Distinguishing Engineers of the Future: Comparisons with EWB-USA Members

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Distinguishing Engineers of the Future: Comparing Students Involved and Not Involved with EWB-USA

Abstract

In order to achieve the Millennium Development Goals (MDGs), which require access to clean water and sanitation, UNESCO[1] estimates that 2.5 million new engineers and technicians are needed in sub-Saharan Africa alone. Fortunately, engineers are responding to such needs through larger participation in engineering development organizations and curricula. Among these programs, Engineers Without Borders-USA (EWB-USA) stands out as one of the largest and most senior of engineering for development programs in the US, making it an important group to study in order to gain insight into engineers who participate within these organizations. This research aims to understand differences between engineers involved and not involved with the organization to help educators and employers better understand engineers of the future.

Extensive qualitative data collection led to the creation of a survey to test pre-educational traits, educational gains, and career expectations between engineers involved and not involved with EWB-USA to help address whether engineers involved in EWB-USA are different from engineers not involved in EWB-USA. This paper presents and discusses the results of responses from 566 engineering students at the University of Colorado, Boulder. Results showed significant differences in which EWB-USA engineers displayed different personality traits and community service attitudes, higher professional ABET learning outcomes, and higher expectations of professional skills in their future careers than engineers not involved with the organization. These results can help inform how to recruit, create, and retain engineers to work toward the MDGs and other major challenges that engineers of the future can address.

Introduction

With a growing need for engineers, engineering diversity, and more globally prepared engineers of the future, Engineers Without Borders-USA (EWB-USA) represents an example of change within the profession. Since its establishment in 2002, this voluntary engineering service organization has grown to over 13,800 student and professional members[2]. It also has over 40% female involvement[3], which contrasts the typical trends in engineering that rarely surpass 20%[4]. In addition, EWB-USA continues to be mentioned as a promising way in which to teach engineers professional skills, global and cultural competencies, hands-on experience, and complex problem solving[1,3,5,6]. These claims have fueled this research's focus on EWB-USA members.

In order to better understand EWB-USA members, this research compares questionnaire responses from engineers who are EWB-USA members with engineers not involved with the organization. In general, we seek to better understand the ways in which these two groups of engineers are similar and different in (1) how they begin their engineering studies, (2) what they learn during their educational experiences, and (3) what they expect in their future engineering careers. This paper shares the findings from a pilot survey that will later be deployed to the entire memberships of EWB-USA, SWE, ASCE, and ASME in order to gain large-scale insight

into these two groups. Findings from the pilot survey give initial insight into the ways in which these two groups differ and will inform changes to be made to the final survey.

Conceptual Framework & Literature

Despite the size of EWB-USA, there have not been any large-scale studies of its membership. Some studies have been published on individual chapters (e.g. [7,8]), but we lack an understanding of the membership as a whole. In addition, we lack a strong theoretical framework by which to compare these two groups. Therefore, we have combined multiple theories in order to establish our conceptual framework.

One of the theories that we draw on, expectancy value theory[9], has been used by researchers to study the gender gap in engineering and science. Specifically, the theory focuses on expectations of success and value expectations (including attainment, enjoyment, utility and cost) in order to understand why women and men make the career choices that they do[10]. Studies using expectancy-value theory (e.g. [11]) have noted the importance of engineering identity and intrinsic interest in making achievement-related choices.

Another framework that we draw on, provides a systems-level view to study college-level learning[12]. This framework was established from over 30+ years of research in higher education, including engineering education[13], and it highlights pre-college traits, the undergraduate experience, and future outcomes as main elements. This framework guides our study of EWB-USA members to focus on the pre-educational motivations and characteristics, the educational outcomes, and the career expectations in the comparison of EWB-USA and Non-EWB[a] members. See Figure 1 for a summary of our conceptual framework.

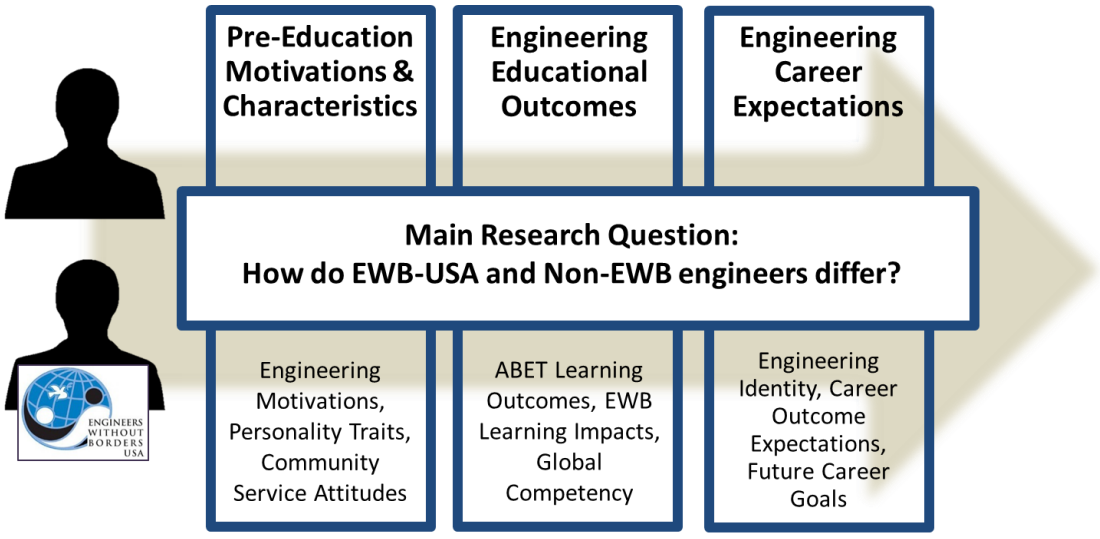

Figure 1: Conceptual Framework for Research Questions

[a] The term Non-EWB is not intended to be derogatory; it is used to simplify the distinction between EWB-USA members and engineers not involved with the organization.

Within each of the three main components of the conceptual framework, we chose to focus on three sub-themes, for a total of nine subthemes. These nine themes are summarized in Table 1. The selection of these themes came from a combination of the qualitative data previously gathered as a separate part of this research and from important themes previously identified in literature (shared below). While the scope of this paper does not allow for adequate review for each of the nine sub-themes, we will provide a brief discussion on a few themes here.

Table 1: Survey Constructs and Sub-Themes

Conceptual Framework Component	No.	Sub-Theme
Pre-Education Motivations & Characteristics	1	Engineering Motivations
	2	Personality
	3	Community Service Attitudes
Educational Outcomes	4	ABET Learning Outcomes
	5	EWB-USA Learning Impacts
	6	Global Competency
Career Expectations	7	Identity
	8	Career Outcome Expectations
	9	Future Career Goals

As shared in the introduction, EWB-USA continues to be mentioned as an influential learning activity, particularly in project-based service learning (PBSL) and learning through service (LTS) literature (e.g. [14,15]). In his study on LTS students, which included EWB-USA students, Carberry[15] found that LTS students exhibited personality traits "which fl[y] in the face of engineering stereotypes" (p.110). As a result, we plan to compare personality profiles, using questions from the big five personality domains[16], between EWB-USA engineers with Non-EWB engineers. In his report, Carberry went on to say that "[t]he inclusion of students with such personality profiles is a necessity for the success of engineering" (p.110). We agree that a diversified engineering population is important to the future of the engineering field and seek to understand if EWB-USA helps contribute to this by including members with different personality profiles.

In a study of the impacts due to PBSL, Bielefeldt et al.[14] included EWB-USA as an extra-curricular PBSL. Their review of PBSL programs notes that, "It has not yet been fully determined what differences exist in those that self-elect to participate in PBSL. But it is probable that these students start at a different level of self awareness and possess different attitudes" (p.5). The authors go on to include community service attitudes as a specific example of attitudes that may differ for self-elected PBSL students. Therefore, we have included a measure of such attitudes in our survey in order to build upon this finding.

The other remaining seven sub-themes in the survey include engineering motivations, ABET learning outcomes, EWB-USA learning impacts (compared with coursework, questions only given to EWB-USA members), global competency, engineering identity, career outcome expectations, and future career goals. These themes are briefly described below.

Methods

Findings from qualitative data, combined with the literature shared above, led to the selected survey themes presented in Table 1. Of the nine survey themes, seven themes used items from

existing scales, and two themes used items developed by the research team. A summary of the scales used, their sources, and any modifications made is shared in Table 2. Items for theme 6, global competency for engineers, are still in development, and items for theme 8, outcome expectations of engineering career, came from qualitative data in a prior stage of the research[17]. The final pilot survey consisted of 35 questions, many with multiple items per question.

Table 2: Survey Scales, Sources, and Modifications

No.	Survey Measurement Scale & Source	Modification Note
1	Academic Pathways of People Learning Engineering Survey (APPLES) Motivations [18]	Adding two questions for EWB related motivations
2	Big Five Personality Domains[16]	Using their reduced, 10-item scale
3	Community Service Attitudes Scale (CSAS)[19]	Using reduced scale with three of eight original constructs
4	Student and Faculty Engagement in Engineering Education[20]	Using their expanded A-O outcomes (from original A-K); Using reduced questions for each of the A-O criteria to reduce survey size (from 62 to 45 items)
5	Modified National Engineering Students' Learning Outcomes Survey (NESLOS)[15]	None (only asked to EWB-USA members)
6	Global Competency for Engineers (in development by author and research team)	Pilot instrument embedded within the larger pilot survey
7	Engineering identity[21] & Career-fit confidence[22]	Using their reduced versions, modified language to be inclusive of professional engineers
8	Codes from qualitative data	(Pilot data from freshman engineering course)
9	Five year goals/intentions, modified from APPLES[18]	Added more options and changed wording to be inclusive of professional engineers

The survey was sent to 5,275 students within the College of Engineering and Applied Sciences at the University of Colorado, Boulder. Each student was sent a personalized email with a unique link to the survey, which was administered through Qualtrics software. The survey stayed open for 19 days, and any student who had not completed the survey after two weeks was sent an email reminder. In total, 583 students completed the survey, an 11% response rate. Students who indicated that they did not major in engineering or who did not answer the majority of the questions were removed, which left 566 respondents for analysis.

Demographic questions on the survey included major, organizational membership, gender, working status, undergraduate year (for those indicating undergraduate status), level of participation in organizations, year of birth, and undergraduate GPA. The remaining survey items were primarily Likert-style items. For analysis, this data was treated as ordinal, and comparisons were made using non-parametric tests, which avoid the assumptions associated with parametric tests of comparisons such as a t-test. All results presented below, with the exception of a few demographic variables, are from Mann-Whitney U tests of two independent samples calculated using SPSS.

Two separate comparisons were run in the analysis. The first was a comparison of EWB-USA members and Non-EWB members based on the direct responses about membership. The second comparison was run in order to account both for EWB-USA members who did not actively participate with the organization regularly and for engineers who are active in another organization or program similar to EWB-USA. Respondents in the "EWB-like" group are those who indicated that they had either limited, moderate, or extensive active participation in EWB-

USA or a similar organization. Respondents were required to write in the organization or program that they considered similar to EWB-USA, and the research team evaluated whether or not the response fit the definition of EWB-like for the research project, which included having voluntary, service, and engineering components that included an international or development focus. Organizations that did not fit the category included professional organizations such as Society of Women Engineers or Association of General Contractors or generic volunteering such as tutoring, honors programs, and ROTC. Organizations that did fit the EWB-like category included Bridges to Prosperity, the Mortenson Center for Engineering in Developing Communities (University of Colorado, Boulder), Habitat for Humanity, Humanitarian Engineering program (Colorado School of Mines), and organized disaster relief efforts. Results from both comparisons are included below.

Results

Table 3 presents a summary of the descriptive statistics from the demographic variables in the survey broken up by our two comparisons of interest. Of the 566 respondents, 51 (9%) were EWB-USA members, and 63 (11%) were in the EWB-like category.

Comparisons of Descriptive Statistics

Chi-square tests of proportions were used to determine significant differences in the demographic variables with nominal data for both comparison groups. Four engineering majors showed significant differences, which were the same for both the EWB-USA and the EWB-like comparisons. More EWB-USA and EWB-like respondents majored in civil and environmental engineering, and more Non-EWB and Non-EWB-like respondents majored in aerospace engineering and computer science/engineering. Significantly more females were involved with an EWB-like activity, and significantly more males were not involved with an EWB-like activity. Significantly fewer seniors were not involved with EWB-USA, and significantly more undergraduates were involved with EWB-USA and EWB-like organizations than those not involved.

Table 3: Descriptive Statistics for Demographic Variables (nominal data)

	Non-EWB n=515		**EWB-USA n=51**		**Non-EWB-like n=503**		**EWB-like n=63**	
Survey Item	N	%	N	%	N	%	N	%
Major								
Aerospace Engineering	80	15.5	1	2.0	79	15.7	2	3.2
Biological/Biomedical Eng.	9	1.7	3	5.9	9	1.8	3	4.8
Chemical Engineering	61	11.8	8	15.7	62	12.3	7	11.1
Civil Engineering	59	11.5	11	21.6	50	9.9	20	31.7
Computer Science/Engineering	86	16.7	1	2.0	86	17.1	1	1.6
Electrical Engineering	68	13.2	4	7.8	67	13.3	5	7.9
Environmental Engineering	25	4.9	12	23.5	25	5.0	12	19.0
Industrial Engineering	1	0.2	0	0.0	1	0.2	0	0.0
Materials and Metallurgical Eng.	4	0.8	0	0.0	4	0.8	0	0.0
Mechanical Engineering	68	13.2	5	9.8	66	13.1	7	11.1
Other Engineering	54	10.5	6	11.8	54	10.7	6	9.5
Organizational Membership								
ASCE	24	4.7	14	27.5	21	4.2	17	27.0
ASME	28	5.4	2	3.9	27	5.4	3	4.8

IEEE	35	6.8	4	7.8	36	7.2	3	4.8
SWE	76	14.8	12	23.5	73	14.5	15	23.8
EWB	0	0.0	51	100.0	11	2.2	40	63.5
Gender								
Male	308	59.8	25	49.0	305	60.6	28	44.4
Female	197	38.3	25	49.0	188	37.4	34	54.0
Working Status								
Undergraduate Student	254	49.3	34	66.7	248	49.3	40	63.5
Graduate Student	223	43.3	17	33.3	219	43.5	21	33.3
Practicing Engineer	29	5.6	0	0.0	28	5.6	1	1.6
Academic	5	1.0	0	0.0	4	0.8	1	1.6
Other	3	0.6	0	0.0	3	0.6	0	0.0
Undergraduate Status								
Freshmen	54	10.5	10	19.6	56	11.1	8	12.7
Sophomores	65	12.6	10	19.6	61	12.1	14	22.2
Juniors	68	13.2	11	21.6	66	13.1	13	20.6
Seniors	39	7.6	1	2.0	37	7.4	3	4.8
Fifth-year senior or more	28	5.4	2	3.9	28	5.6	2	3.2
Other								
Active EWB-like	23	4.5	40	78.4	0	0.0	63	100.0
Yes, Family Member Engineer	213	41.4	16	31.4	205	40.8	24	38.1
No Family Member Engineer	297	57.7	34	66.7	293	58.3	38	60.3

Two demographic variables—year of birth (YOB) and GPA—had ordinal data. For these, we ran Mann-Whitney U tests to test for significant differences; the resulting p-values are shown in Table 4. No significant differences were found for GPA. Both EWB-USA and EWB-like respondents were found to be significantly younger than Non-EWB and Non-EWB-like respondents respectively.

Table 4: Results for Demographic Variables (ordinal data)

Item	EWB p-value	EWB-like p-value
YOB	0.003***	0.015**
GPA	0.894	0.572

**p<0.05; ***p<0.01

Comparisons of Survey Scales

As mentioned, analysis for the survey items used Mann-Whitney U tests of two independent samples. With a few exceptions, results were found to be more significantly different between the EWB-like and Non-EWB-like groups than between the EWB-USA and Non-EWB groups. For simplicity, we will discuss the results from the EWB-like comparison, although results from both comparisons are shared in the tables.

Pre-educational traits and motivations

Table 5 shows the results from the pre-educational traits and motivations. All personalities were found to be significantly different between the two groups. Although we expected only certain personalities to be more prominent for EWB members based on prior research[15,23], these results suggest that perhaps EWB members are a more extreme group, responding to each item with more enthusiasm.

All three of the sub-themes for community service attitudes were found to be significant, which aligns with our expectations from literature. As expected, motivation to go into engineering due to EWB-like interests was significantly higher for EWB-USA and EWB-like groups, and the motivation from doing social good was slightly higher for EWB-like respondents.

Table 5: Results for Pre-Educational Traits & Motivations

Theme	Sub Theme	No. of Items	EWB p-value	EWB-like p-value
Personality Traits	Agreeableness	2	0.022**	0.001***
	Conscientiousness	2	0.106	0.019**
	Emotional Stability	2	0.002***	0.006***
	Extraversion	2	0.106	0.014**
	Openness to Experience	2	0.015**	0.000***
Community Service Attitudes	Connectedness	6	0.005***	0.000***
	Empathy	3	0.135	0.000***
	Intentions	2	0.000***	0.000***
Engineering Motivations	EWB-like	2	0.000***	0.000***
	Family Influence	2	0.155	0.266
	Financial	3	0.248	0.567
	Intrinsic Behavioral	2	0.664	0.262
	Intrinsic Psychological	3	0.258	0.277
	Mentor Influence	2	0.940	0.678
	Social Good	3	0.543	0.084*

*p<0.1; **p<0.05; ***p<0.01

Educational Outcomes

The results from the educational outcomes are shared in Table 6. For the ABET learning outcomes, the individual a-o outcomes were analyzed by aggregating survey items associated with each outcome. The technical, broad, and holistic skills themes—established by IJSLE[24]—were analyzed by aggregating the individual outcomes listed within those themes. Significant differences were found between EWB-like and Non-EWB-like groups for broad and holistic skills where EWB-like respondents were higher in their perceived abilities. For the EWB-USA and Non-EWB comparison, significant differences were found for the technical skills, with Non-EWB members higher in their perceived technical abilities. This difference was no longer significant in the comparison of EWB-like and Non-EWB-like respondents, which may be due to a higher graduate student population with more work experience in the EWB-like group.

As a separate part of this research that is still underway, we have attempted to construct a measure of global competency for engineers. Thus far, the scale is not complete, therefore, Table 6 lists results from six of the individual items on the scale about respondents' global experiences. Significant differences that were higher for EWB-like respondents include the number of times traveled abroad, the number of countries traveled to, and overall interest and knowledge in global matters. Time lived abroad and languages known fluently were not different between the groups. These results suggest that EWB-USA members may have more global experiences due to travel, interest or knowledge, but these are preliminary results to build upon in the future.

The EWB-USA learning impacts items (from the NESLOS[15] scale) were only given to those respondents who indicated EWB-USA membership and therefore have been excluded from Table 6. These items were aggregated into groups of professional skills (n=9 items) and technical skills (n=6 items). Respondents indicated that, on average, they perceived 39.3% of their technical skills came from their EWB-USA experience (meaning that respondents indicated that technical skills are gained more from course work than EWB-USA) and 61.8% of their professional skills came from their EWB-USA experience. These results aligned with our expectation that EWB-USA members gained more professional skills from EWB-USA than coursework, which aligns with findings from studies of LTS students[15].

Table 6: Results for Educational Outcomes & Global Experiences

Theme	Sub Theme	No. of Items	EWB p-value	EWB-like p-value
ABET Outcomes	***Technical Skills***	13	0.066*	0.538
	a: Apply knowledge	3	0.195	0.583
	b: Experiments & data	4	0.800	0.639
	e: Solve Problems	3	0.033**	0.539
	k: Use skills	3	0.004***	0.121
	Broad Skills	26	0.609	0.012**
	d: Multi-disp. Teams	3	0.293	0.227
	f: Ethics	3	0.919	0.292
	g: Communication	3	0.955	0.187
	i: Lifelong learning	3	0.424	0.165
	j: Contemporary Issues	3	0.297	0.002***
	l: Manage & finance	4	0.438	0.031**
	n: Diversity appreciation	4	0.401	0.847
	o: Work ethic	3	0.954	0.939
	Holistic Skills	7	0.831	0.025**
	c: System to meet needs	3	0.047**	0.735
	h: Impact	2	0.495	0.000***
	m: Multi-disp. Systems	2	0.837	0.081*
Global Experiences	Times Traveled	1	0.323	0.008***
	Countries Traveled	1	0.089*	0.002***
	Fluent Languages	1	0.429	0.858
	Time Lived Abroad	1	0.927	0.323
	Global Interest	1	0.009***	0.000***
	Global Knowledge	1	0.306	0.004***

*p<0.1; **p<0.05; ***p<0.01

Career Expectations

Results for the themes regarding career expectations are shown in Table 7. For the two sub-themes of identity—career fit confidence and engineering identity—no significant differences were found. In contrast, there were several significant differences for career outcome expectations. Expectation of technical skills in future careers were significantly higher for Non-EWB-like respondents, all other significant differences were found to be higher for EWB-like respondents, which included themes of life-long learning, awareness of engineering impact, interpersonal skills, societal awareness, global perspective, networking, humanitarian emphasis, and non-technical subjects. These results show EWB-like respondents' higher expectations of professional skills in their future careers.

For the items about intended future career goals, the only significant difference was in EWB-like respondents' lower intention of working in a traditional engineering job five years after graduation. This finding may point to EWB-USA members' interest in a wider variety of career options.

Table 7: Results for Career Expectations

Theme	Sub Theme	No. of Items	EWB p-value	EWB-like p-value
Identity	Career Fit Confidence	4	0.955	0.896
	Engineering Identity	11	0.898	0.483
Career Outcome Expectations	Problem solving	1	0.988	0.449
	Hands-on application	1	0.877	0.662
	Teamwork	1	0.383	0.178
	Technical skills	1	0.013**	0.045**
	Creativity	1	0.754	0.472
	Life-long learning	1	0.410	0.044**
	Awareness of eng. impact	1	0.195	0.000***
	Project management	1	0.502	0.236
	Interpersonal skills	1	0.206	0.003***
	Communication skills	1	0.931	0.450
	Societal awareness	1	0.005***	0.000***
	Global perspective	1	0.001***	0.000***
	Networking	1	0.237	0.077*
	Humanitarian emphasis	1	0.002***	0.000***
	Non-technical subjects	1	0.178	0.000***
Future Career Goals	Work in traditional eng. job	1	0.239	0.057*
	Work in eng.-related job	1	0.146	0.695
	Work in non-eng. job	1	0.731	0.261
	Grad school engineering	1	0.515	0.261
	Grad school non-eng.	1	0.347	0.119
	Teach engineering related	1	0.565	0.289

*p<0.1; **p<0.05; ***p<0.01

Discussion

The intentions of this pilot survey were to inform revisions for a final survey to be deployed in 2014 to the memberships of EWB-USA, SWE, ASCE, and ASME. In this discussion we will discuss the results, share our intended changes for the final survey, and consider the possible consequences of our findings both from this pilot survey and from the final survey.

Pilot Survey Results

Results from the pre-education traits and motivations suggest that EWB-USA members enter their engineering education with different personalities and attitudes towards community service than their peers. These results make sense in light of what EWB-USA members do through the organization, including traveling to foreign countries and volunteering to design engineering projects, which would likely attract engineers with tendencies towards being adventurous, curious outgoing, kind, and/or hardworking. Although these results cannot make causal claims, it could also be the case that involvement with EWB-USA alters personality traits due to being

around like-minded people. More thorough personality research is needed to clarify these findings, but the results point to the idea that EWB-USA members may have an expanded vision of who can do engineering based on their departure from the stereotypical engineering population.

These results also showed that the two groups of engineers had equal intrinsic motivations for engineering, which indicates that despite personality differences, students involved with an EWB-like activity held similar interest for the subject of engineering. This suggests that EWB-USA members enjoy engineering on an intrinsic level as much as other engineers, which is an important component to making choices to remain in an engineering career[25].

Results from the learning outcomes showed that EWB-USA members perceive themselves to have high professional skills (a combination of holistic and broad skills) compared with their Non-EWB peers. This finding aligns with research that has pointed to such professional gains from EWB-USA involvement (e.g. [3]), and suggests ways in which universities can continue to enhance students' professional skills by providing EWB-like organizations and programs. Again, although causal claims cannot be made with the current data, we can envision that involvement with EWB-USA aids the development of professional learning outcomes through experience-based learning. To verify the influence of EWB-USA on learning outcomes, further research is needed to explore confounding variables such as general organizational involvement, which has been shown to influence learning[26]. Because EWB-USA members in this sample were younger than Non-EWB members, age does not appear to be a confounding factor influencing higher learning outcomes. GPA was also equivalent for the two samples, which eliminated the possibility of GPA confounding the results of higher professional learning outcomes.

The results from the career outcomes themes showed that EWB-USA members had higher expectations of needing a wider variety of professional and non-technical skills in their future jobs. Based on these results, it is unclear whether their perceptions differ because they expect to go into different careers or because they envision the same careers to require different skills. Neither the identity nor the career goals items help distinguish this difference, which is an area we plan to further enhance for the final survey. Although the results do not show why EWB-USA members expected a wider variety of professional and non-technical skills in their future careers, these findings make sense in light of the engineering project work these students take part in. For example, most EWB-USA students work on a complete project from beginning to end which includes problem identification and clarification, fund-raising, communication with non-technical and technical audiences, technical design and iteration, professional mentoring, travel for site assessment and hands-on implementation, and report writing all while working in teams and across cultural contexts. This experience, particularly when repeated multiple times, can certainly change expectations for engineering careers.

Survey Modifications

Many of the survey items appeared to have functioned as intended. As a result, scales of personality, community service attitudes, engineering motivations, ABET learning outcomes, and career outcome expectations will remain the same for the final version of the survey. However, modifications are required for engineering identity and future career goals. Both of

these themes included items that may have caused confusion in interpreting what was meant by "engineering." If EWB-USA members have differing expectations of an engineering career, it is valuable for the field to know if these members actually intend to go into different careers or if they have different perceptions of the same careers. Therefore, the identity and career goals questions will be modified to help further differentiate these findings. For example, instead of asking about intending to work in a traditional or non-traditional career, we will ask respondents to indicate whether or not they have worked in or intend to work in specific careers so that little interpretation is needed. Finally, we plan to continue to modify the global competency scale that was being developed during survey administration to better measure a more well-defined construct that expands beyond global experiences.

Consequences of Findings

These results point to the different ways in which EWB-USA students enter their engineering studies, learn professional and global skills, and think about their future careers. They provide evidence to the prior anecdotal claims about the benefits of the organization, and they suggest that the organization is both attracting diverse engineers and is training engineers for diverse careers. Such evidence should merit increased support for EWB-USA and EWB-like organizations and programs from universities and funders in order to assist the recruitment of engineers and the development of better prepared engineers of the future.

If these results are replicated in the large-scale survey across ASCE, ASME, EWB-USA and SWE organizations, they will provide further evidence for the support of EWB-USA, and they will expand that evidence to the professional setting. Researchers have noted that while student benefits of PBSL are well-established, there is very little research focused on the professional benefits of such activities[14], which this research would provide. Aiding the support of EWB-USA and similar activities may expand the benefits found in this research to an even more wide-spread and diverse population of engineers.

Conclusion

This paper shares the findings from a pilot survey given to engineering students at the University of Colorado, Boulder that is intended to inform a larger study comparing EWB-USA members to their Non-EWB peers in order to learn from the organization's success. Limitations of this work include the sample coming from one university and from primarily young engineering students that cannot be compared with an older professional engineering population. Future work will address both of these limitations when the survey is sent to entire memberships of EWB-USA, SWE, ASCE, and ASME, which will allow for more generalizable findings.

Based on the pilot findings, EWB-USA members show different personalities and community service attitudes, they perceive themselves to have learned more professional skills through their educations, and have expectations for needing more non-technical and professional skills in their future careers than Non-EWB members. Findings also showed that these differences were more pronounced for those respondents who were active in EWB-USA or a similar organization indicating that active participation in such an organization may be more crucial than EWB-USA membership alone. These findings encourage future work to continue understanding this unique

organization in order to aid the profession's development of more numerous and better prepared engineers of the future.

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