IUSE/RED: Adaptation of Design Thinking and Sociotechnical Modules in Electrical Engineering to Advance the Professional Development of Students at an HSI

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Since 1997, Eileen has worked in higher education as a classroom instructor, curriculum designer, and faculty pedagogy coordinator. She spent five years as director of a university writing program before becoming the Executive Director of Student Academic Success Services. Currently based at the University of California at Merced, Eileen serves as senior faculty associate in the Center for Engaged Teaching and Learning and as a teaching professor in the Interdisciplinary Humanities Graduate Group and The Global Arts, Media, and Writing Studies Department. Her work focuses on student and faculty agency and self-efficacy development as well as burnout resistance. She also leads a research group dedicated to exploring strategies for developing student resilience in the face of compounding adversities. Her recent book Joy-Centered Pedagogy in Higher Education: Uplifting Teaching & Learning for All (Routledge Press, 2025) argues that joy—rooted in curiosity, connection, and creativity—provides a powerful framework for both explaining the effectiveness of pedagogical strategies and for guiding educators through academic obstacles.

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Susan Lord is Professor and Chair of Integrated Engineering at the University of San Diego. She received a BS from Cornell University in Materials Science and Electrical Engineering (EE) and MS and PhD in EE from Stanford University. Her research focuses on the study and promotion of equity in engineering including student pathways and inclusive teaching. She has won best paper awards from the Journal of Engineering Education, IEEE Transactions on Education, and Education Sciences. Dr. Lord is a Fellow of the IEEE and ASEE and received the 2018 IEEE Undergraduate Teaching Award. She is a coauthor of The Borderlands of Education: Latinas in Engineering. She is a co-Director of the National Effective Teaching Institute (NETI).

Dr. Diane T. Rover, Iowa State University of Science and Technology

Diane Rover holds the title of University Professor of Electrical and Computer Engineering at Iowa State University (ISU). She also currently serves as the alliance director for the NSF Iowa, Illinois, Nebraska IINSPIRE LSAMP (Louis Stokes Alliance for Minority Participation), co-leads projects in the department funded by NSF Revolutionizing Engineering Departments (RED) and Scholarships in STEM (S-STEM) programs, and is a co-PI of the NSF Center for Advancing Research Impact in Society led by the University of Missouri. Her teaching and research have focused on engineering education, high impact educational practices, inclusive educational practices, broader impacts of research, embedded computer systems, system level design, parallel and distributed systems, and performance analysis. Dr. Rover began her academic career at Michigan State University and has served in department and college administrative positions at MSU and ISU, including associate dean of engineering. She has engaged with

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Sarah Kurtz obtained her PhD in 1985 from Harvard University and is now a Distinguished Professor at the University of California Merced after more than 30 years working at the National Renewable Energy Laboratory, in Golden, CO. She is known for her contributions to developing multijunction, GaInP/GaAs solar cells, supporting the Concentrator Photovoltaic (PV) industry, and leading efforts on PV performance and reliability. Her work has been recognized with a jointly received Dan David Prize in 2007, the Cherry Award in 2012, C3E Lifetime Achievement Award in 2016, and induction into the National Academy of Engineering in 2020. At the University of California Merced she is working both to help the university grow and to support the Energy Transition by studying long-duration energy storage, monitoring of perovskite/silicon tandem modules, and starting a new study on agrivoltaics to help California sustain its agriculture with reduced water consumption while continuing to add more solar.

IUSE/RED Year 1: Adaptation of Design Thinking and Sociotechnical Modules in Electrical Engineering to Advance the Professional Development of Students

1 Introduction

This work-in-progress paper discusses the results from Year 1 of NSF/IUSE: RED Adaptation and Implementation (A&I) grant at the University of California Merced (UC Merced). The Electrical Engineering (EE) Department at this university is working towards revolutionizing the departmental culture to advance the professional development of students who graduate from the program. To achieve this, we are adapting strategies from two past successful projects: (1) design-thinking based course redesign culture from the Iowa State University of Science and Technology, and (2) integration of sociotechnical modules in engineering from the University of San Diego.

1.1 Motivation and Background

Context: UC Merced is a new public, Carnegie R1 university in USA. The university was established to serve the local population and advance the professional formation of the students from this region. Table 1 presents recent demographic data for UC Merced, compared alongside Iowa State University and University of San Diego. The difference in demographics forms the basis for our adaptation and implementation activities. The primary goal of our RED A&I grant is to adapt successful strategies to our context and generate new knowledge on this adaptation process so that other universities can also adapt these strategies in the future. To provide department-specific context, the table also compares the university-wide demographics with the undergraduate electrical engineering population.

2 Project Overview

The current curriculum is fairly traditional for EE and designed to meet ABET requirements [5]. We have observed that our current curriculum paired with traditional pedagogy has proven unsuccessful in meeting the needs of URM students because of gaps in prior high school preparation, low self-efficacy, fixed mindsets, and impostor syndrome. This is consistent with the research on URMs in engineering and STEM [6, 7]. Towards addressing these issues, in this project, we specifically focus on the middle years of the curriculum (Lord and Chen 2014). We have targeted interventions in two courses: (1) Introduction to EE Programming (sophomore year course), and (2) Semiconductor Devices (junior year course). We chose these courses because they are taught by team members and are courses that all students will enroll in. In both courses, we will adapt and implement strategies from both Iowa State and University of San Diego with the following project goals:

Table 1: Fall 2025 demographics at UC Merced compared with those for previous RED studies

Classification	**Student categories**	**UC Merced: ALL**	**UC Merced: EE**	**Iowa State**	**Univ of San Diego**
Student demographics	Women	42%	4%	44%	56%
	URM	61%	67%	10%	33%
	Pell Eligible	60%	71%	-	-
	First Generation	62%	70%	-	-
Student ethnicity/race	Hispanic	56%	61%	7.7%	24%
	African American	5%	6%	2.6%	4.7%
	American Indian	0.1%	0%	0.1%	0.1%
	Asian	23%	20%	4.3%	7.1%
	White	9%	9%	75.7%	42.1%
	Others	7%	1%	10%	17.6%

[2] Data sourced from institutional research databases [1, 2, 3, 4].

1. Create cross-disciplinary faculty teams that work collaboratively to deliver a curriculum that advances electrical engineers' formation.
2. Develop regional-context-driven socio-technical modules in two courses: Introduction to EE Programming and Semiconductor Devices.
3. Generate knowledge to demonstrate the value of the cultural change so that the EE faculty embrace the cultural change leading to broader modification of the EE curriculum.
4. Generate knowledge on how a culture of EE can be defined, as similar new programs are established by modeling the theory of change of organizational culture.
5. Establish a robust student-centered and authentic process of continuous improvement that replaces the current culture of performative self-study and accreditation.

Pedagogical impact:

1. Generate new knowledge on adaptation of cultural change theories and faculty development from PWIs to HSIs.
2. Map the EE curriculum to the skills that we expect students to develop.
3. Maintain pedagogical sustainability as instructors change over time to minimize learning loss.

3 Project Team

The team is led by the department chair who has 30+ years of research and leadership experience. The team is well-supported by prior RED awardees in the advisory board (see Table 2).

Table 2: Project team members and advisory board

Individual	Title, Institution	Experience	Role / Meetings
Sarah Kurtz (PI)	Professor and Department Chair at UC Merced	30+ years of research and leadership experience	PI and project leader
Ayush Pandey (Co-PI)	Assistant Professor at UC Merced	Early career faculty	Course redesign and lead project activities
Eileen K Camfield (Co-PI)	Professor and Senior Faculty Associate at Center for Engaged Teaching and Learning at UC Merced	20+ years of education research and faculty development expert	Lead faculty development workshops and education research
Susan M Lord (Project Advisor)	Professor and Department Chair at University of San Diego	Past RED awardee	Meet with the project team 4x in 1st year; 2x in years 2-5
Ashfaq Khokhar (Project Advisor)	Professor and Department Chair at Iowa State University	Past RED awardee	
Diane T Rover (Project Advisor)	Professor at Iowa State University	Past RED awardee	
Linda Sheehan	Assessment Analyst at UC Merced	Education research evaluator for 10+ years	Will meet with team as needed
Ten individuals	Advisory Board of UC Merced EE program	Industry, research, teaching	Annual

4 Activities and Results

We have organized several activities in Year 1 (AY 2025-26) of our grant. We discuss the results from these activities in this section.

4.1 Advisory board meetings

To lay the groundwork of adaptation from past RED projects, we met with the RED advisory board (see Table 2) on Zoom for a pre-kickoff meeting. In this meeting, we identified specific items that must be discussed in detail to successfully adapt past RED strategies in our new context. These items were then discussed during the project kickoff meeting in-person at UC Merced that followed 6 weeks after the pre-kickoff. For this in-person meeting, the project advisors traveled to UC Merced. In a full-day workshop, the advisors shared resources from their project activities, their results of the interventions, and the sustained revolutionized culture at Iowa State and University of San Diego. For the adaptation process, the project team gained a better understanding of how to implement design-thinking based course redesign [8, 9, 10] and how to integrate sociotechnical modules in electrical engineering [11, 12, 13] suited for the specific context of UC

Merced. This meeting was also the first introduction of the RED A&I grant to the rest of the EE department faculty at UC Merced at lunch. During this hour, the project team presented the goals and highlighted the opportunities that the department has with this new grant, the incentives for faculty to participate in various project activities, and faculty development workshops.

Outcome The team discussed the development of student personas [14] to specifically capture the institutional context from the student point of view. To better understand the sociotechnical context of UC Merced, the team identified the important role of a local expert on Latinx studies and the importance of including industry professionals. The team has successfully identified a professional from a national lab and an industry professional (from department advisory board, see Table 2; last row) to participate in the course redesign process planned for AY 2026-27. Additionally, to facilitate the design-thinking process among the EE faculty, the team has received mentoring support from the REDPAR Community of Practice [15] to invite the design thinking expert from Iowa State University to facilitate the process.

4.2 Baseline Departmental Culture

We learned about the baseline departmental culture by adapting a previously published faculty culture evaluation survey instrument [16]. The fully anonymous survey was administered using Qualtrics and no identifiable information was collected from the faculty. Out of 7 total faculty members in the department, we received 6 responses. The results of this survey are shown in Table 3. This survey is designed to help us understand where we are starting in order to measure change and also to identify where we may have the most room for improvement. We observe that all faculty who responded to the survey strongly agreed with "Teaching effectively is important to me." It is surprising that not every faculty member felt that there are competing priorities that limit the time available for teaching, as faculty burden is a commonly understood problem. We note that the most room for improvement is on understanding how the department may not be willing to change and why only half of the faculty felt that their efforts were appreciated/fairly rewarded.

4.3 Department's Visions and Values Workshop

The faculty development expert, Co-PI on the grant, organized a "Vision and Values" workshop for all faculty in the EE department to establish a shared foundational purpose, with the goal of facilitating change management and mitigating future conflict. This strategy is adapted from similar efforts at other campuses and institutions [17, 18]. In this workshop, the faculty learned about the cognitive processes involved in learning and the importance of creating a classroom climate that welcomes students, one where students can trust the faculty, and the faculty can effectively nurture curiosity among students to enhance long-term deep learning [19, 20, 21].

Outcome: The main outcome is the following vision and values statement for the department that the faculty collaborated on during the workshop:

"We value a learning environment where students feel curious, confident, and emotionally prepared to grow — supported by belonging, trust, and openness. We strive to cultivate thinkers who en-

Table 3: Baseline departmental culture survey results

Question	SD	D	N	A	SA	Total
A. Teaching effectively is important for me.	0	0	0	0	6	6
B. I have competing priorities (such as research, mentoring, and service) that restrict my time commitment to teaching in the department.	0	1	2	2	1	6
C. In my teaching practice, I believe that I am capable of responding to the needs of the students at UC Merced and their backgrounds.	0	0	1	3	2	6
D. I am confident in my ability to adapt and innovate my teaching to improve the learning outcomes of EE students in the department.	0	0	1	2	3	6
E. The EE department is committed and ready to make changes that improve student outcomes.	0	1	0	3	2	6
F. My teaching efforts are recognized and rewarded fairly in the EE department.	1	1	1	2	1	6

Response options: SD = Strongly Disagree, D = Disagree, N = Neutral, A = Agree, SA = Strongly Agree.

gage actively, question critically, and approach challenges with creativity, systems awareness, and solutions-oriented reasoning blending both hardware and software perspectives with strong logical and mathematical foundations. We empower students to act with purpose by communicating effectively, connecting ideas, and confidently "figuring things out" through building, testing, and experimentation. Our values guide students to transform short-term learning into lasting understanding, prepare thoughtfully for their futures, and conduct themselves with ethical responsibility and professional integrity."

5 Next Steps

We have identified several next steps in this project. First, we are assembling a team of faculty members, institutional context experts, industry professionals, and a design thinking facilitator, that will start redesign of "Introduction to EE Programming," specifically looking at how AI is impacting the teaching and learning in a computer programming class. We will also create hypothetical personas of students who are in our program to better understand where the students are coming from, their needs, and expectations.

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