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دانشکده روان‌شناسی و علوم تربیتی

A Journal Club Presentation



دانشگاه صنعتی خواجه نصیرالدین طوسی

علی اشرفی زاده – دانشکده مهندسی مکانیک

۶ تیر ۱۴۰۰

فرهنگ اضطراب در دانشجویان مهندسی

۱/۵۷

پیشگفتار (چند نکته)

- گستردگی و غنای حوزه فعالیت های مشترک علوم انسانی (از جمله روانشناسی و علوم تربیتی) و آموزش مهندسی در مراجع خارجی
- روش انتخاب مقاله برای این جلسه
- موضوع مقاله : فرهنگ **stress** (فشار روحی یا اضطراب) در دانشجویان مهندسی
- توجه به تفاوت شرایط، مسائل و محیط کار و زندگی محققین آمریکایی با شرایط ما
- مختصری در باره زمینه تخصصی ارائه دهنده "برداشتی از مقاله"



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Engineering stress culture: Relationships among mental health, engineering identity, and sense of inclusion

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KEYWORDS

engineering identity, gender, inclusion, mental health, undergraduate education

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Dr. Kelly J. Cross, assistant professor of chemical engineering at University of Nevada Reno, is a culturally responsive practitioner, researcher, and educational leader.

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After completing the doctoral program in the Engineering Education Department at Virginia Tech in 2015, Dr. Cross worked as a post-doctoral researcher with the Illinois Foundry for Innovation in Engineering Education at the University of Illinois at Urbana-Champaign (UIUC).

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دانشکده روان‌شناسی و علوم تربیتی

Abstract

Background: Stress is commonly experienced by college students, especially engineering students. However, the role of stress within engineering culture and its implications for engineering programs have not been fully explored in the literature.

Purpose/Hypothesis: The purpose of this study was to measure and examine the relationships among self-reported stress, anxiety, and depression; engineering identity; and perceptions of inclusion of undergraduate engineering students.

Design/Method: We validated a quantitative survey instrument built on previously published scales and used it to measure self-reported stress, anxiety, and depression; engineering identity; and perceptions of inclusion.

Results: Our findings indicate that self-reported levels of stress, anxiety, and depression are high for engineering students. Further, levels of stress and anxiety are significantly higher for female students, while levels of depression are higher for first-generation students. We find correlations between self-reported mental health symptoms, engineering identity, and perceptions of inclusion, and these relationships differ by gender. Lastly, we find that students underrepresented in engineering rate their departments as less diverse than their peers.

Conclusions: Our results suggest that perceptions of inclusion and engineering identity are related to student mental health, further emphasizing the importance of developing inclusive cultures in engineering programs. The findings suggest that mental health needs greater attention in engineering education, particularly for female and first-generation students.



دانشگاه صنعتی خواجه نصیرالدین طوسی

- Stress is commonly experienced by college students, especially engineering students.
- Role of stress within engineering culture and its implications have not been fully explored in the literature.



Abstract

Purpose/Hypothesis



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We want to measure and examine the relationships among

- self-reported stress,
- anxiety and depression;
- engineering identity; and
- perceptions of inclusion.

The study group: **Undergraduate engineering students.**



دانشگاه خواجه نصیرالدین طوسی



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Abstract

Design/Method

- We validated a quantitative survey instrument built on previously published scales.
- Then used it to measure self-reported stress, anxiety, and depression; engineering identity; and perceptions of inclusion.



دانشگاه سوادکوه



دانشگاه صنعتی خواجه نصیرالدین طوسی



دانشگاه شاهرود - دانش و علم تریقی

Abstract

Results

- Self-reported levels of stress, anxiety, and depression are high for engineering students.
- Levels of stress and anxiety are significantly higher for female students.
- Levels of depression are higher for first-generation students.
- Gender-dependent correlations exist between self-reported mental health symptoms, engineering identity, and perceptions of inclusion.
- Students underrepresented in engineering, rate their departments as less diverse than their peers.



دانشگاه صنعتی خواجه نصیرالدین طوسی

- Our results suggest that perceptions of inclusion and engineering identity are related to student mental health.
- Developing inclusive cultures in engineering programs is important.
- Mental health needs greater attention in engineering education, particularly for female and first-generation students.



1. Introduction

Preliminary Remarks

1.1 Purpose

1.2 Theoretical Framework



دانشکده روان‌شناسی و علوم تربیتی



دانشگاه صنعتی خواجه نصیرالدین طوسی



1. Introduction

Preliminary Remarks



دانشگاه شاهرود
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Definition of the **engineering culture**:

the explicit and implicit customs and behaviors, norms, and values that are normative in the field. (NAS, NAE, NAM, 2016).

Engineering education culture (key assumptions):

the expectation of harshness coupled with struggle throughout the educational experience (Godfrey & Parker, 2010).

Heavy workloads and high expectations create an environment of “suffering and shared hardship” or boot camp mentality (Godfrey & Parker, 2010, p. 12).



دانشگاه صنعتی خواجه نصیرالدین طوسی



1. Introduction

Preliminary Remarks



دانشگاه شاهرود
دانشگاه شاهرود

In a 2012 study of engineering students, feeling a “lack of belonging” in engineering was cited as a top reason for their leaving the program (Marra et al., 2012, p. 6).

Understanding accepted norms in engineering culture, both how they arise and how they are perpetuated, is necessary for developing supportive and inclusive environments for all students.



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1. Introduction

Preliminary Remarks



دانشگاه سوادین

The culture of suffering and rigor in engineering academics suggests a norm of high stress levels that are already common among college students. Students report lack of sleep, fear of low grades, high levels of competition, changes in lifestyle, and other significant stressors throughout their undergraduate education (Ross et al., 1999), with engineering students emphasizing grades and academic rigor as significant stressors (Beiter et al., 2015; Jensen & Cross, 2019; Schneider, 2007).

One recent study found that engineering students were twice as likely to experience mood and anxiety disorders compared with the general college population (Danowitz & Beddoes, 2018).



دانشگاه سوادین



1. Introduction

Preliminary Remarks



دانشگاه شاهرود
دانشگاه شاهرود

Over the last two decades, higher education has been grappling with what has been described as a mental health crisis (**Kruisselbrink Flatt, 2013; Schwartz & Kay, 2009**) as mental health disorders are rising in prevalence and severity in college students (**Hunt & Eisenberg, 2010**).

As the number of cases and severity of mental health problems have increased, the requests for services at campus counseling centers are also on the rise (**Benton et al., 2003; Gallagher, 2013; Hunt & Eisenberg, 2010**). For the period 2007–2017, rates of treatment increased from 19 to 34% (**Lipson et al., 2019**).



دانشگاه صنعتی خواجه نصیرالدین طوسی



دانشگاه تهران

1. Introduction

Preliminary Remarks

In a recent study, engineering students with apparent mental health problems were less likely to receive treatment compared with students in other academic disciplines (Lipson et al., 2016). Together, these studies suggest that proactive interventions that consider social identities are needed to support engineering students and create inclusive cultures.



دانشگاه صنعتی خواجه نصیرالدین طوسی



1. Introduction

Purpose



Previous studies have focused on factors that cause individual students stress while completing undergraduate engineering degree programs (Schneider, 2007). However, it is not well understood how a culture of stress is perceived by students nor how this perception impacts student levels of identification with engineering and feelings of inclusion. The purpose of the study is to characterize the engineering stress culture (ESC) and understand the relationship of various identities with these constructs.

This research is part of a larger mixed methods study that seeks to understand the role of mental health in engineering culture.





1. Introduction

Purpose



Our previous work has shown that undergraduate engineering students associate studying engineering with poor mental health (**Jensen & Cross, 2019**).

Here, we lay the foundation for our study that examines the relationships among constructs including mental health, engineering identity, and perceptions of inclusion, and how these relationships vary by social identities.



1. Introduction

Theoretical Framework

Social identity theory (SIT) is a broad social psychology theory of the role of self and identity within group and intergroup interactions (Hogg, 2016; Tajfel, 1974).

Researchers have used SIT to study both group relations and self-categorization to understand intergroup behaviors such as conflict, cooperation, and social change.

There are limited studies applying identity theory to investigate the experience of engineering students (Pierrakos et al., 2009).



دانشگاه سوادکوه و علوم تربیتی

1. Introduction

Theoretical Framework

In this exploratory study, we chose SIT as a theoretical framework to understand the social interactions that occur within the engineering culture.

SIT provided a basis for us to understand the group identities of the participants and the contextual role of engineering culture when students interact among groups.



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دانشگاه سوادکوه

2. Methods

2.1 Research Questions

2.2 Measures

2.2.1 Stress, Anxiety and Depression

2.2.2 Engineering Identity and Career

2.2.3 Inclusion

2.2.4 Demographic Information

2.2.5 Open Response

2.3 Eligibility

2.4 Participants

2.4.1 Data Collection



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2. Methods

2.1 Research Questions

Our study sought to answer the following questions:

1. To what extent do levels of self-reported stress, anxiety, and depression for engineering undergraduates differ by social identities?
2. To what extent do perceptions of inclusion and engineering identity for engineering undergraduates differ by social identities?
3. What is the relationship between engineering students' level of identification with engineering and their self reported mental health and perceptions of inclusion? How do these relationships differ by social identities?

social identities:

gender, race, first-generation status, native English-speaking status, and socioeconomic status





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2. Methods

2.1 Research Questions

We hypothesized that

- Levels of stress, anxiety, and depression would vary by social identities (RQ1).
- Levels of inclusion and engineering identity would vary by social identities (RQ2).
- The relationships among these constructs would also vary across social identities (RQ3).

To address these research questions, we conducted quantitative surveys to understand the relationships among mental health, engineering identity, and perceptions of inclusion.

Mental health: self-reported stress, anxiety, and depression



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2. Methods

2.2 Measures

Four existing surveys were used to measure each of these constructs in addition to demographic information. Together, the survey consisted of 56 items. A complete list of survey items is included in the Appendix (Table A1).

TABLE A1 Complete list of 56 survey items including prompts, scales, and individual items

Survey	Subscale	Prompt	Scale	Items
Engineering identity		In general, how much do you agree with the following statements about you?	7-point scale with anchored ends (strongly disagree to strongly agree)	<p>Being good at engineering is an important part of who I am.</p> <p>Doing well on engineering tasks is very important to me.</p> <p>Success in engineering school is very valuable to me.</p> <p>It matters to me how I do in engineering.</p>



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2. Methods

2.3 Eligibility

The participant inclusion criteria included full-time students in the College of Engineering who were 18 years of age or older who agreed to participate in the study.

The eligibility of students was determined by undergraduate student status in the college, which was evaluated by student identification number.



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2. Methods

2.4 Participants

A total of 1190 responses were collected. Of these, we deemed 1173 responses valid for analysis based on agreement to the study terms and eligibility criteria.

The response rate was approximately 15.5% of the student body. Responses that did not meet the eligibility criteria were removed from the dataset.

The percentage of women participating in the survey (32.2%) is greater than the percentage of undergraduate women enrolled in the college (22.0%). Thus, our survey population represents an oversampling of female undergraduates in the college.



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2. Methods

2.4 Participants

The study participants represented all departments in the college.

Participants included undergraduates at all levels of study.

The average age of the participants was 20.04 ± 1.89 years.



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The respondents included

- 17 (1.45%) Black or African American students,
- 85 (7.25%) Hispanic/LatinX students, and
- 4 (0.34%) American Indian/Alaskan Native students.
- Non-AHN students comprised 90.96% of the respondents.
- 87.34% indicated they were in the middle to upper socioeconomic status.
- 15.31% of the respondents reported being first generation college students.
- 23.99% indicated that English was not their first language.

AHN: African American/Black, Hispanic/LatinX, and Native American/Alaskan Native responses





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2. Methods

2.4 Participants

2.4.1 Data Collection

Institutional Review Board approval was obtained to conduct the study at three large public universities in the United States that offer undergraduate engineering degree programs (University of Illinois Urbana-Champaign).

A pilot study was conducted in Fall 2017 with 18 undergraduate and graduate students at two large public universities in the United States to test the survey platform and clarity.

For the main data collection, we collected survey responses from undergraduate engineering students enrolled at a large public research-intensive institution in the Midwest United States.



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2. Methods

2.4 Participants

2.4.1 Data Collection

The survey was distributed via email at the end of the Fall 2017 Semester to more than 7000 engineering students. Additional recruitment material included fliers displayed in buildings that primarily held engineering courses.

A second email reminding students of the survey was sent one week after the initial invitation to participate.

Participants were asked to provide their student identification number to verify eligibility.



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2. Methods

2.4 Participants

2.4.1 Data Collection

We randomized the location of the demographic questions at the beginning or end of the survey to determine if there was an impact on the responses.

We offered a \$5 Amazon.com gift card to the students for participation. At the conclusion of the survey, participants were presented with information for the campus counseling center and health center, information for the emergency dean, and contact information in the event of a mental health crisis. Across all responses collected, on average, participants completed the survey in less than 6 min.



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3. Analysis

3.1 Statistical Analysis

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS) Version 25 (2017) and R Version 3.3.3 (2017).

We made statistical comparisons between

- AHN versus non-AHN,
- first-generation versus non-first generation status, and
- native English speaking versus non-native English speaking student groups, as well as by gender.

We used skewness and kurtosis (both univariate and multivariate) to evaluate normality.



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4. Results

4.1 Instrument Validity

4.1 Instrument Validity

4.2 Instrument Reliability

4.3 Order of Demographic Questions

4.4 Descriptive Statistics

4.5 Levels of self-reported stress, anxiety, and depression

4.6 Comparison of perceptions of engineering identity and perceptions of inclusion

4.7 Relationships among mental health, engineering identity, and perceptions of inclusion



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4. Results

4.3 Order of Demographic Questions

Survey	Construct	Cronbach's alpha
DASS-21	Stress	0.781
DASS-21	Anxiety	0.875
DASS-21	Depression	0.896
Identification with academics subscale adapted to engineering	Engr Identity	0.905
EDIL	Dept Caring	0.929
EDIL	Dept Pride	0.847
EDIL	Dept Diversity	0.814

TABLE 1
Reliability
of survey
subscales
using
Cronbach's
alpha

EDIL: Engineering Department Inclusion Level.

DASS-21: Depression Anxiety Stress Scales



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4. Results

4.4 Descriptive Statistics

Descriptive data (number of measures, minimums, maximums, means, and standard deviations) for all subscales are reported in Table 2.

To provide justification for statistical testing procedures, we calculated skewness and kurtosis and used the Shapiro–Wilk test to determine whether our data are normally distributed (**Razali & Wah, 2011**).

We found that all constructs do not fit a normal distribution and, therefore, are suitable for nonparametric analysis.



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TABLE 2
Descriptive
statistics
for
constructs

Construct	N	Minimum	Maximum	Mean	SD
Stress	1008	0	42	13.93	9.264
Anxiety	1008	0	42	8.30	8.505
Depression	1008	0	42	11.41	10.023
Engr Identity	1000	1	7	5.83	1.212
Engr Career	1003	1	7	5.84	1.628
Dept Caring	1005	1	6	4.31	0.904
Dept Pride	1005	1	6	4.88	0.974
Dept Diversity	1004	1	6	4.68	0.976

4. Results

4.5 Levels of self-reported stress, anxiety, and depression



High levels of self-reported stress, anxiety, and depression were reported in our student population (Table 3).

In our sample,

- 28.97% of students reported moderate to extremely severe stress,
- 35.81% moderate to extremely severe anxiety, and
- 34.92% moderate to extremely severe depression.





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دانشگاه شاهرود - دانش و علم تریقی

5. Discussion

Preliminary Remarks

5.1 High prevalence of self-reported stress, anxiety, and depression in undergraduate engineering students

5.2 Culture in undergraduate engineering programs

5.3 Limitations

5.4 Implications for higher education



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While concern has grown about the mental health crisis for both undergraduate and graduate students in recent years (Evans et al., 2018; Kruisselbrink Flatt, 2013; Schwartz & Kay, 2009), there is limited research on the mental health of undergraduate engineering students.

The research presented here measures the prevalence of self-reported stress, anxiety, and depression in a sample of undergraduate engineering students and the relationships among these metrics and engineering identity and perceptions of inclusion. Overall, the results from this study suggest that mental health is an urgent issue needing immediate attention in undergraduate engineering programs and that social identity may be an important consideration in developing interventions.

5. Discussion

5.1 High prevalence of self-reported stress, anxiety, and depression in undergraduate engineering students

- 29.0% of students reported symptoms of moderate to extremely severe stress,
- 35.8% symptoms of moderate to extremely severe anxiety, and
- 34.9% symptoms of moderate to extremely severe depression.

The results suggest that engineering students may suffer from particularly high levels of stress, anxiety, and depression that are already high for college students.



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5. Discussion

5.1 High prevalence of self-reported stress, anxiety, and depression in undergraduate engineering students

These findings emphasize the need to develop targeted interventions that specifically address the specific needs of students from varying backgrounds to support their mental health and retention in engineering programs.



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دانشگاه شاهرود شاهی و علوم تربیتی

5. Discussion

5.2 Culture in undergraduate engineering programs

In the study reported here, we investigated student engineering identity and perceptions of inclusion to better understand students' experiences of the culture in undergraduate engineering programs.

We further investigated relationships among engineering identity, perceptions of inclusion, and self-reported mental health. These correlations indicate potential relationships among these metrics but do not prove causality.

The study results suggest that these correlations varied both in presence/absence and strength by gender.



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5. Discussion

5.3 Limitations

The present study has several limitations that affect its generalizability.

The current study is limited in that it describes only one time point during the semester. The survey was administered toward the end of the semester, which could be a time of higher stress for undergraduate students due to upcoming final examinations and/or projects.

Participants had the option to skip questions or parts of questions, resulting in some of the responses being incomplete.

Reliance on self-reported mental health could also introduce biased responses.



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5. Discussion

5.3 Limitations

The current study was conducted at one institution, specifically a large public institution, and may not be representative of culture at other institutions.

Small numbers of student groups and the need to maintain participant anonymity limited the analyses by race and ethnicity, which is a significant limitation of the study.

The survey did not include information about student participation in cocurricular activities or about disciplinary supports, which may be useful in understanding student experiences.



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دانشکده روان‌شناسی و علوم تربیتی

5. Discussion

5.3 Limitations

The survey did not ask students to report their level in the program (e.g., freshman, sophomore, junior, or senior), and perceptions of inclusion may change over the course of a degree program.



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دانشگاه شاهرود دانشی و علوم تربیتی

5. Discussion

5.4 Implications for Higher Education

- High rates of mental health challenges for engineering undergraduates necessitate increased services and support for students as well as increased awareness and training for faculty and staff.
- Collectively, our results and previous work suggest that mental health of engineering students is a major concern that needs attention.
- Further, this work suggests that female engineering students experience stress and anxiety at higher levels than male students.



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5. Discussion

5.4 Implications for Higher Education



دانشگاه شاهرود

- How social identities impact student experiences of engineering culture and the implications for mental health will be critical in designing interventions to support student groups.
- Overall, expanding the knowledge of the mental health of undergraduate engineering students will contribute to the development of interventions and recommendations for faculty, advisors, and administrators, who directly impact the climate and reputation of engineering programs.



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5. Discussion

5.4 Implications for Higher Education

- By understanding the relationships among mental health and engineering education, programs, advising, and teaching practices could adopt a more proactive focus on well-being and student thriving (Ge & Berger, 2018) that promotes positive mental health.
- This work can also support optimizing curriculum development and instructional design to support students facing mental health challenges.



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6. Future Work

- Given the high prevalence of mental health problems seen in engineering undergraduate students and the implications for recruitment, retention, and success, it is important to further our understanding of the relationship between engineering education and student mental health and well-being.
- Further work is needed to examine the causes of these relationships and the reason why different demographic groups experience different rates of mental health problems.



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6. Future Work

- Additionally, differences in cultures among engineering disciplines could be examined.
- Future work that analyzes student experiences through the lens of intersectionality may also be beneficial.
- It is important to understand specific stressors and the students' positive and negative coping responses to them.
- It is useful to understand how students' self-reported mental health, engineering identity, and perceptions of inclusion change longitudinally over their courses of study, particularly in relationship to experiences, grades, and other factors.



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6. Future Work

- It is important to understand what programmatic features and discipline-specific factors contribute to a culture of high stress and how students and faculty propagate this culture.
- Future work could include graduate student, postdoctoral, and junior faculty populations to study how a culture of stress affects these populations and their decisions to continue in academia.
- Additionally, due to the small number in the current study sample, in future work we can oversample for minoritized populations and collaborate with minority serving institutions (MSIs) or historically Black colleges and universities (HBCUs) to recruit more AHN-identified respondents.



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7. Conclusion

- While previous work has described high levels of stress experienced by engineering students, the relationships among mental health, engineering identity, and inclusion have not been studied.
- We studied stress as part of engineering culture through the lens of SIT. In this exploratory study, we sought to measure relationships among mental health, engineering identity, and inclusion and how they differ across social identities.
- The results of our study revealed a high prevalence of self-reported stress, anxiety, and depression in undergraduate engineering students, with stress and anxiety levels being higher for female students.



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7. Conclusion

- We identified correlations among engineering identity, inclusion, and mental health, emphasizing the importance of developing inclusive cultures in engineering departments.
- Further, we found that these relationships were different for female students compared with male, supporting other scholarship that highlights the importance of identity in the student experience of engineering culture.
- Additional work characterizing the factors that modulate these relationships is important in developing strategies to promote positive mental health for undergraduate students in engineering to improve student recruitment, retention, and success.



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