

Evaluating Peer-led Undergraduate Surveys and Focus Groups on Campus Climate and Belonging in STEM – Results from a Study at Tufts University

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I. Introduction

Sense of belonging is widely recognized as an essential component of student persistence, engagement, and success in STEM disciplines – areas of study often home to competitive environments and rigorous academic demands [1, 3, 4]. When students perceive that they are valued members of their academic community, they are more likely to participate in class, seek support, and remain in their programs of study, whereas feelings of isolation or marginalization can contribute to disengagement and attrition [2, 5, 6]. These dynamics are particularly important in undergraduate STEM education, where early experiences can strongly influence long-term educational trajectories [7, 8]. As a result, understanding how institutional climate, peer interactions, and faculty relationships influence students' experiences is essential for identifying barriers to success and informing targeted interventions that promote equity, retention, and success in STEM.

While prior research establishes the importance of belonging for student outcomes in STEM, the influence and manifestation of institutional climate can vary substantially across campuses, shaped by fellow students, members of academia, local culture, policies, demographics, and academic structures. To effectively isolate critical issues on a single campus, institution-specific investigations are helpful in determining how students interpret and experience climate within their educational environments. Towards that end, universities often leverage student surveys to inform decision-making, but these products can be problematic as they could be skewed by engagement biases or institutional apprehensions, and do not always explicitly target perceived climate and belonging.

In response to a need for more comprehensive and authentic data on climate and sense of belonging, the present explores how undergraduates in STEM perceive the academic and social climate at Tufts University and how these perceptions of climate relate to their sense of belonging. Results of the research could lead to actionable insight for institutional administrators.

II. Background and Motivation

Tufts University consists of seven schools, with two schools - Arts and Sciences (A&S) and Engineering (SoE) - providing its undergraduate programs. Traditionally, undergraduate students take annual surveys on all aspects of student life, yet only two or three Likert-type questions specifically target belonging and climate. An evaluation of these characteristics occurred in Spring 2022, when an electronic-based, university-wide survey of the climate and sense of belonging was performed with one of the key stakeholders being the undergraduate population (unpublished). Given the breadth of respondents, and a desire to maintain confidentiality, results could only be disaggregated by school and specific stakeholders. Two, Likert-style survey questions (SQs) are most relevant to the current work and are presented below.

SQ1: What is your level of satisfaction with *Overall Climate* at Tufts University? (N = 219, mean = 3.65 out of 5, STD = 0.777)

SQ2: To what extent do you feel you *Belong* at Tufts University? (N = 216, mean = 3.9 out of 5, STD = 0.715)

These SoE results serve as a proxy for the current effort, which focuses on all undergraduate STEM students, which are enrolled in both A&S and SoE.

Additionally, the current work utilized peer-to-peer, in-person data collection - via both a survey and subsequent FGs - that required substantial interactions between survey collectors and respondents; interactions that could lead to more forthright, honest responses than those from an institutionally derived and conducted survey. A rationale for adapting this process is seen in a previous internal study on Tufts University's climate. The study, led and driven by institutional administrators, involved interviews with students who transferred out of the institution. Transferred individuals were given the choice to be interviewed by a student, an institutional employee, or non-institutional employee. More than half of participants opted for the student interviewer, suggesting individuals may be more comfortable sharing their experience with a peer, avoiding potential bias from an administrative- or faculty-run study [2]. In that regard, the work presented herein focuses on two research questions (RQs):

RQ1: What are the impacts on the results from peer-to-peer data collection methods?

RQ2: What are the general perceptions of belonging based on the institution's climate and some of its characteristics?

III. Methods and Instrument Development

This study utilized a student-driven research approach within which three undergraduate students took the lead in (i) identifying structural barriers that affect academic outcomes and sense of belonging, (ii) conceptualizing study components and appropriate questions, (iii) obtaining IRB consent, (iv) securing student participation, and (v) soliciting surveys and conducting FGs. The process involved weekly meetings that fostered feedback and continual development of the project's elements. One unique element was a focus on peer-to-peer data collection, reducing the hierarchical bias present in faculty- and institutional-led research settings. It was believed that in-person data collection facilitated an environment where participants would be more likely to provide honest answers when approached or interviewed by fellow students. This sense of psychological safety and confidentiality was highly important given the personal topics discussed, allowing for a more accurate and representative collection of students' experiences.

Two instruments were utilized for data collection: a Likert-type survey and a FG discussion framed using the same topics covered by the survey. The survey (presented in Appendix A) included questions to assess undergraduate STEM students' educational and emotional experiences, sense of belonging, and feelings of pride and value from and towards the institution. Survey questions were developed to capture both the academic and emotional experience, administered with a scale ranging from Fully Disagree to Fully Agree. After iterative question refinement, the final instrument comprised contained 18 questions, divided by three categories: (i) educational and emotional satisfaction across students' academic years (Q1-8), (ii) the contribution of faculty and peer interactions on a sense of belonging (Q9-12), and (iii) I-statements assessing student beliefs of the institution's value, both 'to them' and 'of them', and their satisfaction in attending the institution (Q13-18).

Survey data collection was conducted in-person with student researchers directly soliciting potential participants. Peer-to-peer data collection captured 125 survey responses in Fall 2024. This process required 1) confirming a respondent's eligibility by verifying their enrollment in an undergraduate STEM degree; 2) having participants complete the survey with the caveat to skip any question, if they wished, and 3) providing an opportunity for survey respondents to participate in a FG discussion. A \$25 compensation, in university credit, was used as an incentive to participate. Typically, the entire process was completed within 15 minutes. In total, 49 respondents opted into FG participation with 13 ultimately joining in one of four FG events.

FGs were structured to allow participants the ability to add depth and context to their survey responses. FGs were scheduled based solely on both participants' and facilitators' availability – no targeted groupings were designed, nor did any develop organically. Group sizes were kept to a maximum of 5 to allow for equal participation. FGs tended to run for 45 to 60 minutes. Zoom Workspace software (freely available to institutional students) was used to record (audio-only) and provide initial transcripts of FG sessions which were subsequently reviewed for accuracy. Participant names were removed in data analysis maximizing anonymization. Participant familiarity within focus groups was explicitly controlled so as to increase participants' willingness to share openly.

The 'semi-structured' protocol for FGs followed the three-category framework, providing scaffolding to the conversation, yet allowing discussions to remain open-ended. FGs were facilitated by only one or two of the three student researchers so that facilitators could avoid participating in FGs with known social relationships. Finally, the participants in each FG session were STEM majors from both schools as well as class years, allowing participants to speak freely about their experiences without concern for peer-to-peer judgment. The Institutional Research Board (IRB) Study ID for both survey and FG protocols was STUDY00004918.

IV. Results from Data Analysis and Discussion

Results from all 125 respondents, without disaggregation, are shown in Figure 1. In this paper, we primarily focus on results of the analysis on questions for which all 125 respondents could respond. As such, evaluations are limited to questions for which at least 115 responses (a response rate $\geq 92\%$) were obtained. Based on these responses, certain trends become notable and are discussed below. [It must be noted that responses to the survey have been converted to numerical values, where 1 = Fully Disagree to 10 = Fully Agree, to facilitate statistical analyses.]

1. Educational and emotional satisfaction, shown in responses to Q1-Q8, ranged between Slightly Agree to Moderately Agree (numerically, means ranged from 6.84 to 8.48) and showed an upward trend as students progressed at Tufts University. It is apparent that education satisfaction was always greater than the emotional satisfaction for each class year, suggesting that though students felt they were receiving appropriate educational support, their emotional support lagged. Given that all four class levels could respond to Q1 and Q5 – first year educational and emotional satisfactions, respectively – an ANOVA comparing Q1 and Q5 indicates a statistically significant difference in student's perceptions in their educational and emotional satisfaction during the first year ($p=0.016$; $Q1_{\text{mean}} = 7.744$, and $Q5_{\text{mean}} = 6.840$). Substantiating quotes from FG discussions include

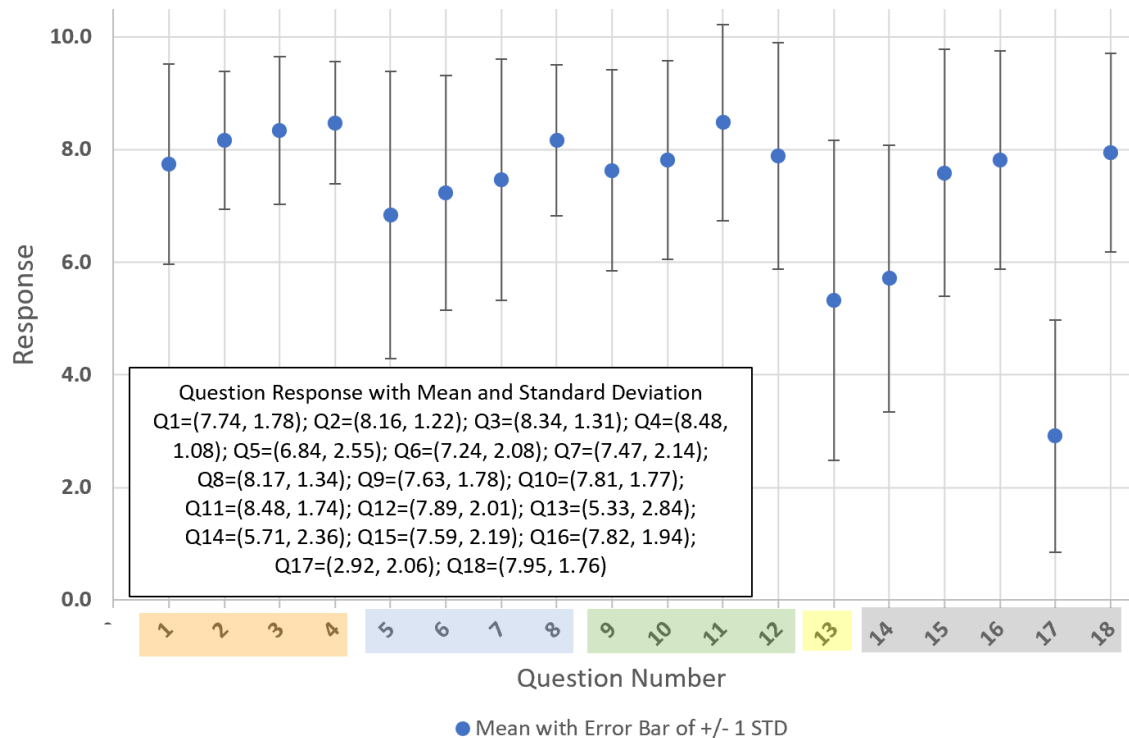


Figure 1. Responses to Survey Questions [List of questions in Appendix A].

Female, Class of 2026 - "I'm recently involved in, like the Muslim Student Association [MSA] ... (t)here was a surprising amount of biomedical engineers, specifically like within the women of biomedical engineering, in the MSA, so it's... nice to see people that like look like you and have similar background do amazing things within... the major that you chose."

Male, Class of 2026... "But I think the farther, like I've gone, like for doing my sophomore and junior year. It's gotten better because ...now I'm taking classes with pretty much the same, exact people, and I have like a solid group of people to work with now, as opposed to where my freshman year is kind of still figuring it out."

2. With respect to belonging, students were more likely to be positively supported by fellow students than professors (illustrated by Q9-Q12). A one-way ANOVA comparing Q9 and Q11 – positive contributions to one's sense of belonging by faculty and students, respectively – indicates a statistically significant difference as to which provided this contribution ($p = 0.002$; $Q9_{\text{mean}} = 7.632$, $Q11_{\text{mean}} = 8.460$) with faculty providing less than students. Alternatively, when comparing department-level interactions, i.e., those within a student's major, there was no statistically significant difference between contribution by faculty versus by students ($p = 0.737$; $Q10_{\text{mean}} = 7.813$, $Q12_{\text{mean}} = 7.894$) indicating respondents felt that both faculty and students provided similar levels of support. Substantiating quotes from FG discussions include

Female, Class of 2026 - "...generally, the professors I've had seem to, at least on some level, care. And I think that sort of is nice in that, like for instance, they'll be like, oh, for instance, if my office hours don't work for you, you can just like email me and come at a different time, or things like that."

Female, Class of 2026 - "The only thing I can think of is...generally speaking, we are still considered like a pretty good school, but at a lot of other pretty good schools it's like a very toxic, cutthroat environment, especially within, like, engineering and STEM. But I have never, and I kid you not, never experienced something like that itself, like people will just be like, "Oh, I don't know how to help you," or they will literally try to help you, even if, like y'all are supposed to be like in competition, or whatever. Everyone, generally speaking, wants to see each other succeed, and I find that really refreshing..."

3. I-statement questions (Q13-Q18) showed the greatest differences in responses. For example, Q13 (the costs of attendance) and Q14 (the perceived value of me by the institution) received the lowest average ratings in the survey; between Very Slightly Agree to Slightly Agree. Conversely, respondents moderately agree that they are happy to have come to Tufts University (Q16) and are proud to attend the institution (Q18). This apparent dichotomy is illustrated via the ANOVA between Q14 (do you feel valued) and Q16 (are you satisfied to have attended) where a $p = 0$ was calculated ($Q14_{\text{mean}} = 5.712$, $Q16_{\text{mean}} = 7.823$). This seems to indicate a disconnect between students' perceptions of the institution versus what makes them happy to be there, which, according to FG discussions, appear to be their peer-to-peer interactions. Substantiating quotes from FG discussions include:

Male, Class of 2025 - "...I think anything that's \$80,000 a year is maybe not worth \$80,000 a year. But I like [that] I will have a job. And so, I can't just totally say it's not worth it. But I would say, there are certainly ways to improve, and I think, like, more experience. And on like creating things, building things not just like a fake business proposal [at] end of every semester, but like something real, like something long term..."

Male, Class 2027 - "...I'm a chem major, but I'm in my lab classes and stuff. It feels underfunded almost like everything is super crammed. We have really dirty, like lab stuff. It's like, really old or just doesn't work properly anymore. And it's been outdated for, like a couple of decades. So I feel like that's a place where it's really falling short, at least for me personally."

Male, Class of 2026 - "Yeah, I think for me, personally, I've overall, like, really enjoyed my [Tufts University] experience up to this point. I think that, like the people are a big part of it. They make me, like, enjoy hanging out with a lot of the people at [Tufts University.]"

Limitation of Results To-date

Several limitations were considered in the design of the study and the collection of the data. One possible limitation is selection bias, since the recruiting of participants may have been influenced by approaching more familiar faces than complete strangers, and/or recruited

participants could have leaned into taking the survey when approached by a familiar face. This limitation was mitigated during FGs via the rotation of researchers so that they did not participate in FGs with familiar participants. There could also be response bias, where respondents with exemplary positive (or negative) experiences would be more likely to participate in the survey and/or FG. For example, though 125 students completed the survey, only 49 indicated a willingness to participate in an FG, with approximately 25% of that population ultimately attending, thus creating a potential discrepancy between survey and FG responses. As analyses continue, other limitations may be noted.

VI. Conclusions and Next Steps

This brief provides preliminary results of an evidence-based practice study at Tufts University that indicates undergraduate STEM students at the institution generally have a moderately strong sense of belonging, one that is driven by peer relationships, collaborative academic culture, and student run clubs. Though results are preliminary, a general pattern noted is that the students' experience improves with each passing academic year. With respect to climate and belonging, these results do not differ substantially from those from the 2022 university-wide climate survey. However, the current survey provides an opportunity to collect more detailed, situational circumstances that influence one's perceptions of institutional climate and sense of belonging (RQ2). Continued work is needed to explore how these perceptions impact one's academic experience.

On the other hand, the perception of institutional valuation, and material investment are mixed. The peer-to-peer study model appears to have encouraged candid participation from students, enriching both qualitative and quantitative insights and supporting RQ1 that students would be more willing to share nuanced experiences with fellow peers than administrators or faculty. While these findings are preliminary and subject to a few limitations, they offer insight into the value of student-driven approaches that assess campus climate and belonging at academic institutions.

Next steps include expanding the study to multiple semesters and replicating this peer-led data collection to further clarify the role of a student driven study. This will help inform institutional interventions that strengthen belonging and success in STEM. Additionally, collected data could be disaggregated into various groupings that can explore nuanced differences in responses based on sex (male versus female), and/or if students were a member of historically marginalized groups in STEM fields, and/or differences in student class level (first-year to senior). Finally, future implementations of the peer-to-peer model could expand evaluations of climate and sense of belonging to include other factors such as political and religious beliefs.

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Appendix A

Climate and Belonging Survey Developed in Current Work

Requested Demographics

Class year (circle one): 2024 2025 2026 2027

Sex (circle one): Male Female

Department (Write in): _____

Major (Write in): _____

Race/Ethnicity (Write in): _____

Questions	a*	b	c	d	e	f	g	h	i	j
My freshman year was/is educationally satisfactory										
My sophomore year was/is educationally satisfactory										
My junior year was/is educationally satisfactory										
My senior year is educationally satisfactory										
My freshman year was/is emotionally satisfactory										
My sophomore year was/is emotionally satisfactory										
My junior year was/is emotionally satisfactory										
My senior year is emotionally satisfactory										
The professors have had an overall positive contribution to my sense of belonging at Tufts University										
The professors within my department have had an overall positive contribution to my sense of belonging at Tufts University										
The students at Tufts University have had an overall positive contribution to my sense of belonging at Tufts University										
The students within my department have had an overall positive contribution to my sense of belonging at Tufts University										
What I am receiving at Tufts University is worth my Total Cost of Attendance										
I feel Tufts University values me										
I feel that I belong in the School of Engineering										
I am satisfied that I committed to Tufts University										
I am not satisfied that I committed to Tufts University										
I am proud to attend Tufts University										

* NOTE: letters indicate the location of actual text used in the survey ⇒ a - Fully disagree, b - Strongly disagree, c - Moderately disagree, d - Slightly disagree, e - Very slightly disagree, f - Very slightly agree, g - Slightly agree, h - Moderately agree, i - Strongly agree, j - Fully agree