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Comparing Wellbeing Indicators, Perception of Stress, Competition, and Achievement Between Undergraduate Engineering, Other STEM, and Non-STEM Majors

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Abstract

The mental health crisis faced by colleges and universities across the U.S. has unveiled the need to understand more about the elements of the college experience that might be contributing to the detriment of students' mental health. While the demands of a college degree are high despite the selected major, there are elements in the student experiences in particular majors that might make things more complicated. In the case of engineering, it has been argued that the assumption of the rigor and prestige involved in the pursuit of an engineering major imposes additional pressures related to competition and achievement, which could reflect in poorer mental health. Furthermore, such pressures might be heightened for underrepresented groups that keep facing cumulative challenges while pursuing an engineering degree. While some recent work has explored stress and mental health indicators of engineering undergraduates, comparisons of such indicators across disciplines are scarce. This study examines the differences in wellbeing indicators, perceptions of stress, competition, and achievement between undergraduates in engineering, non-engineering STEM, and non-STEM majors. Using data from the Healthy Minds Study for the academic year 2019-2020 under the framing of social identity theory, we found no difference in the weighted means of students' positive mental health outlook, also known as flourishing. There were some significant differences in depression and anxiety scores, which indicated lower scores among engineering students when compared to other groups. Furthermore, a lower sense of belonging and identity connectedness was also identified among engineering students at a significant level. These results indicate the need for additional research in understanding the role of belonging and identity in the mental health of engineering undergraduates. A more granular analysis is necessary to disentangle the nuances among the different groups considered and expand our understanding of the cultural elements in engineering education relevant to student mental health and wellbeing.

Introduction

Mental health is an emerging topic that has rapidly become a largely discussed issue. This particular discussion has highlighted the ongoing mental health crisis in students at many universities and colleges in the United States [1]. As a whole, college-aged individuals are prone to mental disorders [2]. The effect of said struggles on college students is emphasized upon returning to school and disrupts these individuals' educational paths [3]. This phenomenon can be attributed to factors such as financial difficulties, relationship difficulties, concerns about the future, lack of faculty support, and workload [4], [5]. Lesser known is the effect of mental health struggles on engineering students. There is evidence that shows that engineering, as a degree, has a low retention rate and that students are not as likely to graduate within four years when compared to other fields [6]. Such can be attributed to course difficulty, hostile academic settings, and lack of support or self-confidence [7]. These are qualities that are often associated with the rigor and stress associated with an engineering degree. While some studies have indicated the increased presence of mental health issues in engineering [8], their prevalence

compared to other fields has not been explored. This paper explore the differences in wellbeing indicators between engineering, non-engineering STEM, and non-STEM students. We followed the NSF definition of Science, Technology, Engineering, and Math fields for this purpose. We define non-engineering STEM students as those in the natural sciences, social sciences, and health sciences; and non-STEM students as those in the humanities, art, education, business, architecture, music, and public policy. Considering these groups, we will answer the following research questions:

RQ1. How do wellbeing indicators compare between undergraduate students in engineering, non-engineering STEM, non-STEM majors?
RQ2. How do perceptions of stress, competition, and achievement compare between undergraduate students in engineering, non-engineering STEM, or non-STEM majors?

Literature Review

In recent years, universities worldwide have seen a surge of students struggling with their mental health [1]. More than ever, college-aged young adults need support but are limited by things such as stigma [9], lack of resources [10], and lapses in the knowledge of such sources [11]. This section dives into the literature documenting the mental health challenges of college-aged adults and situates our contribution in the engineering education space.

Mental Health in College Students

It is no surprise that college-aged young adults (ages 18-24) are subject to increased mental health struggles compared to other age groups [1]. Attending university exposes students to a variety of new situations and is a period of transition. As young adults move towards their future, they are faced with many decisions and new social norms. Heightened challenges for these students are evident when they move into post-secondary education. Students confront the pressure to create a basis for their future through life planning, rapidly transitioning from son/daughter roles to a role as a college student, and self-development. They receive both positive and negative feedback on all of their decisions, prompting them to adjust these plans for their future [12] rapidly. Such pressure feeds into increased stress levels of these students attempting to keep up with the fast-paced world of their chosen university. A study exploring the sources of stress of college students found that the two top stressors for college students were those related to interpersonal stress derived from new relationships, changes in social activities and conflicts with parents, and academic stress [12]. It has also been extensively documented that individuals with higher exposure to high-stress life events are at a higher risk for depression and depression events [13].

Stress is a complex causal factor for poor mental health in college students. Stress is intertwined with stigma [9], lack of support resources [10], lack of knowledge of such resources [11], and not having a perceived need for help also contributes heavily to students' mental health struggles experience [14]. On the forefront of the list of these reasons for poor mental health in college students is a lack of resources. In a 2016 study completed by the *Midwestern Higher Education Compact (MHEC)*, it was found that 54% of four-year institutions offered psychiatric services, while only 8% of two-year institutions offered such services. The study also found that approximately 12.5% of students seek counseling services based on a seven-year average [15].

Although this does seem like a large percentage concerning the total student population, this figure pales compared to the percentage of students who experience poor mental health. A national survey conducted by the *American College Health Association (ACHA)* in Spring of 2019 found that 20% of students across all academic years reported that they were clinically diagnosed with depression within the past 12 months. Additionally, 24.3% of the surveyed college students said they were clinically diagnosed with anxiety in the past 12 months [16]. Therefore, there are significant disparities between the students who need professional services and those seeking them or have access to them.

Mental Health in Engineering Students

Engineering is a degree field that is well known for its rigorous and competitive courses. There is some speculation that engineering students are more prone to poor mental health due to the nature of the course load and consequently an improper work-life balance [4]. Such claimed link stems from the fact that the rigor and competitiveness it takes to succeed in an engineering program are often associated with elevated stress levels [17]. Additionally, the logical thought processes that engineers typically have [18] induces a stigma around mental health struggles while also contributing to an unperceived need for help. As discussed in the previous section, stigma can often reduce the number of people who seek help. The *Australian and New Zealand Journal of Psychiatry* published a study that explored the distress levels and rate of help-seeking in multiple degree fields. It was found that "There were considerable differences in diagnosis or treatment rates across the disciplines, with Mechanical Engineering having the lowest rate at 6%" (p.612). In this same study, it was found that 52% of the Mechanical Engineering were classified as psychologically distressed [19]. Also, of the 204 Mechanical Engineering students who participated in the study, 106 had poor mental health, while only 12 students sought help.

Another study compared and contrasted the serious mental illness screening levels of engineering students against the U.S. adult population. The report detailed that "The Kessler scale indicates that roughly 38% of respondents screen for high risk of Serious Mental Illness. This is roughly an order of magnitude more than the reported 4% of the U.S. adult population estimated to suffer from a Serious Mental Illness, and more than double the 17.9% of adults estimated to suffer from any mental health condition overall" (p. 6) [8]. Such findings further support the notion that college engineering students are more prone to poor mental health and therefore have more of a need for resources (i.e., counseling, mental health services). Although this need is there, a reduction in the stigma surrounding mental health is still required so that engineering students are more open to the idea of using the resources offered at their respective universities.

Research Design

In this study, we use the lens of social identity theory to conduct an exploratory quantitative analysis of existing data. Data was collected by institutions of higher education using validated instruments organized by the Healthy Minds Network [20]. Data was accessed upon request to the Healthy Minds Network in an anonymized format. As such, our procedures for data access were except an Institutional Review Board. Taking advantage of the large secondary data contained in the Healty Minds Study, a series of decisions were made to analyze the presented groups of interest, which are described next.

Theoretical Framework

Social identity theory [21] proposes that we strive to maintain positive identities through differentiation as individuals. By developing a sense of belonging to particular groups, we differentiate ourselves and our ingroups from other groups or *outgroups*. In that sense, the theory helps understand professional cultures' development and how untold behaviors and habits are intertwined with normalized norms and rules within particular groups. The development of a social identity starts with the process of *social categorization*. This categorization helps us developing a perception of the existence of different social groups. The process of *social identification* corresponds to finding which groups we belong to and delineating the ingroup/outgroup nature of those that are like us and those that are not like us according to certain characteristics. We adopt particular values, attitudes, and behaviors as ingroups and reject those corresponding to outgroups through this process. This later supports our process of social comparison between ingroup and outgroup individuals, resulting in an elevated sense of the ingroups and alienation of outgroups.

Social identity is heavily influenced by the labels that we are granted or decide to adopt, like those attached to a profession or field, and differs from self-identity, which the individual consciously defines. In engineering, social identity theory has already been used to question if the norms of stress and endurance are promoted in the field. A recent study using social identity as a framework explored the role of stress in the engineering culture [17]. Their survey results to 1,203 students found that engineering identity was positively associated with students' perceptions of diversity and inclusion, and anxiety was positively correlated with stress and negatively correlated with perceptions of inclusion. Low perceived inclusion or lack of belonging has been an identified issue for engineering students, particularly affecting their retention and success [22]–[24].

Aligned with social identity theory, in this study, we hypothesize that students in different fields will have different levels of wellbeing as well as perceptions of stress, competition, and achievement. This relationship is hypothesized because they would be socialized in different characteristics that are deemed particular to their fields. In this exploration, we first use large groups to identify any specific differentiation of engineering compared against the other two large categories considered. However, future work will involve the exploration of differences between engineering and specific majors individually.

Methods

Data

We used data from the Healthy Minds Study (HMS), a web-based survey administered through the Healthy Minds Network for Research on Adolescent and Young Adult Mental Health (HMN). The initiative was first established in 2007 and uses validated instruments to measure various indicators of mental health status, perceptions of mental health climate, perceptions of diversity and inclusion, and many other indicators of student wellbeing. The HMS has been deployed yearly to institutions interested in using it as an assessment tool for the mental health issues of their undergraduate and graduate students, as well as service utilization and needs. Since its inception, the HMS has been deployed to some 320 colleges and universities, reaching

more than 400,000 students cumulatively. Data collected through the HMS is publicly available upon request to the HMN who distributes merged multi-institutional de-identified data for research purposes. Following this procedure, we accessed data from multiple years, although this first exploration is focused on data for the academic year 2019-2020.

The 2019-2020 HMS dataset had 87,571 valid observations, from which 57,890 (66%) were undergraduates and had 2,356 variables. A limited subset of these variables was used for this first exploration. Data for this year was coming from 75 different colleges and universities. However, it is important to note that each university determines which sets of questions to include on their specific survey each year. Therefore, not all variables were available for all observations. In fact, such restriction reduced our available sample in two orders of magnitude for the analysis of perceptions of stress, competition, and achievement.

We focus our analysis in the HMS sections exploring students perceptions of Mental Health Climate (Sense of Belonging, Perceptions of campus climate, feelings of safety) and students perceptions of Climate for Diversity and Inclusion, which involves measurements for (1) School Climate, (2) Sense of Belonging, (3) Experiences of Discrimination, (4) Identity Connectedness, (5) Perceptions of campus programs/policies/efforts. Finally, we also include the study of an HMS section focused on Competition, which involves measurements for Stress mindset, Perceived Competition, and Clarifying achievement goals and their impact. Each of the listed constructs were measured by different validated instruments. Their actual question items, scales, and original sources mentioned in the HMS are detailed in Appendix 1.

As mentioned, for this exploratory study, three groups of students were identified based on their field of study. The first group includes *engineering* students only; the second was deemed *non-engineering STEM* and includes students from the natural sciences, social sciences, and health sciences to follow the NSF definition of Science, Technology, engineering, and math. Students in the humanities, art, education, business, architecture, music and public policy were deemed as *Non-STEM*. We did not adjust for students having more than one major, although we assigned precedence to an engineering major. Therefore, students that majored in engineering and something else were grouped with engineering. In addition, a large number of students did not found the offered majors suitable and entered theirs as "other" such observations were not included in our analysis, but their inclusion should be considered for future iterations.

Table 1 shows the distribution of the students in our sample for each group by their main demographic characteristics. We can see that the student sample in the engineering group has a higher representation of women than what is known in the field [25] and a proportion higher than 50% females in the Non-Eng STEM and Non-STEM groups. This overrepresentation might be attributed to voluntary response bias, and it is expected that the use of survey weights will balance such disparity.

Table 1. *General characteristics of the sample of undergraduate students in HMS 2019-2020 data*

	Engineering		Non-Eng STEM		Non-STEM	
	n	%	n	%	n	%
Sex assigned at birth						
Male	5062	61.84	4603	21.27	7901	28.16
Female	3109	37.98	17015	78.62	20131	71.74
Intersex	5	0.06	6	0.03	10	0.04
NA	10	0.12	18	0.08	20	0.07
Gender						
Male	4999	61.07	4483	20.71	7787	27.75
Female	3034	37.06	16591	76.66	19593	69.82
Trans Male/Trans Man	12	0.15	84	0.39	107	0.38
Trans Female/Trans Women	18	0.22	35	0.16	41	0.15
Non-Conforming	69	0.84	193	0.89	332	1.18
Self-Identify	51	0.62	137	0.63	181	0.65
NA	3	0.04	119	0.55	21	0.07
Ethnicity*						
African American/Black	406	4.96	1876	8.67	2336	8.32
American Indian/Alaskan Native	102	1.25	360	1.66	466	1.66
Asian American/Asian	1363	16.65	2416	11.16	2639	9.4
Hispanic/Latinx	766	9.36	2597	12	3305	11.78
Native Hawaiian/Pacific Islander	43	0.53	172	0.79	203	0.72
Middle Eastern, Arab, or Arab American	223	2.72	450	2.08	518	1.85
White	5982	73.08	16131	74.54	21174	75.45
Self-Identify	109	1.33	257	1.19	388	1.38
Citizenship						
International Student	498	6.08	691	3.19	936	3.34
Non-International Student	7673	93.73	20919	96.66	27068	96.46
NA	15	0.18	32	0.15	58	0.21
Total	8186	14.14	21642	37.38	28062	48.47

* Ethnicity allowed students to have multiple choices, therefore the sum of proportions go beyond 100%

Data Analysis

For the intended comparison between groups, we used weighted t-tests between (a) Engineering and non-Eng STEM, and (b) Engineering and non-STEM. With this division, we were expecting that the differences between engineering and other STEM majors might have been smaller than those when comparing to non-STEM majors. All considered constructs were mapped to their particular variables through the HMS codebook, inverse coded when necessary, and the total scores were used for the presented comparisons. HMS data included the survey weights that the survey providers calculated after data was initially collected. Such weights were calculated considering the stratification strategy of the survey deployment and the composition of main demographic variables such as gender, ethnicity, academic level, and grade point average [26]. While survey responses can be re-weighted based on the factors of preference, we refrain from doing so as we did not have the information from each institution to use in the re-weight process.

Our analysis was conducted through R and supported by the survey package, which allows for analyzing weighted data derived from survey designs like HMS.

We used a confidence level of 95% for our estimates and performed two-tailed tests to identify differences in either direction. Normality assumptions were evaluated and failed for multiple of the indicators under study, for those scales, non-parametric tests were performed and offered redundant results to those of the t-tests, therefore only t-test results are presented.

Results

The first analysis conducted involved the comparison of student wellbeing indicators described as: (1) Flourishing, (2) Depression, and (3) Anxiety. Flourishing refers to students' positive mental health mindset since it was measured by the Flourishing scale proposed by Diener & Biswas-Diener (2009). This denoted students' perceptions of having a meaningful and happy life. Ranging in values from 8 to 56, we did not find any significant differences in the pairwise comparisons of the groups under analysis.

When analyzing depression levels of students, as measured by the Patient Health Questionnaire-9 & 2 (Kroenke et al., 2001), there was a significant difference between the considered groups. However, engineering students had the lowest levels of depression among the three groups. It is important to notice that the range of the PHQ9-2 is from zero to 25, the general mean, and that of each group is relatively low, which calls for a reconsideration of better alternatives to compare the prevalence of depression issues.

When evaluating differences in Anxiety symptoms, which were evaluated through the GAD-7 questionnaire (Spitzer et al., 2006), engineering students showed the lowest levels of anxiety. However, from its original range of 0 to 20, it is clear that all groups' mean is located in a moderate range and alternatives for their evaluation should be considered.

Table 2. Weighted means for wellbeing indicators per group and results from their pairwise comparisons

	Engineering (n = 5,536) Mean (S.E.)	**NonEngSTEM (n = 16,220)** Mean (S.E.)	**NonSTEM (n =21,460)** Mean (S.E.)	**Eng-NonEng STEM**	**Eng-NonSTEM**
Flourishing	42.9 (0.13)	43.03 (0.09)	43.22 (0.08)	-0.13	-0.32
Depression	8.01 (0.08)	8.91 (0.06)	8.58 (0.05)	-0.91*	-0.58*
Anxiety	6.23 (0.07)	7.69 (0.05)	7.33 (0.05)	-1.45*	-1.09*

When analyzing the weighted comparisons of elements related to mental health climate, engineering students showed a significantly lower mean in their sense of belonging when compared to non-engineering STEM students but not when compared to non-STEM students. This is consistent with the found differences in perceptions of campus climate, in which engineering students showed significantly higher scores. Based on the scale wording, higher scores reflect a poor perception of campus climate. There were no significant differences observed in the feelings for safety.

Focusing on the Climate of Diversity and Inclusion elements, it was interesting to observe that sense of belonging did not show any significant differences between the groups under analysis. It is important to notice that we kept a "sense of belonging" scale for both purposes, as a validation measure, and exploration of the scales' allowances. It was clear that while labeled the same, the measures obtained by both scales were not in agreement, which would warrant further study. Engineering students had a statistically significant lower identity connectedness than the other two groups. Nevertheless, they also showed the highest level of perceptions of campus programs, policies, and efforts, which were significantly higher than their non-engineering STEM counterparts, but not against non-STEM majors.

Table 3. Weighted means for Mental Health Climate and Diversity and Inclusion Constructs across groups and their comparisons

	Engineering (n = 1,671) Mean (S.E.)	**NonEngSTEM (n = 7,666)** Mean (S.E.)	**NonSTEM (n = 9,611)** Mean (S.E.)	**Eng - NonEng STEM**	**Eng - NonSTEM**
Mental Health Climate					
Sense of Belonging	10.31 (0.05)	10.43 (0.03)	10.4 (0.03)	-0.125*	-0.09
Perceptions of Campus Climate	18.58 (0.14)	17.74 (0.11)	17.4 (0.08)	0.835*	1.16*
Feelings of Safety	8.47 (0.09)	8.57 (0.06)	8.52 (0.05)	-0.107	-0.057
Climate for Diversity and Inclusion					
School Climate	19.31 (0.13)	19.31 (0.10)	19.45 (0.10)	0.002	-0.145
Sense of Belonging	40.16 (0.22)	40.16 (0.16)	40.46 (0.15)	-0.03	-0.334
Experiences of discrimination	33.0 (0.16)	33.2 (0.13)	32.66 (0.12)	-0.199	0.336
Identity Connectedness	21.55 (0.23)	23.5 (0.16)	22.99 (0.15)	-1.94*	-1.43*
Perceptions of Campus Programs, Policies, and Efforts	14.03 (0.08)	13.39 (0.06)	13.58 (0.06)	0.64*	0.45*

Finally, the constructs measured by the competition module were analyzed within a small subset of the original sample. Only three out of the 75 institutions in our sample implemented such module, reducing the sample size significantly to a total of 948 observations split between the three groups of students under analysis. Results of the weighted analysis for this subsample are presented in Table 4. No difference was identified in the perceptions of any of the constructs under analysis.

Table 4. Weighted means for Stress, Competitiveness, and Achievement perceptions and their comparisons across groups

	Engineering (n = 233) Mean (SE)	**NonEngSTEM (n =291)** Mean (SE)	**NonSTEM (n = 337)** Mean (SE)	**Eng - NonEng STEM**	**Eng - NonSTEM**
Perceptions of					
Stress	10.54 (0.26)	10.02 (0.17)	10.04 (0.18)	0.516	0.492
Competitiveness	10.32 (0.21)	10.09 (0.20)	10.46 (0.15)	0.231	-0.137
Achievement	15.86 (0.25)	16.12 (0.18)	15.76 (0.20)	-0.255	0.102

Limitations

There are some limitations of this work that need to be acknowledged. They are related to both, the data quality and the data analysis procedures. In terms of data quality, we have that the data corresponds to only one academic year (2019-2020) which was a particular year in terms of students' wellbeing in general since the Spring 2020 saw the start of the COVID-19 pandemic and additional sources of stress in terms related to other sociopolitical issues, such as racial reckoning, and political polarization. This multitude of factors might have affected students in all fields equally, offering a higher baseline to work from the beginning. The analysis of additional years both retrospectively and prospectively will be performed to address this challenge to the validity of our results. In terms of the data analysis procedures, we relied on the survey weights provided by HMS, which are based on a particular set of characteristics of the student population at the different institutions and accounts for non-response bias. However, there is a possibility of additional response bias, for which students with mental health conditions might be more likely to answer the survey than those who do not. Knowing that some minority groups have been documented to have higher prevalence of mental health challenges [27] it would be relevant to address such potential biases on our estimates. Similarly, there could be different response rates among academic disciplines, and such discrepancies need to be accounted for the validity of our results.

Discussion and future work

Overall, our analyses did not show significant differences in the prevalence of mental health struggles in engineering students as compared to non-engineering STEM students non-STEM students. In fact, the obtained estimates picture a better status for engineering students than those outside of it if measured by the depression and anxiety scores. This result aligns with previous evidence obtained from the analysis of data from the Healthy Minds Study. Lipson [28] reported on a comparison of the prevalence of depression, anxiety, suicidality as well as help-seeking attitudes of college students, and found that engineering students did not have a significantly different prevalence of such issues when compared to students in the social sciences. Nevertheless, as a whole, these result are not consistent with the research pertaining to what causes poorer mental health in college students and findings in relations to the nature of engineering degrees. Studies in relation to what causes distress in engineering students have identified that the following aspects as detrimental to learning culture: individualistic nature of the programs, the traditional teaching styles often used by engineering professors, the difficulty

of course material, and competitive grading [7]. However, these same factors are attributed to poor mental health in the general college population [5], which might be argued to the lack of differences. With the main difference between engineering and no-engineering degrees lying in their respective programmatic nature. Engineering students are forced to focus more on the classroom, which brings a more intense curriculum, than enriching educational and social experiences [29]. These studies are indicative that engineering students would be expected to report a lower mental health status as compared to their non-engineering peers. Since that was not the case, we need to uncover other factors playing a role in these differences, as well as re-evaluating the measurement approaches used here. By using the mean scores of the presented scales we might be missing details about the distribution of the prevalence of serious issues, such as those that have depression or anxiety scores above a threshold justifiable of professional attention. Such modifications will be tackled next in the study of this database.

Another potential explanation of the lack of differences, might be related to the timing of this dataset. As described in the limitations section, the academic year 2019-2020 includes the Spring 2020 semester in which the COVID-19 pandemic started throwing a multitude of factors affecting students' mental health significantly. Since the data was not split by semesters it would be important to consider the temporality of the data in its analysis. An additional analysis of data from the academic year 2018-2019 showed a difference in weighted means between engineering and non-engineering students with those in engineering having a lower flourishing scale. This brings to mind the question if engineering students were indeed better during the next academic year, or was the students in other fields faring worst because of the timing. Such explorations will take place next with analysis of multiple previous years of the HMS survey.

Engineering students' ratings of the mental health climate on their respective campus proved to follow a different trend. As compared to non-engineering students, engineering students indicated that they felt less of a sense of belonging and perceived the campus climate to be worse. No statistical difference was found in each groups' feeling of safety on and around their campus. These results are consistent with the prior research findings discussed in the 'General Mental Health' section. The culture supported by engineering curriculum and faculty, and the lack of time to participate in social endeavors affects students in these majors negatively. Instructor characteristics such warmth and encouragement are associated with a strong sense of belonging [30] and these are typically absent in the traditional teaching methods employed in engineering [7]. Additionally, sense of belonging is directly related to a student's self-efficacy to succeed and their value of their coursework [30]. In return this lack of value in their curriculum can support the perception of a poor campus climate as they feel as they are not supported to succeed.

In terms of the elements related to diversity and inclusion, engineering students showed a higher knowledge of campus programs, policies, and efforts than the other two groups; however, they had a significantly lower levels of identity connectedness. Under the frame of social identity theory this result might offer an explanation to the lack of differences found in students' perceptions of stress, competitiveness, and achievement. If students have a lower sense of identity in their educational space, they will not be expected to adopt the told and untold norms, behaviors and rules of the culture. Analyses across different levels of identity connectedness would be valuable to explore such relationship.

Discrepancies between the measurement of similar elements through multiple instruments will also need to be tackled in our future work. In this exploration we found different results for the measurement of sense of belonging through two different strategies. A more thorough understanding of the specificity and theory behind each subset of questions will be conducted to re-evaluate the observed discrepancies and ensure its usability to approach the inquiries of interest. Not many differences between engineering and non-engineering students arose in the analysis of their respective perceived campus climate in relation to diversity and inclusion. The only difference found was in the perceived campus inclusion climates. Engineering students rated the feeling of inclusion on their respective campus to be worse than that of non-engineering students. There was no difference in each groups' feeling of value, experiences of discrimination, perception of campus inclusion programs and identity connectedness.

Other methodological challenges to tackle in the near future involve the evaluation of the weighting structure for the HMS survey. Knowing that the composition of the population varies across majors, like is the case with engineering having a smaller proportion of females than that usually found university-wide, we need to evaluate the possibility of recalculating survey weights based on the knowledge of each field. Such endeavor would involve substantial research investments, but might be worth the gain in the accuracy of estimates obtained.

This exploratory study only scratches the surface of the rich data offered by the HMS. Extensions of this work will include the analysis of subgroups with respect to multiple sociodemographic variables that are known to be relevant in the experience of engineering students. Similarly, a more granular analysis will be conducted with respect of majors, since non-engineering STEM majors also include a variety of other high-pressure fields such as the health sciences. Additionally, validation of the instruments used in the different waves of the HMS needs to take place in order to ensure the use of appropriate items to measure the intended constructs.

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Appendix

HMS Section	Scale Name & Source	Number of Questions & Scale	Questions
Mental Health Climate	Sense of Belonging	3	How much do you agree with the following statement? 1. I fit in well at my school (reversed) 2. I feel isolated from campus life 3. Other people understand more than I do about what is going on
	Perceptions of Campus Climate	6	How much do you agree with the following statement 1. At my school, I feel that students' mental and emotional wellbeing is a priority. 2. At my school, I feel that the campus climate encourages free and open discussion about mental and emotional health. 3. At my school, students are working to promote mental health on campus 4. At my school, the administration is listening to the concerns of students when it comes to health and wellness. 5. At my school, I feel that the campus environment has a negative impact on students' mental and emotional health. (reversed) 6. At my school, I feel that the campus environment has a negative impact on students' eating and body image. **(reverse scale)**
	Feelings of Safety	4	1. How do you feel on your campus during the day? 2. How safe do you feel on your campus at night? 3. How safe do you feel in the community surrounding your campus during the day? 4. How safe do you feel in the community surrounding your campus at night?
	Diversity and Discrimination	2	How much do you agree with the following statement?: 1. At my school, I have been exposed to diverse opinions, cultures, and values.

			In the past 12 months… 2. How many times have you been treated unfairly because of your race, ethnicity, gender, sexual orientation, or cultural background?
Climate for Diversity and Inclusion	School Climate	5	Using the scale below, please rate the overall climate at [school name] over the past 12 months on the following dimensions: 1. Friendly-Hostile 2. Cooperative-Uncooperative 3. Welcoming-Not Welcoming 4. Respectful-Disrespectful 5. Comfortable-Uncomfortable
	Sense of Belonging	11	Considering your experiences over the past 12 months, please indicate the extent to which you agree or disagree with the following statements: 1. I feel valued as an individual at this school. 2. I feel I belong at this school. **3.** I have considered leaving this school because I felt isolated or unwelcomed **(reverse scale)** 4. This university is a place where I am able to perform up to my full potential. 5. I have found one or more communities or groups where I feel I belong at this school. At [school], I feel valued and listened to by… 6. Faculty 7. Student Instructors (GSIs/TAs) 8. Other Students 9. Staff Members 10. University Administrators 11. Other University Mentors/Advisors
	Experiences of Discrimination	16	Please rate the extent to which you agree or disagree with the following statements: I am treated fairly and equitably… 1. on campus in general 2. in classrooms and classroom settings 3. in out-of-classroom University spaces --- 4. We are interested in learning about your experiences at your school in the past 12 months. Please indicate the extent to which you agree or disagree with the following statement: I have been concerned about my personal safety on campus. **(reverse scale)** 5. Over the past 12 months, have you personally experienced any exclusionary, intimidating, offensive, and/or hostile behavior at your school? Please Note Whether and how often you have experienced each of the following events in the **past year** at [school] 6. Being treated rudely or disrespectfully 7. Being accused of something or treated suspiciously 8. Others reacting to you as if they were afraid or intimidated

			9. Your ideas or opinions minimized, ignored, or devalued 10. Overhearing or being told an offensive joke or comment 11. Being treated as if you were "stupid", being talked down to 12. Not being taken seriously 13. Being treated in an "overly" friendly or superficial way For the following questions, please think about your own experiences in your classes. In your classes, how often… 14. did your professors call on you less than others because of your race/ethnicity? 15. did you have fears of representing your racial/ethnic group in a negative way discouraged you from participating in class? 16. did you feel that others were taking your opinion as speaking for all members of your racial/ethnic group?
	Identity Connectedness	11	1. Pleases indicate the extent to which you agree or disagree with the following statement: I have a group, community, or social circle at [school] where I feel I belong (feel at home, known, connected to, support in my identity) How often do you attend meetings, events, activities, clubs, social gatherings, etc., that support your… 2. Racial/Ethnic Identity 3. Sexual Identity 4. Gender/Gender Identity 5. Religious/Spiritual Identity The following questions ask you about your ethnic identity. Remember there are no right or wrong answers, just answer as accurately as possible. Please indicate the extent to which you agree or disagree with the following statements 6. I have spent time trying to find out more about my ethnic group, such as its history, traditions, and customs. 7. I have often done things that will help me understand my ethnic background better. 8. I have often talked to other people in order to learn more about my ethnic group. People may think about their racial or ethnic identity in different ways. Please respond how much you agree or disagree with the following statements. 9. Being a member of my racial/ethnic group is an important reflection of who I am. 10. I have a strong sense of belonging with other people in my racial/ethnic group. 11. I have a strong attachment to other people in my racial/ethnic group.
	Perception of Campus Programs, Policies, and Efforts	4	Please rate the extent to which you agree or disagree with the following statements… 1. [School name] makes a genuine effort to recruit a diverse community of students 2. [School Name] fosters respect for cultural differences

			3. [School Name] has made a special effort to help students from diverse backgrounds feel like they belong on campus. 4. How much time do you spend during a typical week participating in campus activities, organizations, sports or extracurriculars connected to [School Name]?
Competition	Stress Mindset	4	Please rate the extent to which you agree or disagree with the following statements: 1. Experiencing stress depletes health and vitality (reverse scale) 2. Experiencing stress enhances performance and productivity 3. Experiencing stress inhibits learning and growth (reverse scale) 4. The effects of stress are positive and should be utilized
	Perceived Competition	4	1. How would you rate the overall competitiveness among students in your current classes? 2. How would you rate the overall competitiveness among students at your school? 3. How would you rate the overall competitiveness among students in your field of study? 4. How frequently do instructors in your major/field of study grade your work on a curve (adjust grades based on the grade distribution among students in a class)?
	Clarifying Achievement Goals and Their Impact	4	How much do you agree with the following statements?: 1. It is very important to me to do well in my courses. 2. It is important to me to confirm my intelligence through my schoolwork. 3. In school, I am always seeking opportunities to develop new skills and acquire new knowledge. 4. It is very important to me to feel that my coursework offers me real challenges.