

PEER-REVIEWED ARTICLES

Black Undergraduate Engineering Students' Learning Outcomes From On-Campus Co-Curricular Participation in the National Society of Black Engineers

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This study investigates the professional competencies engaged by technical clubs, focusing on the significant impact of the National Society of Black Engineers (NSBE) within one institution. Using an equity-minded mentoring framework, this paper presents quantitative analysis survey responses from various clubs, revealing NSBE's role in fostering leadership, communication, professionalism, and teamwork among Black engineering students. Disparities are identified, particularly in critical thinking, project management, and engineering design. Integrating equity-minded mentoring practices is imperative to address these gaps, ensuring equitable technical development for Black students. Leveraging NSBE for targeted interventions can advance institutional equity goals, fostering inclusivity in engineering education are discussed.

Introduction

The National Society of Black Engineers (NSBE) isn't solely a national professional association hosting conferences; it serves as a link connecting Black engineers across disciplines nationwide. Through the NSBE collegiate chapters, the national association intertwines with college campuses through its on-campus student chapters, creating a crucial network that supports Black undergraduate engineering students throughout their academic journey (Garrett et al., 2021). NSBE collegiate student chapters have a heavy emphasis on mentoring and networking through social activities, offering a range of resources, mentorship opportunities, and programming tailored to the needs of Black engineering students (White et al., 2023). NSBE collegiate chapters serve as conduits for increasing the retention of Black engineers and align with national initiatives and programs aimed at promoting diversity, racial equity, and inclusion in engineering education and the workforce (Miles, McGee, et al., 2024).

NSBE collegiate chapters can serve as space for Black students to define academic, professional, and personal excellence as students are getting increased exposure to the many facets of the profession. Through their on-campus presence, NSBE chapters play a crucial role in empowering Black students to excel academically, professionally, and personally, thereby contributing to the broader mission of NSBE to increase the number of

Black engineers who excel academically, succeed professionally, and positively impact the community (Sharifan & Moore, 2020). Especially at predominately white institutions (PWIs), NSBE chapters cultivate a sense of community and belonging in the often-isolating STEM environment by connecting Black students who are also interested in engineering, faculty advisors, and industry professionals (Young et al., 2014). NSBE can be a place to affirm the racial identity of Black students as they navigate both higher education spaces and the engineering profession. Moreover, Black students are situated to thrive (rather than survive) when connected with engineering professionals who can model, guide, and collaborate with students.

Despite efforts to promote racial diversity in engineering, Black students remain significantly underrepresented in undergraduate programs, facing ongoing challenges in predominantly white, competitive engineering spaces (Burt, 2019). Thus, affinity groups like NSBE serve a vital role in helping Black students find crucial social supports and mentorship opportunities that help mitigate the negative impacts of racial discrimination and stereotypes (McGee et al., 2024; Morton et al., 2019). These co-curricular spaces provide a sense of belonging, camaraderie, and empowerment, allowing students to navigate their academic journeys more effectively (Burt et al., 2019). Mentorship and networking within NSBE can inspire students to pursue engineering professional credentials; some aspire to become Black STEM faculty members, despite the systemic barriers they face (Ives et al., 2023; McGee et al., 2022).

While co-curricular spaces like NSBE offer invaluable support, they cannot fully address the systemic racism ingrained in engineering fields. Structural changes are necessary to create more inclusive environments and dismantle barriers to success for Black students in engineering. Therefore, diversity programming within organizations like NSBE is essential for fostering a more equitable and supportive academic landscape for Black doctoral students (Burt, 2019). Toward informing the specific types of programming and personal development that require additional institutional support, we sought to understand the value of NSBE involvement as reported by undergraduate members within our institution. The research questions explored in this study is: *What professionally relevant outcomes do NSBE students report from their involvement? How do these outcomes compare with peers involved in other, similar student organizations?*

To answer these questions, we considered data from a professional development survey conducted annually within a large, PWI Research intense institution. We used quantitative methods to analyze responses from a cohort of students involved in NSBE as well as students involved in three other student organizations – American Society of Civil Engineers (ASCE), Institute for Electrical and Electronics Engineering (IEEE), and Society of Automotive Engineers (SAE), during the same time frame. We frame this work through the lens of Equity Minded Mentoring Theory, discussed in the next section.

Equity Minded Mentoring Theory

Equity-minded mentoring theory, informed by Griffin (2019), demonstrates the systemic inequities within educational and professional arenas, particularly in science, technology, engineering, and mathematics (STEM) fields. This mentoring framework emphasizes the imperative of cultivating inclusive and supportive environments that actively confront and rectify discriminatory practices, with a particular focus on addressing the needs of historically marginalized groups (Hund et al., 2018; Wofford, 2022). Equity-minded approaches prioritize dismantling barriers and providing resources, support, and opportunities to foster the success and increased retention of Black, Indigenous, and people of color (BIPOC; Ives et al., 2023). Such an approach differs from more generalized inclusion efforts, which are less concerned with making systemic change and focus more specifically on sense-of-belonging (Moore et al., 2023).

Rooted in mentorship theory, equity-minded theory underscores the importance of recognizing and challenging biases, advocating for equitable policies, and fostering a sense of belonging and empowerment among all community members (White et al., 2023). Scholars have found that Black engineering students benefit significantly from diversity programming and equity-minded mentorship, particularly in co-curricular spaces like the NSBE, given the racially hostile environments and extreme levels of underrepresentation they encounter (White et al., 2023). Equity-Minded Mentoring Theory guides this study and the understanding of Black engineering students' participation in NSBE and retention in engineering programs. Through a comparison with other student organizations, we sought to understand those aspects of professional development that are well-supported through NSBE and those aspects that may require additional forms of support. Professional practice requires a variety of competencies, but undergraduate education does not always afford the effective development of those competencies (Passow & Passow, 2017; Miles, Bonnette, et al., 2024). Co-curricular experiences often supplement the development of those competencies, but access to those experiences is not equitable (Lee et al., 2023; Olewnik et al., 2022).

Methods

Professional Development Survey (PDS) Overview

The PDS was implemented by the institution from 2015 through 2021. The intent was to better understand the navigation and nature of student co-curricular experiences and to also take a first step in establishing a portal that encouraged students to reflect on their experiences outside the classroom. Conducted annually, all undergraduates were asked to self-report and reflect on their co-curricular experiences from the prior year (i.e., undergraduate students who completed the survey in fall 2020 would be reporting about activities that occurred between fall 2019 and summer 2020, inclusive).

Undergraduate students could report on the following experiences: technical work (e.g., internship), non-technical work (e.g., retail store clerk), undergraduate research, student clubs/organizations, makerspace/engineering project micro-credential program, community service, and study abroad. As part of documenting their experience, students were asked to open-response prompts that allowed them to provide details about their positions, roles, and responsibilities. Though there were some variations depending on the type of experience, these prompts generally asked students to respond along these lines. For example, students reporting about technical work experiences were prompted: 1) Please give your position title and briefly describe your overall responsibilities and 2) Please explain your primary project. Similarly, students reporting on club participation, like those considered here, were prompted: Briefly describe your activities.

Additionally, students were asked to select from a list of professional competencies that they believed they had used, developed, and/or improved through their participation in the reported activity. The list of professional competencies included: 1) critical thinking and problem solving, 2) engineering design, including use of relevant codes and standards, 3) use of appropriate computer technology, 4) use of engineering tools, 5) oral and written communication, 6) teamwork and collaboration, 7) leadership, 8) professionalism, work ethic, and integrity, 9) project and time management, and 10) foreign language. This list of competencies was developed based on consideration of ABET criteria (ABET, 2022) and NACE competencies (NACE Staff, 2016). The competencies were not defined, and the interpretation of the terms is left up to the individual student, so difference in meaning is possible.

All PDS and supplementary data used in our analysis was provided by the institution as deidentified data (i.e., this study constitutes a records review and was not subject to a full ethics review as determined through consultation with the IRB). More about the PDS as a potential starting point for reflection and as a diagnostic tool for understanding student co-curricular involvement is described in (Memarian & Olewnik, 2022, 2023).

Student cohort, institutional context, and overview of student organizations

This study is set in a large public research university located in the northeast U.S. with approximately 20,000 undergraduates. Among all undergraduates, 25% are in the School of Engineering and Applied Sciences (SEAS). In the fall of 2018 17.5% of SEAS undergraduates were women, and 14.9% were underrepresented minorities, including 5.7% Black or African American students (but not including those students who are African). In 2018, the school of engineering was home to 9 departments and 10 ABET accredited undergraduate degree programs. Students enrolled in these programs are supported by a range of extra-curricular, co-curricular, and mentoring programs or organizations that aim to support students'

professional development. Students in the school of engineering can choose from over 75 clubs and professional societies, many of which are supported directly by the university's student association and the engineering school.

The data in this study represents a cohort of students who reported involvement in student chapters of National Society of Black Engineers (NSBE), Society of Automotive Engineers (SAE), Institute of Electrical and Electronics Engineers (IEEE), and American Society of Civil Engineers (ASCE), for the four academic years 2015-16 through 2018-19. These organizations offer a meaningful cross-section of overlapping and divergent interests, activities, and objectives, helping us understand the ways that co-curricular organizations support and prepare student engineers. Although all three organizations aim to offer professional support and community, the mission statements and the organizational activities diverge in important ways.

One key point of divergence is the anchor for the organizations. NSBE, as articulated in their national mission statement, focuses on bringing together and enhancing the development of Black engineers. In this way, affinity is anchored in issues at the intersection of the engineering profession and race, ethnicity, and culture. In contrast, based on review of the mission statements, the other organizations are focused primarily on engineering knowledge including the development of civil infrastructure and related technologies (ASCE), fostering technological development (IEEE), and advancing knowledge and solutions for human mobility (SAE). In short, where NSBE membership is often constituted by racial affinity rather than disciplinary (indeed, at our institution, NSBE activities are attended by majors across the university), the other organizational affinities are tied to their respective disciplines.

Second, these organizations diverge in the activities that comprise the clubs' typical work. NSBE, in keeping with the national organization's conference, is focused on professional development, networking, and leadership activities. These aims are carried out through activities like seminars and workshops, outreach programs, and an annual national convention. At the institution considered here, students' involvement took form in those activities, as reported in the PDS open responses. Although ASCE, IEEE, and SAE also host conferences and networking functions, most student involvement in these organizations, as reported through the PDS, is centered around technical competitions and projects. Students in ASCE participate in national competitions like Concrete Canoe and Steel Bridge. Students in IEEE participate in national competitions like Micro Mouse and the institutional robot wars competition held annually during Engineers Week. Similarly, SAE students participate in national competitions for Clean Snowmobile and Baja.

Finally, it is important to note that these organizations are part of a student association that operates on student fees and which provides bylaws that dictate club structure and rules for accessing funding to support club

activities. Under this governance, all clubs are required to have a university faculty or staff advisor. ASCE, IEEE, and SAE all had faculty advisors with engineering backgrounds. The NSBE advisor was a school administrator whose background was in social science and higher education. One fundamental principle of the club policies is that clubs cannot exclude participation in student events for any reason. Thus, a student does not need to be enrolled in an engineering program in order to attend any of these clubs; additionally, a student does not *need* to identify as Black in order to participate in NSBE.

Quantitative analysis

We used descriptive statistics to compare the data from students who reported participating in each of the four organizations. Comparison considered a demographic profile of each organization, inclusive of participation by year, gender, ethnicity, and major. The demographic profiles are contextualized through comparison with the undergraduate student population within the school of engineering and applied sciences from the 2018-19 academic year.

Additionally, the professional competencies students reported in the survey were compared; statistics represent an aggregation of the professional competencies across years for students who reported involvement for more than one year. Professional competencies are reported as averages per person across years for each organization.

Results

The demographic profile of each organization, alongside reported participation for each academic year, is presented in [Table 1](#). During this four-year period, NSBE had 33 unique students, while ASCE had 112, IEEE had 47, and SAE had 49. Collectively, the unique student participation represented less than five percent of the undergraduate population.

NSBE has a more balanced women participation rate (30%) as compared with ASCE (20%), IEEE (6%), and SAE (6%). This rate is significantly higher than that of the undergraduate population (17.5%) as well. As expected, NSBE is predominantly comprised of Black or African American students, while the other three organizations are predominately White. Additionally, Black women are likely attracted to NSBE over women-centered groups due to the importance of their Black identity (Roby et al., 2022). Similarly, NSBE draws students from across engineering majors, while the other three organizations comprise students from their most closely associated disciplines: civil, electrical, and mechanical engineering for ASCE, IEEE, and SAE, respectively.

[Figure 1](#) shows a comparative profile of each organization in terms of the professional competencies that students reported engaging. This reflects the average professional competencies engaged by each student in NSBE and other (ASCE, IEEE, SAE) organizations over the four-year period and provides valuable insights into the nature of competencies that students

Table 1. Demographic profile of student organizations

		NSBE	ASCE	IEEE	SAE
<i>Participants by Year</i>	2015-16	13	54	26	28
	2016-17	6	42	25	19
	2017-18	14	39	18	18
	2018-19	18	52	17	14
<i>Female/Male Ratio</i>	Female/Male	10/23	23/89	3/44	3/46
<i>Ethnicity</i>	Asian	1	16	10	1
	Black or African American	29	4	2	2
	Dominican	0	2	1	1
	Other Hispanic/Latino	0	1	1	1
	Puerto Rican	0	1	1	0
	South American	1	2	2	2
	Unknown	1	14	3	4
	White	0	72	27	38
	Central American	1	0	0	0
<i>Major</i>	Aerospace Eng	0	2	0	7
	Biomedical Eng	2	2	2	1
	Chemical Eng	3	0	0	0
	Computer Eng	1	2	4	0
	Computer Sci	5	1	2	0
	Civil Eng	5	85	2	3
	Electrical Eng	6	2	28	4
	Environmental Eng	2	1	0	0
	Industrial Eng	0	1	0	0
	Mechanical Eng	6	2	7	28
	Undecided Eng	3	14	2	6

believe they engage/develop through these organizations. We treat the disciplinary organizations in aggregate in order to fully demonstrate differences among the club foci: racial affinity vs. disciplinary affinity.

NSBE students reported higher rates of engagement for development of teamwork and collaboration, leadership, oral and written communication, and professionalism and work ethic competencies relative to the other three student organizations. For instance, 20.76% of students reported NSBE's contribution to teamwork and collaboration competency engagement, compared to 14.22% for other groups. Similarly, NSBE students reported higher levels of leadership competency engagement (15.51% vs. 7.73% for other groups) and written and oral communication competency engagement (15.28% vs. 8.94%). Additionally, NSBE showed a higher reported engagement of professionalism/work ethic/integrity competency (14.03% vs. 9.02%) compared to other clubs.

For two competencies – critical thinking and problem solving and project and time management – NSBE students and those from the other three organizations reported similar levels of engagement. For critical thinking and problem solving 11.74% of NSBE students reported the competency compared with 13.29% of students from the other organizations. Similarly,

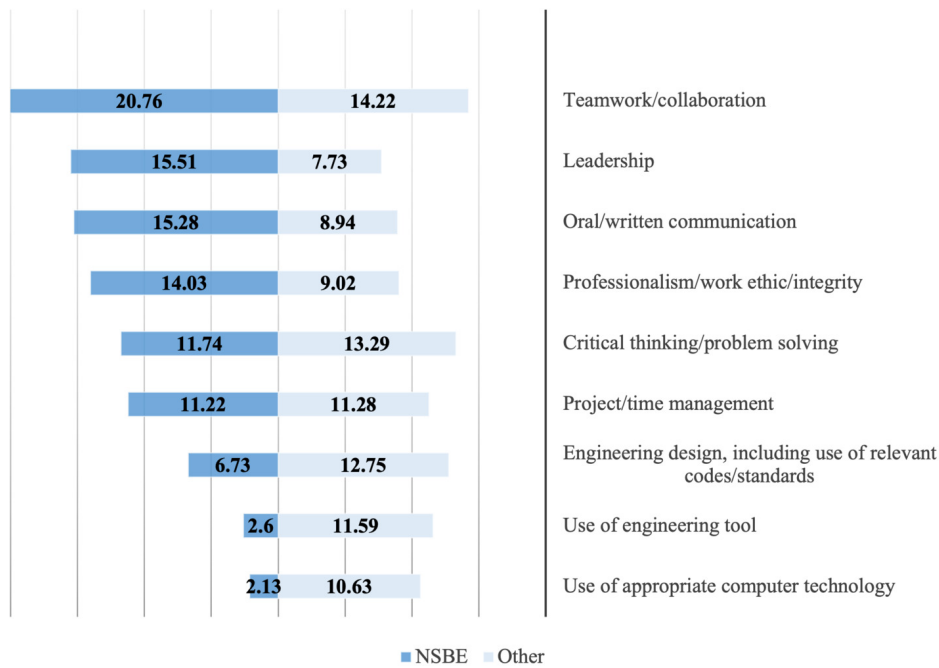


Figure 1. Professional competencies engaged by NSBE and other organizations

for 11.22% of NSBE students reported project/time management competency engagement, compared with 11.28% of students from the other organizations.

For the remaining competencies – engineering design (including use of relevant codes and standards), use of engineering tool, and use of appropriate computer technology – NSBE students reported engaging at a lower rate than students from the other three organizations. For engineering design 6.73% of NSBE students reported engagement compared to 12.75% of students from the other three organizations. Similarly, for use of engineering tool and appropriate computer technology, 2% of NSBE students reported engagement with those competencies compared to approximately 11% of students from the other three organizations.

For a deeper look at students reported professional competency engagement in the different organizations, consider [Table 2](#) (see Appendix). The table shows reported engagement for each competency within each organization on a year-by-year basis for the four academic years considered in this study. The table also provides the mean and standard deviation across those years for each competency. What the data highlights, as measured through the standard deviation, is the stability of professional competency engagement year over year, within each organization. Overall, NSBE had the least stable engagement (highest standard deviation) for all professional competencies among all the considered organizations. For example, the leadership competency was reported by ~20% of NSBE students in 2015-16 and 2016-17, but that dropped to 11% in the last two years considered. Additionally, for use of appropriate computer technology, in addition to being engaged by a much lower percentage of NSBE students relative to other

organizations, we also see that for two years, no NSBE students reported engaging that competency. Similarly, engagement of the engineering design competency is highly variable within NSBE.

Overall, NSBE provides students with opportunities to engage in important competencies at rates that are higher than peer organizations. However, there are apparent opportunities to engage other competencies and to make overall competency engagement more consistent.

Discussion

This study sought to answer two research questions: *What professionally relevant outcomes do NSBE students report from their involvement? How do these outcomes compare with peers involved in other, similar student organizations?* The results identify strengths and opportunities for improvement and potential for implementing targeted interventions to ensure holistic competency development across all technical clubs, aligning with equity frameworks that advocate for equal opportunities and resources for all students, regardless of their background or identity. We focus on opportunities for NSBE in the context of equity minded mentoring.

The demographic observations from [Table 1](#) highlight NSBE's significant role as an affinity group that fosters a sense of belonging, particularly for historically marginalized groups in engineering. NSBE stands out with a more inclusive women participation rate of 30%, significantly higher than that of ASCE (20%), IEEE (6%), SAE (6%), and even the overall undergraduate population (17.5%). This suggests that NSBE not only supports gender diversity more effectively but also creates a more inclusive environment for women in engineering, potentially attracting and encouraging more female participation; it also demonstrates the long-standing marginalization of women in disciplinary engineering clubs. One potential implication is that the emphasis on teamwork and communication more effectively prepares students to engage equitably and inclusively in co-curricular activities. This observation aligns with equity-minded theory, emphasizing the importance of cultivating environments that actively confront discriminatory practices and address the needs of marginalized groups.

Analyzing competency engagement, as illustrated in [Figure 1](#), revealed a significant insight: the highest average engagement is tied to more generalizable competencies, while the lowest engagement is associated with more discipline- or domain-specific skills. This finding aligns with the conclusions drawn by Passow and Passow (2017), who emphasized the coordination of multiple competencies as crucial for engineering practice. NSBE's engagement patterns suggest an effective support system for developing generalizable competencies such as problem-solving, teamwork (redefined as coordinating efforts), and life-long learning (divided into gathering information and expanding skills), which are essential across various disciplines and professional contexts. Conversely, the lower engagement with discipline-specific skills indicates a gap that traditional undergraduate education may not fully address. Passow and Passow (2017) highlighted the

need for more precise competencies such as measuring accurately, interpreting data, and managing projects to be developed through targeted educational experiences. The lower engagement in these areas within NSBE suggests an opportunity for enhanced support and supplemental co-curricular activities to ensure comprehensive competency development. This points to the potential for consistent technical projects within NSBE to enable stability while hitting critical tech competencies, as discussed in the framework of equity-minded mentoring (White et al., 2023).

The analysis of competency engagement, as illustrated in [Figure 1](#), further supports these findings by identifying NSBE's strengths in fostering generalizable competencies critical for engineering practice. However, it also highlights opportunities for improvement, particularly in the development of discipline-specific skills. Passow and Passow (2017) emphasize the importance of targeted educational experiences for developing precise competencies such as measuring accurately, interpreting data, and managing projects, which are areas NSBE can focus on to ensure holistic competency development across all technical clubs. This aligns with the broader equity framework that emphasizes the need for consistent support and resources to foster equitable opportunities for all students.

The results not only provide insights into NSBE's effectiveness in fostering competency development but also offer actionable implications for the organization and similar technical clubs. The need for robust tools like the PDS is crucial for providing important data related to student navigation of hidden co-curriculars, especially for marginalized students. The PDS, implemented from 2015 through 2021, aimed to gain a deeper understanding of students' co-curricular experiences and encouraged them to reflect on these activities. This aligns with Lee et al. (2023), who highlight the challenges of navigation, especially for marginalized students, within higher education. By fostering generalizable competencies and addressing gaps in competency development, NSBE contributes to a more equitable and supportive learning environment for all students, particularly those from marginalized backgrounds.

This study has delved into the professional outcomes and engagement patterns of NSBE students, comparing them with peers from similar organizations. The findings demonstrate NSBE's role as an affinity group that fosters a sense of belonging, particularly for historically marginalized groups in engineering, as evidenced by its inclusive women participation rate and emphasis on generalizable competencies critical for engineering practice. NSBE's strengths in promoting generalizable competencies are commendable; yet there remain opportunities for enhancement, especially in developing discipline-specific skills. Leveraging tools like the PDS can further illuminate these areas and guide targeted interventions for comprehensive competency development. By aligning with equity frameworks and emphasizing consistent support and resources, NSBE exemplifies a commitment to

creating an equitable and supportive learning environment for all students, contributing significantly to the advancement of engineering education and practice.

In essence, to enhance the student experience, programs like NSBE can leverage an equity-minded framework by focusing on intentional mentoring, targeted interventions, and the development of both generalizable and discipline-specific competencies. Programs should ensure that they are not only fostering a sense of belonging but also addressing gaps in technical skill development through consistent, hands-on projects that reflect real-world demands. Tools like the PDS can be instrumental in providing data on student experiences and revealing hidden barriers to success, especially for marginalized students. By using these insights to inform program adjustments and by prioritizing equity in both co-curricular activities and support structures, programs can create more inclusive environments and promote holistic competency development for all students. Incorporating these elements can ultimately strengthen outcomes for underrepresented students and ensure that equity is integrated into every level of student engagement.

Conclusion

By integrating equity-minded mentoring practices, institutions can address systemic barriers hindering the technical development of Black engineering students. Such an approach emphasizes the importance of providing tailored support to ensure Black students receive technical knowledge at a rate commensurate with their peers. Furthermore, the overwhelming participation of Black students in NSBE across the college underscores the club's significance in fostering a supportive environment for this demographic. Leveraging NSBE as a focal point for interventions designed to support Black engineering students could prove instrumental in advancing institutional equity objectives. In essence, this study advocates for a holistic approach to equity in engineering education, one that acknowledges systemic barriers and addresses them through targeted interventions within technical clubs. By prioritizing equity-minded mentoring and leveraging existing support structures within clubs like NSBE, institutions can take significant strides toward achieving equity milestones and fostering an inclusive environment where all students can thrive.

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Appendix

Table 2. Student engagement of professional competencies reported by academic year

Professional Competencies	Organization	Percent of students reporting engagement by year				Mean	SD
		2015-16	2016-17	2017-18	2018-19		
Teamwork/ collaboration	NSBE	19.6	23.8	21.5	18.1	20.8	2.1
	ASCE	15.4	15.8	17.5	15.8	16.1	0.8
	IEEE	15.3	14.2	12.0	10.6	13.0	1.8
	SAE	15.0	12.1	13.3	13.7	13.5	1.0
Leadership	NSBE	21.6	19.1	10.8	10.6	15.5	4.9
	ASCE	8.0	9.7	9.7	8.8	9.0	0.7
	IEEE	5.6	7.1	7.0	7.1	6.7	0.6
	SAE	7.5	9.2	5.9	7.4	7.5	1.2
Oral/ written communication	NSBE	17.7	9.5	16.9	17.0	15.3	3.3
	ASCE	11.2	10.1	9.7	10.4	10.4	0.6
	IEEE	6.3	7.1	8.0	9.4	7.7	1.2
	SAE	5.0	9.2	10.4	10.5	8.8	2.2
Professionalism /work ethic/ integrity	NSBE	13.7	9.5	16.9	16.0	14.0	2.9
	ASCE	10.6	9.7	10.1	12.1	10.6	0.9
	IEEE	6.3	7.1	7.0	9.4	7.4	1.2
	SAE	8.8	9.2	9.6	8.4	9.0	0.5
Critical thinking / problem solving	NSBE	11.8	9.5	10.8	14.9	11.7	2.0
	ASCE	13.5	12.7	12.9	12.8	13.0	0.3
	IEEE	13.2	12.8	15.0	15.3	14.1	1.1
	SAE	13.8	12.1	11.9	13.7	12.8	0.9
Project/ time management	NSBE	9.8	9.5	13.9	11.7	11.2	1.7
	ASCE	12.2	10.5	12.9	11.5	11.8	0.9
	IEEE	12.5	11.4	9.0	9.4	10.6	1.4
	SAE	11.3	11.4	11.9	11.6	11.5	0.2
Engineering design, including use of relevant codes	NSBE	0.0	14.3	3.1	9.6	6.7	5.6
	ASCE	10.3	14.0	8.8	11.8	11.2	2.0
	IEEE	15.3	14.2	13.0	14.1	14.1	0.8
	SAE	14.4	12.8	11.9	12.6	12.9	0.9
Use of engineering tool	NSBE	2.0	4.8	1.5	2.1	2.6	1.3
	ASCE	9.3	9.7	10.1	8.1	9.3	0.8
	IEEE	11.8	12.8	14.0	12.9	12.9	0.8
	SAE	13.1	12.8	11.9	12.6	12.6	0.5
Use of appropriate computer technology	NSBE	3.9	0.0	4.6	0.0	2.1	2.1
	ASCE	8.7	7.5	7.8	8.1	8.0	0.4
	IEEE	13.2	12.8	15.0	10.6	12.9	1.6
	SAE	11.3	10.6	12.6	9.5	11.0	1.1