NSF RIEF: Assessing Emotional Intelligence and Psychological Capital of Engineering Students

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Introduction

Traditionally, engineering is considered a rational discipline where emotions can hinder the ability to make logical decisions.[1] However, it has been argued that including emotions with reasoning leads to optimum engineering decisions.[2] While interventions involving emotions in engineering education can be found in literature, they are designed to improve overall well-being and interpersonal relationships but not explicitly as an essential part of engineering work.[3] Additionally, to be considered emotional may affect one's power status, professional success, and leadership positions.[4] To prepare students for the emotional and interpersonal demands of the engineering profession, the last author developed a course focused on positively introducing emotions to engineering students and making connections with engineering practice. The importance of emotions is introduced not only to improve overall well-being, interpersonal relationships, and leadership, but also as part of engineering work such as in decision-making. The course consists of five modules: (i) introduction to emotions and different emotional intelligence models, (ii) discussing and practicing the ability emotional intelligence model (identify, use, understand, and manage emotions), (iii) discussing empathy and conflict resolution as part of the emotional intelligence competence model, (iv) the use of emotions and reasoning in decision-making, (v) emotions and well-being. The final goal of this NSF RIEF project is to evaluate the course's potential to improve engineering students' emotional intelligence and psychological capital. While the course is not explicitly focused on developing students' psychological capital, it is also evaluated in this work as previous studies have shown that it is positively correlated with emotional intelligence.[5] The first objective of the NSF RIEF project is to assess the current state of emotional intelligence and psychological capital of engineering students before the intervention. More specifically, this study aims to answer the following research question: what is the level of emotional intelligence and psychological capital among engineering students?

Methods

Participant Recruitment

Following IRB approval (IRB ID: 2215359-3), undergraduate engineering students were recruited during the 2024-2025 academic year from two sources: (a) an email invitation sent to all engineering students at the University of California Davis (UC Davis), and (b) students participating in the intervention who completed the research survey as part of an assignment. Participants (N=229) received a $10 Amazon gift card. Demographic information of respondents is shown in Table 1.

Measures

Emotional Intelligence was measured by using the Trait Emotional Intelligence Questionnaire - Short Form (TEIQue-SF), which consists of five subscales: well-being, self-control, emotionality, sociability, and global trait.[5][6] In this model, emotional intelligence is defined as a combination of traits within personalities.[7] Although the course is grounded on the ability emotional intelligence model,[8] which defines emotional intelligence as a cognitive ability, its

measurement (MSCEIT test[9]) consists of a performance-based test containing eight tasks, which makes it less suitable for short-term evaluations. TEIQue-SF captures students' emotions-related self-perceptions. Psychological capital was measured by using the Psychological Capital Questionnaire, which consists of four subscales: hope, resilience, optimism, and self-efficacy.[5][10] Responses for both surveys are rated on a Likert scale (seven and six points for TEIQue-SF and Psychological Capital, respectively). Students were also asked to self-report if they were currently experiencing mental health distress and provide their demographic information. Students completed both surveys twice: at the start of the academic quarter and at the end of the academic quarter. For this present study, only the survey responses collected before the intervention (at the start of the quarter) were considered.

Data analysis

Data collected from the surveys were analyzed using IBM SPSS Statistics for Windows version 30.0. The internal consistency of the two questionnaires was calculated using Cronbach's alpha (α). Descriptive analyses (e.g., mean and standard deviation) were performed for each questionnaires' subscales. Segregated data were analyzed by t-test or one-way ANOVA with a significance level of 0.05. Responses from students with 5+ years of study were combined with responses from students with four years of study, while for the other subgroups, sample sizes of less than 10 (Table 1) were excluded from the analysis.

Results and Discussion

Emotional Intelligence

Figure 1 shows the results from the emotional intelligence questionnaire. Cronbach's alpha ranged from 0.692 to 0.864. Cronbach's alpha > 0.5 indicates good reliability for subscales less than 10 items, which is the case of the TEIQue-SF's subscales. Average scores of all students (Figure 1a) ranged from 4.4 to 5.2 on a 7-point Likert scale. Well-being scored the highest (5.2 ± 1.1), followed by emotionality (4.8 ± 0.9), global trait (4.8 ± 1.1), sociability (4.5 ± 0.9), and self-control (4.4 ± 0.9). The same pattern and similar scores were found in a study conducted with chemical engineering students in Malaysia: well-being scored the highest (5.1), followed by emotionality (4.82), global trait (4.8), sociability (4.36), and self-control (4.32).[5] Well-being measures the generalized sense of wellbeing. Emotionality measures students' abilities to perceive emotions in self and others as well as how these emotions are expressed. Global trait measures overall emotional intelligence. Sociability measures social awareness, managing emotions of others, and effective communication while self-control measures the ability of students to control and manage emotions.[7] Emotional displays and emotional self-control are influenced by cultural expectations.[11] For example, European American cultures focus on individualism while East Asian cultures focus on self-improvement to contribute to social relationships.[12] As a result, it has been shown that pride is valued in individualism cultures and less valued in interdependent cultures.[12] The fact that the findings of this study (obtained at a large American university, Figure 1a), were similar to the study conducted in Malaysia, raises the question if the similarities are due to an engineering emotional culture or if it is because about half of the respondents were Asian Americans (Table 1). This study did not find significant differences between ethnicities in any of the emotional intelligence sub-scales. Future investigation to understand if there is an emotional engineering culture would expand the findings of this study.

Table 1. Demographic information of students participating in the study

	Survey Responses (n=229)		College of Engineering (UC Davis) (n=3629)	
	n	**%**	**n**	**%**
Year of Study				
First Year	79	34	675	19
Second year	39	17	732	20
Third Year	42	18	762	21
Fourth Year	63	28	1454	40
5+ years	6	3	6	0.2
Race/Ethnicity				
Asian or Asian American	109	47	1787	49
Black or African American	4	2	101	3
Hispanic or LatinX	35	15	824	23
Middle Eastern or North African	4	2	-	-
Native Hawaiian or Pacific Islander	0	0	9	0.2
White or European	41	18	792	22
More than two races	4	2	-	-
Declined to answer	32	14	104	2.8
Gender				
Women	105	46	1226	34
Men	116	51	2289	63
Gender expansive	8	3	114	3
First-generation				
Yes	65	28	1171	32
No	159	69	2350	65
Unsure	5	2	108	3
Perceptions of mental health distress				
Yes	43	19	-	-
No	140	61	-	-
Maybe	46	20	-	-

Emotional displays and self-control are also influenced by gender.[4] Segregated data show that men significantly differed from women in self-control and emotionality (Figure 1b). Men scored higher in self-control and lower in emotionality than women. Emotionality is often associated with women, i.e., women are often encouraged to engage and display emotions while men are often raised to suppress and control their emotions.[4] Engineering students participating in this study presented emotional gender norms regarding emotionality and self-control. The importance of emotionally and self-control are discussed and exercised in the course and the effect of the course on men and women is currently being investigated.

Emotionality is also often associated with underrepresented groups.[2] However, in this study, first-generation students presented significantly lower emotionality compared to continuing-generation students (Figure 1c), which is contrary to what was expected. It is hypothesized that first-generation students may be practicing emotional labor to better fit in engineering. Emotional labor is "*when professionals display an emotion different of their true feeling or when*

*they **change** what they are feeling in order to align with the profession's expectations"*.[13][14] Engineering is considered a rational discipline, and, therefore, emotional displays may be considered unprofessional. Students' perceptions on the value and role of emotions in engineering are also being currently investigated as part of an interview-based qualitative study.

A relationship between overall health (including mental health) and emotions has also been reported in literature. [15] Therefore, it was hypothesized that students currently coping with a mental health challenge would differ in their emotional skills compared to students who were not experiencing mental health challenge at the time they answered the survey. We included in the survey the following question: "Are you currently coping with a mental health challenge?" Students who answered "yes" or "maybe" scored significantly lower than students who answered "no" in global trait, well-being, and self-control (Figure 2b). It is of interest to determine if the course has helped students to cope with their mental health challenge and this study is also currently under investigation.

There were no significant differences within scores based on year of study for any of the emotional intelligence sub-scales.

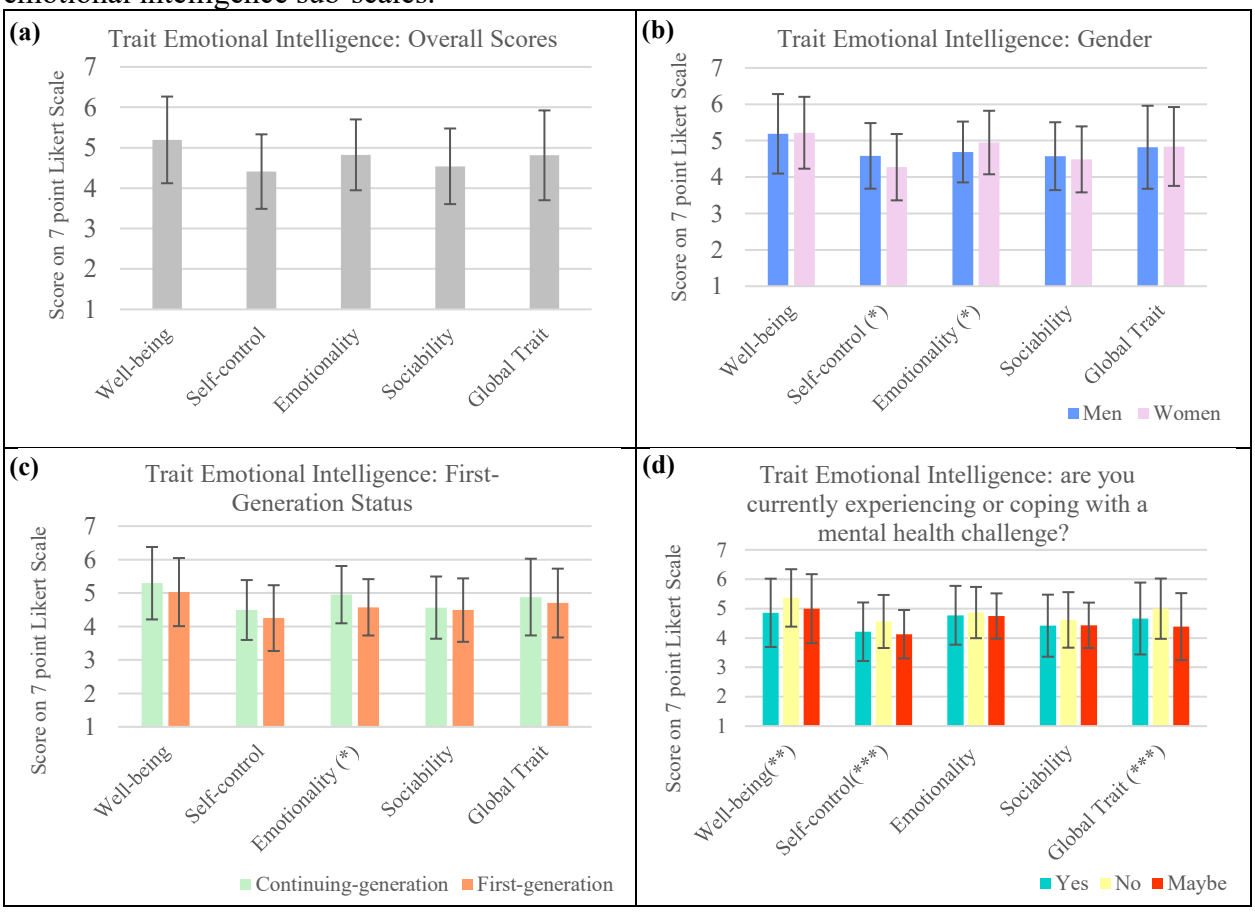

Figure 1. **(a)** Students' trait emotional intelligence subscales for all students (N=229). **(b)** Students' trait emotional intelligence subscales for men (N=116) and women (N=105). (*) indicates statistically significant differences at $p < 0.05$. **(c)** Students' trait emotional intelligence subscales for first-gen (N=65) and continuing-gen (N=159). (*) indicates statistically significant differences at $p < 0.05$. **(d)** Students' trait emotional intelligence subscales for self-perceptions of

mental health distress: "yes" (N=43), "no" (N=140), and "maybe" (N=46). (**) indicates statistically significant differences between students coping with a mental health challenge ("yes") and students not coping with a mental health challenge ("no") at $p < 0.05$. (***) indicates statistically significant differences between students not coping with a mental health challenge ("no") and maybe coping with a mental health challenge ("maybe") at $p < 0.05$. Error bars indicate standard deviation.

Psychological Capital

Figure 2 shows the results from the Psychological Capital Questionnaire. Cronbach's alpha ranged from 0.738 to 0.843. Average scores of all students (Figure 2a) ranged from 3.9 to 4.3 on a 6-point Likert scale. Hope scored the highest (4.3 ± 0.8), followed by resilience (4.2 ± 0.7), self-efficacy (4.1 ± 0.9), and optimism (3.9 ± 0.8). Self-perceptions of mental health distress presented significant differences in resilience. Students who answered "maybe" presented lower resilience score than students who reported "no". There were no significant differences in ethnicity, year of study, gender, and first-generation status for any of the subscales of psychological capital. This result will be used to compare survey scores after the intervention.

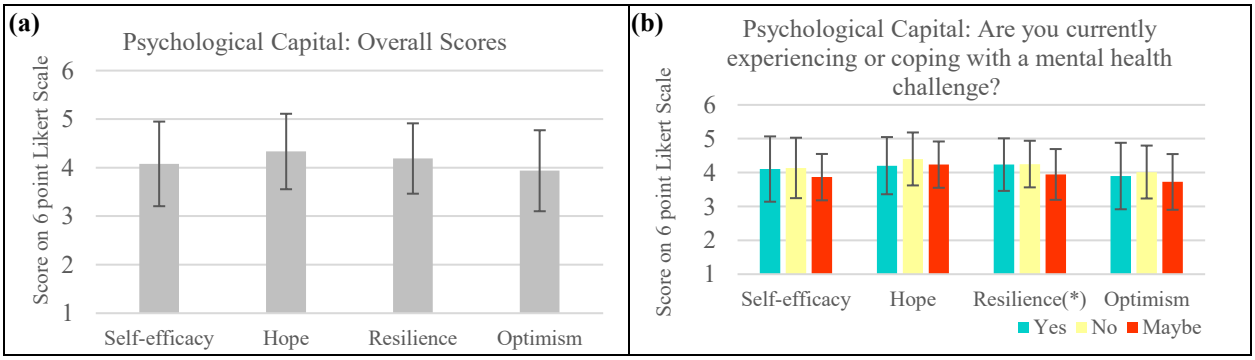

Figure 2. (a) Students' psychological capital subscales for all students (N=229). **(b)** Students' psychological capital subscales categorized by self-perceptions of mental health distress: "yes" (N=43), "no" (N=140), and "maybe" (N=46). (*) indicates statistically significant differences between students not coping with a mental health challenge ("no") and maybe coping with a mental health challenge ("maybe") at $p < 0.05$. Error bars indicate standard deviation.

Conclusions and Future Work

This study investigated emotional intelligence and psychological capital of engineering students. Perceptions of current mental health state presented significant differences in wellbeing, self-control, global trait, and resilience. Male and female students differed significantly in self-control and emotionality. The only domain evaluated in which first-generation students significantly differed from continuing-generation students was emotionality. There were no significant differences in emotional intelligence and psychological capital subscales between students in different years of study or of different ethnicities. These results will serve as baseline to achieve the final goal of the project, i.e., evaluate the impact of an emotional intelligence course on students' emotional intelligence and psychological capital.

Acknowledgments

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