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The Initial Condition: Faculty Perspectives at the Beginning of a Department Change Effort

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Abstract

The Cal Poly Computer Engineering department is engaged in a process to create a more inclusive and diverse culture for students and faculty through an NSF funded RED grant called "Breaking the Binary". Our goal is to empower students and faculty to identify barriers to inclusion, and to build an environment where such structures can be dismantled so students can thrive. As part of this work, it is important to understand current faculty attitudes around the department climate and culture, and faculty knowledge of inclusive pedagogical practice and curricular design. Such knowledge will allow us to better guide our change efforts going forward. The work described here explores these current or baseline faculty attitudes as captured by a survey sent to both department and college of engineering faculty members.

The survey includes validated instruments on culturally responsive teaching, department climate and culture, psychological safety, climate for innovation, and feelings of community as it relates to the goals and activities of the department transformation project, and perspectives, specifically from computer engineering department faculty, on their personal alignment with and commitment to the department vision, perceived and anticipated barriers to departmental transformation, and current priorities within the context of the project goals. This survey is part of a larger mixed method approach to record the initial state at the start of the department transformation.

This paper analyzes faculty responses collected across the college of engineering to identify how faculty knowledge and attitudes differ and which departments we may learn from during our transformation process.

Introduction

Many of our students encounter and are constrained by normative social constructions and systems of oppression of gender, race, and socio-economic class. They are aware that many departments are white-, straight-, and male-centered, controlling who is welcome, or even permitted entry. As described in the literature [1] [2][3][4], our students experience tensions between engineering contexts and their gender, race/ethnicity, sexual orientation, and socioeconomic background. Camacho and Lord use the "borderlands of education" as a metaphor for studying this interplay between intersectionality and systemic exclusion [2].

Simply increasing the numbers of people from any underrepresented and/or minoritized group in a department will not guarantee increased participation or belongingness, as numbers and percentages do not expose and address the cultural norms that promote marginalization and exclusion of certain groups [5], [6], [7]. Change requires more than targeted percentages [8]. We must be prepared to examine climate, pedagogy, and subject matter. For example, Margolis and

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Fisher identified significant gender differences in major selection for male- and female-identified students in computing based on individuals' attention to "computing with a purpose" [9]. However, it is important that we recall Slaton's cautions against the operation of essentialism within this approach to diversity and inclusion and not predicate calls for change on a "natural difference" in approaches to engineering, rather we call for a change in values for liberation [10].

Our department is at the beginning of a multi-year journey of transformational change. We are engaging faculty, staff, and students in a substantial process of collaborative transformation that involves rejecting binaries or dualisms commonly used to create hierarchies in engineering thought and practice (rational-emotional, male-female, social-technical, mental-manual, hard-soft, concrete-abstract, etc.) and embracing a complex coexistence [11]; developing new skills in co-creation of holistic learning experiences and inclusive cultures; and evolving personal and professional identities that are constantly challenged and often in flux.

Our transformation is guided by the following vision. Members of the Computer Engineering department at Cal Poly, San Luis Obispo co-created this vision to guide our department transformation. While the level of engagement during this co-creation process varied across the department, the majority of faculty and staff played a significant role in writing, reviewing, and modifying it.

- We envision diversity in race, gender, sexuality, ability, class, and other social identities (in all their combinations) that transcends current institutional structures.
- We envision a place in which all find community, where there are support structures that connect students with their peers, that provide mentoring between faculty and students, and promote collaborative work between faculty.
- We envision a place where if one encounters an unjust or arbitrary barrier, it is the system that yields. We acknowledge the immense cultural wealth [12] people bring with them to Computer Engineering and will strive to act in a manner to ensure that that wealth is valued and celebrated.
- We envision a place where all understand and value Computer Engineering being more than a sum of the traditional fields from which it grew. We envision a place that has insight into societal needs and is agile to adapt to address those needs from a critical theory orientation [12], [13], [14], [15], [16].
- We envision a place where industry continues to seek to hire our students. They value our students' technical expertise and, of equal importance, our students' diversity in body and voice, ability to negotiate complexity and ambiguity, and capacity and inclination for change. We envision greater numbers of graduates pursuing graduate school and working in non-profits and educational organizations.
- We envision a place where each of us can say, "I belong here." We aspire to create a space grounded in equity, compassion, and empowerment.

We have three broad, aspirational goals for our project to achieve our vision: 1. enhance critical consciousness and expand group capacity by engaging participants with key theories and praxis and educating faculty, students, and staff through reflective dialogue and workshops; 2. interrupt structures that inhibit action by deepening relationships and healing from oppression; 3. dismantle and reimagine by uncovering and repairing disparities caused by policies and

procedures, identifying and understanding structures of oppression within, impacting, and impacted by our department, and co-creating alternatives.

We are interested in how students, faculty, and staff navigate and respond to the process of transformation – transformation of a revolutionary nature that results in changes of kind rather than changes of degree [17]. This paper describes our starting point from a mostly quantitative perspective (*the initial condition*) through a baseline survey as we begin to do the work.

We ask the research questions:
R1. As we engage in our transformation process will the department culture reject binaries that commonly create hierarchies in engineering thought and practice, and embrace a culture that is holistic and integrated?

a) *characterize the current state of the departmental culture with regard to endorsement or rejection of historical binaries in engineering,*
b) *describe the systemic conditions and processes that build capacity for students, staff, and faculty to co-create revolutionary change*,
c) *examine how the culture shifts over time.*

R2. To what extent does our change model help students, staff, and faculty navigate, respond to, and engage in critical organizational change?

R3. What are the impacts of a holistic environment on individual growth and social cohesion?

To describe faculty members' basic assumptions and the ways in which these assumptions manifest as observable aspects of curricula and pedagogy, we find it useful to frame curricular change as *culture change* [18], [19]. We draw upon Schein's definition of culture, which depicts culture as operating on three levels: (a) *artifacts – visible phenomena* including physical space, published goals, activities, and observed behaviors; (b) *espoused beliefs and values – ideals, aspirations,* including articulations of why a group does what it does; and (c) *basic underlying assumptions – unconscious, taken-for-granted beliefs and values* that shape behavior, perception, thought, and feeling [20]. Schein describes how an *individual* can be understood as a cultural entity, embodying all three levels of culture. As such, we can apply Schein's framework to educational change initiatives on multiple levels: the individual changemaker, our team of changemakers, and the institution in which our change effort takes place.

We expect quantitative surveying to yield a wide range of characterizations of faculty and students' educational beliefs and values, professional identities, sense of community and belonging, empathy, motivations, and perceptions of the departmental culture. Deployment of the survey measures throughout the project will allow for illustration of the change trajectories of individuals and groups, linking of significant conceptual shifts with specific experiences, and assessment of temporally dynamic versus stable responses to the ongoing change process. Collection and analysis of qualitative data in the form of observations, course artifacts, interviews, and self-reflections will enable construction of rich personal change narratives – stories that will elucidate how individuals approach, interpret, and navigate the proposed departmental changes; reveal where individuals find consonance or dissonance with the new ideas and approaches; how individuals and group manages areas of agreement and difference; how and where and how the

department community develops a shared sense of values, identity, and beliefs about themselves, engineering education, and the world.

Methods

In the fall of 2023, with Institutional Review Board approval, we invited all engineering and computing faculty to complete our online baseline survey. The purpose of this survey was to collect baseline information to inform project planning and to establish a reference point against which to measure change over time as a result of the project. The survey explored faculty perspectives on Culturally Responsive Teaching Practice (developed by our external evaluator consultant), Psychological Safety [21], Climate for Innovation [22], and Departmental Community [23]. In addition, faculty within the Computer Engineering department were asked to share their perspectives on the department's vision that outlines aspirations for the transformational undertaking.

Data were retained for analysis if respondents completed at least one of the scales in full. Twenty-one (21) responses were removed from the analysis because they did not meet this criterion. Seventy-three (73) out of 288 faculty members in the College of Engineering at Cal Poly, SLO completed the college baseline survey at the beginning of the Fall 2023 semester (Table 1), representing an average response rate of 25%. The response rate by department is shown in Table 1.

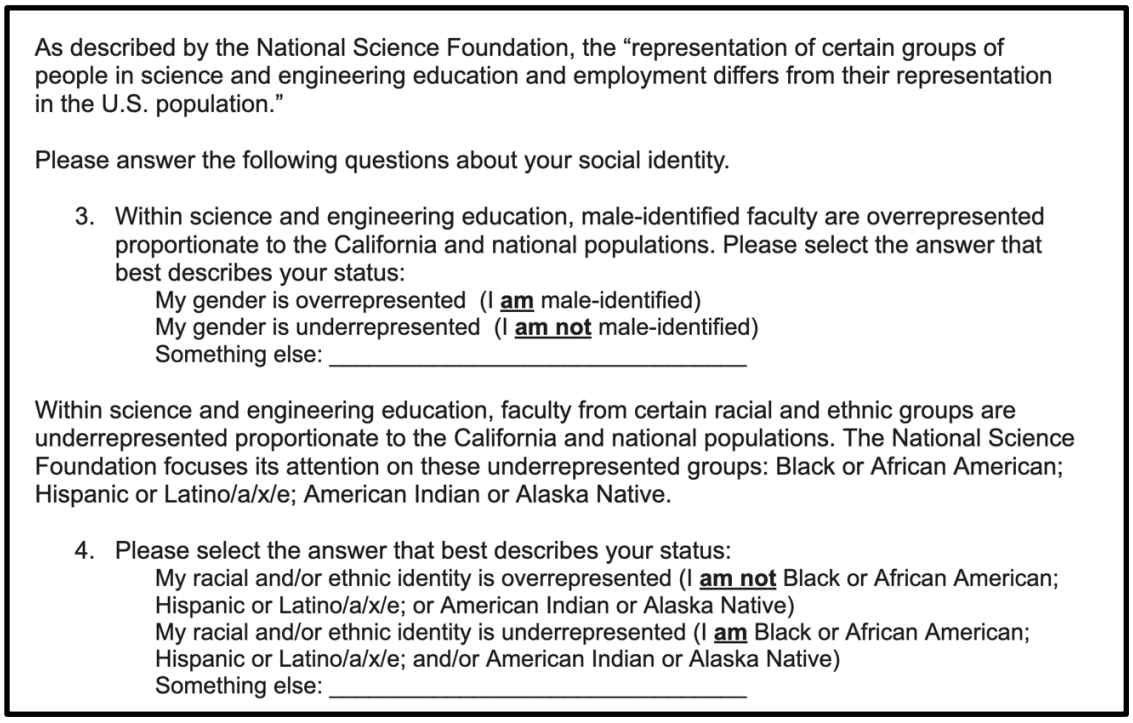
Table 1. Response rate by department.

Department	**Response Rate (%)**
Aerospace Engineering	14%
Biomedical Engineering	16%
Civil & Environmental Engineering	14%
Computer Engineering	63%
Computer Science & Software Engineering	27%
Electrical Engineering	11%
Industrial & Manufacturing Engineering	19%
Materials Engineering	44%
Mechanical Engineering	25%
Average Response Rate	**25%**

The baseline survey analyses explored change for the full population and examined differences by subgroups including the faculty characteristics listed below. No significant differences were found across the first four. Department comparisons could not be computed due to insufficient sample sizes for many of the departments.

- Gender
- Ethnicity, including membership in a historically marginalized group
- Faculty Position (Lecturer, Tenure-line, Early retirement)
- Number of years as a faculty member at the institution
- Discipline department

Questions on faculty position and number of years of service were defined by ranges to minimize the likelihood of identifying any individual participant based on their responses. Participants were asked to respond to whether their gender (or separately ethnicity) was overrepresented, underrepresented, or something else compared to how their gender (or separately ethnicity) is represented with respect to our state and national populations (see Figure1 for the exact wording of this question).


As described by the National Science Foundation, the "representation of certain groups of people in science and engineering education and employment differs from their representation in the U.S. population."

Please answer the following questions about your social identity.

3. Within science and engineering education, male-identified faculty are overrepresented proportionate to the California and national populations. Please select the answer that best describes your status:
   My gender is overrepresented (I **am** male-identified)
   My gender is underrepresented (I **am not** male-identified)
   Something else: _____

Within science and engineering education, faculty from certain racial and ethnic groups are underrepresented proportionate to the California and national populations. The National Science Foundation focuses its attention on these underrepresented groups: Black or African American; Hispanic or Latino/a/x/e; American Indian or Alaska Native.

4. Please select the answer that best describes your status:
   My racial and/or ethnic identity is overrepresented (I **am not** Black or African American; Hispanic or Latino/a/x/e; or American Indian or Alaska Native)
   My racial and/or ethnic identity is underrepresented (I **am** Black or African American; Hispanic or Latino/a/x/e; and/or American Indian or Alaska Native)
   Something else: _____

Figure 1: Demographic questions

Demographics

Table 2 summarizes the respondents' demographics. Among those that shared demographic information 65% identified as male-identified, 90% reported that their ethnicity was overrepresented[2], and 74% occupied a tenure-line role. The majority (60%) of respondents were faculty members at our institution for longer than 11 years.

Faculty were also provided the opportunity to share additional aspects of their identity as it related to over/under representation amongst science and engineering faculty. Three faculty described themselves as Queer or LGBTQ and eight faculty provided additional comments (not shared here to prevent unintended disclosure of their identities).

[2] The National Science Foundation focuses its attention on these underrepresented groups: Black or African American; Hispanic or Latino/a/x/e; American Indian or Alaska Native

Table 2. Respondent Demographic Characteristics (n = 62-66)*

Gender	Overrepresented	65%
	Underrepresented	27%
	Something else[1]	8%
Ethnicity	Overrepresented	90%
	Underrepresented	3%
	Something else[1]	7%
Role	Lecturer	26%
	Tenure-Line	72%
	Early retirement[3]	2%
Years as a Faculty Member	1-5 years	20%
	6-10 years	20%
	11+ years	60%

* Due to rounding, rows may not total 100%

[1] The individuals who chose these options declined to provide further details

Reliability Analysis & Descriptives

The four survey scales were subjected to reliability analysis using Cronbach's alpha to examine their internal consistency. The alpha values reported in Table 3 indicate that most scales have good internal consistency ($\alpha = 0.90 – 0.96$). Overall, these findings indicate that the scales are reliable.

Higher scores represent more positive outcomes. With mean scores ranging from 3.24 to 3.88 (out of a possible 5.00), these results suggest that there is significant room for growth in the areas of interest to the transformation project.

Table 3. Descriptives and Cronbach's alpha Statistics

Scale (Likert: 1 low to 5 high)	**Number of Items used from validated survey**	**Mean**	**Standard Deviation**	**α**
Culturally Responsive Teaching Efficacy	14	3.24	0.82	0.90
Psychology Safety	7	3.69	0.98	0.90
Climate for Innovation	22	3.28	0.73	0.92
Department Community	9	3.88	1.02	0.96

[3] This is faculty participating in our early retirement program but still teaching and engaged with departments.

Results

As mentioned, the survey included four scales to measure faculty's perspectives on various topics related to STEM education. Response frequencies for each scale are provided. Percentages reflect the sub-sample of participants who provided responses for each question.

Culturally Responsive Teaching

Engineering faculty reported their confidence levels with implementing culturally responsive teaching (Figure 2). Overall, the results show that faculty members have mixed feelings about their ability to implement culturally responsive teaching strategies. The variability in scores (Mean = 3.24; SD = 0.82) could potentially be explained by the diverse experiences faculty members have in implementing culturally responsive teaching practices with some having previous exposure to such practices, while others may not have encountered the integration of such topics in STEM courses).

Specifically, faculty members were most confident in their ability to connect with students in meaningful ways (66%)[4], consider how their identity and biases affect their teaching and relationships with students (56%) and engage in their own reflective practices (55%). They exhibited lower levels of confidence in building awareness of their implicit and unconscious biases (52%), adapting instruction to meet the needs of specific students (52%) or implementing equitable assessment practices (50%). More than a third of faculty lacked enough confidence to implement an asset-based teaching approach (43%), incorporate concepts of identity, positionality, and social and power dynamics into course design to explicitly promote and foster diversity, equity, and inclusion in their courses (41%), implement strategies to address power dynamics in the classroom (37%) or have difficult conversations about systematic and institutional racism in the classroom (35%).

Psychological Safety

Figure 3 summarizes the responses collected from engineering faculty who completed the Psychology Safety scale. The overall mean for the scale was 3.69 (SD = 0.98), with higher scores suggesting a greater sense of psychological safety among faculty.

Faculty expressed high levels of psychological safety, feeling members can bring up problems and tough issues (77%)[5], and that their unique skills and talents are valued and utilized when working with colleagues (68%). They also felt that it is safe to take a risk (60%), and that no one would deliberately act in a way that undermines their efforts (55%). More than half of the faculty disagreed with the reverse coded items regarding actions that may harm their psychological safety, like mistakes being held against them (n = 68%), difficulty asking others for help (62%), and people being rejected for being different (n = 57%), indicating a feeling of safety in the system.

[4] Percentage is parathesis are those that responded Moderately or Extremely confident
[5] Percentage is parathesis are those that responded Somewhat agree of Strongly agree

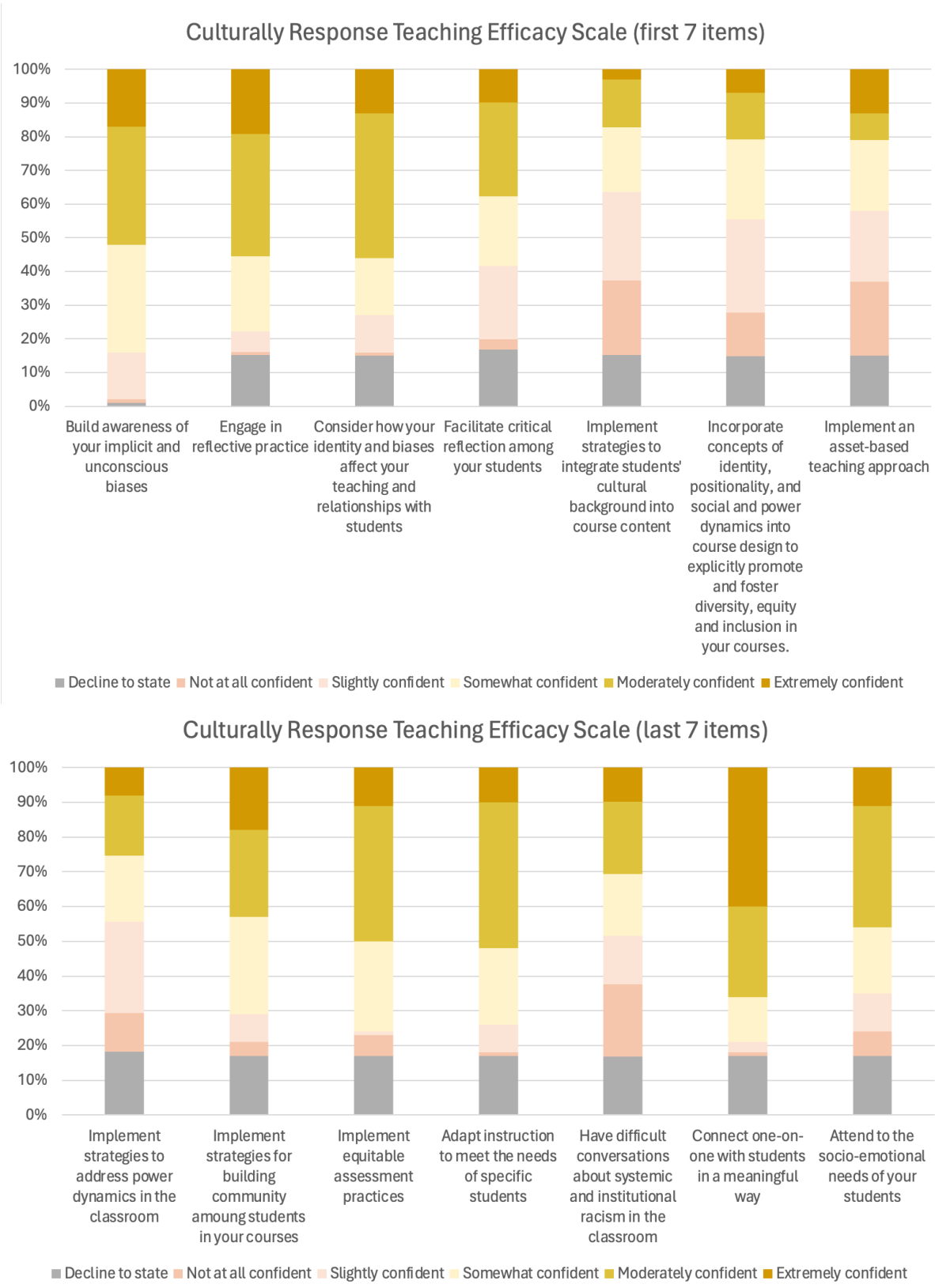


Figure 2. Culturally Responsive Teaching Efficacy Scale Results

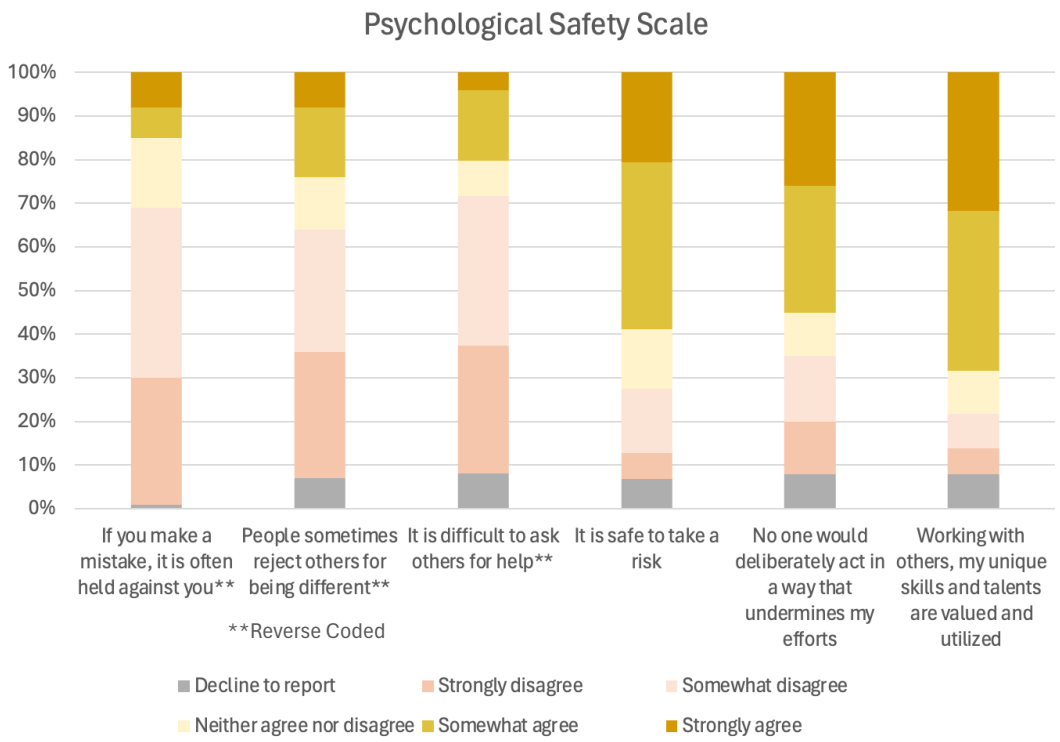


Figure 3: Psychological Safety Scale Results

Climate for Innovation

Figure 4 contains the results of the climate for innovation scale completed by faculty members. Generally, faculty are positive about the innovative climate with the exceptions of personnel shortages that inhibit innovation and enough free time for creative ideas during the workday. Mixed opinions were also expressed about assistance available to develop new ideas, adequate resources devoted to innovation, reward systems that do not encourage innovation or departments that stick to tried and tested ways.

Departmental Community

In Figure 5, the results of the department community scale that was completed by faculty members reveal that they are generally positive about the sense of community in their departments (Mean = 3.88; SD = 1.02).

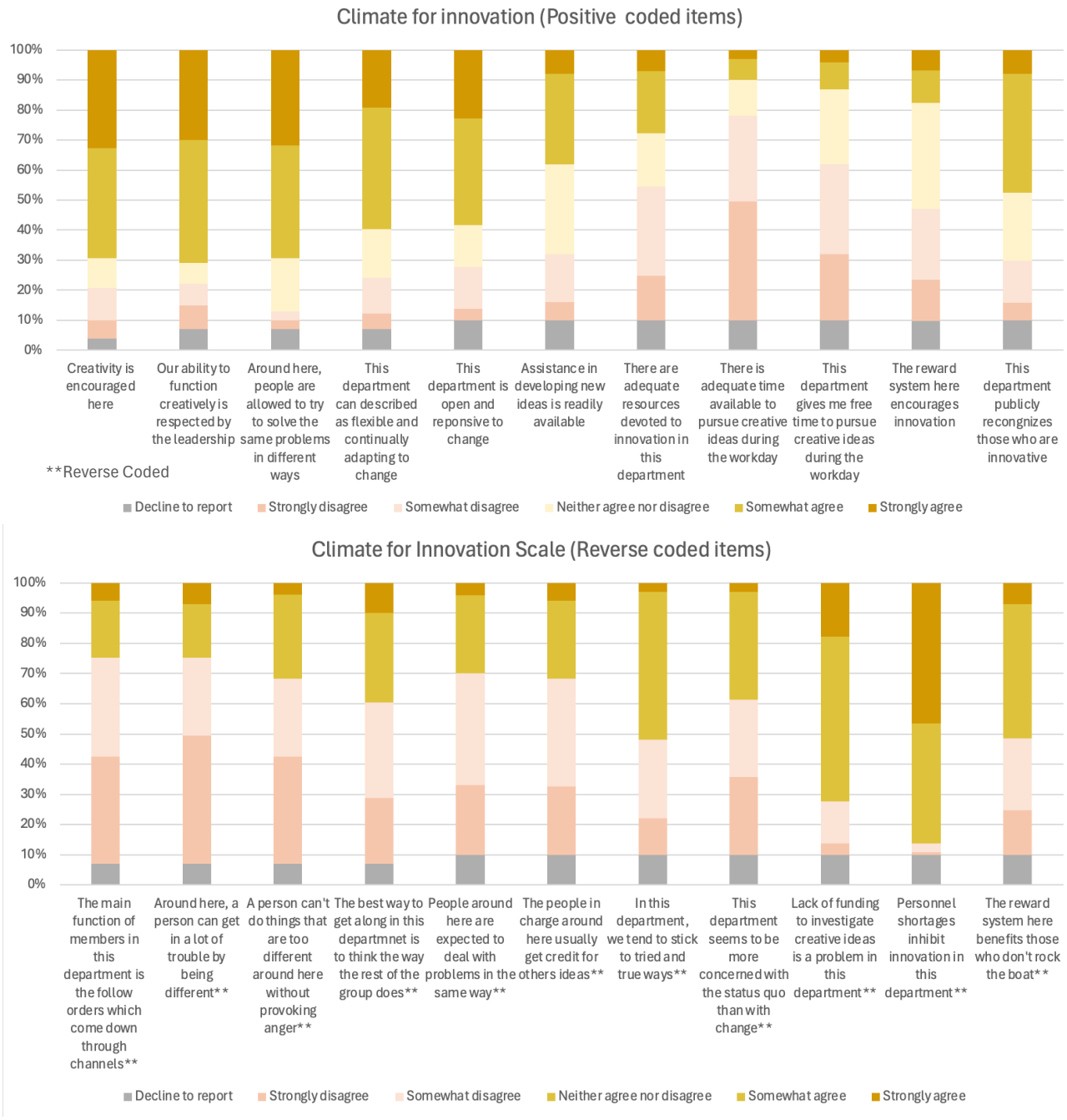


Figure 4. Climate for Innovation Results

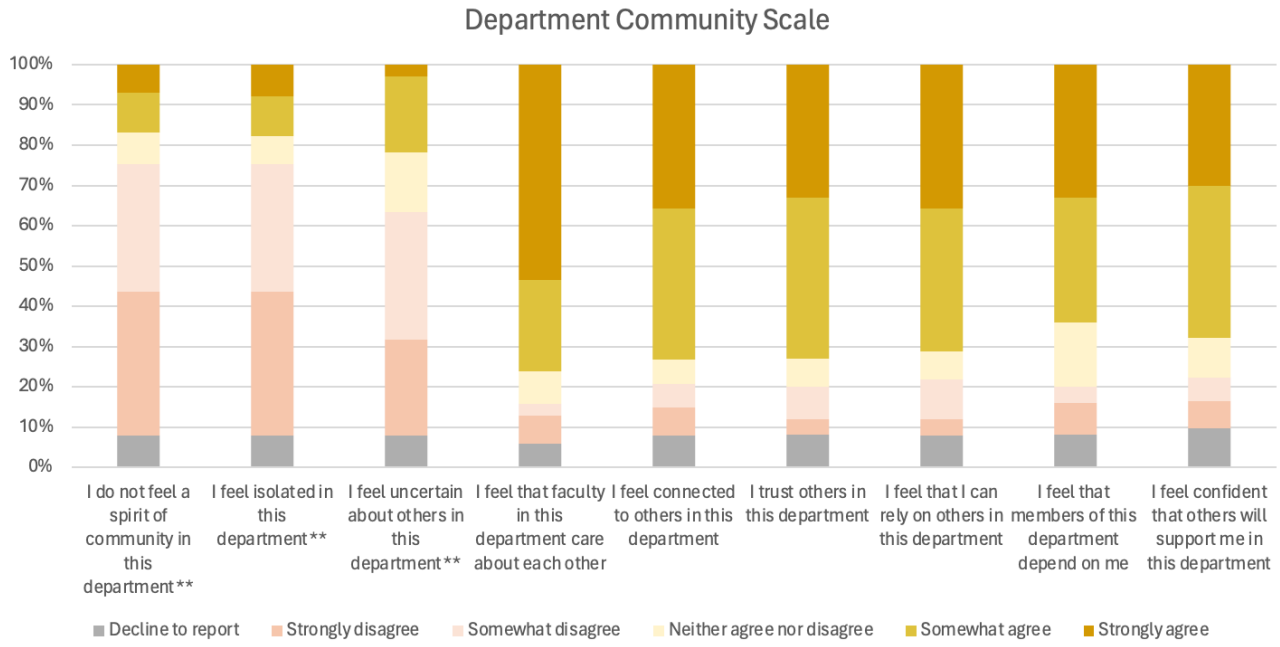


Figure 5. Department Community Scale Results

Perspectives on Department Transformation Project

Unlike the previous scales which was is reported for the entire college, members of the Computer Engineering department responded to a longer survey that asked about their commitment to the department vision, barriers to achieving that vision, and their personal priorities in the department transformation process.

Table 4 shows the Department of Computer Engineering's faculty members' (n = 17) commitment to the department vision. Commitment levels were high with the majority (82%) of faculty feeling committed or extremely committed to the vision. No faculty responded that they were not at all committed.

Table 4: Commitment to the Vision

	Not at all committed	Slightly committed	Somewhat committed	Committed	Extremely committed
Personally committed to the vision	--	6%	12%	35%	47%

Computer Engineering faculty members were asked to identify primary barriers that may impede the success of the project or limit the change the department hopes to accomplish. A thematic

analysis of faculty responses reveals three themes. University systems and policies that are not conducive to change (n=6), limitations due to workload, lack of time and resource constraints (n=5), and concerns about the organizational climate (n=3) are perceived barriers reported by faculty.

Representative comments about university systems and policies include, "*I think the biggest barrier will be that "the system" will try to converse [sic] itself to remain unchanged*", and "*The system (college, university, CSU university system) is NOT designed according to the values expressed here. This system will not yield. I think it is hard to build a flexible system on top of this.*"

"*Class size, teaching loads, resources for flexible pedagogies*" and "*Not enough time to focus on these activities*" show up in the theme on workload, time, and resource constraints.

Finally on concerns about organizational culture we have, "*The people in charge are in charge because they support the status quo. I hope things change but I don't see how that will happen unless the type of change in question supports the ideas of those in charge*." and "*Not everyone wants to find community in their workplace or major of study and that's okay too. Some people thrive by having a j-o-b they're good at and find community elsewhere to recharge. The rest looks really good though*."

When asked to share their personal priorities, a thematic analysis of faculty responses show that they prioritize more effective teaching practices and learning tools for diverse student populations (n=6) and having a supportive community for faculty and students (n=5). For the former, "*I can see rationally that the education envisioned by the RED project has the potential to be a radially better educational model. I'm also frightened by certain aspects of the project, and this seems like the kind of challenge that I should be able to rise to*." Faculty spoke highly of the current feel of our community: "*I want all CPE students and faculty to feel the same level of support and love for this department that I do*." and "*Making sure that our department values me for who I am and values others for who they are. Being a beacon of hope for others to see change based in equity and justice is possible. Living my values*"

Conclusions

Our initial baseline survey captures the current state of college of engineering faculty with respect to culturally responsive teaching practices, psychological safety, climate for innovation, and department community. It also provides insight into initial aspirations and commitment to our department vision. While acknowledging the potential for a non-representative sample population, the overall responses are positive, especially for a baseline, yet there is room for increases in faculty abilities to incorporate culturally responsive teaching practices into the classroom and improvements around climate, community, and psychological safety.

Although the results reported are from the entire college of engineering, this reflects the culture and we will use this to guide our activities. For instance, faculty feel confident in connecting with individual students, but are less confident in addressing power, privilege, and having difficult conversations in the classroom. We will consider this by both addressing power and having hard conversations in our faculty retreats. From the result of the psychological safety it does appear that a majority of faculty feel psychological safe, but it is notable that there are not an insignificant number of people who report feeling unsafe (those who report negative responses to items range from 11% to 27%). Because we want to attend to everyone in the system, we will be doing individual interviews

understand more deeply the issues of safety. The Climate for Innovation scale also reveals some troubling issues. First there are about a quarter of the faculty who indicate lack of support of innovation. Also, in this scale we see real issues around resources and workload. Both these areas will need to be addressed in our work by recognizing the real cost of innovation.

Fundamentally, this project is about creating new and revolutionary educational experiences and environments that will lead to development of tools and frameworks that will help other educators in collaborative change processes, e.g., methods for dismantling existing oppressive structures and mindsets, tools to promote reflective and generative dialogue in diverse faculty and student groups, and guides to contextual or personal variables that may be critically important to change but perhaps overlooked by educators.

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