UCLA SAIRO

Student Affairs Information and Research Office

A department of Student Affairs

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Diverse Learning Environments (DLE) Survey: Variations in STEM Student Experiences

The Student Affairs Information and Research Office (SAIRO) is the research and assessment office within UCLA's Student Affairs organization. The mission of SAIRO is to support the learning and development of the whole student by providing reliable, timely and useful information about students and their experiences; by developing the capacity of student affairs and other stakeholders to collect, interpret, and utilize data to enhance the quality of students' educational experience and environment; and by helping Student Affairs units assess and document the effectiveness of their programs and practices.

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Executive Summary

In the winter and spring quarters of 2011, UCLA Student Affairs administered the Diverse Learning Environments (DLE) survey to explore aspects of diversity and climate on campus. The DLE captured information on a variety of student experiences and perspectives. This topical brief focuses on students enrolled in Science, Technology, Engineering, and Mathematics (STEM) majors and how various subgroups of students in STEM experience their academic and co-curricular environments.

Compared to their non-STEM peers, STEM students:

- Reported higher perceptions of academic self-concept.
- Were less likely to be exposed to diversity-related curriculum, specifically courses that included materials about race/ethnicity, class, sexual orientation, political orientation, gender, privilege, or disability.
- Reported lower levels of engagement with academic and social environments on campus and lower perceptions of individual social agency.

Across major fields, student experiences differed in the following ways:

- URM STEM students showed lower mean scores in terms of academic validation in the classroom in comparison to their non-STEM peers (45.2 vs. 50.0).
- Female STEM students were more likely to participate in civic engagement than their male STEM counterparts.
- International male students in non-STEM fields were strikingly less likely to have conversations across differences in comparison to their STEM peers.

DLE Survey & Sample

The Diverse Learning Environments (DLE) survey developed by the Higher Education Research Institute (HERI) at UCLA, stems from research indicating that optimizing diversity in the learning environment can facilitate achievement of key outcomes, including improving students' motivations for lifelong learning, competencies and skills for living in a diverse society, and student retention and success. UCLA participated in this national research effort to generate greater understanding of diversity, student learning, and student success both inside and outside of the classroom.

The DLE was administered in the winter and spring quarters of 2011 as a census survey of all enrolled undergraduate students at UCLA. In all, 7,597 students responded to the survey, representing 30% of enrolled UCLA undergraduates. Compared to the overall undergraduate population at that time, the sample slightly over-represents Asian students and students that enrolled directly from high school and slightly under-represents African American/Black students.

DLE Sample

	Percent	#
Race (n=4,962)		
American Indian	<1%	11
African American/Black	2%	83
Hispanic	15%	737
Asian	46%	2,283
White	31%	1,536
Multiracial	6%	308
Gender (n=4,989)		
Male	37%	1,847
Female	63%	3,142
Year in School (n=7,461)		
First Year	17%	1,270
Second Year	20%	1,551
Third Year	31%	2,371
Fourth Year or More	32%	2,405
Entry Status (n=7,461)		
Direct Entry	76%	5,685
Transfer	24%	1,776
First Generation College Students (n=4,857)		
Yes	20%	952
No	80%	3,905
Field of Study (n=4,851)		
STEM Major	45%	2,191
Non-STEM	55%	2,660

Overall Experiences of STEM Students

Comparisons of the experiences of STEM and non-STEM students were examined through the analysis of factor variables. These factors were developed by HERI and represent broader thematic areas comprised of multiple variables. HERI conducted extensive factor analyses and created conceptual categories to better understand how groups of variables help inform a broader understanding of themes, such as sense of belonging, validation, discrimination, etc. The reliability of these factors was also confirmed with the UCLA data and the mean scores (the average normalized score of items in each factor) are reported. The DLE Survey Factor Variable list of all 18 factors and the items that make up each factor is available on the SAIRO website at www.sairo.ucla.edu/dle. Factors were standardized to a mean of 50 and a standard deviation of 10. This brief compares factor mean scores for STEM and non-STEM populations. In addition, recognizing that there are different patterns of major choice among groups of students, additional analysis (general linear modeling, GLM) was conducted to explore relationships between major, sex, and race.

Analyses of the data revealed that students enrolled in STEM majors were significantly more likely to report higher academic self-concept than their non-STEM peers. Academic self-concept referred to students' self-rating of their academic, mathematical, intellectual, and motivational abilities in comparison to their peers. Academic self-concept was the only area of comparison between the two groups in which STEM students showed a more favorable outcome (see Table 1). Interestingly, there were no significant differences between STEM and non-STEM students in terms of measures of campus climate with the exception of one factor, discrimination and bias ($p \leq .05$), where non-STEM students showed a slightly higher rate of experience.

Aside from a significantly higher academic self-concept, STEM students have:

- **Lower engagement with academic and social environments** (e.g., integration of learning, civic engagement, habits of mind, and general interpersonal and academic validation). STEM students reported lower frequencies of applying course materials (integration of learning) and problem-solving techniques (habits of mind). Additionally, STEM students were less likely to participate in community or global causes (civic engagement). STEM students were less likely to feel validated within the classroom (academic validation) or make connections with faculty and staff that furthered their development (general interpersonal validation).
- **Lower engagement with diversity-related activities** (e.g., in the curriculum and co-curricular activities, conversations across differences, and cross racial interactions). STEM students were less likely to be exposed to materials, activities, or interactions with diverse peers or materials regarding differences in race/ethnicity, socioeconomic class, gender, privilege, or sexual orientation.
- **Lower perceptions of agency** (e.g., critical consciousness and action, social agency, and pluralistic orientation). STEM students were less likely to indicate that they had engaged in social or political issues (critical consciousness and action), feel prepared to engage in global issues (pluralistic orientation) and value these goals personally (social agency).

Table 1. Comparison of STEM and Non-STEM Students	STEM Students (n=2,185)	Non-STEM Students (n=2,655)	Difference	Significance
Academic and Social Environment				
Integration of learning	47.1	50.3	-3.2	***
Civic engagement	49.0	52.0	-3.0	***
Habits of mind	47.6	49.4	-1.8	***
General interpersonal validation	47.3	48.9	-1.6	***
Academic validation	46.0	49.3	-3.3	***
Diversity-related Activities				
Curriculum of inclusion	44.1	51.0	-6.9	***
Co-curricular diversity activities	48.2	50.5	-2.3	***
Conversations across differences	48.5	50.6	-2.1	***
Cross racial interactions	49.6	50.5	-0.9	**
Negative cross-racial interactions	51.1	50.7	0.6	
Perceptions of Individual Agency				
Social agency	48.3	52.0	-3.7	***
Academic self-concept	50.9	49.8	1.1	***
Pluralistic orientation	48.0	50.8	-2.8	***
Critical consciousness and action	47.9	51.3	-3.6	***
Campus Climate				
Discrimination and bias	50.0	50.6	-0.6	*
Harassment	50.5	50.1	0.4	
Institutional commitment to diversity	50.9	50.7	0.2	
Sense of belonging	51.1	51.2	-0.1	
Note: *** p≤ .001; ** p≤ .01; * p≤ .05				

Variations in STEM Experiences

Extensive research has documented that student experiences in STEM majors often vary by race/ethnicity (Cole & Espinoza, 2008; Hurtado, Cabrera, Lin, Arellano, & Espinosa, 2009). Students of color (including Black, Latino, Native American, and Asian American students), in particular, may encounter experiences with racial discrimination, self-doubt, and negative stereotypes (McGee & Martin, 2011; Steele, 1997). The negative experiences often associated with belonging to a racial minority group have been identified as challenges to degree completion (Chang, Eagan, Lin, & Hurtado, 2011; Elliot, Strenta, Adair, Matier, & Scott, 1996).

Recognizing the role of race and sex on students' experiences, general linear modeling (GLM) was conducted to take into account race (i.e., Asian, URM, International students, and White students) and sex on the significant outcomes previously discussed (see Table 2 for the racial/ethnic breakdown of STEM sample). The underrepresented minority student (URM) category included American Indian, African American/Black, and Hispanic students. When controlling for race and sex, five variables remained significant, indicating a true effect due to major choice: civic engagement, academic validation, and three diversity-related dimensions (i.e., curriculum of inclusion, conversations across differences, and co-curricular diversity activities). The continued significance of these variables tells us that differences cannot be accounted for by variations in race or sex of students pursuing STEM majors, despite the greater likelihood of Asian, White, and male students to enroll in STEM majors.

Table 2. Student Demographics in STEM

	DLE STEM Sample (n=2,191)	UCLA Enrollment in STEM 2011-12 (n=12,113)
American Indian[1]	1%	<1%
Asian	56%	47%
African American/ Black [1]	1%	3%
International	5%	6%
Hispanic[1]	9%	12%
White	24%	27%

[1]Included in URM category

Interaction Effects

Beyond controlling for race and sex, general linear modeling (GLM) also allows for exploration of variation in patterns among various sub-groups of students through examination of interaction effects. A significant interaction indicates that the pattern of responses in a particular area varies for different subgroups. There were three factors with significant interactions between major choice (i.e., STEM and non-STEM) and race, three significant interactions by major and sex, and one factor with a significant three-way interaction between major, race, and sex (see Table 3).

Table 3. Interaction Effects of Major Choice and Background Demographics

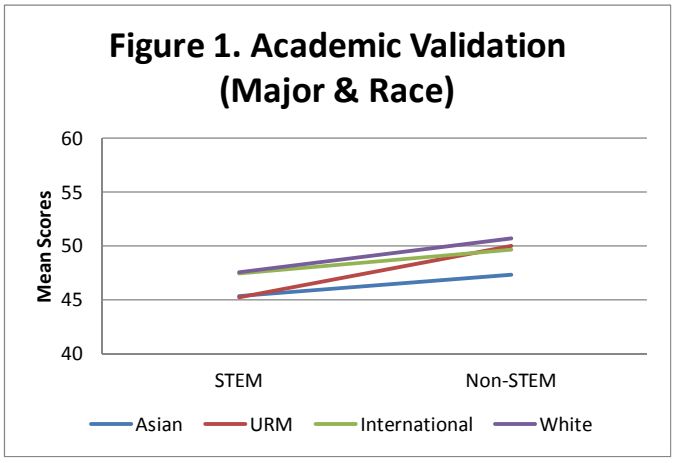
	Major & Race	Major & Sex	Major & Race & Sex
Academic and Social Engagement			
Civic engagement		**	
Academic validation	*		
Diversity-related Activities			
Curriculum of inclusion	***		
Conversations across differences			*
Co-curricular diversity activities	*	**	
Climate			
Harassment		*	

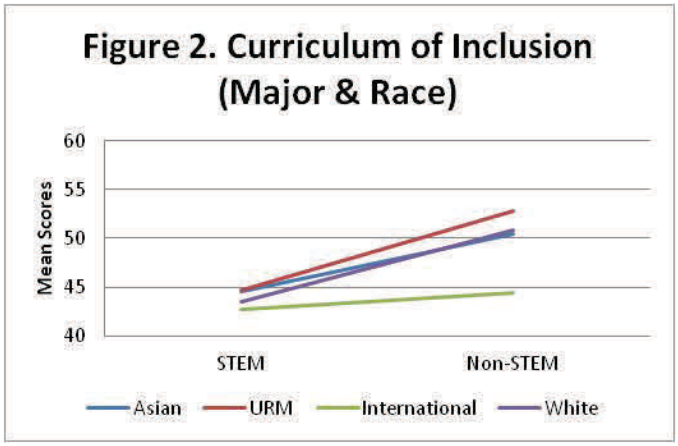
Major Choice & Race Interactions

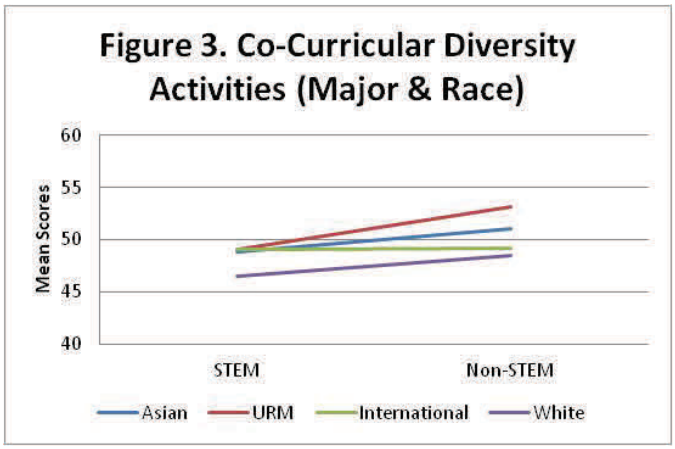
In general, students in STEM majors were less likely to feel academically validated in comparison to their non-STEM counterparts. Within racial groups by major choice, URM, Asian and White students in STEM reported significantly lower scores for academic validation in comparison to their counterparts in non-STEM fields (mean score differences of -4.8, -2.0, and -3.1 respectively; $p \leq .000$). However, URM students showed the greatest difference in their sense of academic validation in the classroom by major choice (mean scores of 45.2 for STEM vs. 50.0 for non-STEM) (see Figure 1).

Within racial groups, the greatest differences by major choice in terms of exposure to diverse curriculum were among URM, White, and Asian students (mean difference of -8.2, -7.3, and -6.0; $p \leq .000$). URM students in non-STEM fields reported the highest overall rates of exposure to diverse curricula and international STEM students the lowest. International students differed from the overall trend with minimal differences in exposure to diverse curriculum across major field (see Figure 2).

In general, students in non-STEM majors participated in diversity-related co-curricular activities at greater rates than their peers in STEM fields. The exception was with international students in which there were no significant differences in participation by major choice. URM students in non-STEM fields reported the highest rates of participation in diversity-related co-curricular activities. The greatest differences by major choice were among URM students, Asian, and White students (mean differences of -4.2, -2.3, and -2.1 respectively; $p \leq .000$) (see Figure 3).

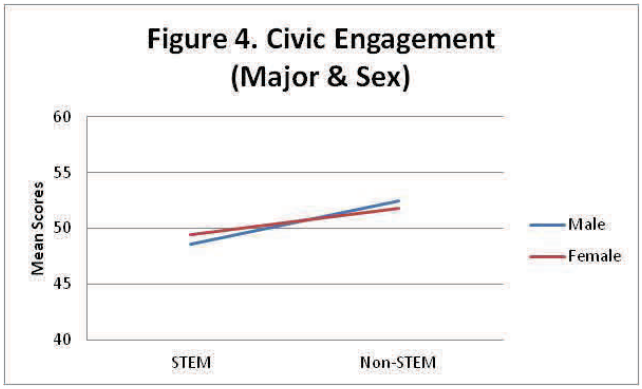






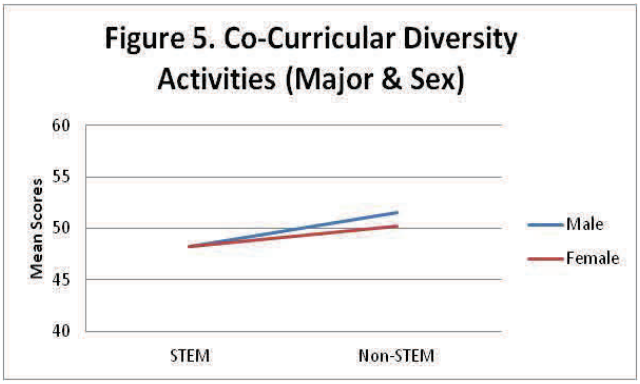
Major Choice & Sex Interactions

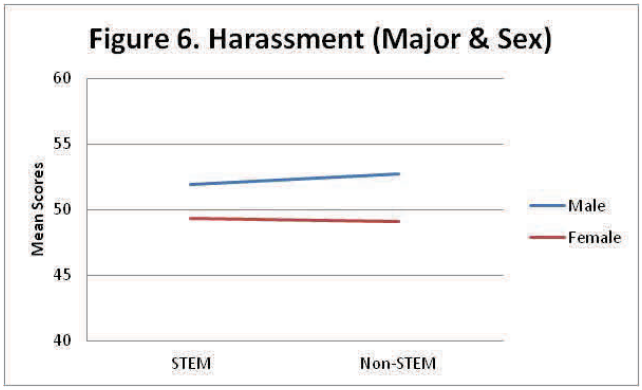
Research on sex and STEM fields has primarily focused on differences in enrollment and the under-representation of women in STEM fields in comparison to their male counterparts (Kahveci, Southerland, & Gilmer, 2006). Related to their numeric under-representation, research has also documented that for many women of color in STEM, there are often feelings of marginalization or a limited sense of belonging within their academic majors (Locks, Hurtado, Bowman, & Osegura, 2008). Within



the DLE data, the interactions of major and sex revealed a more nuanced perspective of UCLA STEM students' postsecondary experiences when taking into consideration students' sex and race. Within a STEM context, the following differences were present:

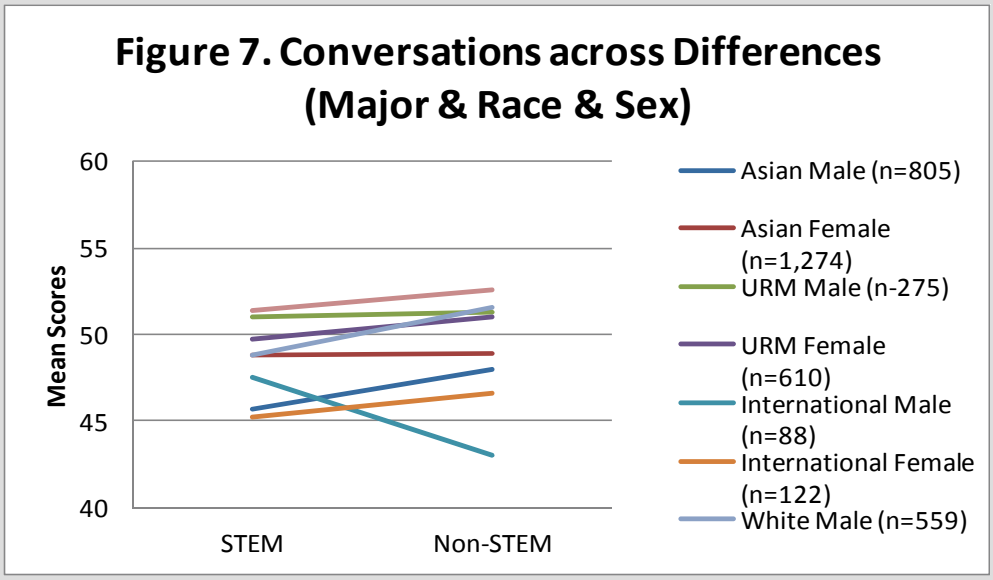
- Female students are more likely to be engaged civically in comparison to male students; however, the reverse is true in non-STEM fields (see Figure 4).
- Regardless of sex, STEM students reported similar rates of participation in co-curricular diversity activities; however, male students in non-STEM majors reported greater participation than their female counterparts (see Figure 5).
- Interestingly, the STEM context appears to serve as a protective factor to male students from experiences with harassment. Male students in non-STEM majors reported higher rates of experiences with harassment (see Figure 6).





Major & Race & Sex Interactions

Existing scholarship and the previous analyses confirm that student's experiences in STEM majors are influenced by their race and sex. In general, non-STEM students reported higher mean scores related to the frequency of conversations across differences. Conversations across differences, specifically the frequency with which students engaged with diverse peers or perspectives, was the **only factor** that demonstrated significant interactions across all three variables. The most distinct difference highlighted the low mean score (43.0) of conversation across differences among international men in non-STEM fields (see Figure 7) in comparison to a mean score of 47.5 among their counterparts in STEM. International male students had the largest difference in mean by major choice, while URM male students and Asian female students maintained similar frequencies of interactions across fields. International students as a whole reported low mean scores for conversations across differences; however, this analysis shows that international male students in non-STEM majors present a clear sub-group for attention and programming.



Conclusion

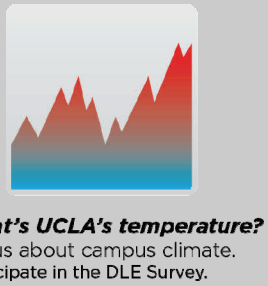
The postsecondary experiences of STEM students are of great concern for scholars and practitioners alike to ensure the academic and emotional success of students, particularly those not traditionally represented in STEM majors. These results highlight specific areas that could benefit from greater attention, particularly in the ways in which students' engage with their academic and social environments and strategies to overcome experiences with harassment.

Student's academic and social engagements with a diverse curriculum and co-curricular activities remain as priority for the campus. Analyses of the DLE data revealed that students in STEM have a lower exposure to materials about differences across race/ethnicity, class, sexual orientation, political orientation, gender, privilege, or disability groups. While STEM majors are known for their extensive curricular requirements, much can be gained by presenting a curriculum that prepares students with global perspectives and the skills to interact with diverse peers. Likewise, students' participation in co-curricular diversity activities can help foster community and sense of validation. This may be particularly important for international male students who reported the lowest rates of interactions and conversations across differences.

Male students' experiences with harassment on campus are also another area of concern. While the experiences of female students on campus across major choice remained similar, this was not true for male students. These results provide more nuanced considerations in terms of potential student needs.

Results from this brief offer an opportunity for student affairs professionals to consider how students of color and international students experience their academic disciplines differently. As UCLA strives to support the persistence and success of underrepresented students in STEM, these results help frame a discussion of how campus climate influences students' experiences and areas in which greater attention could be focused.

The UCLA DLE logo, designed by Brian Phan, a 2nd year UCLA student in Design and Media Arts, was utilized for all promotional materials and UCLA-affiliated websites.



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