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Engineering Faculty's Mindset and The Impact on Instructional Practices*

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Multiple factors influence faculty instructional practices and strategies in engineering. Effective strategies for improving instructional practices are correlated to the belief of the individual faculty. While substantial research has been done on how faculty and their instructional practices can make a positive difference in student achievement, less research has been done on how faculty's mindset drives instructional practices. This study aims to fill this gap. This study sought to answer two research questions: (1) What is the continuous fixed through growth mindset of engineering faculty with respect to faculty demographics? (2) Is there a difference in self-reported instructional practice with respect to faculty mindset and faculty demographics? In Fall of 2019, we used an online survey to collect survey responses from 105 engineering faculty from 14 different engineering colleges at Carnegie classified as Doctoral/Professional universities. The survey instrument included two scales with existing validity evidence: the Dweck Mindset (DMI) and the Postsecondary Instructional Practices Survey (PIPS). The analysis generated three key results: (1) engineering faculty in the sample did not score along the mindset spectrum, most fell in the middle of the spectrum and were categorized as incremental; (2) there was a statistically significant difference in engineering faculty mindset that varied by faculty demographics including gender, ranking, and tenure status; and (3) student-content engagement and student-student engagement were found to be the most discriminant teaching practices. Our study demonstrates strong correlation between the mindset of engineering faculty and instructional practices, as well as how that correlation varies by faculty demographics. Our results suggest faculty mindset is a malleable construct that can directly affect teaching practices leading to better teaching and learning in engineering. Furthermore, our study supports the implementation of training to ensure tenured faculty are comfortable with a growth mindset as well as the need to continue to increase the diversity of engineering faculty.

Keywords: engineering faculty; growth mindset; instructional practices; teacher authenticity

1. Introduction

Engineering faculty play a key role in educating the next generation of engineers, and while there are many pedagogical factors that influence students' motivation, retention, and success in the engineering classroom, what faculty believe about their students' ability to learn matters a great deal. Research suggests that faculty beliefs [1], along with faculty-student interactions can greatly influence the learning environment, and thus, student success [2, 3]. The learning environment and the different ways that educational content is created, delivered, and evaluated within a particular context impacts on student learning outcomes. For example, instructional practice is one of the factors shown to result in different outcomes for minority students when compared to majority students [4]. Current engineering education research on instructional influence regarding student success in engineering programs, highlight the impact and importance of instructional practice strategies on different student groups [5, 6].

Education researchers have considered how instructional strategies and practices play an influential role in the classroom and on student learning outcomes [7]. For example, active, problem-based learning strategies have been shown to positively impact student engagement, motivation, retention, and learning when compared to more passive, lecture-based modes of instruction [8–10]. Additional literature has also demonstrated that high teacher expectations increases student success in the classroom [11]. Understanding how these instructional strategies impact student success is even more when teaching students of color because minoritized students experience more harassment, unfair treatment, and identity threat [12–15]. In hostile learning environments, minoritized students experience less motivation and less retention. The findings

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in this study raise important question about how faculty perceptions, expectations, and beliefs influence instructional practice.

1.1 Purpose

The impetus of this research was to examine faculty mindset and demographic differences and how they influence self-reported instructional practice in the engineering classroom. Previous research focused on student mindset rather than faculty mindset [17–21]. And while this research acknowledged the importance of growth mindset interventions for faculty and teaching faculty the concepts in order to teach their students, the emphasis remained on the students [18, 20]. There is limited research on the impact of faculty mindset as fixed or growth and their pedagogical practices and relationships. The following study provides an in-depth examination of faculty mindset and its contribution to their instructional practice in the engineering classroom. Specifically, we connect the fixed mindset or growth mindset of engineering faculty to their teaching practices.

1.2 Background and Theoretical Framework

Researchers have studied many characteristics and behaviors that impact the achievement and success of students. What has been investigated to a lesser extent is how the mindset of the faculty instructor influences instructional practices and the learning environment that supports students' success, especially the success of marginalized students. For the purposes of this study, we discuss mindset according to Carol Dweck's theoretical findings. While previously mentioned concepts of reflection, expectancy of success, and beliefs about problem-solving have been shown to influence classroom practice, these concepts are all tied to Dweck's concept of mindset.

1.2.1 Growth or Fixed Mindset

According to Dweck's mindset theory, people can hold a "fixed" mindset or a "growth" mindset [21, 22]. Fixed mindset beliefs dictate that people have a certain amount of intelligence, and there is not much that can be done to change it. On one hand, when individuals possess a fixed mindset, they tend to focus on what they might call "natural" ability; and they focus on performance. People who have a fixed mindset tend to avoid challenges due to anxiety surrounding their expectancy of immediate success. On the other hand, when individuals possess growth mindset beliefs, intelligence is seen as largely malleable with practice and effort. People who score on Dweck's scale as having a growth mindset tend to value effort over natural ability. They are excited by challenges, seeing failure as a natural component in the process of growth [23].

Studies illustrate that a faculty's growth mindset or fixed mindset influences their students' mindsets [24, 25]. And other studies analyze the effect of interventions and teaching methods used to foster a growth mindset in students [18, 20]. While these papers and interventions consider the role of teacher mindset, the central focus remains on student mindset. For example, studies have analyzed how the mindset of the teacher influences the student's decision to persist in the face of a challenge [26, 27]. Previous research has shown that faculty mindset not only impacts instructional practice [28, 29], faculty mindset also impacts assessment [30], feedback to students [31], and active learning practices [32]. More specifically, faculty with a growth mindset are more likely to hold high standards and use active learning strategies in the classroom [32, 26, 27] which is congruent with previously mentioned literature discussing the benefits of high expectations and active learning strategies.

1.2.2 Instructional Practice

All students benefit from faculty who have high standards and use instructional practices that include active learning, achieving higher grades, and maintaining higher retention rates when compared to students in a traditionally taught course. However, researchers in physics education found that undergraduate students who identify as female and minority students benefited the most from a classroom environment that was built around student-centered instructional strategies and incorporated collaborative and cooperative elements [33]. In this same study, Etkina and colleagues found that students who identified as female, Asian, Black, and Hispanic were more deeply impacted, showing a more pronounced impact to grades and retention rates [33].

Researchers continue to emphasize how classroom environment and faculty instructional practices influence undergraduate student engagement and retention, particularly for students who have been historically marginalized in higher education such as African Americans, Native Americans, Asian Americans, and Latino/as [34–36]. Greenman and colleagues found that practices such as faculty mentorship, involvement in a learning community, being enrolled in a highly interactive capstone course, and participation in service learning greatly influenced engagement for minority students and increased their success [37]. Researchers also found that while active learning strategies do impact both cognitive and behavioral aspects of engagement for all students, minority students still show a significant learning gap [38, 39]. This gap

can be explained in part by the fact that minoritized students receive less instructional exposure to these active learning strategies. Some of these instructional strategies to which minority students receive include previously mentioned particularly impactful factors, such as faculty mentorship, involvement in a learning community, and enrollment in a highly interactive capstone course [35]. This is important when considering the influential role that engagement and instructional practice can play in student retention and academic success.

Research suggests the beliefs, perspectives, and general mindset of the faculty instructor can influence instructional strategies enacted in the classroom, and therefore affect student outcomes, but there is not a straightforward relationship. For example, McKenna and colleagues explored how collaborative faculty reflection impacted how faculty shifted practices from a knowledge-transmission teaching framework to a more student-focused teaching framework in their classroom [4]. They found that knowledge-centered and assessment-centered approaches promoted deeper and more meaningful student learning. As another example, Matusovich and colleagues found that a faculty member's expectation of success in the classroom greatly influences their decision to implement new teaching strategies [40]. Beliefs about benefits of problem solving in the classroom versus the payoffs of traditional lecture impact what practices are used during class time [41]. Likewise, the instructor's beliefs about student-focused approaches [40], new and creative teaching strategies [42], and problem-solving strategies in the classroom [11, 12] have been shown to impact student learning objectives.

Mindset is communicated through student-faculty interactions, impacting instructional practices and impacting educational outcomes for students – impacting some students more than others. When students perceive that the professor teaching the course they are taking holds a growth mindset, they tend to experience less psychological distress. That is, they struggle less with their identity, they report more positive moods, and they spend less time concerned with how they will be evaluated by people in institutional positions of power. This lack of psychological distress can in turn lead to higher levels of engagement, performance, student outcomes, and retention [43, 44]. When students perceived that the professor teaching the course they are taking holds a fixed mindset, they tend to report lower levels of motivation, and they comparatively received lower grades [2]. Moreover, results revealed that who taught the course impacted students from different groups in different ways. Faculty with fixed mindset appear to particularly impact Black, Latinx and Indigenous (BLI) students through situational cues.

While our study uses Dweck's theory as our operational definition of mindset, it is also necessary to identify the terms for understanding instructional practice. In this study, instructional practice was measured by the Postsecondary Instructional Practices Survey (PIPS) Two-factor model. The PIPS two-factor conceptual model includes two dimensions: student-centered practice and instructor-centered practice. "Student-centered practice" is defined as a practice where the student is the central actor, including student interactions, student engagement with content, and formative assessment. "Instructor-centered practice" is defined as a practice where the instructor is the central actor, including the instructor's presentation of information, summative assessment design, and grading policies [50]. The PIPS conceptual model is further demarcated into four discrete components: instructor-student interactions, student-content interactions, student-student interactions, and assessment. The PIPS is a survey designed to measure the instructional practices of post-secondary instructors from any field of study.

The PIPS was studied using factor analysis from 72 departments at four institutions. Developed to be used by any postsecondary instructor from any discipline, it uses PIPS scores to determine a range of "very descriptive of my teaching" (4) or "not at all descriptive of teaching" (0). Answers from each category are summed, averaged, and multiplied by 100 to get a factor score ranging from 0–100. Based on factor scores, the PIPS is used to determine instructional practices. For the purpose of this study, PIPS is used to determine the instructional practice of faculty members in departments of engineering throughout the US.

The combined theories of Dweck and PIPS is used in the current study to inform the instructional practices of the participants and how instructional practices align with faculty mindset and demographic data.

2. Methods

The project team applied a sequential mixed-methods study design to collect the data for this project. For this study, we analyzed results from the quantitative phase of the research to address the research questions. The original list of survey items was adopted from published surveys and refined by a panel of topic experts to create the finalized list of items. The final piloted instrument included the following scales: Dweck Mindset (DMI) [23] and the Postsecondary Instructional Practices Survey (PIPS) [45]. The survey instrument concluded with

open-ended responses to indicate the participant's willingness to be interviewed and provide demographic information that included gender, race/ethnicity, tenure status, academic rank, and SES. We asked participants to also provide an email address, mailing address, and phone number if they would be willing to consider an individual interview as part of the primary data collection for the second phase of the study. The survey completion time typically lasted between 15-25 minutes and the research team will report summative data to maintain anonymity of the participants and only use identifying information to solicit further participation in the research study.

2.1 Research Questions

Based on the purpose of this study, our team sought to answer the following research questions:

RQ1: (1) What is the spectrum fixed through growth mindset of engineering faculty with respect to faculty demographics?
H_1: There is no difference between the engineering faculty mindset with respect to faculty demographics.

RQ2: Is there a difference in self-reported instructional practice with respect to faculty mindset and faculty demographics?
H_2: There are differences on the instructional practices (e.g., content delivery, student-student engagement, student-content engagement, formative assessment, summative assessment) by faculty demographics and growth mindset is positively associated with student-centered/active-learning instructional practices.

2.2 Participants Selection and Recruitment

The target population for the study was engineering faculty members currently working in colleges of engineering. The participants in the study included engineering faculty from 14 different institutions. The partner institutions were selected for regional geographical location and the professional network of the research team. After identifying a college of engineering liaison to distribute the survey and securing IRB approval, a distinct survey link was shared with the liaison to distribute to their engineering faculty list serve. Engineering faculty members were recruited through an email outlining the purpose of the research and the procedure to access the survey and acknowledge consent to participate in a research study. All participants were 18 years of age or older. Participants were offered a $25 gift card compensation for their participation. All the participants were notified that they were free to withdraw at any point without penalty. Participants were encouraged to advertise the study to their respective networks (i.e., snowball sampling).

A combination of sampling approaches was used to reach the final study sample who identified as a faculty member in a college of engineering (N = 106). The participant pool represented more than nine engineering areas of study or disciplines. Over 91% of the participants indicated they held a doctorate and 83% identified as male. We acknowledge the limitation of having only two genders collected in the demographics of our study [46].

The faculty rankings of the participants ranged from a non-tenure track to full professor (see Table 3). Non-tenure track faculty included instructors, lecturers, research scientists, visiting professors, and other including professors of practice, in-residence, and clinical professors. The tenure-track included faculty who were tenured and untenured. Tenured faculty members included faculty who currently had earned tenure at their institution, faculty members on tenure track at their institution not yet tenured, but also faculty members not on tenure track at their institution because tenure track is not available. The faculty rankings of participants are aligned with faculty rankings of engineering teaching personnel by rank as noted in Engineering by the Numbers [47]. Thirty-six percent of the engineering faculty sampled identified as full professor, twenty-one percent as associate professor, nineteen percent as assistant professor and twenty-four percent as other. Engineering by the Numbers states that thirty-six percent of engineering teaching personnel are Full professors, nineteen percent are associate professors, twenty percent are associate professors, and twenty-four percent are classified as other (non-tenure track personnel and FTE of all PT personnel). Thirty-six percent of the sample population identified as African American, Asian, Multi-racial, or other (some other race than White, Black or African American, American Indian or Alaska Native, Asian, Native Hawaiian or Other Pacific Islander). The self-reported intersectional distributions of identities including gender, faculty rankings, and tenure status by SES and ethnicity are presented in Tables 1–3. We report the intersectionality of the faculty participants demographics to avoid essentializing any particular identity dimension and to encourage future scholarship of engineering faculty to consider how their multiple identities impacts their decision making (e.g., course design and instructional practices).

2.3 Measures and Data Collection

Data collection consisted of a quantitative survey managed through Qualtrics, a secure, online, data management system. Faculty accessed the online survey instrument using the link provided in the

Table 1. Faculty's gender by race/ethnicity and SES

Gender	Ethnicity	SES				Total
		Affluent	Middle Class	Working Class	Poor	
Male	Asian	1	5	12	1	19
	Black or African American	0	1	3	0	4
	Multi-racial	2	0	3	0	5
	White	1	17	37	0	55
	Other	0	2	1	0	3
	Total	4	25	56	1	86
Female	Asian	0	0	1	0	1
	Black or African American	0	3	1	0	4
	Multi-racial	0	0	1	0	1
	White	1	2	9	0	12
	Other	0	0	0	0	0
	Total	1	5	12	0	18
Total		5	30	68	1	104

Table 2. Faculty's tenure status by race/ethnicity and SES

Tenure Status	Ethnicity	SES				Total
		Affluent	Middle Class	Working Class	Poor	
Tenured	Asian	1	5	10	0	16
	Black or African American	0	3	3	0	6
	Multi-racial	1	0	3	0	4
	White	1	9	34	0	44
	Other	0	1	1	0	2
	Total	3	18	51	0	72
Not Tenured	Asian	0	0	3	1	4
	Black or African American	0	1	1	0	2
	Multi-racial	1	0	1	0	2
	White	1	10	12	0	23
	Other	0	1	1	0	2
	Total	2	12	18	1	33
Total		5	30	69	1	105

Note. Tenured: Currently hold tenure at this institution + Currently on tenure track at this institution; Not Tenured: Not on tenure at this institution + Tenure is not available at this institution.

recruitment email. The survey instrument started with explanation of the participation requirements and obtained consent to participate in the study. The survey instrument included multiple published and previously validated measurement scales and included the Dweck Mindset Instrument and the Postsecondary Instructional Practices Survey (PIPS).

2.3.1 Dweck Mindset Instrument

The adopted Dweck Mindset Instrument (DMI) was used to assess how faculty view intelligence. The DMI comprises 16 separate items, which faculty ranked from "strongly agree" (6) to "strongly disagree" (1). The items are written in such a way that faculty reveal their thoughts and feelings about the extent to which they believe that the talent and intelligence of engineering students are malleable or unable to change. For example: "Engineering students have a certain amount of intelligence, and as a professor, I really can't do much to change it." and "Minority students are able to compete academically at the collegiate level in engineering."

The adopted DMI contained both entity item statements and incremental item statements. Where an entity item statement refers to fixed traits, an incremental item statements refers to perception possibility of mastery even when initial ability to perform a task is low (growth). The scores from the incremental items are "reverse scored" so that strongly disagreeing with an entity item is similar to strongly agreeing with an incremental item. There are four entity items and four incremental

Table 3. Faculty ranking by race/ethnicity and SES

Ranking	Ethnicity	SES				Total
		Affluent	Middle Class	Working Class	Poor	
Assistant Professor	Asian	0	4	4	0	8
	Black or African American	0	3	1	0	4
	Multi-racial	0	0	0	0	0
	White	0	0	8	0	8
	Other	0	0	0	0	0
	Total	0	7	13	0	20
Associate Professor	Asian	0	1	5	0	6
	Black or African American	0	0	0	0	0
	Multi-racial	0	0	1	0	1
	White	0	5	9	0	14
	Other	0	0	1	0	1
	Total	0	6	16	0	22
Professor	Asian	1	0	1	0	2
	Black or African American	0	0	1	0	1
	Multi-racial	1	0	2	0	3
	White	1	9	19	0	29
	Other	0	1	1	0	2
	Total	3	10	24	0	37
Non-tenure track	Asian	0	0	3	1	4
	Black or African American	0	1	2	0	3
	Multi-racial	1	0	1	0	2
	White	1	5	9	0	15
	Other	0	1	0	0	1
	Total	2	7	15	1	25
Total		5	30	68	1	104

Note. Non-tenure track: Instructor + Lecturer + Research Scientist + Visiting Professor + Other.

items focusing on intelligence, and there are four fixed items and four incremental items focusing on talent development. Reverse scored incremental item scores were averaged with the fixed item scores separate for intelligence statements and talent statements.

2.3.2 The Postsecondary Instructional Practices Survey (PIPS)

The PIPS was used to measure the self-reported instructional practices of the faculty of the College of Engineering. The PIPS comprise 24 instructional practice statements and nine demographic questions. The faculty ranked descriptive statements of their teaching from "strongly agree" (6) to "strongly disagree" (1). "Strongly agree" corresponds to "very descriptive of my teaching" and "strongly disagree" corresponds to "not at all descriptive of my teaching." For example, a sample item from PIPS is: "I use student assessment results to guide the direction of my instruction during the semester." The survey instrument concluded with two open-ended responses to indicate the participant's willingness to be interviewed and along with requested demographic information. The survey, in its entirety, typically lasted between 20–35 minutes.

2.4 Data Analysis

The preliminary data analysis included descriptive statistics using IBM SPSS (Version 27). The overall mindset was computed by averaging sum of all mindset responses and the faculty variables were dummy coded (i.e., reference group: female for gender, not tenured for tenure status, and white for ethnicity). Next, a multiple linear regression using the enter method was conducted to examine how the mindset was related to faculty demographics: gender, ethnicity, and tenure status. Multiple regression is a powerful set of methods for examining hypotheses and relationships among experimental, quasi-experimental, and nonexperimental data [45]. Typically, multiple regression is used as a data-analytic strategy to explain or predict a criterion (dependent) variable with a set of predictor (independent) variables. The simplest multiple regression type is the enter method is where all independent variables all included in the regression

equation and the default multiple regression tool in SPSS. As a result, we performed a multiple regression using enter method to examine the influence of instructional practice by mindset and faculty variables including gender, ethnicity, and tenure status. This approach has been applied in medical education research [46]. Among faculty variables, faculty rank was not used due to collinearity issue since the distribution of rank position were mostly consistent with tenure status (i.e., most rank of professors were tenured) and SES was excluded since normality of residuals were not plausible [47].

2.5 Quality of the Work

We used several tactics to ensure the highest standard of quality of this work. Specifically, we followed the five recommendations of Hjalmarson and Moskal [48] to address the quality in quantitative approaches to educational research and stressed alignment throughout the entire research design. By alignment, we mean where the research methodology and methods actually test the intended topic and address the clearly articulated significant research questions [49]. (1) After developing our research questions based on our literature search of engineering faculty mindset and STEM teaching practices, we determined direct survey questions to draw out the appropriate data to address our questions; (2) We sought survey data from current engineering faculty we could collect electronically from multiple campuses, modeled numerically, and analyzed with classic statistics and multiple linear regression; (3) We identified growth mindset/fixed mindset as the theoretical underpinning and we investigated how well our proposed model aligned with the theory; (4) Data was collected through a secure, online tool; groups were assigned only based on school affiliation later, however, they were evaluated based on specific faculty characteristics, and the quantitative values where assigned based on the Likert scale values for the previously validated scales used in the survey instrument; and finally, (5) We acknowledge that our results are not generalizable to all engineering faculty, thus we restricted our conclusions to the engineering faculty included in the study. Included multiple institution types to draw inferences across various engineering context. Also, we maintained participant anonymity, maintained data security throughout the entire study, and performed the evaluated the essential criteria for each analysis procedure. Therefore, the entire research team worked collectively to maintain the highest quality of the research study design throughout the complete study from inception to execution and dissemination.

3. Results

3.1 Descriptive Statistics

The descriptive statistical analyses were conducted using SPSS. The missing values were less than 0.05% of the entire data set and there were no variables with 5% or more missing values. Little's MCAR test showed that data was missing completely at random (χ^2 (76) = 95.763, p = 0.062). Thus, missingness was ignorable to proceed further analysis.

As shown in Table 4, DMI showed excellent internal consistency or reliability. The Student-Student Engagement and Student-Content Engagement subscales of the PIPS showed good reliability while other three dimensions showed poor reliability. The internal consistency of the survey subscales in the current results are at the acceptable minimum of greater than 0.70 [50–52]. Therefore, in this study, formative assessment, summative assessment, and content delivery dimension were excluded from the analysis and results section.

In addition, the zero-order correlation of each variable used in this study was shown in Table 5 and the description of each variable was presented in

Table 4. Reliability of Dweck Mindset Instrument and Post-secondary Instructional Practices Survey

	Cronbach's Alpha	N of Items
DMI	0.967	16
Intelligence	0.963	8
Ability	0.959	8
PIPS	0.805	23
Student-Student Engagement	0.853	5
Student-Content Engagement	0.782	5
Content Delivery	0.398	4
Formative Assessment	0.604	5
Summative Assessment	0.224	4

Table 5. Correlation of Faculty Mindset Metrics and Corresponding Teaching Approach

	Mindset	Student-Student Engagement	Student-Content Engagement
Mindset	1		
Student-Student Engagement	0.28**	1	
Student-Content Engagement	0.28**	0.66**	1

** Correlation is significant at the 0.01 level. (<0.01).

Table 6. Faculty Mindset Metrics Descriptive Statistics

						Skewness		Kurtosis	
	N	*Min*	*Max*	*M*	*SD*	Statistic	*SE*	Statistic	*SE*
Mindset	106	1.00	6.00	4.26	1.02	–0.37	0.24	0.22	0.47
Student-Student Engagement	106	1.20	6.00	4.02	1.05	–0.17	0.24	–0.45	0.47
Student-Content Engagement	106	2.60	6.00	4.71	0.73	–0.08	0.24	–0.24	0.47

Table 7. Faculty Mindset by faculty variables

Source	*SS*	*df*	*MS*	*F*	*p*
Regression Model	18.931	6	3.155	3.481	0.004
Residual	87.934	97	0.907		
Total	106.865	103			
Coefficient	***B***	***SE***	***t***	***p***	
Intercept	4.867	0.269	18.115	<0.001	
Male	–0.333	0.259	–1.287	0.201	
Tenured	–0.501	0.205	–2.451	0.016	
Asian	–0.335	0.246	–1.358	0.178	
Black	0.870	0.367	2.374	0.020	
Multi-racial	–0.308	0.406	–0.759	0.450	
Other race	0.154	0.564	0.273	0.786	

Table 6. Mindset had a close to moderate association with each variable of PIPS while both of PIPS were strongly correlated. All of them were normally distributed in terms of normality test and the ratio of skewness and kurtosis and their standard errors.

3.2 The Mindset of Engineering Faculty by Faculty Variables (RQ1)

To examine engineering faculty's mindset, first, overall mindset was computed by averaging sum of all items of DMI. A multiple regression using the enter method was conducted to examine how the mindset was related to faculty demographics including tenure status, ethnicity, and gender. The interaction effects were excluded from the model since there was no significant change of R^2 and there were no statistically significant interaction effects after comparing the model including interaction effects and the model without interaction model. As shown in Table 7, the engineering faculty's variables including gender, ethnicity and tenure status can explain a statistically significant amount of variance in faculty's mindset scores, $F(6, 97) = 3.481$, $p = 0.004$, $R^2 = 0.177$, Adjusted $R^2 = 0.126$.

The unstandardized regression coefficient for male was not significant, while male showed lower mindset score by 0.333 than female after controlling faculty tenure status and ethnicity. The unstandardized regression coefficient for tenured faculty was statistically significant, $t(97) = -0.501$, $p = 0.016$, indicating tenured faculty showed lower mindset score by 0.501 than not tenured faculty after controlling gender and ethnicity. Unstandardized regression coefficient for Black was statistically significant, $t(97) = 0.870$, $p = 0.020$, indicating Black showed higher average mindset score by 0.870 than white after controlling other variables. Unstandardized regression coefficient for Asian and Multi-racial was not significant, while Asian reported lower mindset scores by 0.335 and multi-racial by 0.308 than White after controlling other variables.

3.3 The Difference in Instructional Practices by Mindset and Faculty Variables (RQ2)

3.3.1 The difference on student-student engagement by engineering faculty's mindset and faculty variables

A multiple regression using enter method was conducted to examine how the engineering faculty's student-student engagement was affected by mindset and faculty's variables including tenure status, ethnicity and gender. The interaction effects were excluded from the since there was no significant change of R^2 and there were no statistical significant interaction effects model after comparing the model including interaction effects and the model without interaction model.

As shown in Table 8, the engineering faculty's mindset and faculty variables including gender, ethnicity, and tenure status can explain a statistically significant amount of variance in faculty's student-student engagement scores, $F(7, 96) = 3.504$, $p = 0.002$, $R^2 = 0.204$, Adjusted $R^2 = 0.145$.

Unstandardized regression coefficient for male

Table 8. Student-student engagement by mindset and faculty's variables

Source	*SS*	*df*	*MS*	*F*	*p*
Regression Model	22.227	7	3.175	3.504	0.002
Residual	86.982	96	0.906		
Total	109.209	103			
Coefficient	***B***	***SE***	***t***	***p***	
Intercept	3.999	0.562	7.111	<0.001	
Male	–0.648	0.261	–2.486	0.015	
Tenured	–0.368	0.211	–1.746	0.084	
Asian	0.140	0.249	0.564	0.574	
Black	0.485	0.377	1.287	0.201	
Multi-racial	0.852	0.407	2.094	0.039	
Other race	0.565	0.564	1.002	0.319	
Mindset	0.152	0.102	1.500	0.137	

Table 9. Student-content engagement by mindset and faculty's variables

Source	*SS*	*df*	*MS*	*F*	*p*
Regression Model	7.802	7	1.115	2.363	0.029
Residual	44.806	95	0.472		
Total	52.608	102			
Coefficient	***B***	***SE***	***t***		
Intercept	4.322	0.407	10.625	<0.001	
Male	–0.305	0.189	–1.614	0.110	
Tenured	–0.121	0.153	–0.790	0.432	
Asian	0.119	0.179	0.665	0.508	
Black	0.141	0.272	0.517	0.606	
Multi-racial	0.505	0.294	1.720	0.089	
other race	0.764	0.407	1.876	0.064	
Mindset	0.145	0.074	1.968	0.052	

was –0.648 and statistically significant, $t(96) = -2.486$, $p = 0.015$, indicating that male showed lower student-student engagement score by 0.646 than female, controlling faculty's mindset, ethnicity, and tenure status. Unstandardized regression coefficient for tenured faculty was statistically not significant, while tenured faculty showed lower student-student engagement score by .368 than not tenured faculty after controlling mindset, ethnicity, and gender.

Unstandardized regression coefficient for Multi-racial was statistically significant, $t(96) = 2.904$, $p = 0.039$, indicating Multi-racial showed higher average student-student engagement score by 0.852 than White after controlling other variables. Unstandardized regression coefficients for Asian, Black, Other race were not significant, while all of them showed higher student-student engagement score than White after controlling other variables.

Unstandardized regression coefficient of mindset was not significant, while average student-student engagement score increased by 0.152 for each additional increase of mindset, after controlling faculty's gender, ethnicity, and tenure status.

3.3.2 The Difference on Student-Content Engagement by Engineering Faculty's Mindset and Faculty Variables

A multiple regression using enter method was conducted to examine how the engineering faculty's student-content engagement was impacted by mindset and faculty's variables including tenure status, ethnicity, and gender. The interaction effects were excluded from the model since there was no significant change of R^2 and there were no statistically significant interaction effects after comparing the model including interaction effects and the model without interaction model.

As shown in Table 9, the engineering faculty's mindset and faculty variables including gender, ethnicity, and tenure status can explain a statistically significant amount of variance in faculty's student-content engagement scores, $F(7, 95) = 2.363$, $p = 0.029$, $R^2 = 0.148$, Adjusted $R^2 = 0.086$.

Unstandardized regression coefficient for male was not significant, while male showed lower student-content engagement score by 0.305 than female, controlling faculty's mindset, ethnicity,

and tenure status. Unstandardized regression coefficient for tenured faculty was statistically not significant, while tenured faculty showed lower student-content engagement score by 0.121 than not tenured faculty after controlling mindset, ethnicity, and gender. Unstandardized regression coefficients for Asian, Black, Multi-racial and other race were not significant, while all of them showed higher student-content engagement score than White after controlling other variables. Unstandardized regression coefficient of mindset was not significant, while average student-student engagement score increased by 0.145 for each additional increase of mindset, after controlling faculty's gender, ethnicity, and tenure status.

4. Discussion

As highlighted in the results of this study, several significant findings arose that add value to the literature for engineering education researchers and the education community, more broadly. First, when we considered the first research question, *what is the spectrum fixed through growth mindset of engineering faculty with respect to faculty demographics?*, our initial hypothesis was that there would be no difference between the engineering faculty when considering demographics such as gender, rank, tenure, status and socio-economic status (SES). We found, however, that there was a significant difference by gender. Faculty members who identified as female had higher scores on growth mindset than faculty who identified as male and more positively think intelligence and ability can be improved. These results provide insight into how the gender of a faculty member may shape their growth mindset linked to students' academic abilities. We could not locate any literature previously conducted in engineering education that examined these questions. We were able to find research that quantitatively studied the mindset of faculty, but it was not major specific [53]. Therefore, we suggest more research to relate faculty mindset to teaching practices within specific disciplines and to identify ways to enhance the growth mindset of our male colleagues who still are the majority of STEM faculty.

The underrepresentation of female faculty is evident by a study limitation that female faculty participants only made up 21% of the total respondents (18 of 86). Overall, the implications for the engineering education community would be to continue focusing on encouraging more women to pursue engineering careers including positions in academia. Several organizations (public and private), continue to invest in avenues that would diversify the engineering workforce, including focusing on women. Higher education can learn from industry where it has been shown that female leadership enhances the company performance and profit share [54, 55]. Additionally, researchers are calling for more gender balance in academic leadership [56]. Therefore, based on our results we should continue to reflect on not only female representation within the faculty but also how the teaching of female faculty can influence student career choices.

Similarly, our results related research question one, there was also a significant difference on mindset between tenured professors and non-tenured or tenured-track faculty who had yet to earn tenure (i.e., instructor, lecturer, research scientist, visiting professor, and other) showing that the non-tenure group had higher scores on mindset leading to more positive views on students' ability to improve their intelligence. This was also the same for pre-tenured and with tenured professors. For example, when full professors courses that are considered gateway courses (i.e., calculus, etc.) or courses that have high fail rates in engineering there is an increased chance that the culture of the classroom is more instructor-centered rather than student-centered. This can be explained by Dweck's concept of mindset and the PIPS. These results have implications on student academic success in engineering. Specifically, we should build structures to support STEM faculty adopting teaching innovation [57] and optimize faculty motivation to actively foster student success.

For the second research question, *is there a difference in instructional practice by mindset or faculty demographics*, our hypothesis is that there would be no difference. However, we found a gender-related difference also regarding instructional practice. While some studies examined faculty use of formative assessment within instructional practice, we were unable to find previous work that explored if the gender of the faculty member impacted the use of the assessment [58]. When focusing on *student-student engagement and student-content engagement*, results showed that faculty members who identified as female were more likely to engage in these activities. These findings support our earlier conclusion that increasing the number of women in engineering – specifically, increasing the number of women in engineering faculty positions – has a positive impact on student engagement and academic success. Future engineering education research can connect this finding to other student outcomes we know are related to their persistence and success in STEM, like sense of belonging or identity development.

Finally, tenured faculty showed less scored in mindset than not-tenured faculty, indicating not-

tenured faculty are having more incremental mindset. Also, the student engagement, while there is no statistically significant difference by tenure status, our data suggests that not-tenured faculty participated more in student-student engagement and student-content engagement than tenured faculty. Therefore, our analysis produced observable differences among faculty tenure status. The implications of these results include developing strategies to encourage full professors to maintain high levels of student engagement while focusing on technical content and continuing to support STEM faculty in adopting innovative assessment practices such as adopting culturally responsive assessment tools that are currently being investigated by some STEM educators in computer science [59, 60].

5. Conclusion

This study advances growth mindset and fixed mindset research by focusing on the engineering faculty who teach students, rather than centering our research on engineering undergraduate students which is usually what is done. We found statistically significant differences of areas when the demographics of faculty were considered. The results of our study highlight the need to further explore the instructional practices and mindsets of engineering faculty, especially as students pursing engineering degrees increasingly diversifies. Our study suggests that administrators and faculty can and should work to create tools and training to reshape the beliefs that might have a negative effect on student success and engagement. Significant findings related to this work provide strong cause for us to expand this research and include colleges of engineering that are larger in size and across varying regions of the country.

Implementing qualitative data from the interview and focus groups from this study along with new participants will provide additional context and explanations for the results found in this study. The survey instrument used in this study can also be refined and deployed in a national-level instrument to assess engineering faculty mindset across the United States.

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References

1. M. T. Hora, Exploring faculty beliefs about student learning and their role in instructional decision making, *The Review of Higher Education*, **38**(1), pp. 37–70, 2014.
2. K. Muenks, E. A. Canning, J. LaCosse, D. J. Green, S. Zirkel, J. A. Garcia and M. C. Murphy, Does my professor think my ability can change? Students' perceptions of their STEM professors' mindset beliefs predict their psychological vulnerability, engagement, and performance in class, *Journal of Experimental Psychology: General*, **149**(11), pp. 2119–2144, 2020.
3. K. Trzesniewski, D. Yeager, D. Catalán Molina, S. Claro, C. Oberle and M. Murphy, Global mindset initiative paper 3: Measuring growth mindset classroom cultures, Available at SSRN 3911591, 2021.
4. A. F. McKenna, B. Yalvac and G. J. Light, The role of collaborative reflection on shaping engineering faculty teaching approaches, *Journal of Engineering Education*, **98**(1), pp. 17–26, 2009.
5. National Research Council, *Discipline-based education research: Understanding and improving learning in undergraduate science and engineering*, National Academies Press, 2012.
6. D. N. Huntzinger, M. J. Hutchins, J. S. Gierke and J. W. Sutherland, Enabling sustainable thinking in undergraduate engineering education, *International Journal of Engineering Education*, **23**(2), p. 218, 2007.
7. K. A. Nguyen, M. Borrego, C. J. Finelli, M. DeMonbrun, C. Crockett, S. Tharayil, P. Shekhar, C. Waters and R. Rosenberg, Instructor strategies to aid implementation of active learning: a systematic literature review, *International Journal of STEM Education*, **8**(1), pp. 1–18, 2021.
8. S. Freeman, S. L. Eddy, M. McDonough, M. K. Smith, N. Okoroafor, H. Jordt and M. P. Wenderoth, Active learning increases student performance in science, engineering, and mathematics, *Proceedings of the National Academy of Sciences*, **111**(23), pp. 8410–8415, 2014.
9. B. C. Jones, C. M. Epler, P. Mokri, L. H. Bryant and M. C. Paretti, The effects of a collaborative problem-based learning experience on students' motivation in engineering capstone courses, *Interdisciplinary Journal of Problem-Based Learning*, **7**(2), pp. 34–71, 2013.
10. A. Yadav, D. Subedi, M. A. Lundeberg and C. F. Bunting, Problem-based learning: Influence on students' learning in an electrical engineering course, *Journal of Engineering Education*, **100**(2), pp. 253–280, 2013.
11. V. Tinto, Through the eyes of students, *Journal of College Student Retention: Research, Theory, and Practice*, **19**(3), pp. 254–269, 2017.
12. C. Hill, C. Corbett and A. St. Rose, *Why so few? Women in science, technology, engineering, and mathematics*, AAUW, 2010.
13. E. J. Theobald, M. J. Hill, E. Tran, S. Agrawal, E. N. Arroyo, S. Behling, N. Chambwe, D. L. Cintrón, J. D. Cooper, G. Dunster, J. A. Grummer and S. Freeman, Active learning narrows achievement gaps for underrepresented students in undergraduate science, technology, engineering, and math, *Proceedings of the National Academy of Sciences*, **117**(12), pp. 6476–6483, 2020.
14. J. K. Lee, A. T. Alston and K. B. Kahm, Identity threat in the classroom: Review of women's motivational experiences in the sciences, *Translational Issues in Psychological Science*, **1**(4), pp. 321–330, 2015.
15. P. A. Tetreault, R. Fette, P. C. Meidlinger and D. Hope, Perceptions of campus climate by sexual minorities, *Journal of Homosexuality*, **60**(7), pp. 947–964, 2013.

16. L. S. Blackwell, K. H. Trzesniewski and C. S. Dweck, Implicit theories of intelligence predict achievement across and adolescent transition: A longitudinal study and an intervention, *Child Development*, **78**(1), pp. 246–263, 2007.
17. M. D. Powers, *Growth mindset intervention at the community college level: A multiple methods examination of the effects on faculty and students*, [Doctoral dissertation, University of California Los Angeles], 2015.
18. G. S. Stump, J. Husman and M. Corby, Engineering students' intelligence beliefs and learning, *Journal of Engineering Education*, **103**(3), pp. 369–387, 2014.
19. S. E. Zappe, S. Cutler and T. A. Litzinger, *Teaching to promote a growth mindset.* IEEE Frontiers in Education Conference (FIE), Indianapolis, IN, USA, October 18–21, 2017, no. 17429297, 2017.
20. C. Dweck, What having a "growth mindset" actually means, *Harvard Business Review*, **13**, pp. 213–226, 2016.
21. C. Dweck, Carol Dweck revisits the growth mindset, *Education Week*, **35**(5), pp. 20–24, 2015.
22. C. S. Dweck, *Mindset: The new psychology of success*, Random House Incorporated, 2006.
23. J. Detwiler, J. L. Cox and K. Cheser, *A triptych study of the impact of teacher dispositions on teacher hiring and student outcomes, teacher and student growth mindsets, and student perceptions of teacher-student relationships*. (No. 3707252) [Doctoral dissertation, Northern Kentucky University]. ProQuest LLC, 2015.
24. C. A. Gutshall (2016). Student perceptions of teachers' mindset beliefs in the classroom setting, *Journal of Educational and Developmental Psychology*, **6**(2), pp. 135–142, 2016.
25. C. S. Dweck, Mind-sets and equitable education, *Principal Leadership*, **10**(5), pp. 26–29, 2010.
26. A. Rattan, C. Good and C. S. Dweck, It's ok – not everyone can be good at math": Instructors with an entity theory comfort (and demotivate) students, *Journal of Experimental Social Psychology*, **48**(3), pp. 731–737, 2012.
27. F. Brown and K. Cross, *Engineering faculty's mindset: An analysis of instructional practice, learning environment, and teacher authenticity.* 2019 IEEE Frontiers in Education Conference (FIE), Covington, KY, USA, October 16–19, 2019, no. 19469072, 2019.
28. F. Brown and K. Cross, *Engineering faculty's mindset and the impact on instructional practices*, 2020 IEEE Frontiers in Education Conference (FIE), Uppsala, Sweden, October 21–24, 2020, no. 20241865, 2020.
29. C. DeLuca, A. Coombs and D. LaPointe-McEwan, Assessment mindset: Exploring the relationship between teacher mindset and approaches to classroom assessment, *Studies in Educational Evaluation*, **61**, pp. 159–169, 2019.
30. K. S. Calisto, *A comparative case study of teachers who support an entity versus incremental view of intelligence*. (No. 3568616) [Doctoral dissertation, Capella University]. ProQuest LLC, 2013.
31. O. R. Aragón, S. L. Eddy and M. J. Graham, Faculty beliefs about intelligence are related to the adoption of active-learning practices, *CBE-Life Sciences Education,* **17**(3):ar47, pp. 1–9, 2018.
32. E. Etkina, K. Gibbons, B. L. Holton and G. K. Horton, Lessons learned: A case study of an integrated way of teaching introductory physics to at-risk students at Rutgers University, *American Journal of Physics*, **67**(9), pp. 810–818, 1999.
33. K. M. Holmes, The perceived undergraduate classroom experiences of African American women in Science, Technology, Engineering, and Mathematics (STEM) (No. 3599607) [Doctoral dissertation, University of Maryland], 2013.
34. J. Sweat, G. Jones, S. Han and S. M. Wolfgram, How does high impact practice predict student engagement? A comparison of white and minority students, *International Journal for the Scholarship of Teaching and Learning*, **7**(2), pp. 1–24, 2013.
35. L. C. Benson, K. Becker, M. M. Cooper, O. Hayden Griffin and K. A. Smith, Engineering education: Departments, degrees and directions, *International Journal of Engineering Education*, **26**(5), p. 1042, 2010.
36. S. J. Greenman, V. Chepp and S. Burton, High-impact educational practices: leveling the playing field or perpetuating inequity? *Teaching in Higher Education*, pp. 1–13, 2021.
37. C. J. Ballen, Enhancing Diversity in College Science with Active Learning, in: J., Mintzes Walter E. (eds), Active Learning in College Science: The case for evidence based practice. Berlin: Springer Nature, 2020.
38. A. Lisberg and B. Woods, Mentorship, mindset and learning strategies: An integrative approach to increasing underrepresented minority student retention in a STEM undergraduate program, *Journal of STEM Education*, **19**(3), 2018.
39. H. M. Matusovich, M. C. Paretti, L. D. McNair and C. Hixson, Faculty motivation: A gateway to transforming engineering education, *Journal of Engineering Education*, **103**(2), pp. 302–330, 2014.
40. M. Borrego, J. E. Froyd, C. Henderson, S. Cutler and M. Prince, Influence of engineering instructors' teaching and learning beliefs on pedagogies in engineering science courses, *International Journal of Engineering Education*, **29**(6), pp. 1456–1471, 2013.
41. J. Savage and J. Healy, Creative teaching design in STEM: Using graduate learning outcomes to distribute students' existing knowledge in first-year biology practical work group, *Journal of University Teaching & Learning Practice*, **16**(3), pp. 1–13, 2019.
42. G. D. Kuh, J. L. Kinzie, J. A. Buckley, B. K. Bridges and J. C. Hayek, What matters to student success: A review of the literature (Vol. 8), Washington, DC: National Postsecondary Education Cooperative, 2006.
43. W. M. Phillips, G. D. Peterson and K. B. Aberle, Quality assurance for engineering education in a changing world, *International Journal of Engineering Education*, **16**(2), pp. 97–103, 2000.
44. E. M. Walter, C. R. Henderson, A. L. Beach and C. T. Williams, Introducing the Postsecondary Instructional Practices Survey (PIPS): A concise interdisciplinary and easy-to-score survey, *CBE-Life Sciences Education*, **15**(ar53), pp. 1–11, 2017.
45. A. Haverkamp, M. Bothwell, D. Montfort and Q. L. Driskill, Calling for a Paradigm Shift in the Study of Gender in Engineering Education, *Studies in Engineering Education*, **1**(2), pp. 55–70, 2021.
46. American Society for Engineering Education (ASEE), Engineering and Engineering Technology by the Numbers 2019, Washington, DC, 2020.
47. J. V. Petrocelli, Hierarchical multiple regression in counseling research: Common problems and possible remedies, *Measurement and Evaluation in Counseling and Development*, **36**(1), pp. 9–22, 2003.
48. S. Setia, Z. Bobby, P. H. Ananthanarayanan, M. R. Radhika, M. Kavitha and T. Prashanth, Case based learning versus problem based learning: a direct comparison from first year medical students perspective, 2011.
49. B. H. Hancock, B. L. Sykes and A. Verma, The problem of "cameo appearances" in mixed-methods research: Implications for twenty-first-century ethnography, *Sociological Perspectives*, **61**(2), pp. 314–334, 2018.
50. M. A. Hjalmarson and B. Moskal, Quality Considerations in Education Research: Expanding Our Understanding of Quantitative Evidence and Arguments, *Journal of Engineering Education*, **107**, pp. 179–185, 2018.
51. C. M. Hoadley, Methodological Alignment in Design-Based Research, *Educational Psychologist*, **39**(4), pp. 203–212, 2004.

52. R. A. Peterson, A meta-analysis of Cronbach's coefficient alpha, *Journal of Consumer Research*, **21**(2), pp. 381–391,1994.
53. J. R. A. Santos, Cronbach's alpha: A tool for assessing the reliability of scales, *Journal of Extension*, **37**(2), pp. 1–5, 1999.
54. L. M. Rubin, E. A. Dringenberg, J. J. Lane and A. J. Wefald, Faculty beliefs about the nature of intelligence, *Journal of the Scholarship of Teaching and Learning*, **19**(4), pp. 1–17, 2019.
55. C. DeLuca, A. Coombs and D. LaPointe-McEwan, Assessment mindset: Exploring the relationship between teacher mindset and approaches to classroom assessment, *Studies in Educational Evaluation*, **61**, pp. 159–169, 2019.
56. L. Flabbi, M. Macis, A. Moro and F. Schivardi, Do female executives make a difference? The impact of female leadership on gender gaps and firm performance, *The Economic Journal*, **129**(622), pp. 2390–2423, 2019.
57. A. Khushk, Z. Zengtian and Y. Hui, Role of female leadership in corporate innovation: a systematic literature review, *Gender in Management: An International Journal*, (ahead-of-print), 2022.
58. L Howe-Walsh and S. Turnbull, Barriers to women leaders in academia: tales from science and technology, *Studies in Higher Education*, **41**(3), pp. 415–428, 2016.
59. K. J. Cross, N. Mamaril, N. Johnson-Glauch and G. Herman, Building cultures of collaboration that promote instructional change, *Studies in Engineering Education*, **2**(2), 2021.
60. D. Codding, B. Alkhateeb, C. Mouza and L. Pollock, From professional development to pedagogy: Examining how Computer Science teachers conceptualize and apply culturally responsive pedagogy, *Journal of Technology and Teacher Education*, **29**(4), pp. 497–532, 2021.

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