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The Popularity and Intensity of Engineering Undergraduate Out-of-Class Activities

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Abstract

Background Although researchers have documented the outcomes of various out-of-class activities for undergraduate students, less attention has been given to student perspectives on activity category and activity levels, particularly when considering demographics such as gender and race/ethnicity.

Purpose/Hypothesis This study aims to create a more nuanced profile of engineering undergraduate engagement in out-of-class activities disaggregated by gender, race/ethnicity, and level of activity. As an exploratory study, its goal is to identify patterns that can be explored in the future.

Design/Method A purposive sample of 649 engineering students from three institutions provided complete survey responses that were quantitatively analyzed using frequency tables, diverging bar charts, and calculated odds ratios. This study included an intentional focus on gender and racial/ethnic differences.

Results Job and Sports were most commonly identified as the top out-of-class activity for engineering students. Select pre-professional activities and activities related to the humanities, arts, environment, and civic life were identified less frequently as top activities. Significant differences in choice of top activity and level of activity were found when comparing students by gender and race/ethnicity.

Conclusion A better understanding of engineering student engagement in out-of-class activities helps guide actions of program administrators and educators and the direction of future research exploring out-of-class engagement. Such opportunities can be shaped to improve engagement, particularly among underrepresented groups.

Keywords co-curricular; extracurricular; engagement; out-of-class activities; underrepresented students

Introduction

Government, industry, and academics emphasize the need to increase the number of graduates in science, technology, engineering and mathematics (STEM) and to diversify the associated predominately White male professions (Chubin, May, & Babco, 2005; National Academy of Engineering, 2011; President's Council of Advisors on Science and Technology, 2012). However, despite increased efforts to attract and retain larger numbers of undergraduates and

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more diverse students, data continue to suggest that these goals have not been met in engineering (National Science Foundation, National Center for Science and Engineering Statistics, 2017; Ohland et al., 2008; Sax et al., 2016; Yoder, 2016). Prior work in engineering education has dedicated much attention to increasing persistence, an outcome that has been linked to environmental factors such as pre-college mentorship, student demographics, parental influence, and student engagement (Eris et al., 2010; Ohland et al., 2008).

While student engagement has received significant attention from researchers, policymakers, and educators over the past two decades, this increased focus has not resulted in a consensus about the definition and measurement of student engagement (Fredricks, Filsecker, & Lawson, 2016). Instead, student engagement has been defined based on multiple perspectives, theoretical traditions, and educational contexts (Kahu, 2011). Laird, Chen, and Kuh (2008) identified student engagement as consisting of two components: (a) the time and effort students put into their studies and other activities related to student success and (b) the institutional resources, learning opportunities, and services that support student participation in these activities. This definition highlights a proposed dual nature of student engagement: the first component primarily pertains to students' own resources (i.e., time and effort) that they invest in their studies and other activities, and the second captures the ways in which university administrators can directly influence student engagement through the creation or modification of support programs.

While understanding how institutions can support student engagement is important, this study focuses on it from the student perspective. As Coates and McCormick (2014) wrote: "Students always lie at the heart of conversations about student engagement" (p. 3). In his foundational work on student development, Astin (1984) described student involvement with a focus on the individual student: "Student involvement refers to the amount of physical and psychological energy that the student devotes to the academic experience" (p. 518). Similarly, Hu and Kuh (2002) defined student engagement as "the quality of effort students themselves devote to educationally purposeful activities that contribute directly to desired outcomes" (p. 555). In addition, many researchers have supported a multidimensional construct of student engagement as they described behavioral, emotional, and cognitive student engagement, all of which are grounded in the student experience (Fredricks, Blumenfeld, & Paris, 2004). As these examples suggest, the commonality among these definitions and conceptions of student engagement is their focus on the student.

A major portion of this student engagement research focuses on describing and quantifying how students spend their time, both in and out of class. Many studies investigating students' academic experiences have been limited to formal, in-class learning settings; yet, prior research has estimated that undergraduate students spend only 7.7% of their waking hours in such settings (National Research Council, 2009). The academic experience does not consist of isolated activities in the "classroom, library and laboratory" (Zehner, 2011, p. 1) but rather is supported and extended through student participation in an array of out-of-class activities. Researchers have recently begun to explore these avenues of student learning outside of class and how these activities may promote or hinder student engagement (Pascarella & Terenzini, 2005; Zehner, 2011).

The term *out-of-class activity* is used to refer to any organized activity (e.g., club, organization) a student engages in during waking hours outside of formal instruction in a classroom. These typically involve one of three types: curricular-related, co-curricular, or extracurricular activities. Curricular-related activities, though directly connected to a particular academic course that is part of a student's plan of study, occur outside of class time, while co-curricular activities are not linked to a particular academic course but somehow complement the student's academic

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curriculum. Extracurricular activities, on the other hand, capture activities that are not directly or indirectly connected to the academic curriculum. Table 1 includes descriptions of and examples for each activity type. Based on these definitions, this research seeks to divide college-related activities that students participate in as either an in-class or out-of-class activity.

Literature Review

A growing body of literature has begun to empirically identify positive and negative outcomes associated with a range of out-of-class activities (e.g., Astin, 1993; Bergen-Cico & Viscomi, 2012; Brownell & Swaner, 2009; Kuh, 2008; Miller, Rocconi, & Dumford, 2018; Pascarella & Terenzini, 2005; Terenzini, Pascarella, & Blimling, 1999). Because of the differences in contextual factors among academic environments (e.g., student demographics, program requirements, institution type, geographic location, etc.), it is often difficult to generalize findings associated with the impact of out-of-class engagement on a particular major. Fortunately, recent research has begun to explore positive and negative outcomes associated with out-of-class engagement in engineering (Burt et al., 2011; Simmons et al., 2017; Strauss & Terenzini, 2007; Wilson et al., 2014). Within the past 2 years, engineering education stakeholders such as ABET and the American Society for Engineering Education (ASEE) have become interested in the beneficial outcomes associated with out-of-class engagement. In the proposed 2016–2017 accreditation criteria, ABET added a student outcome to Criterion 3, emphasizing that during their undergraduate careers, students should obtain "an ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately" (ABET, 2016).

Despite the value of out-of-class activities, students pursuing a degree in engineering spend significantly more time preparing for class compared to their nonengineering counterparts, leaving less time for out-of-class activities not directly connected to a course (Lichtenstein, McCormick, Sheppard, & Puma, 2010). This comparison suggests that out-of-class activities for engineering students may need to be restructured and better promoted so that students can more easily commit their available energy and time to becoming more engaged beyond classroom and laboratory experiences. An in-depth exploration of the current participation of engineering students in out-of-class

Table 1 Types of Out-of-class Activities (Adapted from Simmons, Creamer, & Yu, 2017)

Activity type	Description	Examples
Curricular-related	Tasks or activities associated with a course and connected to academic learning, but occurring outside of the classroom	Homework assignments, studying for an exam, group projects
Co-curricular	Activities, programs, and learning experiences that complement formal course content and/or degree major, but are not connected directly to a particular course	Engineering professional societies, undergraduate research, internships and co-ops
Extracurricular	Organizations or activities not explicitly connected to academic learning or the scope of a regular curriculum and usually carry no academic credit	Athletics (intercollegiate and intramural), fraternities and sororities, student government, job (off-campus or on-campus)

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activities not directly linked to a particular class will provide researchers and educators with an increased understanding of these contexts to shape the development and evolution of the out-of-class activities offered to these students.

The exploratory study reported here aims to develop a more complex and nuanced understanding of engineering student perceptions of engagement in out-of-class activities by exploring three areas of inquiry. Using survey data, we first identified the categories of out-of-class activities not directly linked to a course that are perceived to be the most beneficial to students through self-identified outcomes. Second, we examined the reported levels of activity across these categories to examine the student commitment required to achieve such outcomes. Third, to explore how different groups of students engage in these activities, we examined trends of student engagement among a variety of activities based on student demographic characteristics, specifically, gender and race/ethnicity. We used the following questions to guide our inquiry:

RQ1: What out-of-class activities not directly linked to a class provide the most perceived outcomes for students?

RQ2: How does level of activity vary for each of the top activities?

RQ3: Are there differences among engineering students' engagement in these activities by gender and race/ethnicity?

For the purpose of this study, a *top activity* is defined as the one from which the student reports obtaining the most outcomes. We narrowed our research focus to examine students' self-selected top activities to develop an understanding of the categories of activities in which students perceive they receive the most benefit. This definition of top activity was provided to the survey respondents before a list of outcomes was presented to them (see the Appendix for the survey questions). Students were also asked to select their level of activity in their top activity, which then served as an indicator of student engagement. Using this approach, we could examine the relationships among a student's chosen top activity and their level of activity with respect to their reported demographics, specifically gender and race/ethnicity.

Methods

Survey

Participants completed the Postsecondary Student Engagement (PosSE) Survey on their out-of-class activities and the associated outcomes and level of activity. In this survey, each activity category and its outcomes of student engagement were determined based on a literature review of 45 relevant studies published between 2000 and 2014, focus group data and think-aloud protocols (Simmons et al., 2017; Simmons & Yu, 2015; Yu & Simmons, 2015). During survey development, definitions and examples of selected activities were added to the survey if the developers determined that such explanations would be useful to respondents. For example, for the activity category of jobs, the examples of employment on or off campus and work study were provided.

Measures

Survey participants were provided with a list of 20 categories of out-of-class activities not linked to a particular class (see the Appendix) and were asked to mark every activity category in which

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they participated during the current or previous semesters at the time of the study. Examples of activities were provided to clarify more ambiguous categories. Participants selected the "Other" category and completed the write-in option for their activity categories not listed on the survey.

A series of Likert-type questions (Likert, 1932) were used to gather data regarding the students' levels of activity in each selected activity. More specifically, they rated their degree of activeness for each of their activity categories using a four-point scale: 0 (not active at all), 1 (minimally active), 2 (moderately active), and 3 (highly active). During survey development, undergraduate students participated in think-aloud sessions where they were asked to explain how many hours per month they devoted to an activity that they marked as being highly active in. Because their responses varied widely, the interpretation of the Likert scale for level of activity was not associated with a specific amount of time; rather this measure represents each student's perception of their level of activity.

Among the activity categories selected, survey participants were also asked to identify their top activity, choosing the one from which they believed they gained the most outcomes. Using this approach, we could identify survey participants' top activities and the associated level of activity, both of which constitute the focus of this study and analysis.

Participants

The study surveyed students at three public institutions, all classified as R1, indicating the highest level of research activity according to the Carnegie Classification of Institutions of Higher Education (n.d.). Two of the universities were predominantly White institutions and the third was a Hispanic-serving institution. As this exploratory study focused on select underrepresented groups (based on gender and race/ethnicity), we purposefully wanted to survey students from institutions awarding a significant number of undergraduate engineering degrees to women and members of underrepresented ethnic/racial groups. We used recent data about trends in undergraduate engineering education in the United States (Yoder, 2016) to select schools that met this criterion. The institutions selected have student–faculty ratios ranging from 16:1 to 19:1, maintain total enrollments of more than 25,000 students, have established common first-year experiences for all undergraduate engineering students, and have clubs and organizations in each of the activity categories. Two of the institutions are located in the southeastern region and one in the southwestern region of the United States (National Geographic, 2018). In 2017, the number of engineering undergraduates in each institution's engineering program ranged from 2,700 to 8,000.

Study participants were recruited during the Spring 2016 term through the Spring 2017 term using an online survey sent via e-mail. Participation in the online survey was voluntary and confidential. In each case, recruitment emails were sent by a department or institution employee commonly known to the participants, with two reminders being sent following this initial e-mail. As this was an exploratory study, we were not concerned about obtaining a representative sample but rather wanted to receive responses from a significant number of underrepresented groups, the reason for selecting these three institutions.

Constraining our inquiry to explore responses from undergraduate engineering students in the United States ensured a group of generally similar pre-college academic experiences and yielded a total of 845 completed participant surveys. In the survey, participants were asked to provide demographic information (e.g., gender, race/ethnicity, citizenship, enrollment status, college year, engineering major, out-of-class engagement in high school, and parent education). A summary of participant characteristics is shown in Table 2. As demographic

Table 2 Characteristics of Undergraduate Engineering Student Sample

Characteristic ($n = 845$)	Frequency	%
Gender		
Male	509	60.2
Female	325	38.5
Other	11	1.3
Race/Ethnicity		
White	424	50.2
Asian	47	5.5
Black	88	10.4
Hispanic	167	19.8
American Indian/Alaska Native	1	0.1
Native Hawaiian/Pacific Islander	1	0.1
Multiracial	90	10.7
Other	27	3.2
Enrollment status		
Full-time	813	96.2
Part-time	32	3.8
College year		
First year	174	20.5
Second year	149	17.6
Third year	202	23.9
Fourth year	202	23.9
Fifth year or more	74	8.7
Not specified	44	5.2
Engineering major		
First year program	86	10.2
Mechanical	246	29.1
Civil, const., and env.	265	31.4
Industrial	42	5.0
Electrical and computer	74	8.7
Chemical	21	2.5
Biomedical	16	1.9
Other	95	11.2
High school out-of-class engagement		
Yes	777	92.0
No	68	8.0
Parent education		
Less than Bachelor's	258	30.5
Bachelor's	257	30.4
Master's or Doctorate	323	38.1

responses were not required for a survey to be considered complete, participants could be included in this study without providing this information.

Students in individual engineering majors comprising less than 2% of the sample were aggregated to create an "Other" category consisting of the agricultural, architectural, biological, material, nuclear, and textile engineering fields, as well as engineering management, engineering physics, and engineering science. The Parent Education measure was created based on two guardians' highest level of educational attainment as indicated via a list of predetermined

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responses ranging from 1 (did not finish high school) to 8 (doctoral degree). The highest level of educational attainment reported for either parent/guardian was recorded.

Data Analysis

Data were quantitatively analyzed using descriptive statistics comprising frequencies, percentages, diverging stacked bar charts, and odds ratios. Frequency tables showed the popularity of each category as a top activity, while diverging stacked bar charts illustrated the relationship details for top activity and level of activity. The odds ratio charts provided evidence of the relative popularity of various top activities by gender and race/ethnicity as well as a clear representation of statistical significance.

Odds ratios are an accepted method of comparing odds of events relative to membership in two categories. In general, odds ratios help determine whether the odds of an event differ based on an independent variable, with this ratio being one when an event is equally likely to occur for both categories of an independent variable. In the context of this study, odds ratios were used to demonstrate whether the odds of an individual participating in a top activity (i.e., the event) differed based on gender or race/ethnicity (i.e., the independent variables). Odds ratios are provided with 90% confidence intervals from SAS/STAT® software Version 9.4 using Proc Freq. As our study was exploratory, the more conservative value of alpha = 0.1 or 90% confidence was chosen in an effort to suggest areas for further investigation in the relationship between activities and underrepresented populations. Standard calculations for odds ratios and exact confidence intervals are detailed in Agresti (2013).

Significance testing was then interpreted using the confidence interval: A $(1 - \alpha)\%$ confidence interval that contains 1 is not significantly different from 1 at the alpha level; alternatively, if the interval does not contain 1, the odds ratio is significantly different from 1. Because odds ratios are calculated relative to a particular category, they must be interpreted relative to it. For this analysis, gender ratios were calculated relative to males, the majority in most engineering disciplines. An odds ratio greater than 1 means that females are more likely to participate in the given activity, and conversely, an odds ratio of less than 1 indicates that males are more likely to participate. When examining racial representation, odds ratios were calculated relative to the combined categories of Whites and Asians, the two groups representing the majority in most engineering disciplines, with all other demographic categories being considered as underrepresented. Therefore, an odds ratio greater than 1 indicates that underrepresented races are more likely to participate in a top activity, whereas an odds ratio less than 1 indicates that the majority is more likely to participate.

Results

Engagement in Top Activity

The survey data analyzed in this study included responses from 845 U.S. engineering undergraduates. Of these, 649 participants selected 1 of the 19 activity categories listed as their top activity (i.e., the remaining 196 undergraduates chose “Other”). This sample comprising 649 participants was used for the subsequent analyses. Table 3 provides the frequency and percentage in descending order of selection of each activity by respondents as their top activity category. The categories of Job, Sports, and Design Competition Team were the most popular choices, each with more than 10% of the respondents choosing it. Environmental; Student Government; Film, Theater, Visual Arts; and Media, Publication, Journalism were the least popular categories, each with less than 1% of respondents selecting it as a top activity. Film,

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Table 3 Engineering Students' Choice of Top Activity

Top activity	Frequency	%
Job	109	16.8
Sports	81	12.5
Design Competition Team	77	11.9
Culture, Faith, Gender, and Identity	55	8.5
Professional Experiences	44	6.8
Research	39	6.0
Fraternity or Sorority (social)	37	5.7
Living-Learning Community	34	5.2
Engineering Outreach Support	33	5.1
Music and Dance	29	4.5
Service and Public Service	29	4.5
Military	22	3.4
Pre-professional	17	2.6
International Experiences	15	2.3
Fraternity or Sorority (Major-related)	12	1.8
Environmental	6	0.9
Student Government	5	0.8
Film, Theatre, and Visual Arts	4	0.6
Media, Publications, and Journalism	1	0.1
Total	649	100.0

Theater, Visual Arts and Media, Publication, Journalism saw the fewest number of selections as a top activity, at only 0.6% and 0.1%, respectively.

Table 4 shows the frequency and percentage of students reporting each level of activity in their top activity. The majority of students (67.2%) reported that they were highly active in their top activity, followed by moderately active (28.7%), and minimally active (3.5%). Four students reported their level of activity as not active at all.

The distributions of student level of activity for each activity category are illustrated by the set of diverging stacked bar charts (Heiberger & Robbins, 2014) shown in Figure 1, with each bar representing all students selecting that category as their top activity. Totaling 100%, each bar is partitioned based on the percentage of survey participants who selected each of the four levels of activity. The zero mark is a dividing line with "not active at all" and "minimally active" on the left and "moderately active" and "highly active" on the right. Figure 1 does not include Environmental; Student Government; Film, Theater, Visual Arts; and Media, Publication, Journalism activities due to their small sample sizes.

Table 4 Level of Activity in Top Activities

Level of activity	Frequency	%
Not active at all	4	0.6
Minimally active	23	3.5
Moderately active	186	28.7
Highly active	436	67.2
Total	649	100.0

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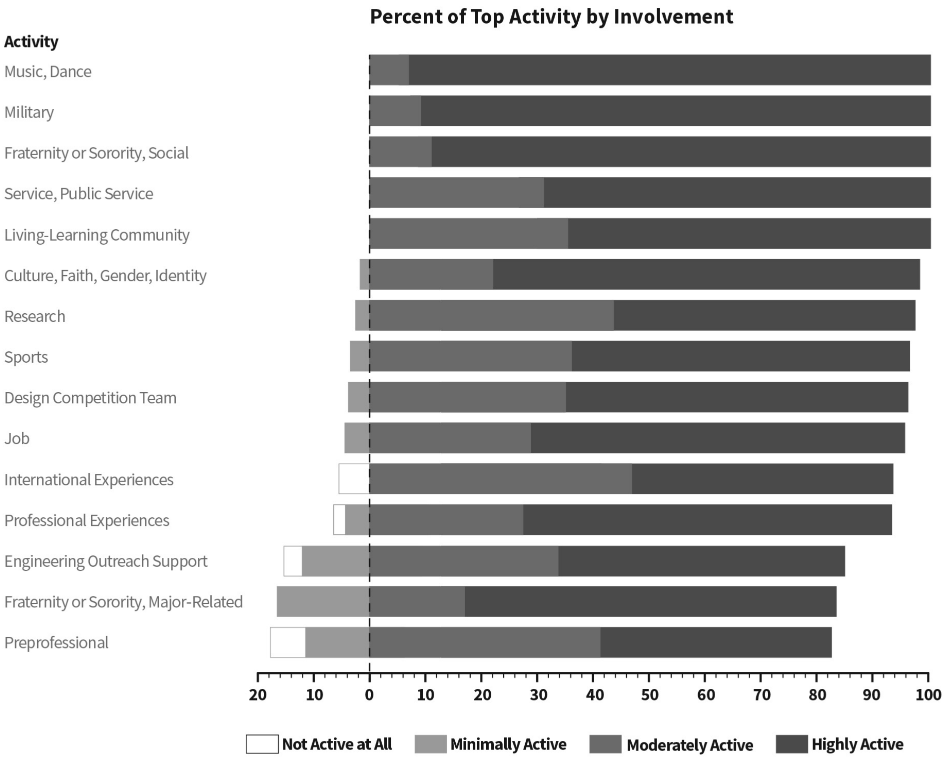

Figure 1 Student-reported levels of activity for top out-of-class activities.

Music and Dance, Military, and Fraternity or Sorority (Social) had a substantially large percentage (approximately 65% to more than 90%) of "highly active" participants, whereas the Professional Experiences, Engineering Outreach Support, Fraternity or Sorority (Major-Related), and Pre-professional categories constituted the largest percentage (approximately 20%) of survey participants who reported being "not active" or "minimally active" in their top activity.

Top Engagement by Student Demographics

Table 2 provides demographic data for the 849 undergraduate engineering students completing the survey. To examine engagement in top activity in relation to selected student demographics, we summarized the frequency and percentage of gender and race/ethnicity for survey participants who selected one of the activities provided as their top activity ($n = 649$). As Table 5 displaying the gender and race/ethnicity for this subsample shows, males comprised a larger proportion (57.3%) than females (41.3%), with five respondents not specifying their gender. Females were oversampled in this study as data for enrollment in U.S. engineering programs indicate that in 2016, 77.7% of engineering undergraduates were male and 22.3% were female (Yoder, 2016). The race composition of the subsample was 53.2% White, 16.8% Hispanic, 11.4% African American, and 6.3% Asian; the category of Multiracial (respondents who checked more than one choice for the survey question) comprised 11.2% of the total sample,

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Table 5 Level of Activity in Top Activities

	Male		Female		No response		Total	
Race/ethnicity	Freq*	%	Freq	%	Freq	%	Freq	%
White	201	58.2	139	40.3	5	1.5	345	53.2
Hispanic	68	62.4	41	37.6	0	0.0	109	16.8
African American	37	50.0	37	50.0	0	0.0	74	11.4
Multiracial	43	58.9	28	38.4	2	2.7	73	11.2
Asian	20	48.8	20	48.8	1	2.4	41	6.3
NA	2	33.3	3	50	1	16.7	6	0.9
American Indian/Alaska Native	1	100.0	0	0.0	0	0.0	1	0.2
Total	372	57.3	268	41.3	9	1.4	649	100.0

* Freq = frequency.

and six did not specify their race. The number of White students in the sample is similar to the number of White students enrolled in U.S. undergraduate engineering programs in 2016 (54.4%; Yoder, 2016); however, this sample contains slightly higher percentages of Hispanic, African American, and Multiracial students but a lower percentage of Asian students than the 2016 enrollment data for students in U.S. undergraduate engineering programs (Yoder, 2016).

When compared to enrollment data for each of the three institutions sampled, underrepresented groups (African American, Hispanic, Multiracial, and Native American/Pacific Islander) were sampled at a rate of three times their enrollment in the population based on the 2016 institutional research reports for two institutions in this study; this group was proportionally undersampled for the other institution in the study, which was composed of approximately 55% underrepresented students based on the 2016 institutional research report. Females in the study were oversampled at approximately two times the rate represented at each institution. A table of institutional racial and gender breakdowns is not provided to maintain the confidentiality of the institutions. Readers are encouraged to interpret the results in the context of the racial/ethnic breakdown of their own institutions using Table 5.

To investigate the associations between top activity and gender and race/ethnicity, odds ratios (Agresti, 2013) were employed; the calculated odds ratios and associated 90% confidence intervals for each top activity by gender are shown in Figure 2. Categories such as Environmental; Student Government; Film, Theater, Visual Arts; and Media, Publication, Journalism were not tested due to low participation, and the "Other" category was not profiled largely due to an inability to interpret the students' write-in activities or no activity being entered. For this analysis, $n = 640$ due to the nine survey participants who did not specify gender.

The lower confidence interval limits for the odds ratios for Living-Learning, Music and Dance, Film, and Media were greater than 1, while the upper confidence limits for both Job and Sports were less than 1. As shown in Figure 2, females were more likely to participate in Living-Learning Communities and Music and Dance as their top activity, while males were more likely to engage in Job or Sports as their top activity. The remaining top activities in the survey show no statistically significant difference when comparing across genders.

To demonstrate the differences in top activity based on race/ethnicity, the odds ratio approach was again used, with race/ethnicity being represented by the two categories of majority and minority (underrepresented races/ethnicities). The responses of 643 respondents were analyzed, excluding those who did not indicate race. The majority category included White and Asian demographic categories, while the underrepresented category included

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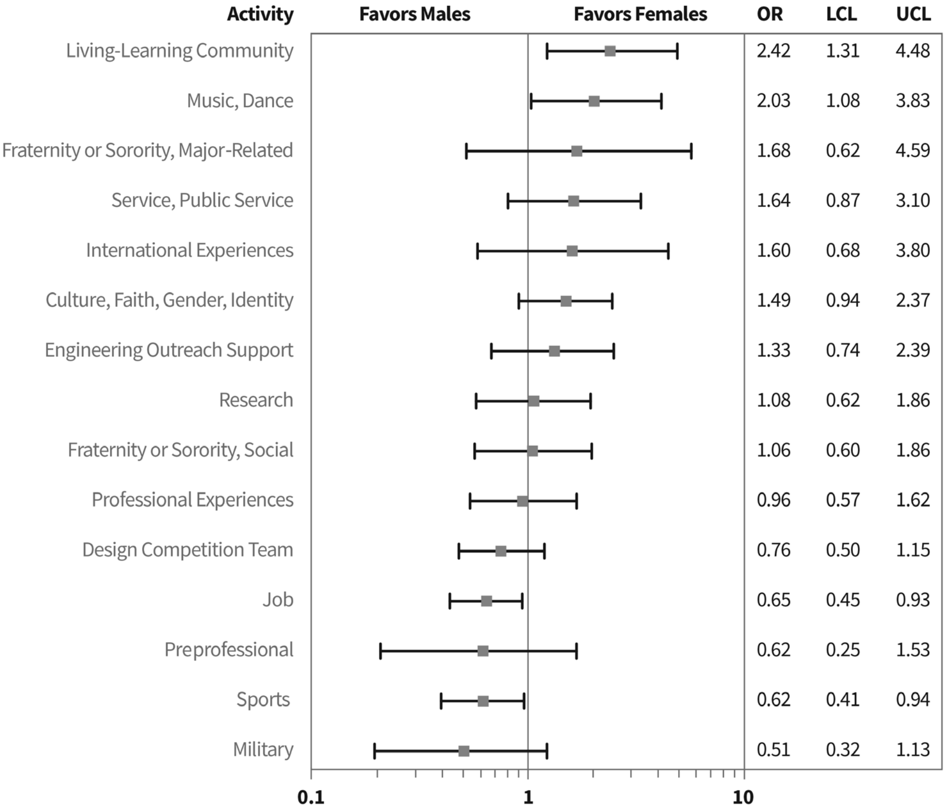

Figure 2 Gender representation of top activity participation.

African American, Hispanic, Multiracial, and Native American/Pacific Islander demographic categories. An odds ratio significantly greater than 1 indicates that underrepresented populations are more likely to participate in specific top activities, whereas an odds ratio significantly less than 1 indicates that the majority category is more likely to participate in a specific activity. Figure 3 presents the results of this odds ratio analysis.

The lower confidence intervals for the odds ratios for Engineering Outreach Support and Job, both of which are greater than 1, favor the traditionally underrepresented populations in engineering, indicating a higher participation from these groups. The odds ratio for the Design Competition Team category indicates that demographics traditionally seen as the majority in engineering are more likely to highly participate in this activity, with an upper confidence limit of less than 1. All other activities show no significant difference between the two racial representation groups and their category of top activity.

Discussion

Top Out-of-class Activities Among Engineering Students

The survey results offer an exploratory profile of engineering students' engagement in out-of-class activities not directly linked to a class by examining their choice of top activity.

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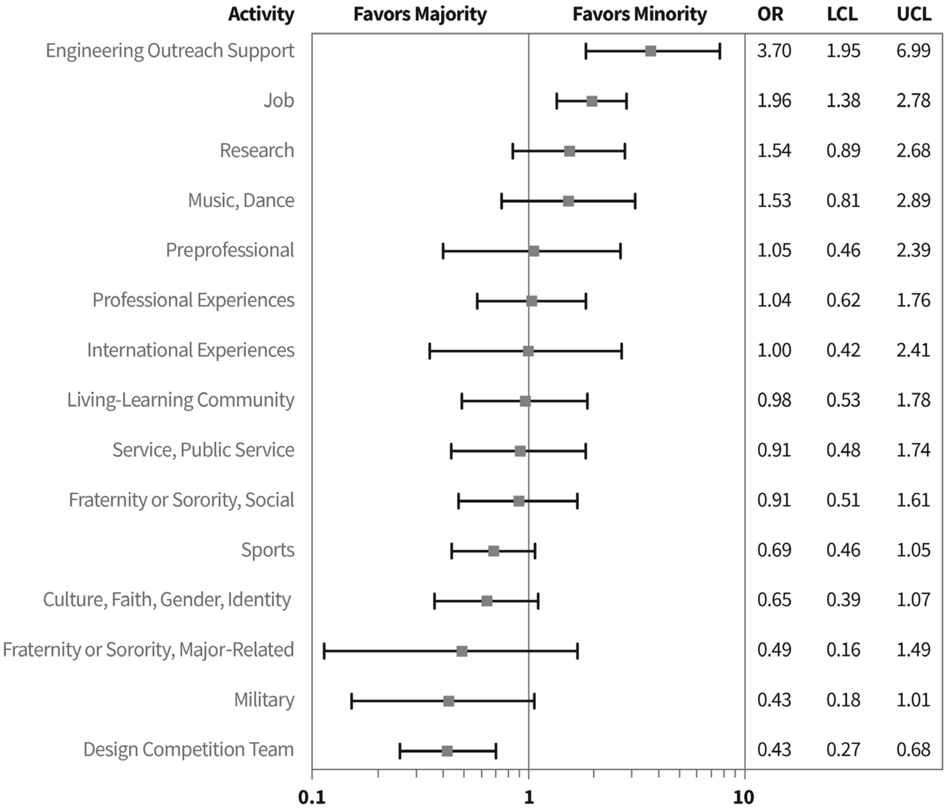

Figure 3 Racial representation of top activity participation.

Results indicate that the five top activities based on perceived outcomes are Job; Sports; Design Competition Team; Culture, Faith, Gender, and Identity; and Professional Experiences such as internships or co-ops (see Table 3). Three of the top activities—Job; Sports; and Culture, Faith, Gender, and Identity—are probably extracurricular, while the other two activities, Design Competition Team and Professional Experiences, have a more direct connection to the academic curriculum. In their study comparing the engineering undergraduate experience to that of non-engineers, Lichtenstein et al. (2010) expressed concern that "the greater workload engineering demands and the packed curriculum [force] students to choose between earning the engineering degree and participating in enriching educational experiences" (p. 314). The selections of Job; Sports; and Culture, Faith, Gender, and Identity indicate that at least some engineering students in this sample have strong interests outside engineering and potentially value experiences not connected to the engineering curriculum. Students who chose Design Competition Team and Professional Experiences as their top activity may represent what Lichtenstein et al. (2010) warned us about—undergraduate students who believe that they must focus solely on engineering-related activities.

Engineering students in this sample reported activities such as Film, Theater, and Visual Arts and Media, Publication, and Journalism, activities closely aligned with the humanities,

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as their least likely top activity, findings that highlight reasons to increase the engagement of engineering students in these types of activities. In response to a perceived divide between STEM and the humanities, Brint, Cantwell, and Hanneman (2008) emphasized the need to integrate these two cultures, arguing that "scientists and engineers need to develop some of the skills more typical of humanists, and that humanists need to develop some of the skills more typical of scientists and engineers" (p. 398). We support this recommendation, arguing that doing so will deepen engagement in out-of-class activities among students regardless of major, a situation which will positively influence both student outcomes and campus communities (Brint et al., 2008).

However, survey participants did not completely ignore humanities-related activities as Culture, Faith, Gender, and Identity activities were selected as a top activity by 8.5% of the sample and Music and Dance by 4.5%. Furthermore, a relatively high number of students, 28.5% of the sample, indicated participation in a humanities-related activity though it was not necessarily their top activity nor was the level of activity specified. These results highlight the need for more research pertaining to the STEM/humanities divide, particularly concerning how it affects students' decisions when choosing major and supplementary out-of-class activities that may have lasting impacts on retention in their field.

Associated Levels of Activity with Top Activity

The majority of participants identified their level of activity in their top activity as highly active (67.2%) or moderately active (28.7%), data preliminarily supporting that engineering students are engaged outside of the classroom even if this activity level is not commensurate with that of nonengineering undergraduates (Lichtenstein et al., 2010). Military, Music and Dance, and Fraternity or Sorority (Social), all extracurricular activities, demonstrated some of the highest levels of activity, results that can be viewed as contradicting the stereotype that engineers are only interested in activities related to technology. That engineering students are engaged in these types of activities outside of engineering and more generally outside academics suggests that they are developing as whole individuals. However, these three areas with the highest reported levels of activity—Military, Music and Dance, and Fraternity or Sorority (Social)—were not the more popular choices for a top activity. These were reported as the top activity by only 4.5%, 3.4%, and 5.7%, respectively, of students, with 86% reporting their top activity as something requiring a lower level of commitment. This finding suggests that some students in the study sample may be struggling with the consequences of a packed curriculum (Lichtenstein et al., 2010).

When examining the reported levels of activity from an academic viewpoint, perhaps troubling is a comparative lack of engagement in co-curricular out-of-class activities. The five activities with the lowest levels of activity included Professional Experiences, Engineering Outreach Support, Fraternity or Sorority (Major-Related), International Experiences, and Pre-professional, categories that encompass activities providing significant academic, social, and professional outcomes for students (Lee & Cross, 2013; Simmons & Martin, 2011). For example, participation in a student chapter of a professional association or society has been shown to improve analytical and group skills (Strauss & Terenzini, 2007) and promote a strong, positive association with academic emotional engagement, both of which could lead to improved retention and persistence rates in the engineering disciplines (Wilson et al., 2014).

Our results indicate that students find Job to be a top activity and one in which they are heavily engaged. However, student employment has been linked to "smaller gains on various measures of academic, intellectual, or cognitive growth" (Terenzini et al., 1999, p. 618), lower GPA (Brint & Cantwell, 2006) and reduced likelihood of persistence (Lichtenstein et al., 2010; Pascarella & Terenzini, 1991). On the other hand, positive outcomes of student employment include gains in critical thinking (Gellin, 2003) and an increase in analytical and group skills (Strauss & Terenzini, 2007). Of course, as Gellin (2003) points out, studies rarely differentiate between on- and off-campus work or work study programs, and our study is no exception. Admittedly, students in this study may have participated in a job related to engineering, but our survey did not specify the context of their employment. Therefore, we cannot assume that undergraduate students are more or less likely to work in such positions, making it difficult to determine how employment relates to student outcomes. More research specifically exploring types of employment and related outcomes will clarify this issue.

Examining Activities for Underrepresented Groups in Engineering

A major strength of this study is that several underrepresented groups in engineering were oversampled based on a comparison between the survey sample and data about engineering undergraduates in the United States (Yoder, 2016). The gender and race/ethnicity of the sample more closely resemble that of the total U.S. population in 2016 (U.S. Census Bureau, n.d.). Thus, our survey results provided data about several underrepresented groups in engineering based on gender and race/ethnicity.

The higher odds for men to report Sports and Job as their top activities may align with the tendency for men to be more competitive (Campbell, 2013), but it is not necessarily negative for them to find these outlets. As indicated earlier, no information was collected in this study regarding the type of job a student held. Men may have sought jobs to be more competitive in the job market, an outcome that may be realized if they held jobs relating to the engineering profession by providing them with positive experiences associated with such a pathway. The choice of sports as their top activity may help men learn collaboration and teamwork skills while satisfying their competitive natures, which is an outcome that may benefit them in the engineering classroom. However, this study did not collect information on why men made those choices, an area future work should investigate. In addition, exploring if and why there are differences between the reasons men of color participate in a job and the reasons White men do would further add to our understanding.

Women were more likely than men to identify a Living-Learning Community as their top activity, a result consistent with research suggesting women value community more than men (Chesler & Chesler, 2002). What is not known is whether the survey respondents are participating in such communities outside of engineering because they cannot find community in engineering curricular activities (Tonso, 2006) or if they are part of engineering focused Living-Learning Communities that may enhance their sense of community within the discipline (Johnson, 2011; Kahveci, Southerland, & Gilmer, 2008). Women were also more likely than men to identify Music and Dance as top activities. A greater integration of the arts with engineering, as discussed earlier, could help to increase their sense of belonging.

The finding that White students have higher odds of identifying Design Competition Team as their top activity is consistent with findings from Foor, Walden, Shehab, and Trytten (2013) that such teams lack diversity. Although Foor and her colleagues focused on issues of access and integration of women in such teams, their findings imply that similar issues affect the racial/ethnic integration as well. Input from student participants in those teams such as "I think we all recognize that the team is all white, Caucasian males. We just go with it" (p. 5) emphasizes that the choice-proximal environment created within these teams excludes students from various "outsider" populations. In contrast, the higher odds that racially/ethnically

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underrepresented students identified Engineering Outreach Support as their top activity is indicative of their attraction to a place where they "belong." In this case, the relative odds are also affected by the presence of such support programs targeting underrepresented racial/ethnic groups. Although White students may be overrepresented in general programs (e.g., design teams), there are no programs that specifically target the White majority population.

The higher odds that underrepresented students specify Job as their top activity could have various explanations, including the overrepresentation of socioeconomic disadvantage in the groups underrepresented by race/ethnicity, meaning they are more dependent on earning money to support their education or are more conscious of the importance of gaining experience for securing a good paying job. Indeed, multiple studies in engineering and STEM more broadly find that racial/ethnic differences in various outcomes can be accounted for by socioeconomic differences (Corbett, Hill, & St. Rose, 2008; Ohland, Orr, Lundy-Wagner, Veenstra, & Long, 2012).

Limitations

Although we explored student engagement using quantitative survey approaches, the results are part of an exploratory study with the main purpose of identifying possible new trends and areas of study. Two major delimitations of this study influence the interpretation and use of the results: (a) the decision not to seek a representative sample and (b) a focus on students' perceptions of level of activity and outcomes. As one of our most important research questions focused on underrepresented groups, we sought institutions known for having higher numbers of women and members of underrepresented ethnic/racial groups in their undergraduate student body. The three universities selected are considered large R1 institutions that may differ culturally from other institutions. For example, small, public, and predominantly undergraduate institutions may not possess the resources to be able to offer as many support programs such as living-learning communities, one of the top activities reported for women, as their larger R1 counterparts. In addition, although the three institutions share several characteristics, there is also likely variation in the activities offered and the student populations at each.

Second, the findings from this study are based on students' self-reported level of activity and outcomes, which can be subjective and interpreted in a variety of ways as evidenced by the early stages of survey development that confirmed students often define outcomes and level of activity differently based on individual interpretation. Highly active for one student may mean 5 hr of involvement in an activity each week, but another student may believe this amount of time is only moderately active. We were interested in the student perceptions of the level of activity and outcomes rather than strictly objective measures as we believe student perceptions are an important part of understanding student engagement. Finally, as alluded to in the discussion of the results, there are several areas where more data are needed before valid conclusions can be drawn. Several of these areas for future work are discussed below. Results from this round of survey implementation at purposefully selected institutions revealed several potential and interesting trends, but these results are not meant to be generalized to the larger engineering student population.

Implications and Future Work

As exploratory research including the collection of data, analysis, and the generation of research questions, the primary contribution of this study is to motivate, guide, and prioritize future research. The survey used in this study lacked specificity to avoid survey fatigue, but

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future work will benefit from knowing where more specificity is needed and can gain some guidance toward that end. We focused on student selection of their top activity based on perceived outcomes and on levels of activity as self-reported by students who were encouraged to use their own interpretation of the activity scale. Future work could focus on more objective measures of activity levels and outcomes associated with each activity and on standardizing definitions of activity types. For example, in future explorations of the activity levels highly active, moderately active, and minimally active could be quantified by associating a range of hours with each descriptor. Alternatively, researchers could explore qualitatively how students define these descriptors in the absence of a predefined term.

Specific responses to the survey questions suggest areas of the survey that would benefit from more in-depth exploration of existing data. For example, students were given the option to choose "Other" as a top activity and to complete a write-in option specifying it. These responses should be analyzed for activities not currently acknowledged as potential top activities. Other demographic data were collected from respondents, representing an opportunity to investigate additional student characteristics that might influence engagement such as Parent Education.

The findings here also highlight those responses that merit clarification and even subclassification, the foremost of these being the activity category of Job. A limitation of this work is that informants did not indicate what kind of job they had: whether it was related to their major, whether it was on-campus or off-campus, whether they sought a job because they had to pay for college or as a means to gain experience. Clarification of these points would contribute considerably to a richer understanding of the out-of-class experiences of students.

While surveys are a good tool for gathering a large amount data, the results of this survey suggest several avenues where qualitative investigations might yield significant information and insight. For example, results showed that some students focused on engineering-related activities and others value activities not related to their major. Future work could confirm these choices and explore the motivations of these groups and their beliefs about the outcomes from these different activities. Activity categories were kept broad here, but future research could delve into the specific activities in each category as well as how activities vary in quality and quantity at different institutions. This study focused on top activities, but students may participate in a range of activities that should be explored along with the varying levels of activity associated with multiple out-of-class activities.

Given that employment was the most frequently chosen as the top activity, student engagement in jobs deserves special attention. This work fails to distinguish differences between students' major-related jobs and those with no professional connection that can occur either on- or off-campus, thus complicating the interpretation of job-related findings. Students often hold multiple jobs throughout their undergraduate experience; however, it is not known whether this work is related to their academic major, such as a paid position with an engineering firm, or is a temporary job necessary for helping the student pay for college and living expenses, for example, a work study position at the school library or a job at a local restaurant. Future work should determine the types of jobs students hold, their reasons for working, the effects of working, and the compensation they receive. While past research has looked at working and undergraduates (e.g., Darolia, 2014; Nuñez & Sansone, 2016; Stinebrickner & Stinebrickner, 2003; Triventi, 2014), there does not appear to be significant research regarding this topic related to engineering undergraduates to examine differences, based on such characteristics as gender, race, and ethnicity.

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Ultimately, more work needs to be done to fully and deeply explore the link between students' out-of-class engagement and the associated positive and negative outcomes. To further understand the benefits received from participating in out-of-class activities, researchers should work to identify factors that may interfere with the link between activity engagement and outcome attainment. These factors may then be used to inform the design of out-of-class activities and other support programs. To further our understanding of out-of-class activity engagement and help identify their prolonged effects on student outcomes, longitudinal data collection and analysis would be useful in examining these constructs over time. Future research also needs to fully explore the negative outcomes associated with out-of-class activities as well as what they might mean for underrepresented groups in engineering.

Although the majority of implications of this study relate to future research, this initial data exploration suggests several practical implications. As explained in the introduction, student engagement is often viewed as consisting of two parts, student resources and institutional support. While this study focused on the student side of engagement, the student's choices of top out-of-class activity revealed that engineering schools can play an important role in student engagement. The mixed involvement with humanities-related activities suggests that engineering schools may want to partner with schools, departments, and organizations involved with the humanities to develop and promote humanities-related activities (Brint et al., 2008).

As identified throughout this discussion, the engineering students participating in this study displayed various levels of participation and engagement in curricular-related activities. Instances of lack of engagement may indicate that students are actively seeking alternative forms of engagement, what Kuh (1995) referred to as the "other curriculum," to enrich their academic experiences and gain professional skills not traditionally associated with formal, in-classroom settings (p. 124). Though research has shown that engineering majors spend more time preparing for class than other students (Lichtenstein et al., 2010; National Survey on Student Engagement, 2012), our results indicate that they still engage at a high level in a wide variety of extracurricular activities. Engineering programs may consider including those activities not necessarily or directly related to engineering in their recruitment messages to emphasize opportunities for intensive training for the engineering workforce while achieving a well-rounded educational experience.

Conclusion

Student engagement is a complex topic with important implications for increasing persistence and diversity in engineering education as well as contributing to overall student success. By differentiating between activity categories, gauging students' perceptions of activeness, and focusing on selected underrepresented groups in engineering, this study provides a more nuanced profile of engineering undergraduate student engagement. Our results suggest that engineering students participate in a range of activities when outside of class and that their reported level of activity is often high. Top activities include both engineering-related activities and activities not connected to engineering. Many students report high involvement with jobs, representing an area in need of future research as student employment and its outcomes are not yet well-understood. In addition, these exploratory findings suggest engineering students could use further encouragement to engage in certain curricular-related activities and activities aligned with the humanities.

We discovered differences in student engagement of underrepresented groups that also warrant further exploration. Our results raise a number of questions for future research that include examining how and why students choose to participate in out-of-class activities and the associated levels of activity and outcomes. A more complete picture of student engagement, including one focused on underrepresented groups, can help program administrators and educators better equip engineering students with the professional and personal skills needed to succeed while in college and upon entering the workforce. We echo the call for continued efforts by engineering schools to support engineering outreach programs focused on student engagement in underrepresented groups that can help address the lack of diversity in the engineering professions (Dika & Martin, 2017; Kahveci et al., 2008).

Appendix

This appendix contains the survey questions from the PosSE Survey relevant to the data and results presented in this paper.

Which of the following out-of-classroom activities have you participated in for the current/previous semesters? (You can choose multiple items.)

☐ Design Competition Team
☐ Culture, Faith, Gender, Identity (e.g., Asian American Alliance, feminist, Lesbian, Gay, Bisexual Transsexual, Queer or Questioning, Buddhist meditation group, other international and multicultural groups)
☐ Engineering Outreach Support
☐ Environmental (e.g., earth coalition and sustainable development group)
☐ Film, Theater, Visual Arts
☐ Fraternity or Sorority, Social
☐ Fraternity or Sorority, related to your major (e.g., business, engineering, or service)
☐ International experiences
☐ Job (e.g., employment on or off campus and work study)
☐ Living-Learning Community
☐ Media, Publications, and Journalism
☐ Military
☐ Music/Dance
☐ Pre-professional (e.g., Society of Women Engineers, National Society of Black Engineers, American Society of Civil Engineers, etc.)
☐ Professional Experiences (e.g., internship, co-op, practicum, etc.)
☐ Research
☐ Service, public service
☐ Sports (e.g., intramural, varsity, attending sport events, etc.)
☐ Student Government
☐ Other student clubs & organization. Please specify below.

____

How actively have you participated in the activities you selected?

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	Not active at all	Minimally active	Moderately active	Highly active
Design Competition Team	☐	☐	☐	☐
Culture, Faith, Gender, and Identity	☐	☐	☐	☐
Engineering Outreach Support	☐	☐	☐	☐
Environmental	☐	☐	☐	☐
Film, Theater, Visual Arts	☐	☐	☐	☐
Fraternity or Sorority, Social	☐	☐	☐	☐
Fraternity or Sorority, related to your major	☐	☐	☐	☐
International Experiences	☐	☐	☐	☐
Job	☐	☐	☐	☐
Living-Learning Community	☐	☐	☐	☐
Media, Publications, and Journalism	☐	☐	☐	☐
Military	☐	☐	☐	☐
Music/Dance	☐	☐	☐	☐
Pre-professional	☐	☐	☐	☐
Professional Experiences	☐	☐	☐	☐
Research	☐	☐	☐	☐
Service, public service	☐	☐	☐	☐
Sports	☐	☐	☐	☐
Student Government	☐	☐	☐	☐
Other student clubs & organization	☐	☐	☐	☐

In this section, you are asked to focus ONLY on your top activity, the one from which you gained the most outcomes.

From the activities you have participated in, select your top one, the one from which you gained the most outcomes.

☐ Design Competition Team

☐ Culture, Faith, Gender, Identity (e.g., Asian American Alliance, feminist, Lesbian, Gay, Bisexual Transsexual, Queer or Questioning, Buddhist meditation group, other international and multicultural groups)

☐ Engineering Outreach Support

☐ Environmental (e.g., earth coalition and sustainable development group)

☐ Film, Theater, Visual Arts

☐ Fraternity or Sorority, Social

☐ Fraternity or Sorority, related to your major (e.g., business, engineering, or service)

☐ International experiences

☐ Job (e.g., employment on or off campus and work study)

☐ Living-Learning Community

☐ Media, Publications, and Journalism

☐ Military

☐ Music/Dance

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- ☐ Pre-professional (e.g., Society of Women Engineers, National Society of Black Engineers, American Society of Civil Engineers, etc.)
- ☐ Professional Experiences (e.g., internship, co-op, practicum, etc.)
- ☐ Research
- ☐ Service, public service
- ☐ Sports (e.g., intramural, varsity, attending sport events, etc.)
- ☐ Student Government
- ☐ Other student clubs & organization. Please specify below.

____

What gender do you most identify with?

- ☐ Man
- ☐ Woman
- ☐ Trans*
- ☐ Other (please fill in below)

____

- ☐ I do not want to respond.

What is your race/ethnicity? (Check all that apply.)

- ☐ White (A person having origins in any of the original peoples of Europe, the Middle East, or North Africa.)
- ☐ American Indian or Alaska Native (A person having origins in any of the original peoples of North and South America (including Central America) and who maintains tribal affiliation or community attachment.)
- ☐ Asian (A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.)
- ☐ Black or African American (A person having origins in any of the Black racial groups of Africa.)
- ☐ Hispanic, Latino or Spanish Origin (A person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin regardless of race.)
- ☐ Native Hawaiian or Other Pacific Islander (A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.)
- ☐ Some other race, ethnicity or origin (please specify) ______________________________

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