoring, and a summer undergraduate research experience. Each component included structured activities designed to reinforce student engagement with engineering practice, professional communities, and academic pathways, with intentional alignment to the program's goals (**Table 2**).

Table 2. FCC Engineering Ambassador Program Components and Alignment

Program Component	Key Activities	Intended Outcomes	Aligned Goals
Seminars and Workshops	Guest speaker and industry-led seminars; workshops on internships, undergraduate research, and transfer preparation; makerspace training in safety, prototyping, and fabrication; team-based development of hands-on engineering learning activities.	Increased awareness of engineering pathways and transfer options; improved preparedness for internships and undergraduate research; strengthened technical and professional skills.	Goals 1 and 3
Student-Led Outreach Activities	On- and off-campus outreach to FCC classes and student organizations; outreach to local K–12 schools;	Strengthened sense of belonging and engineering identity; reinforcement of	Goals 1 and 2

	presentations on engineering education and ambassador experiences; facilitation of hands-on engineering activities; participation in campus STEM events.	learning through leadership and teaching; increased visibility and participation in the FCC engineering program.	
Faculty and Industry Mentoring	Monthly faculty and industry mentoring meetings; academic planning and transfer guidance; support with scholarships, internships, and undergraduate research applications; professional skill development; mentor orientation and training.	Increased self-confidence and self-efficacy; improved retention and persistence; increased awareness of and preparation for external STEM opportunities.	Goal 3 (primary); Goals 1 and 2 (secondary)
Summer Undergraduate Research Experience	Preparatory activities at FCC; Arduino programming and applied technology training; immersive residential research experience at Cal Poly; team-based research on sustainable engineering; poster development and presentation.	Enhanced engagement with authentic engineering research; increased technical, teamwork, and leadership skills; greater confidence navigating four-year research environments.	Goals 1 and 3

Year 1 Implementation Across Sites

The EAP was implemented beginning in Fall 2024, with the first cohort's activities occurring across Spring 2025, Summer 2025, and Fall 2025 at both FCC and Cal Poly. Implementation followed a deliberate sequence designed to support sustained engagement with engineering practice, beginning with cohort formation and skill development at FCC, followed by an immersive undergraduate research experience at Cal Poly, and concluding with synthesis and outreach activities at FCC (Table 3). Ten Engineering Ambassadors were selected through a blind review process and participated in all core program components, including seminars, workshops, mentoring, and the summer undergraduate research experience. The program engaged 5 FCC faculty members and 10 industry mentors.

Table 3. Year 1 Engineering Ambassador Program Implementation Timeline

Timeframe	Location	Key Activities	Purpose
Fall 2024	FCC	Recruitment and selection of Engineering Ambassadors	Cohort formation
Spring 2025	FCC	Orientation; seminars and workshops; makerspace training; faculty and industry mentoring; transfer exploration.	Skill development and preparation for immersive research
Early Summer 2025	FCC	Preparatory activities; introduction to Arduino programming; teamwork and leadership development.	Research readiness
Summer 2025	Cal Poly	Residential undergraduate research experience; applied construction materials research and data acquisition using microcontroller technology, with hands-on experimentation and data analysis for building performance evaluation.	Engagement with authentic engineering practice
Fall 2025	FCC	Poster development; research symposium; student-led outreach to classes, student organizations, and K–12 schools.	Synthesis, communication, and outreach

Research Design

The research component of this NSF ITYC project is guided by Kolb's Experiential Learning Cycle, which conceptualizes learning as a process involving concrete experience, reflective observation, abstract conceptualization, and active experimentation (Kolb, 1984). This framework informed the design of the study and the organization of data collection across program activities. Within the context of this project, concrete experiences included participation in hands-on makerspace workshops, mentoring interactions, outreach activities, and a residential undergraduate research experience at Cal Poly. Reflection and observation were supported through structured discussions with faculty and industry mentors, post-activity surveys, and synthesis activities designed to elicit students' descriptions of their experiences. Abstract thinking and analysis were examined through students' interpretations of research activities, connections to coursework, and articulation of academic and career pathways. Active experimentation was reflected in students' application of skills and insights through research design and implementation, development and delivery of outreach activities, and pursuit of additional engineering-related opportunities. The study is guided by two research questions: (1) how participation in an engineering ambassador program contributes to students' understanding of the engineering field and its real-world applications, and (2) how students apply their experiences in an immersive engineering program to learn about and pursue additional engineering opportunities.

To address the research questions, the study draws from multiple data sources aligned with stages of the experiential learning cycle. Participation records, surveys, reflections, and student artifacts from workshops, mentoring, outreach, and the undergraduate research experience were used to examine how engagement and reflection supported students' understanding of engineering practice and its real-world applications (Kandiko Howson & Matos, 2021; Dunsmore et al., 2011; Brunhaver et al., 2017). Evidence of analysis and active experimentation, including goal-setting behaviors and exploration of internships, undergraduate research, and transfer opportunities, was used to examine how students operationalized their experiences to pursue future pathways (Gilmartin et al., 2017; Herrera & Hurtado, 2011). An in-person facilitated reflection conducted during the final week of the immersive research experience employed mind mapping to capture students' holistic program experiences (Streiner et al., 2016; Nove & Purwanta, 2022).

External Evaluation

An independent external evaluator conducted a mixed-methods evaluation to provide objective, formative and summative assessment under an IRB approved by all participating institutions. The evaluator operated separately from program implementation and research activities and examined student participation, engagement, persistence, and progress toward equity-focused objectives outlined in the project proposal. Formative evaluation was conducted at the conclusion of each major program component (spring seminars and workshops, early summer preparatory activities, and the summer undergraduate research experience) through brief student surveys and review of participation records to provide timely feedback for continuous program improvement. Summative evaluation occurred annually and included student and mentor surveys, analysis of participation and persistence data, and synthesis of formative findings. During Year 1, surveys were administered to all Engineering Ambassadors (n = 10) and to FCC faculty (n = 5) and industry mentors (n = 10) involved in program activities. Student surveys included Likert-scale and open-ended items examining perceived impacts on understanding of engineering practice, awareness of engineering-related opportunities, self-efficacy, and intent to pursue internships, undergraduate research, and transfer pathways, while mentor surveys examined perceptions of student engagement, preparedness, and professional growth. Sample student survey items are provided in Appendix A.

Preliminary Findings

Year 1 findings indicate that participation in structured, experiential program components supported students' understanding of engineering practice and strengthened their interest in continuing along engineering pathways. Following the Summer Research Experience ($n = 10$), students reported high gains in their understanding of how scientists and engineers work on real-world problems (5-point Likert; $M = 4.80$), their ability to collect and analyze data ($M = 4.80$), and their ability to collect research results ($M = 5.00$). Additionally, students reported strong increases in teamwork and collaboration skills ($M = 4.80$), suggesting growth in professional competencies associated with engineering practice. Across both the Spring Workshop Series and the Summer Research Experience, students also reported increased interest in engineering and related pathways. The Spring Workshop Series contributed to learning and growth as an engineering student to a good or great extent for 88% ($n = 8$). In the Summer Research Experience ($n = 10$), 100% of students reported increased interest in continuing as an engineering student ($M = 5.00$), 90% reported increased interest in engineering design and prototyping ($M = 4.80$), and 90% reported increased interest in an engineering career ($M = 4.90$).

Student engagement also extended beyond coursework into engineering-related communities and leadership roles, aligning with the project's first goal of strengthening students' connection to engineering pathways and professional identity. At the start of the project, two ambassadors participated in the Society of Women Engineers and the Science and Engineering Club. By Fall 2025, participation increased to six ambassadors, four of whom were serving in officer roles. Additional findings indicate that students translated experiential learning into concrete next steps, including identifying internships, undergraduate research opportunities, and transfer pathways. Through mentoring and professional development activities, participants described using information gained through the program to make more informed decisions about their academic and professional trajectories. While these findings align with prior research, they should be interpreted within the context of a first-year implementation study focused on formative outcomes from a single cohort; continued data collection in subsequent project years will enable examination of longer-term outcomes and participation in engineering pathways.

Conclusion and Future Work

This paper describes the design, implementation, and early findings of an Engineering Ambassador Program at a two-year institution, highlighting a coordinated experiential approach to supporting students' engagement with engineering practice and pathway exploration. Preliminary Year 1 research and evaluation findings suggest that integrating mentoring, undergraduate research, skills development, and outreach supports students in contextualizing engineering coursework and identifying academic and professional opportunities. Although findings reflect formative outcomes from a single cohort, they provide early insight into the potential of structured experiential programs to strengthen engineering pathways at two-year institutions. Continued research and external evaluation will examine longer-term outcomes and inform refinement and scalability in alignment with NSF ITYC goals.

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Appendix A. Representative Survey Items

Spring Workshop Series Survey

- Overall Contribution to Learning
    - Students rated the extent to which the workshop series contributed to their growth and development as engineering students.
- Technical Skill Development
    - Students reported the degree to which participation increased their understanding of the uses and applications of makerspace technologies (e.g., 3-D printing).
    - Students rated growth in their knowledge of safety procedures and safe practices in a makerspace environment.
- Comfort and Confidence with Equipment
    - Students ranked their relative comfort levels across multiple types of fabrication and prototyping equipment.
    - Students reflected on why they felt more or less confident using certain tools.
- Interest in Engineering Pathways
    - Students indicated whether participation increased their interest in:
        - Continuing in engineering
        - Engineering design and prototyping
        - Pursuing an engineering career
- Reflective Feedback
    - Students identified aspects of the workshop experience that could be strengthened.
    - Students described which tools they would feel prepared to teach others and why.

Summer Research Experience Survey

- Overall Contribution to Learning
    - Students rated the extent to which the research experience contributed to their growth and development as engineering students.
- Preparation for Research
    - Students evaluated how effectively pre-program instructional modules prepared them for the research experience.
    - Students provided feedback on additional preparation needed.
- Understanding of Engineering Practice
    - Students rated gains in their understanding of how engineers and scientists address real-world problems.
    - Students reported growth in research-related skills, including:
        - Data collection and analysis
        - Interpreting and reporting results
        - Teamwork and collaboration
- Interest and Academic/Career Exploration
    - Students indicated whether participation increased their interest in:
        - Continuing in engineering
        - Engineering design and prototyping
        - Engineering careers
- Program Improvement Feedback
    - Students described changes that could improve the research experience.