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Reimagining the ECE Curriculum by Bridging Technical Preparation, Professional Formation, and University Mission for a Holistic Education: Pilot Implementation

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Abstract

The evolution of engineering education over the past few decades reflects the growing complexity of the challenges engineers encounter in today's world. Where once technical proficiency was the primary emphasis of engineering education, there is now a growing recognition of the distinct but complementary role that professional formation plays in shaping well-rounded engineers **[1] [2] [3]**. A holistic approach to engineering education will help us shape future engineers who possess the foundational knowledge and applied skills in their discipline, as well as across disciplinary boundaries, along with global and cultural awareness, social responsibility, ethical leadership, and sustainability and environmental stewardship **[4] [5]**.

In response to Seattle University's call for a bold and comprehensive reimagining of program curricula throughout the university, the ECE department has embarked on a transformative journey that bridges professional formation and technical preparation in a mission-aligned manner. Prior work by the authors focused on reimagining the ECE curriculum, while the pilot study described in this paper will focus on 7 out of 12 modules that were designed and implemented in select courses spread throughout the four years of the undergraduate ECE curriculum at Seattle University. The modules were designed to include

- Themes such as sustainability and climate change, racial and economic justice, technology and its impacts on society, community engagement and experiential learning, and universal design.
- Elements of professional formation such as ethical and social critical thinking, mentorship, teamwork and conflict resolution, sustainable design, injustice and inequity in access to energy, professional continual learning and professional identity, community-engaged learning, and social responsibility.

This paper provides an overview of the modules, assessment results from the pilot implementation, and our observations throughout the process. A combination of direct and indirect assessments is used to evaluate both student learning outcomes and students' sentiments regarding the holistic educational experience.

Background

As part of its 2022–2027 Strategic Directions Plan, Seattle University launched a multi-year, multi-phased effort to comprehensively reimagine and revise curriculum with a call to integrate practices that would make the education we offer distinctly unique and relevant to global challenges. The *Reimagine and Revise the Curriculum* (RRC) initiative was divided into four phases: launching, reimagining, revising, and implementing curricular changes in priority areas

such as *Sustainability and Climate Change*, *Racial Injustice and Widening Economic Inequity*, and *Technological Change and its Impact on Society*.

Prior work by the authors **[5]** focused on reimagining the undergraduate ECE curriculum by bridging professional formation and technical preparation in alignment with the strategic directions of the university. Curricular revisions were proposed to integrate the RRC priority areas along with four broad categories of professional formation skills that we would like our students to acquire by the time they graduate –STEM Technical Skills, Ethical Leadership and Project Management, Personal Skills, and Interpersonal Skills. An inventory of professional-formation skills was generated and grouped into program curricular outcomes (PCOs) and mapped to the relevant university-level *Curricular Priorities*. Figure 1 illustrates a high-level overview of these themes.

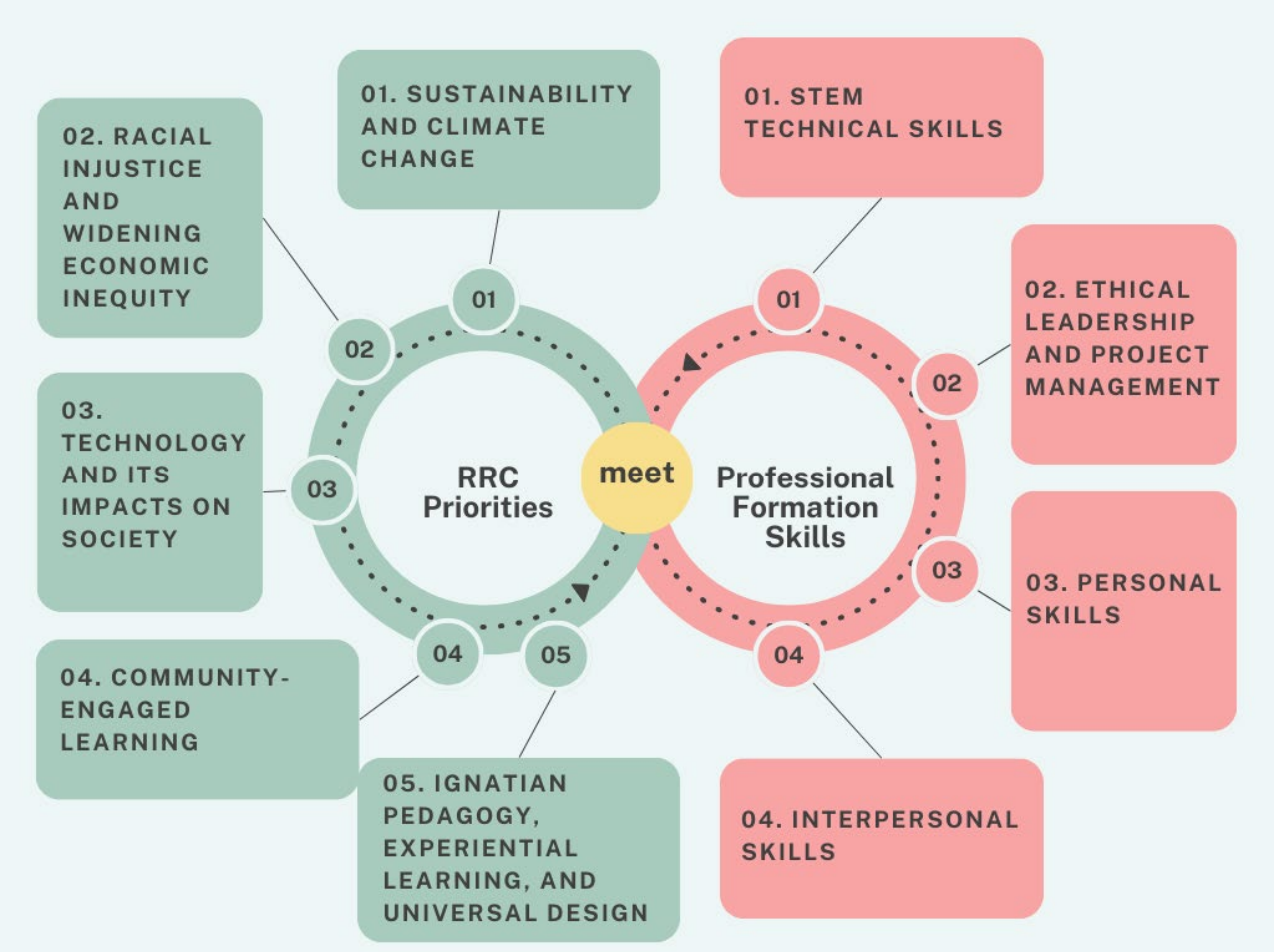

Figure 1: Interconnectedness of RRC Curricular Priorities and Professional Formation Skills [5]

In this paper, we present our pilot implementation plan for AY 2024–25, which includes 12 modules spread across the four years of the undergraduate ECE curriculum. Each module focuses on a specific PCO, and when applicable, a corresponding RRC curricular priority. This is followed by an overview of 7 modules that were implemented in fall quarter 2024 and a preview of the remaining 5 modules that will be implemented in winter and spring quarters.

Pilot Implementation Plan

Following *Phase 1: Reimagine* of the multi-phase RRC initiative *[5]* in which PCOs were mapped to RRC curricular priorities, we launched *Phase 2: Revise*, during which our department identified courses in which an outcome or multiple outcomes would be revised to address one or more PCO–RRC priorities. This led to the creation of aspirational roadmaps integrating PCOs and RRC *Curricular Priorities* into our curriculum *[5]*. To ensure successful integration, we initiated a pilot implementation on a smaller scale, allowing us to assess the effectiveness of these interventions and refine our approach accordingly. Table 1 lists the courses picked for the pilot implementation, with their corresponding outcomes/skills/priorities.

In most cases, the placement of modules was deliberate and strategic. For example, the combined 'Mentorship' module in ECEGR 1200 and ECEGR 3110, both fall-quarter courses, was designed to strengthen interclass connections between first-year and third-year students. This experience highlighted the value of being both a mentor and a mentee, both being desired skills in personal and professional settings. Another example is the 'Professional Continual Learning' module in ECEGR 3710, a spring quarter course for students in their junior year. It is at this point that many students begin thinking about post-graduation pathways and exploring opportunities to strengthen their career preparedness. Finally, ECEGR 4870, the first course in a three-quarter senior design (capstone) sequence and a key touchpoint before students enter the workforce, seemed well-suited for the 'Social Responsibility' and 'Bias and Microaggression' modules.

Table 1: Pilot Implementation Plan for AY 2024-25. An overview of the modules highlighted is included in this paper.

Course Number	Course Title	Quarter Offered	Program Curricular Outcome	Professional Formation Skills	RRC Priorities
ECEGR 1200	Digital Operations	24FQ	Ethical Leadership and Project Management	Mentorship	-
ECEGR 2100	Electrical Circuits I	25SQ	STEM Technical Skills	Ethical and social critical thinking- Bias and Microaggression	Racial Injustice and Widening Economic Inequity
ECEGR 3110	Electrical Circuits II	24FQ	Ethical Leadership and Project Management	Mentorship	-

ECEGR 3111	Laboratory I: Circuits	24FQ	Interpersonal Skills	Teamwork and conflict resolution	Ignatian Pedagogy, Experiential Learning, and Universal Design
ECEGR 3120	Semiconductor Devices and Circuits	25WQ	STEM Technical Skills	Design informed by rare and dangerous materials used in technology	Sustainability and Climate Change
ECEGR 3500	Electrical Energy Systems	25WQ	Ethical Leadership and Project Management	Knowledge of UN sustainability goals and grand challenges	Sustainability and Climate Change
ECEGR 3500	Electrical Energy Systems	25WQ	Ethical Leadership and Project Management	Injustice and inequity in access to energy	Racial Injustice and Widening Economic Inequity
ECEGR 3710	Signals and Systems	25SQ	Personal Skills	Professional continual learning-grad school, FE exam, certifications	-
ECEGR 4640	Internet of Things	24FQ	Interpersonal Skills	Community-focused communication	Community-Engaged Learning
ECEGR 4750	Machine Learning I	24FQ	Personal Skills	Professional identity-digital portfolio	-
ECEGR 4870	Engineering Design I	24FQ	Ethical Leadership and Project Management	Social Responsibility	Technology and Its Impact on Society.
ECEGR 4870	Engineering Design I	24FQ	STEM Technical Skills	Ethical and social critical thinking (Eg. Bias and Microaggression)	Racial Injustice and Widening Economic Inequity

Module Overview and Assessment

This section presents an overview of the seven modules that were implemented in fall quarter 2024. In the interest of being concise, special emphasis is placed on the 'Mentoring' module.

ECEGR 1200 (Digital Operations) and ECEGR 3110 (Electrical Circuits II): Mentorship

Learning Objectives:

By the end of the module, students were expected to:

1. Understand the importance of mentoring in academic and professional growth
2. Identify how they can benefit from both being a mentor and having a mentor
3. Develop communication and leadership skills by participating in mentoring activities
4. Build connections across student cohorts to foster a collaborative department culture

Content and Structure:

ECEGR 1200 and ECEGR 3110 are required for both EE and CMPE majors. This pilot mentoring module was designed to strengthen interclass connections, advance professional development, and instill a lasting appreciation for the value of mentorship among students. Its dual objectives were to immerse participants in hands-on mentorship roles and to equip them with skills to navigate academic and professional challenges. The module brought together first-year students (mentees) from ECEGR 1200 (n=41), third-year students (mentors and mentees) from ECEGR 3110 (n=24), and recent alumni (mentors) in a structured framework. Key components included a pre-survey to assess baseline understanding, an in-class introduction and discussions to establish foundational concepts, two collaborative group activities, reflective writing assignments, and a post-survey to evaluate outcomes and gather feedback. Given that the surveys were paper-based, all enrolled students completed them.

Students began by completing the pre-survey that was designed to gauge their understanding of mentorship, identify expectations, and uncover potential misconceptions. The responses provided valuable insights, enabling the module to be tailored to better meet students' needs and address any preconceived notions about mentorship. Following the survey, the department chair delivered a concise 10-minute in-class presentation on the importance of mentorship, its role in engineering, and its reciprocal benefits. The presentation debunked common myths, such as the idea that mentorship is a one-sided or strictly formal relationship, while emphasizing how mentorship fosters professional growth and personal development. After the lecture, students engaged in a brief interactive discussion with a peer, reflecting on their experiences with mentorship (or lack thereof) and sharing their expectations for an effective mentor. This activity encouraged students to connect the theoretical aspects of mentorship with their personal contexts.

Subsequently, students were organized into 10 groups, each consisting of around four mentees from ECEGR 1200 and around two mentors from ECEGR 3110. These groups were tasked with engaging in two structured activities specifically designed to cultivate mentorship skills and promote meaningful dialogue among participants.

Activity 1: Academic Success and Time Management

Mentors and mentees arranged an in-person meeting to explore topics such as effective study habits, time management during exams, and strategies for preventing burnout. To help initiate the conversation, a set of guiding questions was provided; however, students were encouraged to personalize their discussions by introducing their own questions and topics of interest.

At the conclusion of this activity, mentees were tasked with writing a 300–500-word reflection detailing the insights they gained about academic success and how they intended to implement these strategies in their own studies. Similarly, mentors were asked to compose a 300–500-word reflection on how providing advice to their mentees reinforced their own study habits and what new perspectives or insights they had gained from the experience.

Activity 2: Career Exploration and Professional Skills

Each group participated in a Zoom session with two recent alumni, focusing on career pathways, essential professional skills, and the transition from college to the workforce. During these sessions, alumni offered valuable insights into overcoming challenges, building successful careers, and preparing for the realities of professional life.

Following the second activity, students were assigned a 600–1000-word reflection essay to summarize their mentoring experience with alumni. The assignment encouraged students to explore several key topics in their reflection: personal takeaways, such as the most valuable insights or advice they received; career and academic guidance, including specific recommendations about internships, career preparation, or coursework; skills and professional development, focusing on technical or professional skills to cultivate; new perspectives and inspiration regarding their future in engineering; and subsequent steps, highlighting any new goals or actions they planned to pursue as a result of the experience. This comprehensive reflection was designed to help students internalize what they learned and translate it into actionable growth.

The final step of the mentoring module was a post-survey, designed to evaluate changes in students' perceptions of mentorship and assess the overall effectiveness of the module. The survey gathered feedback on various aspects, including the module's impact on academic success, career preparation, and the overall mentoring experience, providing valuable insights for refining future iterations of the program.

Assessment and Observations:

Pre-survey:

In the pre-survey, students (n=65) were asked about the role of a mentor. Most students picked "helping mentees set and achieve goals", "share knowledge and experience", and "provide advice and guidance". Interestingly, fewer students thought that mentors are there to offer emotional support. Detailed results are shown in Figure 2.

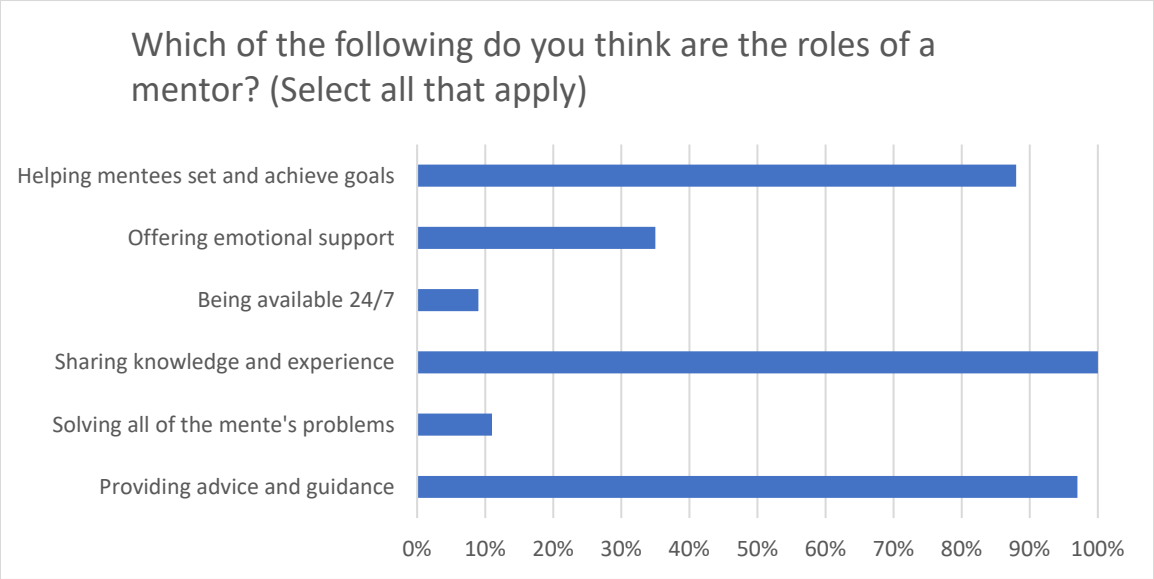

Figure 2. Pre-survey results: Roles of mentors.

When asked about the benefits of being a mentee (Figure 3), students accurately identified key advantages such as developing personal and professional skills, gaining access to resources and networks, and expanding their professional connections. However, surprisingly, 17% of students selected "avoiding all challenges and difficulties" and 29% chose "avoiding making mistakes," indicating some misconceptions about the role of mentorship. Moreover, students value the interpersonal, developmental, and networking aspects of being a mentor over more extrinsic rewards like recognition or status (Figure 4).

Overall, students demonstrated a strong understanding of mentorship principles. Only 3 students incorrectly believed that a mentor should have all the answers, while 62 correctly identified this as false. Similarly, just 2 students believed mentorship is solely helpful for academic success, with 63 recognizing its broader benefits.

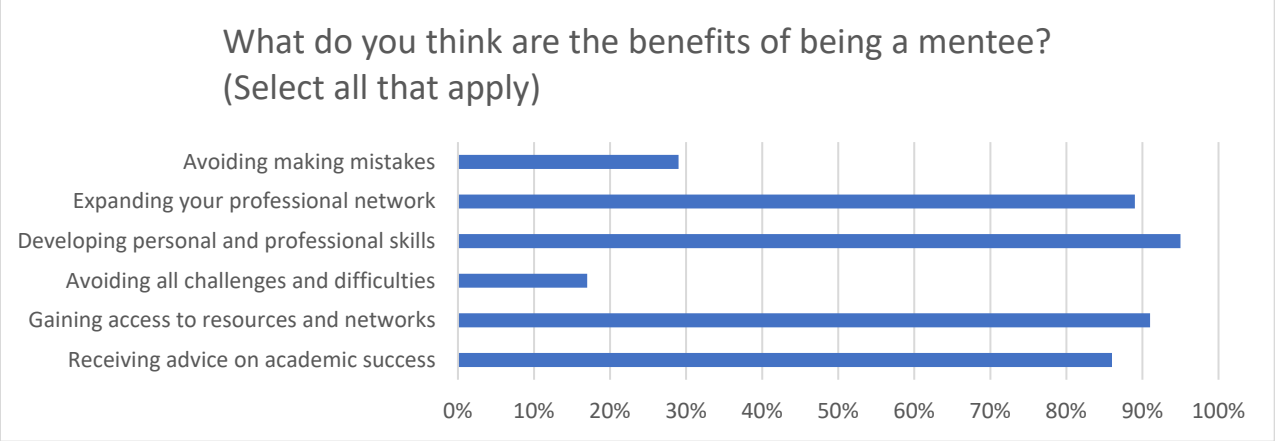

Figure 3. Student understanding of benefits of being a mentee.

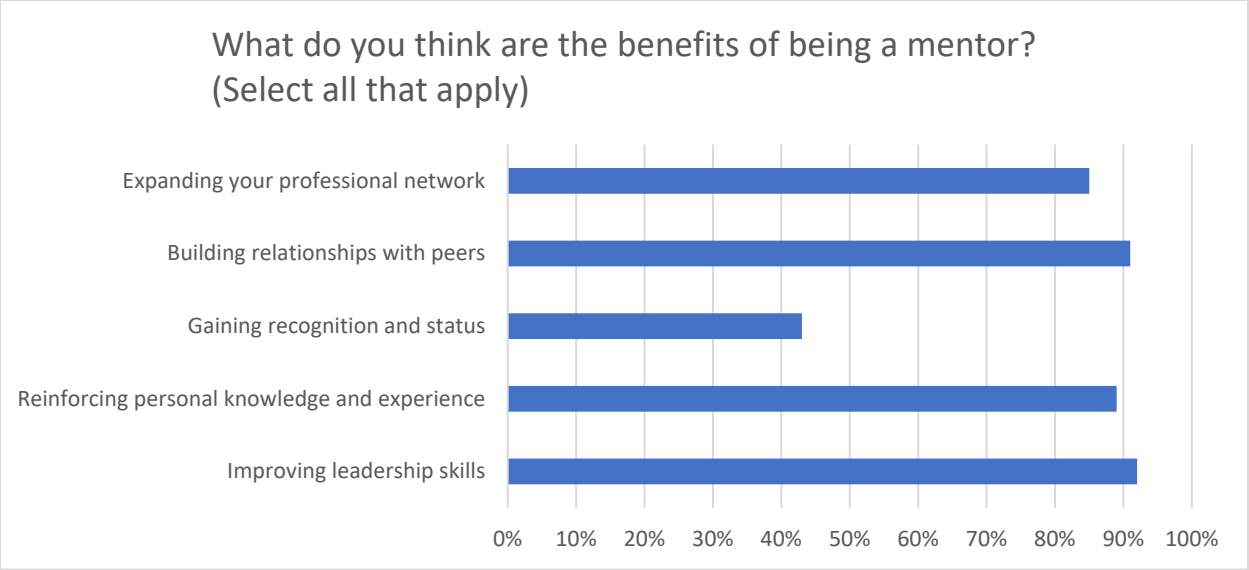

Figure 4. Benefits of being a mentor.

Regarding the mentee's role, 54 disagreed with the statement that a mentee must always follow the mentor's advice, while 11 agreed. A majority (63) correctly acknowledged that a successful mentoring relationship requires regular effort from both mentor and mentee, with only 2 disagreeing. Opinions were more divided on whether a mentor and mentee should have similar backgrounds, with 23 students agreeing and 41 disagreeing, suggesting a mix of perspectives on the importance of shared experiences in mentorship.

Only 35% of the students surveyed reported having prior experience with a mentor. Many of these students reported positive mentorship experiences, highlighting the value of open communication, emotional support, and practical guidance in their intellectual, emotional, and professional growth. Challenges included limited availability or engagement from mentors and less impactful outcomes from informal or irregular interactions. Successful mentorships were characterized by enthusiasm and mutual understanding between mentors and mentees. Students shared examples of mentorship ranging from family members, coaches, and academic advisors to professional mentors in the tech industry, with a focus on skill-building, career advice, and navigating challenges. Overall, the responses underscore the importance of clear communication, mutual commitment, and structured opportunities to maximize the benefits of mentorship.

Post-Survey:

Students were surveyed on the benefits they experienced through the mentorship module, with their responses summarized in Figure 5. The results reveal distinct advantages for participants in both ECEGR 1200 and ECEGR 3110. Career insights stood out as the most significant takeaway, with students across both classes valuing the guidance they received for their professional development. Increased confidence and motivation were also notable outcomes, reflecting the module's usefulness for empowering students and strengthening their academic and career trajectories. Leadership and mentoring skills were more prominently developed among ECEGR 3110 students, likely due to their dual role as mentors and mentees. While ECEGR 1200 students

showed stronger improvements in time management, the mentorship module successfully fostered meaningful connections and collaborative relationships across both groups. Overall, the module contributed to academic and professional growth, with its impact tailored to the students' unique roles and experiences.

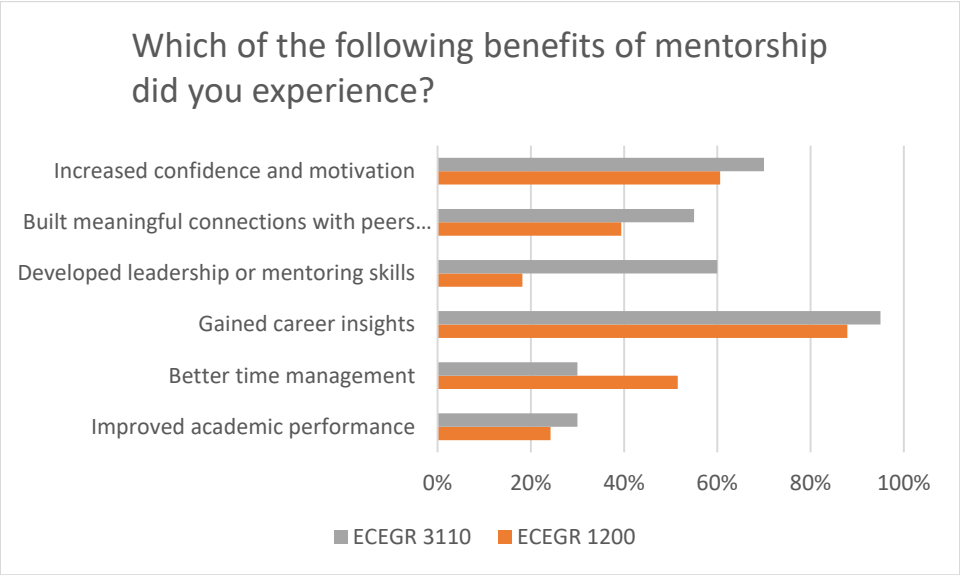

Figure 5. Perceived benefits of mentorship activities.

The survey results reveal that the mentorship sessions were most effective in supporting career preparation, particularly for ECEGR 3110 students, who found significant value in the professional guidance provided (Figure 6). Both groups also highlighted the module's role in fostering meaningful connections and enhancing interpersonal skills, with ECEGR 3110 students generally perceiving greater benefits than their ECEGR 1200 counterparts. However, the sessions were less effective in directly impacting academic success, suggesting the module's strengths lie more in professional and relational development rather than academic outcomes.

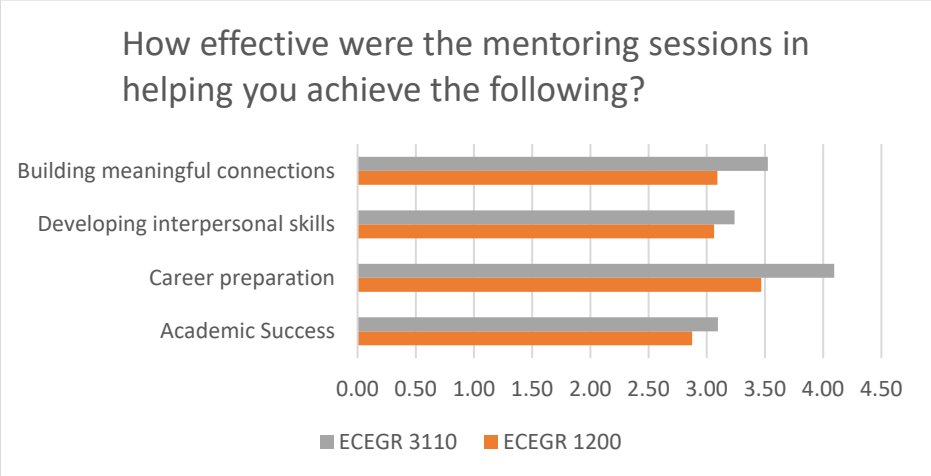

Figure 6. Effectiveness of mentoring sessions.

Eighty-five percent of students in ECEGR 1200 and 75% of students in ECEGR 3110 reported that the mentorship module met their expectations. Additionally, the interaction with alumni was highly valued, with 79% of ECEGR 1200 students and 90% of ECEGR 3110 students stating it enhanced their mentoring experience. Furthermore, 76% of ECEGR 1200 students and 75% of ECEGR 3110 students expressed interest in participating in future mentoring programs, indicating a strong overall engagement and appreciation for the module.

Challenges included a lack of engagement from some students, such as missing mentoring meetings or not actively participating in discussions with their mentees or mentors. These issues were further compounded by some scheduling difficulties, which added to the overall challenges of the program.

ECEGR 3111 (Laboratory I: Circuits): Teamwork and Conflict Resolution

Learning Objectives:

By the end of the module, students were expected to:

1) Understand the dynamics of effective teamwork and identify different roles within a team and their importance
2) Recognize common sources of conflict in team settings and apply conflict resolution strategies in practical scenarios
3) Develop skills for constructive communication and feedback

Content and Structure:

ECEGR 3111 is the first course in a three-quarter laboratory course series that progresses toward a final project. This course is required for both EE and CMPE majors. Students work in teams of two throughout the quarter. This module included

1) An in-class session on conflict-management styles followed by a quiz designed to gauge students' understanding of teamwork dynamics and conflict-resolution strategies.
2) A group activity on team building and conflict resolution, which involved various scenarios to provide teams with the opportunity to practice core team-building and conflict-resolution skills in an engaging manner. (Examples include scenarios in which tasks are incomplete, deadlines are being missed, the workload is unevenly distributed, and disagreements arise from miscommunication and clashing personalities. Teams were encouraged to use strategies discussed in class to identify best practices for resolving conflicts presented in these scenarios, and practice using them throughout the quarter.)

Assessment and Observations:

Towards the end of the fall quarter, a survey was conducted among students (n=21) to gather feedback on their experiences with the module and teamwork in general. A general theme that was observed was that all students expected creative freedom when working in a team. 85% of students reported that they had very few or no conflicts due to early introduction to best practices for teamwork in class. 15% of students reported that miscommunication and lack of time management were the two most common reasons for conflict. 90% of students specified that "open communication" and "effective work distribution" were the two most popular reasons for reduced conflict in their team. Students appreciated the scenario-based conflict-resolution class activity. Their feedback indicates that this activity helped them gain insight into various methods for solving team conflict and strengthening team bonds.

ECEGR 4640 (Internet of Things): Community-focused Communication

Learning Objectives:

By the end of the module, students were expected to:

1) Be able to apply IoT technology towards addressing a real-world problem

2) Collaborate and communicate with community partners to address specific challenges

Content and Structure:

ECEGR 4640 is a senior-level elective for both EE and CMPE majors. This module included

1) An in-class orientation to community-engaged learning by staff from the Sundborg Center for Community Engagement (CCE) at Seattle University, which included a discussion on best practices for effective community-focused communication.
2) A site visit to the community partner, Yes Farm, to help students gain contextual understanding of the partner's mission, goals, and challenges, serving as the first step towards developing a commitment to the partnership and establishing expectations.
3) A quarter-long team project using IoT technology to address specific challenges faced by the community partner, in which Team 1 was tasked with building a weather station that monitored temperature, humidity, and wind speed at the partner site and Team 2 was tasked with building a soil moisture+nutrient sensor system: Both systems were configured to be monitored remotely, with alerts sent to assigned personnel when condition thresholds were met. Design constraints included lack of access to a Wi-Fi network and electrical outlets.
4) A project proposal, final report, and final presentation from each team.
5) Two reflection assignments, one after the site visit and one at project completion.

Assessment and Observations:

Throughout the quarter, teams communicated with community-partner liaisons to better understand the goals of the project, the design constraints, and the desired outcomes. Since this

was the first introduction to community-engaged learning for all students in the class, special emphasis was placed on understanding that both students and the community partner derive meaningful value from their collaboration. Informal assessment of student interactions with community partners was done by observing the clarity of student questions, responsiveness to partner input, and the ability to synthesize ideas that prioritized needs of the community. Student reflections were rich and insightful, demonstrating deep appreciation for the opportunity for experiential learning, the uniqueness of which lies in its constraints, and which reflect the realities of the community.

At the end of the quarter, a survey was conducted among students (n=11) to gather feedback on their experiences with the community-engaged project. Of the respondents, 64% reported that the project had a significant impact on their perspective regarding the role of IoT in addressing real-world problems while 36% indicated it had a moderate influence. In response to the question, "How do you feel your project impacted the community or addressed its needs?" 27% of the students felt very positively about the impact of their project while 64% indicated that they felt somewhat positively. The project had a notable impact on students' understanding of IoT technologies and their applications, with 91% expressing that it significantly deepened their knowledge. The overall experience with the community-engaged IoT project was highly positive, with nearly half of the students describing it as excellent and the remaining students rating it as good. Among the technical and non-technical skills students developed during the project, the most commonly mentioned were time management, teamwork, budgeting, persistence, and field testing.

ECEGR 4750 (Machine Learning I): Professional Identity-Digital Portfolio

Learning Objectives:

By the end of the module, students were expected to:

1. Understand the importance of a digital portfolio in career development
2. Learn the basics of version-control systems and technical platforms for collaboration and development

Content and Structure:

ECEGR 4750 is a required course for CMPE majors and an elective for EE majors. This module included

1) An in-class session introducing the importance of a digital portfolio and the basics of building it.
2) An assignment that encouraged students to explore the Web to learn about *git*, *GitHub*, *GitLab*, *Kaggle*, and *HuggingFace*, select resources being provided to help them get started with their exploration: For example, students were asked to use an open-source git-learning game [6] or a *Hello, World* exercise [7] to learn *GitHub's* pull-request workflow. For each of the chosen tools, platforms, or services, students were asked to

describe the functionality, applications, advantages and disadvantages, alternatives, and definitions of common terms used such as push, pull, merge, fork, etc.

3) In-class exercises that required students to create a *GitHub* account and a *Linkedin* account and profile, if they did not already have one, along with tutorials on *LinkedIn* etiquette and best practices to organize repositories. (Additionally, students were encouraged to create a *teal* account to help modularize their résumé and help them tailor versions of it for job applications. Another exercise required students to work in teams of two to find and use models on *HuggingFace.*)

Observations:

Through the assignment and exercises, students demonstrated their understanding of the tools and techniques utilized in creating a digital portfolio. Students recognized the importance of giving proper credit to collaborators and acknowledging the use of open-source resources. Students also appreciated the opportunity to develop proficiency in the tools that were introduced, recognizing that such skills demonstrate technical aptitude and readiness to contribute effectively to projects in a professional setting.

ECEGR 4870 (Engineering Design I): Ethical and social critical thinking: Bias and Microaggression

Learning Objectives:

By the end of the module, students were expected to be able to:

1. Recognize unconscious bias and microaggressions and understand their impact on marginalized individuals and groups
2. Develop strategies to foster inclusive communication and team dynamics
3. Learn techniques for allyship and effective responses to bias or microaggressions

Content and Structure:

ECEGR 4870 is the first course in the three-quarter senior design sequence and is required for both EE and CMPE majors. The *Bias and Microaggression* module was designed as an interactive and reflective workshop for senior design students in our department. The module aimed to deepen students' understanding of diversity, equity, and inclusion (DEI) concepts while equipping them with tools to address bias and microaggressions in professional and academic settings. By fostering a culture of allyship and inclusivity, the module encouraged students to recognize their role in creating equitable environments in STEM fields [8].

The module began with a discussion-based lecture introducing key DEI concepts, including diversity, equity, and inclusion, unconscious bias, privilege, and microaggressions. The presentation highlighted the importance of diversity in STEM for innovation and problem-solving while providing real-world examples of how biases can lead to inequities, such as in hiring practices or product design.

Students were divided into small groups and assigned scenarios depicting instances of bias or microaggressions in professional or academic contexts. Each group analyzed a scenario, discussed possible responses, and shared their insights with the class. This exercise emphasized the importance of bystander intervention, the distinction between intent and impact, and strategies to create a more inclusive environment.

Students completed a written reflection that included three parts: personal experiences with bias or microaggressions, the role of allyship, and an action plan for supporting inclusivity in STEM. They researched initiatives promoting diversity in STEM and proposed specific steps to grow as allies, focusing on education and advocacy.

Assessment and Observations:

Surveys were conducted before the module and after its conclusion. A five-point Likert scale was used with two positive, one neutral, and two negative responses.

Table 2. Results from pre- and post-DEI-module surveys.

	Pre-Survey	Post-Survey
How familiar are you with the concept of DEI?	3.92	4.25
How important do you think DEI is to creating effective teamwork in STEM environments?	4.33	4.17
How familiar are you with the term microaggressions?	3.67	4.42
How confident are you in identifying microaggressions in team interactions?	3.00	3.83
How familiar are you with the concept of implicit bias?	3.67	4.25
To what extent do you believe that implicit bias can influence teamwork and decision making in STEM settings?	4.08	4.08
How familiar are you with the term bystander intervention?	3.36	4.42
Do you believe that DEI training and education can improve team dynamics and productivity in STEM?	4.08	3.92

The survey results indicate that the *Bias and Microaggression* module had a significant impact on students' familiarity with key concepts and their confidence in applying them, as shown in Table 2. Familiarity with terms like "DEI," "microaggressions," "implicit bias," and "bystander intervention" showed notable increases, with "microaggressions" and "bystander intervention" experiencing the largest gains (0.75 and 1.06 points, respectively). Confidence in identifying microaggressions in team interactions also improved significantly, rising from 3.00 to 3.83. However, the belief that implicit bias can influence teamwork and decision making in STEM settings remained consistent. Interestingly, perceptions of DEI's importance in creating effective teamwork and the belief in the value of DEI training for improving team dynamics both saw a slight decline in the post-survey. These changes suggest a possible shift in students' perspectives on the practical application of DEI concepts, even as their understanding and awareness of these topics increased.

ECEGR 4870 (Engineering Design I): Social Responsibility

Learning Objectives:

By the end of the module, students were expected to:

1) Understand the implications of the IEEE Code of Ethics

2) Consider the societal and environmental aspects of design

Content and Structure:

ECEGR 4870 is the first course in the three-quarter senior design sequence and is required for both EE and CMPE majors. This module included

1) Two lecture sessions on engineering ethics and the unintended consequences of technology, and related readings.
2) A Canvas discussion assignment in which students were asked to identify and summarize one recent example of an unintended or unanticipated consequence of technology.
3) An in-class activity session in which each design team was assigned a realistic scenario involving a professional ethical dilemma. Teams were encouraged to explore various perspectives and potential courses of action, informed by relevant codes of ethics. This was followed by an engaging discussion, with teams sharing their insights and observations.
4) A case study assignment in which students were asked to discuss global, economic, environmental and societal impacts of an engineering decision, and their professional and personal ethical responsibilities.

Assessment and Observations:

Upon completion of the module, students were surveyed (n=12) on their understanding of social responsibility and engineering ethics. Of the respondents, 25% reported that the module and corresponding activities significantly enhanced their understanding of engineers' social responsibilities, while 67% felt it somewhat improved their understanding. Approximately 20% of respondents reported feeling very aware of the unintended consequences that technology can have on society and the environment after the session, while 80% felt somewhat aware. The majority of respondents (89%) indicated they are very likely to apply ethical principles when making decisions in their future engineering careers, while 11% stated they are somewhat likely. Most respondents (73%) reported feeling somewhat confident about identifying ethical issues in engineering projects, while 27% expressed feeling very confident. Students recognized the complexity of ethical dilemmas and emphasized the responsibility of engineers to thoughtfully consider design choices and their broader impacts.

Conclusions

This pilot study marks an important step in Seattle University's Electrical and Computer Engineering (ECE) department's efforts to align technical preparation with its mission-driven values of justice, sustainability, and social responsibility. By integrating purposefully designed modules across the undergraduate curriculum, the department has demonstrated that themes such as climate change, racial and economic justice, and community engagement can be meaningfully embedded alongside traditional engineering content.

The implementation of these modules provided students with opportunities to engage with topics related to global challenges that are increasingly vital in today's complex engineering landscape. Assessment data indicates that students not only met the intended learning outcomes but also expressed appreciation for the opportunity to connect their technical education with broader societal issues.

Faculty engaged in the design and implementation of these modules shared challenges they faced, particularly around integrating them into existing course schedules and the substantial time and effort required for their development. The hope is that, once created, these modules can be reused or adapted in future iterations, thereby reducing the burden on instructors over time.

Future Work

Looking forward to winter and spring quarters for the pilot implementation year, modules are being designed for four courses as shown below.

ECEGR 2100 (Electrical Circuits I): Ethical and Social Critical Thinking-Bias and Microaggression

This course is required for both EE and CMPE majors. This module will be similar to the one designed for ECEGR 4870, to reinforce these important concepts in both the sophomore and senior years. This redundancy also helps transfer students who take ECEGR 2100 at another institution. We believe that students should be empowered to recognize their role in creating and fostering equitable environments as early as possible in their academic journey.

ECEGR 3120 (Semiconductor Devices and Circuits): Sustainable Design for Semiconductor Devices

This course is required for both EE and CMPE majors. This module will focus on rare and dangerous materials being used in semiconductor fabrication, with the goal of helping students understand the broader economic, environmental, and societal implications of semiconductor technology. This module will include topics related to sustainability, environmental justice, and ethical supply chain management.

ECEGR 3500 (Electrical Energy Systems) Sustainable Development Goals and Energy Access

This course is required for EE majors and an elective for CMPE majors. Two modules are being designed for this course: 1) A module that aims to provide students with a comprehensive understanding of Sustainable Development Goal 7: Affordable and Clean Energy. It will cover the importance of universal access to energy, the role of renewable energy sources, and strategies for promoting sustainable energy solutions. 2) A module that focuses on injustice and inequity in access to energy. Students will be introduced to energy poverty and its influence on human development.

ECEGR 3710 (Signals and Systems): Professional Continual Learning

This course is required for both EE and CMPE majors. This module aims to prepare students for lifelong professional growth by introducing key pathways for continual learning and career advancement. Students will explore the Fundamentals of Engineering (FE) exam as a stepping stone toward professional licensure, the benefits of graduate education, and professional certifications to enhance expertise and competitiveness in the workforce.

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