An Examination of Inclusivity and Support for Diversity in STEM Fields

Allison BrckaLorenz 1 · Heather Haeger 2 · Christen Priddie 1

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Abstract
The lack of diversity in STEM professions is an ongoing concern for the US both in terms of social justice and in having a globally competitive workforce. This study provides information for campus leaders to be proactive in considering a wide array of identities to meet the needs of students beyond attending to structural forms of diversity. Data from a large-scale, multi-institution study of students’ perceptions of inclusive coursework and institutional commitment to diversity in STEM fields furthers what we know about diversity in these majors. Results encourage campus leaders to additionally consider sexual orientation and disability status in conversations about diversity and to think about how culturally engaging and inclusive courses go beyond the content of the course.

Keywords Diversity · Culturally engaging pedagogies · LGBQ · Disability

The lack of diversity in science, technology, engineering, and math (STEM) professions is an ongoing concern for the USA both in terms of social justice and in having a globally competitive workforce (National Academy of Engineering, & Institute of Medicine, 2011, National Academy of Sciences [NAS]). To compete globally, the USA will need to increase the overall enrollment, persistence, and representation of people of color in STEM majors (President’s Council of Advisors on Science and Technology [PCAST], 2012). Enrollment and persistence of diverse students in STEM majors in college is a critical component in diversifying STEM (NAS et al., 2011). Greater compositional diversity in college is also beneficial for students and related to greater student recruitment and retention (Astin, 1993; Brown, 2006; Cole, 2007; Cole & Espinoza, 2008; Tinto, 2006).

Previous research has often focused on diversity in STEM in terms of gender, race and ethnicity, and socioeconomic status. This narrow focus ignores other aspects of
diversity and inclusion. This study advances that discussion by examining representation in STEM with a broader scope by also looking at inclusion based on sexual orientation and disability status along with examining gender beyond a binary. Additionally, much of the previous research has highlighted the lack of compositional diversity but does not explore the issues of climate or culture in creating diverse environments. Moving beyond looking at diversity in terms of numerical representation and exploring the culture and climate of campuses are also keys to understanding diversity in STEM fields (Milem et al., 2005). This research addresses that notion by exploring the roles of institutional commitment to diversity and culturally engaging coursework in diversifying STEM fields.

Hoping for, talking about, and wanting more diverse students to join our STEM programs are not enough. Campus STEM leaders need to be responsible in creating an environment that welcomes and supports all students. To gather critical information for these efforts, we utilize data from the 2017–2019 administrations of the National Survey of Student Engagement (NSSE) to address the following research questions:

1. How proportionally represented are students in STEM fields by racial/ethnic identification, first-generation status, gender identity, sexual orientation, and disability status?
2. How do perceptions of institutional commitments to inclusivity and culturally engaging coursework compare for STEM and non-STEM students?
3. Within STEM fields, how do students with different identity characteristics perceive institutional commitment to inclusivity and culturally engaging coursework?

Background Literature Within the Conceptual Framework

In understanding diversity and inclusivity in STEM, we approach this topic through a three-tiered lens. First, we look at a more nuanced examination of compositional diversity, then examine inclusivity in coursework within different disciplines, leading to a broader examination of perceptions of the supportiveness of the campus culture. These components of inclusivity are nested and intertwined with compositional diversity or representation at the core of creating a diverse environment. However, compositional diversity is not enough to create an inclusive environment; courses that foster inclusion and intercultural dialog and a broader campus culture (in and out of the classroom) are necessary to support a diverse student body and create an inclusive environment (Fig. 1).

Representation

The core of diversity and inclusion is how represented students are in STEM, our first tier, Representation, and much work is needed in increasing the compositional diversity of STEM majors (President’s Council of Advisors on Science and Technology [PCAST], 2012). The disproportional representation can be seen clearly in degrees awarded from US institutions. Though 29% of the population is from traditionally underrepresented minorities (URMs), only 15% of STEM bachelor’s degrees and 8%
of doctorates are awarded to URM students (Estrada et al., 2016). A recent study found that when looking at STEM overall, women are just as likely to receive degrees and enroll in graduate school as their peers who identify as men; however, specific fields including math, engineering, and computer science are still dominated by men (Okahana & Zhou, 2018). Bettencourt et al. (2020) also found that students who are the first in their family to go to college are less likely to persist in STEM fields and that this disadvantage is compounded by other intersecting barriers including racism and unequal educational preparation. These studies and much of the research on representation in STEM has focused on race, class, and binary sex (male and female). We expand on this by also looking at how sexual orientation, disability status, and non-binary gender identification are represented in STEM majors. Taking a more nuanced look at representation is an important foundation not only for creating more equitable access to STEM degrees, but also in the contribution to higher levels of diversity and inclusion. Studies have also demonstrated that increasing representation is beneficial to the broader campus community in terms of recruitment, retention, and academic success (Astin, 1993; Brown, 2006; Cole, 2007; Cole & Espinoza, 2008; Tinto, 2006). Additionally, Pike and Kuh (2006) demonstrated that as compositional diversity increases, so do diverse interactions among peers and perceptions of more supportive campus environments. Students that engage in interactions with diverse others experience direct and indirect positive educational outcomes such as cognitive development and increased openness to diversity (Rossmann & Trolian, 2020).

**Culturally Engaging Courses**

The next level of our model, *Culturally Engaging Courses*, moves from creating a more numerically diverse and representative environment to examining the degree to which courses and coursework on that campus foster an inclusive environment. In

![Nested model for diversity and inclusion](image-url)
moving beyond a focus on compositional diversity, we look at how college coursework can foster a supportive campus environment for a diverse group of students. Culturally relevant pedagogy, which incorporates students’ diverse backgrounds and cultures into the classroom, has been associated with several positive student outcomes including increased college persistence and graduation (Marquez Kiyama & Rios-Aguilar, 2017) and retention of content knowledge (Ladson-Billings, 2006). A meta-analysis of research on culturally relevant education (including culturally relevant pedagogy and culturally responsive teaching) found support for culturally relevant education leading to increased engagement and motivation in math and science courses, improved learning in science courses, and advanced understanding of bias and how knowledge is constructed (Aronson & Laughter, 2016). The authors also noted that culturally relevant education increased competency in math and science for low-income and first-generation students. Culturally relevant pedagogy also provides an important distinction from discussions of “diversity courses.” In thinking about including diverse perspectives in the curriculum, it is common for faculty to see this as the role of a specific general education course that exposes students to diverse cultures and perspectives. In culturally relevant pedagogy and in the present paper, the focus is on how all courses can utilize examples and activities that invite students to bring their funds of knowledge and cultural experiences into the classroom (Marquez Kiyama & Rios-Aguilar, 2017).

Creating culturally relevant courses is a critical part of supporting students and fostering their development; however, we are also interested in how students engage with course content and with others. Previous studies on culturally relevant education are often focused on specific interventions and then testing the impact of that intervention on a student outcome. We build on this research by focusing instead on students’ perceptions of course work and their engagement with culturally relevant pedagogy. We are focusing on culturally engaging courses by measuring how much students engage in discussions with each other and with faculty about their own culture and background, learning about other cultures and perspectives, and engaging in discussions of equity and privilege (see Table 1 for measures of culturally engaging courses). Focusing on how culturally engaging courses are, in and out of STEM, can help us understand how students are supported and how they are being prepared to function in a diverse society.

**Supportive Campus Environment**

Though faculty teaching practices are intertwined with students’ perceptions of support (Umbach & Wawrzynski, 2005), we also explore beyond what happens in the classroom. Represented in our third tier, **Supportive Campus Environment**, the overall campus climate and culture is also a critical factor in creating an inclusive campus environment (Milem et al., 2005). Interactions in and out of the classroom, along with institutional policies, communicate to students the level of institutional commitment to diversity and inclusion (Pike & Kuh, 2006). With the guidance of the Culturally Engaging Campus Environments indicator Proactive Philosophies, this study is intended to lead faculty, administrators, and staff on campus to be proactive in considering a wide array of diverse identities, and creating spaces, support structures, and opportunities that meet the needs of diverse students beyond attending to
compositional diversity (Museus, 2014). The indicators in this model represent characteristics of an optimally inclusive and equitable campus environment. One aspect of such an institution would include a support system dedicated to responding to the needs of diverse students. The Proactive Philosophies indicator, more specifically, focuses on an institution-wide philosophy that encourages faculty, staff, and administrators to be proactive in their support efforts. Campus leaders with this philosophy bring information, opportunities, and support to students so that students do not need to put effort toward gathering this information and help for themselves. We conceptualize a supportive campus environment as students reporting that their institution emphasizes a commitment to diversity, provides students resources for success in a multicultural world, creates a sense of community, and prevents students from being stigmatized because of their identity (see Table 1). The culmination of representation, culturally engaging coursework, and institutional commitment to diversity is a supportive campus environment.

### Methods

#### Data Source

The data for this study comes from the 2017–2019 administrations of the National Survey of Student Engagement (NSSE). The data that support the findings of this study are available from the Center for Postsecondary Research at Indiana University.

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Table 1: Select inclusiveness and engagement with cultural diversity items and scale information

| Select items: | Scale information: |
|---------------|--------------------|
| 1. During the current school year, how much has your coursework emphasized the following? | Course emphasis (ICD1CE) |
| Response options: very much, quite a bit, some, very little | |
| (a) Developing the skills necessary to work effectively with people from various backgrounds | Min 0 Max 60 |
| (b) Recognizing your own cultural norms and biases | Mean 33.5 SD 15.99 |
| (c) Sharing your own perspectives and experiences | α .926 |
| (d) Exploring your own background through projects, assignments, or programs | ICC .034 |
| (e) Learning about other cultures | |
| (f) Discussing issues of equity or privilege | |
| (g) Respecting the expression of diverse ideas | |
| 2. How much does your institution emphasize the following? | Environment emphasis (ICD2IE) |
| Response options: very much, quite a bit, some, very little | |
| (a) Demonstrating a commitment to diversity | Min 0 Max 60 |
| (b) Providing students with the resources needed for success in a multicultural world | Mean 38.1 SD 15.54 |
| (c) Creating an overall sense of community among students | α .890 |
| (d) Ensuring that you are not stigmatized because of your identity (racial/ethnic, gender, religious, sexual orientation, etc.) | ICC .032 |
Bloomington, but restrictions apply to the availability of these data, which were used under agreement for the current study, and so are not publicly available. NSSE asks students how often they engage in various effective educational practices, their perceptions of the college environment, and how they spend their time in and out of the classroom. This study focuses on 126,310 respondents from 248 institutions that selected to administer the Inclusiveness and Engagement with Cultural Diversity (ICD) Topical Module. If an institution participated in more than one administration within this time frame, we used the institution’s most recent administration. The ICD items examine environments, processes, and activities that reflect engagement with cultural diversity and greater understanding of societal differences. Most data in this study come from responses of students enrolled at institutions with larger undergraduate enrollments, more specifically doctoral-granting institutions (55%), followed by master’s-granting institutions (32%). Around two-thirds (61%) of the students were enrolled at public institutions.

**Variables**

We combined items from the ICD module to create two scales: *Course Emphasis* and *Environment Emphasis*. The Course Emphasis scale asked students how much their coursework emphasized such culturally engaging activities as learning about other cultures and respecting the expression of diverse ideas. The Environment Emphasis scale asks students how much their institution emphasizes such things as a commitment to diversity and creating an overall sense of community among students. See Table 1 for component items and scale details. Demographic variables of interest are students’ major field, racial/ethnic identification, first-generation status, gender identity, sexual orientation, and disability status. We grouped students into STEM if they majored in Agriculture, Biological Sciences, Computer Sciences, Engineering, Mathematics, Natural Resources, or Physical Sciences fields. Students self-identified their identity characteristics except for multiracial students which we categorized based on student selections of multiple racial/ethnic identities. Although not central to our study, we additionally include information about the enrollment size, public/private control, and Basic Carnegie Classification for the institutions at which students were enrolled to provide additional context about their environment. This data was collected from the Integrated Postsecondary Education Data System (IPEDS). See Tables 2 and 3 for more details on the variables included in this study.

**Analyses**

To answer our first research question about how proportionally represented students are in STEM fields by various student demographics, we examined results from chi-squared tests. We considered differences with adjusted residuals greater than 2 or less than −2 to be notable (Agresti & Finley, 2009). To answer our second research question about how students’ perceptions of institutional commitment to inclusivity and culturally engaging coursework compare for STEM and non-STEM students, we examined a series of regression equations. The dependent variable in models was either the Coursework Emphasis or Environment Emphasis scales. We standardized the dependent variables before entry into models so that unstandardized coefficients can
be interpreted as effect sizes. We interpreted the magnitude of effect sizes as recommended for use with NSSE data: \(d < .1\) is small, \(d < .3\) is medium, and \(d < .5\) is large (Rocconi & Gonyea, 2018). The independent variable of interest was students’ major field, collapsed into STEM and non-STEM fields. We ran models with and without institution-level variables. Table 2 contains information about the coding of additional independent controls.

To answer our final research question about how students with different identity characteristics perceive institutional commitment to inclusivity and culturally engaging coursework within STEM fields, we examined a series of regression models. These models were identical to the models in the second research question except that we limited these models exclusively to students with STEM majors, and we removed the STEM independent variable. We used effect coding to code non-dichotomous multicategorical demographics and institutional characteristics so that comparisons could be made to the average score of STEM students in the model as opposed to a reference group (Mayhew & Simonoff, 2015). For example, in regression models with traditional dichotomous coding,
Table 3  Select student demographics and institution characteristics by STEM major

|                              | Non-STEM (%) | STEM (%) | Total (%) |
|------------------------------|--------------|----------|-----------|
| **Classification**           |              |          |           |
| First year                   | 42.8         | 46.7     | 43.8      |
| Senior                       | 57.2         | 53.3     | 56.2      |
| **Racial/ethnic identification** |            |          |           |
| American Indian or Alaska Native | < 1        | < 1      | < 1       |
| Asian                        | 6.7          | 11.1     | 7.8       |
| Black or African American    | 6.2          | 4.6      | 5.8       |
| Hispanic or Latino           | 8.2          | 6.5      | 7.7       |
| Native Hawaiian or other Pacific Islander | < 1    | < 1      | < 1       |
| White                        | 66.2         | 63.7     | 65.6      |
| Another race/ethnicity       | 1.0          | 1.3      | 1.0       |
| Multiracial                  | 8.4          | 8.9      | 8.5       |
| I prefer not to respond      | 2.6          | 3.3      | 2.8       |
| **First-generation status**  |              |          |           |
| Not first generation         | 58.7         | 66.6     | 60.8      |
| First generation             | 41.3         | 33.4     | 39.2      |
| **Gender identity**          |              |          |           |
| Man                          | 27.5         | 47.7     | 32.7      |
| Woman                        | 70.6         | 49.8     | 65.2      |
| Another gender identity      | < 1          | 1.1      | 1.0       |
| I prefer not to respond      | 1.0          | 1.3      | 1.1       |
| **Sexual orientation**       |              |          |           |
| Straight                     | 84.0         | 83.7     | 83.9      |
| Bisexual                     | 6.0          | 5.9      | 6.0       |
| Gay                          | 1.6          | 1.7      | 1.6       |
| Lesbian                      | 1.1          | 1.0      | 1.1       |
| Queer                        | 1.1          | < 1      | 1.0       |
| Questioning or unsure        | 1.3          | 1.4      | 1.3       |
| Another sexual orientation   | 1.4          | 1.7      | 1.5       |
| I prefer not to respond      | 3.5          | 3.9      | 3.6       |
| **Disability status**        |              |          |           |
| No                           | 82.6         | 84.4     | 83.1      |
| Yes                          | 14.0         | 12.1     | 13.5      |
| I prefer not to respond      | 3.4          | 3.5      | 3.4       |
| **Institution undergraduate enrollment size** | | | |
| Very small (fewer than 1000) | 2.8          | 1.7      | 2.5       |
| Small (1000–2500)            | 13.9         | 12.1     | 13.4      |
| Medium (2500–4999)           | 16.5         | 11.4     | 15.1      |
| Large (5000–9999)            | 23.3         | 23.7     | 23.4      |
| Very large (10,000 or more)  | 43.6         | 51.1     | 45.5      |
| **Private/public control**   |              |          |           |
| Public                       | 60.4         | 60.9     | 60.6      |
| Private                      | 39.6         | 39.1     | 39.4      |
| **Basic Carnegie Classification** |            |          |           |
| R1: Doc Us = very high research activity | 21.8   | 31.9     | 24.4      |
| R2: Doc Us = high research activity | 15.4 | 18.4     | 16.2      |
| Doctoral/professional universities | 14.7     | 11.5     | 13.9      |
| M1: Master’s C&U = larger programs | 23.4 | 17.8     | 21.9      |
| M2: Master’s C&U = medium programs | 9.5    | 6.2      | 8.6       |
| M3: Master’s C&U = smaller programs | 1.8    | 1.3      | 1.7       |
| Baccalaureate colleges: A&S focus | 6.9    | 9.4      | 7.5       |
a reference group would be left out of the model, say women, resulting in the coefficients of all other gender identity groups being interpreted as being compared to the women reference group. With effect coding, all groups receive coefficients, and these coefficients are interpreted as being compared to the average score of students in the model, in this case, the average score of STEM students.

**Limitations**

In institutions elect to participate in NSSE and further, they optionally choose to append additional item sets such as the items that are the focus of this study. This may create a selection bias where institutions that choose to administer this module of items are somehow substantively different from other institutions, therefore limiting generalizability. In several situations (e.g., LGBQ+, STEM students), we aggregated students together either to increase group counts or to simplify comparisons. There is great diversity within these and all subgroups of students studied here, so generalizations should be made with caution. We would also like to acknowledge that although we expanded the notion of diversity in STEM fields beyond what researchers normally examine, there are still many ways in which students vary that we were unable to include. Future research could expand on the variation within these subpopulations and ways in which students are diverse. Even the grouping of majors into a STEM/non-STEM dichotomy hides variation that likely occurs within individual majors and specific departments. Although we use effect coding to compare subgroups of students to the average score of STEM students rather than an arbitrary reference group, this methodology does have its limitations. As we learned in our first research question, there is not a proportional balance among identity characteristics and so the “average score of a STEM student” may be more like the majority subgroups in STEM fields. Additionally, subgroups of students may be closer to the “average score” of students than one another, masking differences between the subgroups themselves. We additionally would like to acknowledge the intersectional systems of oppression that impact student experiences and note that our study does not directly examine the unique experiences of students with multiple or varying combinations of identities that might impact their experiences as STEM students. Although we have expanded upon aspects of diversity for consideration, we view this study as an exploratory foundation upon which more nuanced notions of intersectionality can be assessed.

**Results**

The student respondents in this study consisted of 55,319 first-year students and 70,991 seniors who responded to the ICD Topical Module item set and reported a major field.
To see more details about respondents and the institutions at which they were enrolled, see Table 3.

**Representation**

There was a significant relationship between racial/ethnic identification and major field ($\chi^2 = 911.04, p < .001$). American Indian or Alaska Native students (AR = −2.8), Black or African American students (AR = −10.9), Hispanic or Latino students (AR = −9.5), Native Hawaiian or other Pacific Islander students (AR = −2.4), and white students (AR = −4.7) were underrepresented in STEM fields. Asian students (AR = 25.7), another race or ethnicity (self-identified) students (AR = 3.6), and multiracial students (AR = 2.9) were overrepresented in STEM fields. There was additionally a significant relationship between whether a student was first generation or not and their major ($\chi^2 = 638.42, p < .001$); first-generation students were underrepresented in STEM (AR = −25.3). Gender identity also had a significant relationship with major field ($\chi^2 = 4672.55, p < .001$); women were underrepresented in STEM fields (AR = −67.9), and students identifying with a nonbinary gender identity were overrepresented in STEM fields (AR = 3.3). Sexual orientation had a significant relationship with major as well ($\chi^2 = 46.26, p < .01$). Students who identify as lesbian (AR = −2.5) and queer (AR = −3.3) were underrepresented in STEM fields, and students who identified with a non-listed sexual orientation were overrepresented (AR = 3.9). Lastly, disability status had a significant relationship with students’ major ($\chi^2 = 72.92, p < .001$). Students who self-reported having a disability were underrepresented in STEM fields (AR = −8.5). Table 4 contains additional $\chi^2$ details.

**Perceptions by Major**

STEM students’ coursework emphasized significantly and notably less culturally engaging content compared to non-STEM students with ($B = −.482, p < .001$) and without institution-level controls ($B = −.490, p < .001$). The impact of this difference would be large by NSSE standards (Rocconi & Gonyea, 2018). Additionally, STEM students perceive less of an institutional emphasis on a commitment to diversity with ($B = −.111, p < .001$) and without institution-level controls ($B = −.118, p < .001$) although this difference would be small (see Table 5).

**Perceptions by Identity Characteristics**

Coursework emphasis for STEM students varies by all the demographics examined. Asian ($B = .09, p < .001$) students perceived a stronger emphasis on cultural engagement as well as women ($B = .15, p < .001$), students without a diagnosed disability or impairment ($B = .06, p < .001$), straight students ($B = .05, p < .01$), and first-generation students ($B = .10, p < .001$) compared to the average score of STEM students. White ($B = −.19, p < .001$) and multiracial students ($B = −.11, p < .001$) perceived a less strong emphasis on cultural engagement than the average score of STEM students. Results did not substantially change with or without institution-level controls. Table 6 contains the full regression results.
Perceptions of institution emphasize on a commitment to inclusivity varied by gender identity, disability status, and sexual orientation. Hispanic or Latino students ($B = .12, \ p < .001$), men ($B = .14, \ p < .001$) and women ($B = .19, \ p < .001$), students without a diagnosed disability ($B = .09, \ p < .001$), and straight students ($B = .01, \ p < .001$) all felt that their institution more strongly emphasized a commitment to diversity and inclusion than the average score of STEM students. Students choosing “another gender identity” ($B = -.23, \ p < .001$) and black or African American students ($B = -
.09, \( p < .01 \) felt that this commitment was emphasized less strongly than the average score of STEM students. Results did not substantially change with or without institution-level controls. Table 7 contains the full regression results.

**Discussion and Significance**

Much of the diversity research in STEM fields has focused on equity issues based on binary sex, race and ethnicity, or socioeconomic status, but these results remind us that there is a larger view of diversity that researchers often do not discuss. By examining non-binary gender, sexual orientation, and disability status in addition to first-generation status and racial/ethnic identification, we see that there are many identities that students hold that researchers may not be addressing in conversations about diversity. These results validate findings from previous studies and demonstrate that continued work is needed to increase the representation of women (PCAST, 2012), students of color (Estrada et al., 2016), and first-generation students (Bettencourt et al., 2020) in STEM. Additionally, we see a lack of diversity in STEM fields, not only with race/ethnicity, gender, and socioeconomic status, but we also see that sexual orientation and disability status may be marginalized in STEM environments. Given this disparity, other forms of diversity should be examined and discussed as well. Considering the Proactive Philosophies model, campus leaders should proactively discuss the ways that messages about welcome, acceptance, and inclusion can extend beyond the current norm for STEM programs for a wider variety of students (Museus, 2014).

One area that might be a good place to start is in more inclusive and culturally engaging coursework. Though culturally engaging classes can have a dramatic impact on the retention of students of color in STEM (Jackson et al., 2016), STEM students were less likely to experience culturally engaging curriculum or perceive institutional commitment to diversity. To address the issue of underrepresentation in STEM and the country’s need for a larger and more diverse STEM workforce, institutions of higher education need to increase access to culturally relevant coursework in STEM in addition to ensuring that all students feel safe, supported, and valued on campus. STEM faculty may feel that cultural norms and topics of diversity are beyond the scope of their content curriculum, but models such as Nelson Laird’s (2014) Diversity Inclusivity Framework offer a variety of ways beyond curricular content where courses

### Table 5 OLS regression coefficients for ICD scales

| Coursework emphasis | Institution emphasis |
|---------------------|-----------------------|
|                     | \( B \)  | SE  | \( \beta \) | Sig. | \( B \)  | SE  | \( \beta \) | Sig. |
|---------------------|---------|-----|-----------|------|---------|-----|-----------|------|
| STEM major in model 1 | \(-.490\) | .006 | \(-.215\) | ***  | \(-.118\) | .007 | \(-.052\) | ***  |
| STEM major in model 2 | \(-.482\) | .006 | \(-.211\) | ***  | \(-.111\) | .007 | \(-.049\) | ***  |

Model 1 controls include racial/ethnic identity, gender identity, disability status, sexual orientation, class level, and first-generation status. Model 2 controls include those in model 1 as well as institution enrollment size, private/public control, and Basic Carnegie Classification

***\( p < .001 \)
Table 6 OLS regression coefficients for coursework emphasis for STEM students with and without institution-level controls

|                          | B    | SE   | β    | Sig. | B    | SE   | β    | Sig. |
|--------------------------|------|------|------|------|------|------|------|------|
| (Constant)               | −.35 | .03  |      | ***  | −.33 | .03  |      | ***  |
| Am. Indian/AK Native     | .10  | .08  | .02  | .06  | .08  | .01  |      |      |
| Asian                    | .09  | .02  | .03  | ***  | .11  | .02  | .04  | ***  |
| Black or African Am.     | .04  | .03  | .01  | .04  | .03  | .01  |      |      |
| Hispanic or Latino       | .00  | .03  | .00  | .00  | .03  | .00  |      |      |
| Native HI/other PI       | .13  | .12  | .02  | .13  | .12  | .02  |      |      |
| White                    | −.19 | .02  | −.10 | ***  | −.19 | .02  | −.10 | ***  |
| Another race/ethnicity   | .08  | .05  | .02  | .08  | .05  | .02  |      |      |
| Multiracial              | −.11 | .03  | −.04 | ***  | −.10 | .03  | −.03 | ***  |
| I prefer not to respond  | −.14 | .04  | −.03 | ***  | −.14 | .04  | −.03 | ***  |
| Man                      | .02  | .02  | .01  | .04  | .02  | .02  |      |      |
| Woman                    | .15  | .02  | .08  | ***  | .15  | .02  | .08  | ***  |
| Another gender identity  | −.03 | .04  | .00  | −.04 | .04  | −.01 |      |      |
| I prefer not to respond  | −.15 | .04  | −.08 | ***  | −.14 | .04  | −.07 | ***  |
| LGBTQ+                   | .04  | .02  | .02  | **   | .04  | .02  | .01  | *    |
| Straight                 | .05  | .01  | .02  | ***  | .05  | .01  | .02  | ***  |
| I prefer not to respond  | −.09 | .02  | −.04 | ***  | −.09 | .02  | −.04 | ***  |
| Disability               | −.02 | .01  | −.01 | −.02 | .01  | −.01 |      |      |
| No disability            | .06  | .01  | .03  | ***  | .06  | .01  | .03  | ***  |
| I prefer not to respond  | −.04 | .02  | −.02 | −.04 | .02  | −.02 |      |      |
| First generation         | .10  | .01  | .05  | ***  | .10  | .01  | .05  | ***  |
| Inst. enrollment size    | --   | --   | --   |      | −.01 | .01  | −.01 |      |
| Private control          | --   | --   | --   |      | .00  | .01  | .00  |      |
| Doctoral highest R       | --   | --   | --   |      | −.08 | .02  | −.04 | ***  |
| Doctoral higher R        | --   | --   | --   |      | −.18 | .02  | −.12 | ***  |
| Doctoral moderate R      | --   | --   | --   |      | .02  | .02  | .01  |      |
| Master’s large           | --   | --   | --   |      | .00  | .02  | .00  |      |
| Master’s medium          | --   | --   | --   |      | .05  | .02  | .03  | *    |
| Master’s small           | --   | --   | --   |      | −.06 | .04  | −.03 |      |
| Bacc. arts and sciences  | --   | --   | --   |      | .20  | .02  | .12  | ***  |
| Bacc. Diverse            | --   | --   | --   |      | .04  | .03  | .02  |      |
| Other Carnegie           | --   | --   | --   |      | .02  | .06  | .01  |      |

\[ F = 70.568^{***} R^2 = .04 \quad F = 59.754^{***} R^2 = .05 \]

We standardized dependent variables before entry into models so that unstandardized coefficients can be interpreted as effect sizes. We used effect coding so that coefficients can be used to compare to the average score of STEM students. We included class level as an additional control. For more details on the variable coding, see Table 2

*p < .05, **p < .01, ***p < .001

can be more inclusive such as having instructors explore and better understand their own views, biases, and values of the learners in their courses. Additionally, a meta-
analysis on culturally relevant education by field of study found some of the strongest evidence for its benefit in STEM courses including increased retention of content.

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*p < .05, **p < .01, ***p < .001

Table 7 OLS regression coefficients for institution emphasis for STEM students with and without institution-level controls

|                      | B    | SE  | β    | Sig. | B   | SE  | β    | Sig. |
|----------------------|------|-----|------|------|-----|-----|------|------|
| (Constant)           | −.32 | .03 | ***  | −.31 | .03 | *** |      |      |
| Am. Indian/AK Native | −.01 | .08 | .00  | −.02 | .08 | .00 |      |      |
| Asian                | .02  | .02 | .01  | .01  | .02 | .01 |      |      |
| Black or African Am. | −.09 | .03 | −.03 | **   | −.09 | .03 | −.02 | **   |
| Hispanic or Latino   | .12  | .03 | .04  | ***  | .11 | .03 | .03  | ***  |
| Native HI/other PI   | −.04 | .12 | −.01 |      | −.04 | .12 | −.01 |      |
| White                | .04  | .02 | .02  | .05  | .02 | .02 |      |      |
| Another race/ethnicity| .00  | .05 | .00  | .01  | .05 | .00 |      |      |
| Multiracial          | .02  | .03 | .01  | .03  | .03 | .01 |      |      |
| I prefer not to respond | −.05 | .04 | −.01 |      | −.05 | .04 | −.01 |      |
| Man                  | .14  | .02 | .07  | ***  | .15 | .02 | .08  | ***  |
| Woman                | .19  | .02 | .10  | ***  | .18 | .02 | .10  | ***  |
| Another gender identity | −.23 | .04 | −.03 | ***  | −.23 | .04 | −.04 | ***  |
| I prefer not to respond | −.10 | .04 | −.05 | *    | −.10 | .04 | −.05 | *    |
| LGBQ+                | .01  | .02 | .00  | .01  | .02 | .00 |      |      |
| Straight             | .10  | .01 | .05  | ***  | .10 | .01 | .05  | ***  |
| I prefer not to respond | −.11 | .02 | −.06 | ***  | −.11 | .02 | −.05 | ***  |
| Disability           | .01  | .02 | .00  | .01  | .01 | .00 |      |      |
| No disability        | .09  | .01 | .04  | ***  | .08 | .01 | .04  | ***  |
| I prefer not to respond | −.09 | .02 | −.04 | ***  | −.09 | .02 | −.04 | ***  |
| First generation     | .01  | .01 | .00  | .01  | .01 | .01 |      |      |
| Inst. enrollment size| --   | --  | --   | --   | .03 | .01 | .03  | **   |
| Private control      | --   | --  | --   | --   | −.04 | .02 | −.02 | **   |
| Doctoral highest R   | --   | --  | --   | --   | .02 | .02 | .01  |      |
| Doctoral higher R    | --   | --  | --   | --   | −.13 | .02 | −.09 | ***  |
| Doctoral moderate R  | --   | --  | --   | --   | .05  | .02 | .03  | *    |
| Master’s large       | --   | --  | --   | --   | .00  | .02 | .00  |      |
| Master’s medium      | --   | --  | --   | --   | .06  | .02 | .03  | **   |
| Master’s small       | --   | --  | --   | --   | −.02 | .04 | −.01 |      |
| Bacc. arts and sciences | --   | --  | --   | --   | .12  | .02 | .07  | ***  |
| Bacc. diverse        | --   | --  | --   | --   | −.02 | .03 | −.01 |      |
| Other Carnegie       | --   | --  | --   | --   | −.09 | .06 | −.04 |      |

F = 46.116*** R² = .02  F = 36.015*** R² = .03
knowledge in math and science (Aronson & Laughter, 2016). This meta-analysis also suggests that the increased sense of belonging in STEM that culturally relevant pedagogy fosters is critical in retaining first-generation and low-income students in STEM. Faculty development that highlights the effectiveness of creating culturally engaging coursework along with strategies for implementing this type of pedagogy in STEM courses could increase access to culturally engaging courses for STEM students.

The results from this study further show us that experiences with inclusive coursework and messages about institutional commitment are not received equally by diverse types of students—campus commitment to diversity is not monolithic. The perception of commitment to diversity varied both by discipline, with STEM students perceiving lower commitment to diversity, and by student characteristics within STEM. Perception of commitment to diversity varied by gender identity, disability status, and sexual orientation. This differentiation in experiences of campus inclusivity is caused by interactions between students’ background, faculty backgrounds, and disciplinary culture, all within the overall campus environment (Museus, 2014). Creating structures to foster culturally engaging courses and humanizing student-faculty interactions, and proactive philosophies in campus commitment to diversity, are correlated with increased academic self-efficacy and motivation for students (Museus & Smith, 2016). As institutions work to improve their campus climate and demonstrate their commitment to diversity, they should consider this variability to ensure that interventions are culturally engaging with the full diversity of the student population. It is important that campus leaders proactively work toward making the support for students in STEM universal.

Our study raises several very important points for future research. Although our study provides a foundation for expanding notions of diversity along different social identity characteristics, there are still many ways in which students vary that need to be explored. Some examples of situations that we urge future researchers to explore are students who must spend a notable amount of their time working or caring for others who may not have the time to participate in activities essential to STEM learning (research, internships, etc.) without extra support (Foltz et al., 2014; Roksa & Kinsley, 2018). Further complicating the concepts of diversity and identity, considerations of intersecting systems of oppression (Moradi, 2017) were beyond the scope of this study. We know that students with multiple or varying combinations of marginalized identities will experience their environments in different ways (Jones & McEwen, 2000), and using our work as a foundation, future research can more specifically target student experiences with more nuanced attention to holistic views of student identities and their unique impacts on the student experience.

Finally, although a detailed analysis of institutional factors was beyond the scope of our study, our results indicate a weak relationship between our outcome measures and institutional characteristics (i.e., low variation at the institution level and very little change in results between models with and without institution-level controls) which may imply that the effect of institutions on student experience is negligible. We would like to discourage this message and instead encourage the interpretation that students develop their perceptions of a positive climate for diversity more strongly through the cues of their faculty and curriculum (Mayhew et al., 2005) than characteristics of their institution. The broad category measures used in this study likely do not capture the institutional policies or resources that might have impacted student perceptions.
Regardless, institutions do not create and change their own environments; it is up to the administrators, staff, and faculty to make these changes. We hope that through proactive philosophies, an expansion of what we think about in terms of diversity, and a push towards viewing culturally engaging courses as a matter beyond the content, we can improve the supports and environments for all students in STEM fields.

**Declarations**

**Conflict of Interest**  
The authors declare no competing interests.

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