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Engineering vs. Engineering Technology: Toward Understanding the Factors Influencing the Academic and Career Pathways of African American Students

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Engineering vs. Technology: Toward Understanding the Factors Influencing the Academic and Career Pathways of African American Students

The American Society of Engineering Education (ASEE) reported that in 2016 the percentages of bachelor's degrees in engineering and engineering technology that were awarded to Black or African American students were 3.9% and 8.6%, respectively. The report "Engineering Technology Education in the United States" by the National Academies Press [1] cites a similar statistic for the share of four-year degrees in engineering (EN) and engineering technology (ET) awarded to African Americans (3.8% and 10.7%) and recommends that research into the reasons for this trend might help inform strategies to attract and retain a diverse student population in both types of programs. While this trend is likely due in part to a preference for engineering technology over engineering of some students, we conjecture that institutional, academic, and psychological factors play a role as well. We seek therefore to understand both the reasons for the preference of technology over engineering as well as other factors that might influence the choice of academic and career pathways in technology versus engineering. When considering the barriers to broadening participation in engineering and increasing diversity in the engineering workforce and the engineering professoriate, issues associated with career pathways within STEM and the choice of engineering technology versus engineering in particular remain largely underexplored. While technologists often work alongside engineers and in some instances there may be little distinction between their entry level job descriptions, the relatively large proportion of African American students in engineering technology compared to engineering directly impacts the number of African American students in the pipeline to the engineering professorate, engineering research careers, and leadership positions in industry. Although there are far fewer four-year engineering technology programs compared to engineering, and the number of bachelor's degrees awarded annually in engineering technology is less than 10% of the number of engineering degrees, research that leads to a better understanding of the factors that influence the trend of African American students to pursue degrees in engineering technology versus engineering will contribute to the existing knowledge of how the pipeline to the engineering professoriate might be strengthened and help inform intervention strategies and new approaches to broadening participation of African American students in engineering.

In our preliminary study we conducted an online survey of students enrolled in four year engineering technology programs. The main objective of the survey was to gain insight into the students' high school preparation, path to major, curriculum and institution, and future plans. The data was analyzed and summarized using descriptive statistics and other qualitative methods such as content analysis. We report on the results of the survey and outline how these results will inform the next phase of the research.

Engineering vs. Engineering Technology

The Report of the Committee on Evaluation of Engineering Education (also known as the "Grinter Report") published in 1955 recommended more scientifically oriented engineering

curricula as being essential to the development of competent engineers equipped to handle difficult engineering problems [2]. This report still informs the design and organization of engineering curricula. The Grinter Report included a reference to a preliminary report which suggested a bifurcation of engineering curricula into two types of programs: a general professional category and a scientific professional category. The former would focus on more practical applications to meet the needs of industry and the latter would be centered on math and science geared towards careers in design, research, and development. This proposal was rejected by the engineering faculty who reviewed the preliminary report, and the consensus was that all engineering curricula should incorporate strengthened basic science content. Despite the rejection of this proposed bifurcation by the engineering community, many universities began expanding their existing two-year technology programs into four year engineering technology degree programs in the mid-1950's in response to a need for more practically trained graduates who would be able to enter the workforce without the need for specialized on the job training.

ABET (Accreditation Board for Engineering and Technology, Inc.), the accreditation body for both engineering and engineering technology programs, describes engineering and engineering technology as "closely related professional fields that differ in curricular focus and career paths"[3]. Graduates from engineering programs are called engineers, graduates of four year technology programs are known as technologists, and graduates from two year technology programs are called technicians. In general, engineering curricula are mainly focused on theory, design, and analysis, and include calculus and calculus-based science courses, while engineering technology is focused on application and implementation with coursework based in algebra, trigonometry and applied calculus. The practical differences between engineers and technologists in industry often remain somewhat ambiguous, and the debate about the differences and similarities between their academic preparation and career paths is ongoing [4-7].

Students graduating high school having taken trigonometry and preferable pre-calculus are better prepared for engineering than those who have only taken algebra and geometry [8]. Recruiters and faculty often present engineering technology to prospective students and parents as a more practical, hands-on, and less mathematical route that leads to essentially the same engineering career opportunities as more rigorous engineering programs. Figure 1-1 in the report from the National Academies Press[1] shows an engineering technology – engineering continuum model produced by ASME. The graphic shows that there is a great deal of overlap between the work-related tasks and job descriptions of engineers and technologists. It suggests that an engineering technology degree provides the qualifications for all careers on the spectrum except those at the engineering end which include complex design and analysis and theoretical research. Many engineering technology programs adopt a similar positon when distinguishing between the EN and ET programs and in distinguishing the types of jobs that graduates of four year degrees programs in ET and EN might expect. The significant overlap between EN and ET is supported by engineering technology advocates who make the case that "Engineering Technologists are Engineers". In a paper by that name, Land reports that seven out of ten companies that hire both

engineers and technologists make no distinctions between the two when hiring and assigning responsibilities [6]. The study however only included companies that hire both, and does not acknowledge that many employers do not hire engineering technology graduates for engineering positions for a variety of reasons, including a lack of familiarity with the preparation and qualifications of graduates of four year bachelors in engineering technology programs by many in engineering practice who still associate engineering technology with a two year associates degree program. For example, the University of Toledo's College of Engineering works with an extensive network of 1,892 companies which hire engineering students for semester long cooperative experiences as part of the mandatory co-op program. Of these companies, only 189 hire engineering technology students. In addition, the path to professional engineering licensure is considerably more difficult in some states and impossible in others for technologists, including those who graduate from accredited engineering technology degree programs [9]. Finally, there are few graduate programs in engineering technology, and most graduate programs in engineering require a bachelor's degree from an accredited engineering program. Thus engineering technologists have limited opportunities if they decide to pursue advanced technical degrees. In short, the differences between engineers and technologists are far more complex than the simplified 'more mathematical' vs. 'less mathematical' model that is often used to compare the two. The recent publication of the National Academies of Science, Engineering, and Medicine "Engineering Technology Education in the United States" report on a two-year study on the "status, role, and needs" of engineering technology education in the US notes that ET education has been largely overlooked in the national discussion of the national technological workforce and the general lack of awareness of ET. The authors of the report make several recommendations including further research to understand why ET appears to be more popular among students from many groups traditionally underrepresented in STEM. The study included workshops, a review of ET-related statistics, and surveys of ET educators and employers of engineering technicians and technologists. In our preliminary study we conducted an online survey of students enrolled in four-year ET programs – a population that was not surveyed for the National Academies report.

Engineering Technology Student Survey

At many Predominantly White Institutions (PWIs) that offer ABET accredited programs in both engineering and engineering technology the percentage of students enrolled in engineering technology who are African American is significantly higher than the share of African American students enrolled in engineering. At several institutions, including the authors' home institutions the head count of African American students enrolled in ET is higher than those in EN, despite the fact that their total enrolment in ET is smaller than EN. Table 1 below shows the Fall 2016 enrolment numbers for ET and EN at the ten schools with the highest enrolments in ET as reported in ASEE Profiles (88 schools reporting for ET). At nine of the ten universities the share of African American students enrolled in ET is high than in EN.

Table 1 Fall 2016 Enrolment in engineering technology and engineering at the schools with the highest ET enrolment.

	Engineering Technology			Engineering		
	Total	**Black/AA**	**% Black/AA**	**Total**	**Black /AA**	**% Black/AA**
Purdue University*	4516	178	3.9%	8705	144	1.7%
University of Houston**	3859	384	10.0%	3723	180	4.8%
Arizona State University	3422	186	5.4%	12712	377	3.0%
Ferris State University	2100	79	3.8%	83	1	1.2%
Indiana U. Purdue U., Indianapolis	1402	130	9.3%	1474	76	5.2%
Rochester Institute of Technology	1178	80	6.8%	3331	74	2.2%
The University of Toledo	1164	80	6.9%	2471	44	1.8%
Purdue University Northwest***	1083	90	8.3%	740	44	5.9%
Oklahoma State University	801	20	2.5%	3128	98	3.1%
New Jersey Institute of Technology	756	69	9.1%	3315	259	7.8%

* ET housed in Purdue University Polytechnic Institute; ** ET housed in University of Houston College of Technology; *** ET housed in Purdue University Northwest College of Technology.

As a preliminary step toward understanding this trend the authors conducted an online survey of ET students. While the ultimate goal of our research is to gain insight into the ET academic and career paths of African American students, the survey was open to all students. The central objective of the survey was to learn more about ET students, their high school experiences, paths to their ET majors, their universities and degree programs, and future plans. In this preliminary study we do not attempt to separate or analysis the responses of students by ethnicity. The survey questions were in four categories: Demographics, High School Preparation, Path to Major, Institution and Curriculum, and Future Plans.

Results

A. Demographics

117 students responded to the survey. The majority of the student respondents were from Purdue University Polytechnic Institute and the University of Toledo. Responses were also received from the University of Dayton, the University of Akron, and Kent State University. The majority of the respondents (90.5%) were domestic students who attended high school in the United States or a US territory. The gender split of students responding to the survey was approximately 80% male, 20% female. The ethnic and age breakdown of respondents are shown in the Figure 1 below. Figure 2 shows the distribution of respondents by major.

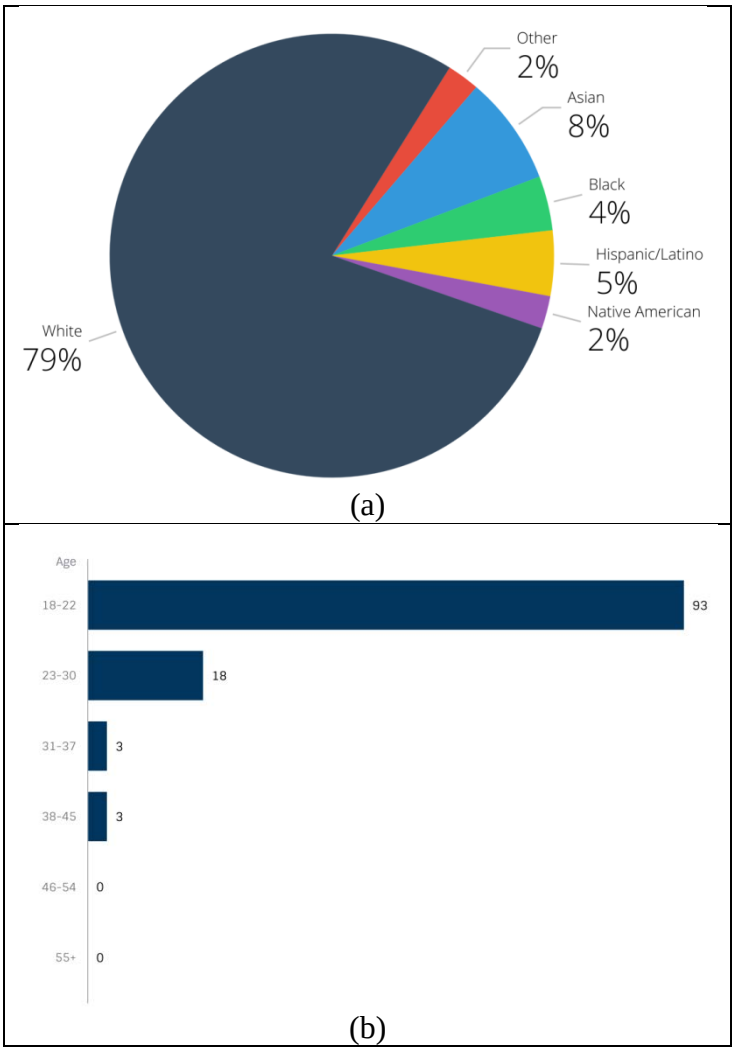

Figure 1 (a) Ethnicity and (b) age demographics of respondents to ET Student Survey.

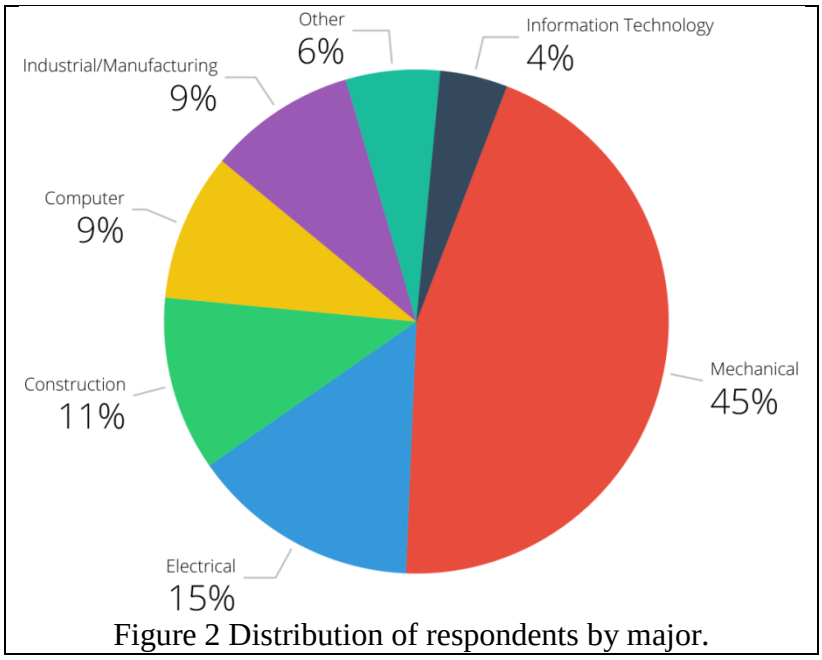

Figure 2 Distribution of respondents by major.

B. High School Preparation

The survey questions related to high school preparation were focused gaining insight into the mathematics and science background of the students. The specific questions asked were:

1. How many semesters of mathematics did you complete in high school?
2. What mathematics courses did you complete in high school?
3. What science courses did you complete in high school?
4. Were Advanced Placement (AP) courses offered at your high school?
5. Please list any AP mathematics or science course you took in high school.
6. High school prepared me adequately for my first college mathematics courses.
7. Clarify your answer to the question: “High School prepared me adequately for my first college mathematics courses.”

73% of respondents completed eight semesters of mathematics in high school while 14% reported having four or fewer semesters of mathematics. Figure 3 shows the responses regarding the mathematics courses taken in high school. Note that each responded selected all the math courses they took in high school, so the total number of courses exceeds the number of respondents. The majority of the respondents (~78%) completed pre-calculus, and 28% reported taking pre-calculus. 102 of the 117 respondents completed high school chemistry while the number of students who took biology and physics in high school was 100 and 90, respectively. Advanced placement (AP) courses were offered at the high schools of 84% of the respondents.

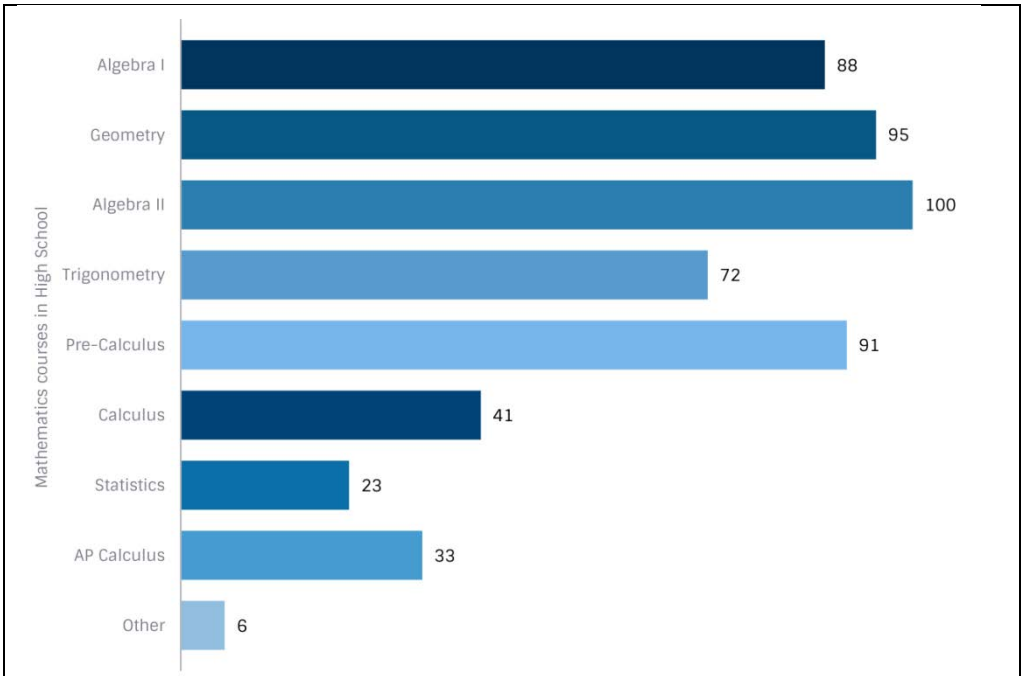

Figure 3 High school mathematics courses completed by survey respondents.

In response to Question 6 “High school prepared me adequately for my first college mathematics course”, 25% strongly agreed, 36% agreed, 18% neither agreed nor disagreed, 13% disagreed, and 9% disagreed strongly. When asked to elaborate on their responses, the students cited the courses they had taken and their teachers as the reasons they felt well prepared for college mathematics courses. A few students reported that they were not required to take any mathematics courses in college because of dual credit or AP or IB credit they received in high school. Some of the student responses are listed below:

> “Calculus was easy for me.”
>
> “High school classes were much more challenging than college level courses.”
>
> “I took all the high end math course offered in my high school and this helped give me a head start in college.”
>
> “While AP courses were offered, so were IB courses which I took as well. Those math and science courses prepared me better than the AP courses.”

Respondents cited several factors that they believe contributed to them feeling underprepared for college mathematics. Some students felt that their pre-calculus course was not good preparation for calculus. One expressed that the curriculum had too heavy a geometry emphasis and another felt that high school pre-calculus pampered them by providing required formulas during tests which has made the adjustment to college calculus difficult. Several expressed that while their high school courses prepared them for the material in the courses, they were not prepared for the

pace of college courses. Non-traditional students who started college several years after graduating high school expressed that they had forgotten much of their high school math which made college courses a challenge. Many students expressed that they would have been more prepared for college mathematics if they had applied themselves more in high school, and expressed regret that they did not challenge themselves or were not challenged by others to take higher level math and science courses or were advised poorly in high school about the courses they should take. Select quotes from students are listed below:

> "I told my academic advisor that I wanted to study engineering in college, but had me sign up for AP statistics, AP English, Environmental Science and Forensic Science. She should have told me to take calculus and either physics or chemistry to help me better prepare for college and engineering. I felt like I was behind my peers when I entered college."
>
> "My high school was very very small. Our math department had very good staff, but I outgrew the classes and was ahead of the content. Our exams and homework were very easy, and everything was clear cut. Coming to college math was like getting hit in the face with a brick. I wish I was challenged more in high school math."
>
> "I was far behind almost every single one of my peers in college. High school math didn't provide any type of transition or preparation for rigorous college math courses."
>
> "I feel that the other people here know more than me. Also, I feel that I am expected to know more than I really do."

C. Path to Major

The survey questions related to the math to engineering major were as follows:

1. Including the current academic year, how many years have you been enrolled in engineering technology?
2. Which best describes your path to your current major?
3. Why did you choose your current major?
4. How did you first hear about engineering technology in general and your current major in particular?

Approximately 27.8% of respondents were in the first year of their ET degree. The number of respondents in the second, third, and fourth year of study were 19.4%, 27.8%, and 20.4% respectively. 4.6% were in their fifth year or later. The paths of respondents to their current major are summarized in Table 2.

Table 2 Paths to Engineering Technology of survey respondents.

	Count
I applied to this program/major directly from high school and was admitted to my current major.	42
I applied to another program/major directly from high school and was admitted to my current major.	23
At my institution majors are declared after the freshman year. I applied to this program/major and was admitted to my current major for my sophomore year.	3
At my institution majors are declared after the freshman year. I applied to another program/major and was admitted to my current major for my sophomore year.	2
I transferred from another program/major at the same university.	21
I transferred to this major after some community college but before receiving an associate's degree.	3
I transferred from community college after receiving an associate's degree	4
I transferred from another four year program at another institution	4
I applied to this program/major after working in industry and was admitted to my current major	6
I applied to another program/major after working in industry and was admitted to my current major	0
Total	108

39% of respondents to this question on the survey applied directly from high school and were admitted to their current engineering major. 21% had applied to another major and were admitted to their current major. The majority of these students reported that they had initially applied to engineering. 19% of respondents transferred from another major at the same university. The majority of these students had transferred from engineering.

Table 3 Reasons for choosing ET major.

	Count
I am a hands-on person and this major allows me to work with my hands more than others I was considering	46
There is a high demand for graduates with degrees in my major.	8
I do not want to work in a cubicle all day.	6
I wanted a curriculum with more hands-on courses and less calculus and theory.	28
Other	20
	108

The majority of students responded that they chose engineering technology because it is more hands-on in nature and involved less theory and calculus as shown in Table 3. The students who selected ‘other’ in response to the question of why they chose engineering technology cited a combination of the options listed in the table or ‘all of the above’ as their reasons for choosing ET.

The responses to the question “How did you first hear about engineering technology in general and your current major in particular” are presented in Table 4. Twenty-seven of the 108 respondents first heard about ET from a university advisor or staff member. Twenty respondents first learned of the major when they were admitted. Additional ways in which the 21 students who selected ‘other’ heard about their major and ET in general were parents, through their own research, college visits, an ET camp in high school, peers in engineering and ET, and an employer.

Table 4. Responses to the question “How did you first hear about engineering technology?”

	Count
High school counselor	3
High school teacher	6
I know an engineering technologist	9
An academic advisor, success coach, or other college staff member	27
An engineering professor	5
An engineering technology professor	6
When I was admitted to the program	20
A student in the program	11
Other	21
Total	108

D. Institution and Curriculum

Survey questions on institution and curriculum are presented below:

1. How many college mathematics courses are required in your degree program?
2. How many semesters or summers of internships or coops have you completed?
3. Are you a member of any student organizations or professional societies related to your field of study?
4. If you answered that you had no internships or coops while an undergraduate student, why is it that you have not had either?
5. At your institution can engineering technology majors take engineering courses?
6. At your institution can engineering majors take engineering technology courses?
7. At your institution are engineering and engineering technology housed within the same college?

8. At my institution engineering technology majors have the same access to resources and opportunities that engineering majors do.
9. At my institution there is a perception among engineering students that one's major is an indicator of academic ability (e.g. 'Smart' students do Major X.)
10. At my institution there is a perception among engineering technology students that one's major is an indicator of academic ability (e.g. 'Smart' students do Major X.)
11. At my institution there is a perception among faculty and staff that one's major is an indicator of academic ability (e.g. Major X would be a better fit for you. It is not as rigorous or challenging).
12. My curriculum is 'hands on'. I am being trained in practical skills that I feel confident I will be able to apply in the real world.
13. What do you perceive as potential advantages to obtaining an internship/coop or permanent employment in your field?
14. What do you perceive as potential obstacles to obtaining an internship/coop or permanent employment in your field?
15. What has been the most rewarding aspect of your undergraduate experience?
16. What has been the most challenging aspect of your educational experience?

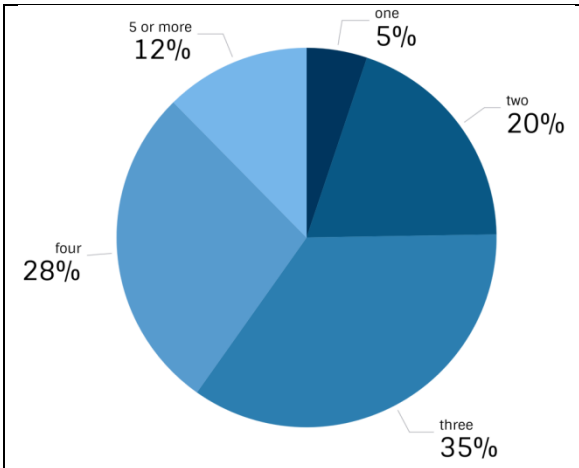

Figure 4. How many college mathematics courses are required in your degree program?

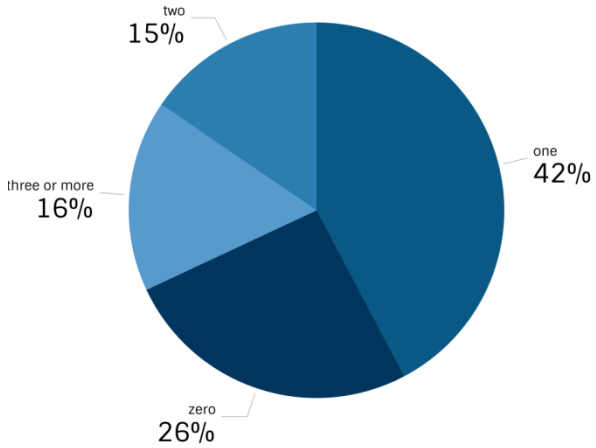

Figure 5. How many semesters or summers of internships or coops have you completed?

Student responses to Questions 1 and 2 are shown in figures 4 and 5. The students who reported that they had not completed any internships or cooperative experiences attributed this to a variety of reasons, with the most frequent responses being that they were freshmen or sophomores and therefore too early in the program, they had recently transferred to their current major, they had not applied for an internship/coop, and that it was difficult to get the experience needed to secure an internship opportunity. 52% of respondents are members of student organizations or professional societies related to their fields of study.

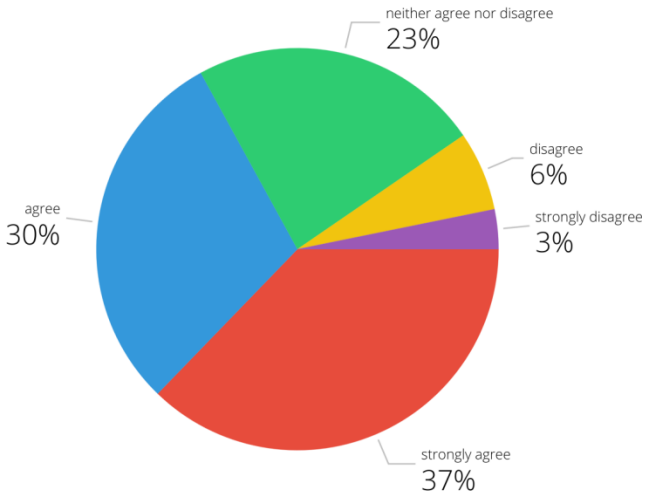

Figure 6 “At my institution there is a perception among engineering students that one’s major is an indicator of academic ability (e.g. ‘Smart’ students do Major X.)”

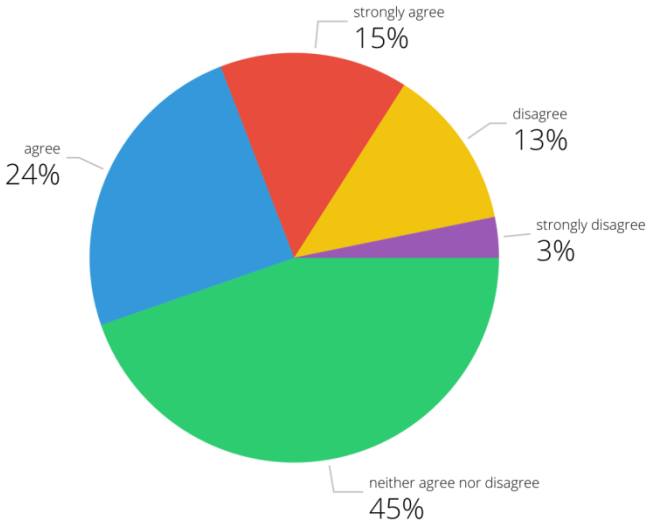

Figure 7 “At my institution there is a perception among engineering technology students that one’s major is an indicator of academic ability (e.g. ‘Smart’ students do Major X.)”

Roughly two thirds of the respondents responded that engineering technology majors could take engineering courses at their institution. The number of students who responded that engineering students were permitted to ET courses at their institution was 77%. Engineering and engineering technology are housed in the same institution for 55% of respondents. In response to the statement “At my institution engineering technology majors have the same access to resources and opportunities that engineering majors do”, 22% strongly agreed, 31% agreed, 23% selected neither agree nor disagree, 16% disagreed and 7% strongly disagreed.

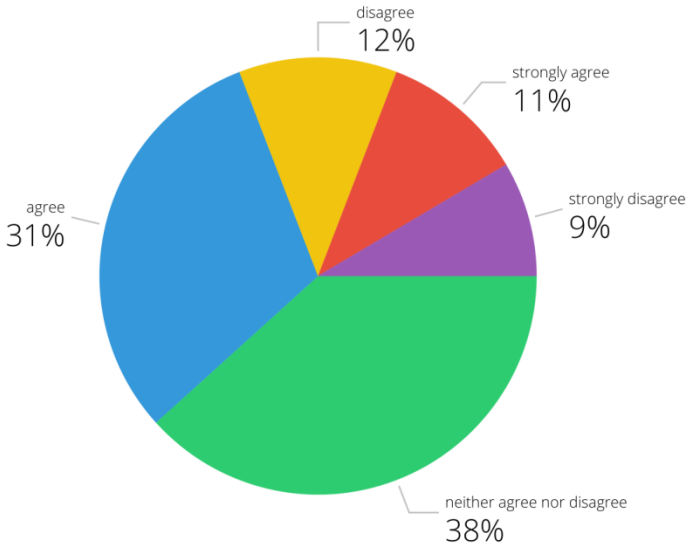

Figure 8 “At my institution there is a perception among faculty and staff that one’s major is an indicator of academic ability (e.g. Major X would be a better fit for you. It is not as rigorous or challenging).”

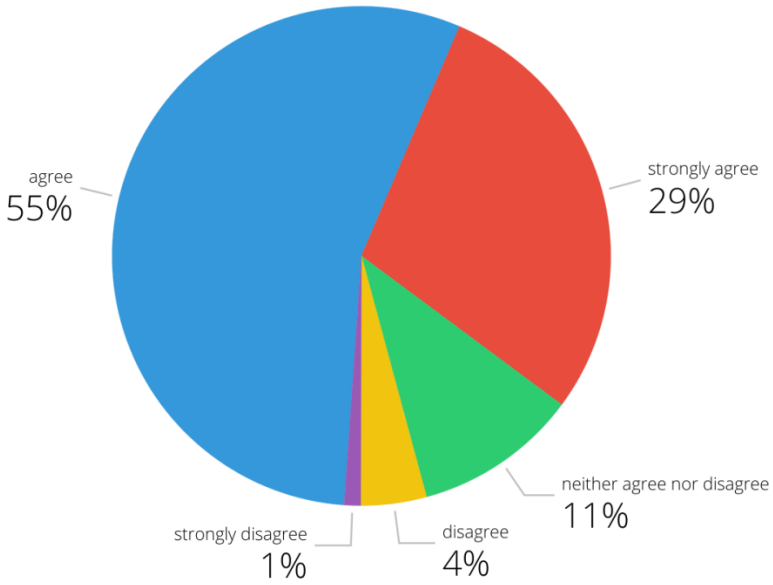

Figure 9 “My curriculum is ‘hands on’. I am being trained in practical skills that I feel confident I will be able to apply in the real world.”

The responses to questions 9 – 12 are shown in Figures 6 – 9. Figures 10 and 11 summarize the factor that the respondents consider advantages and obstacles to obtaining internships or coops and permanent employment in their field. Students to relevant work experience as the greatest advantage and employers’ lack of familiarity with their degree program as the greatest obstacle.

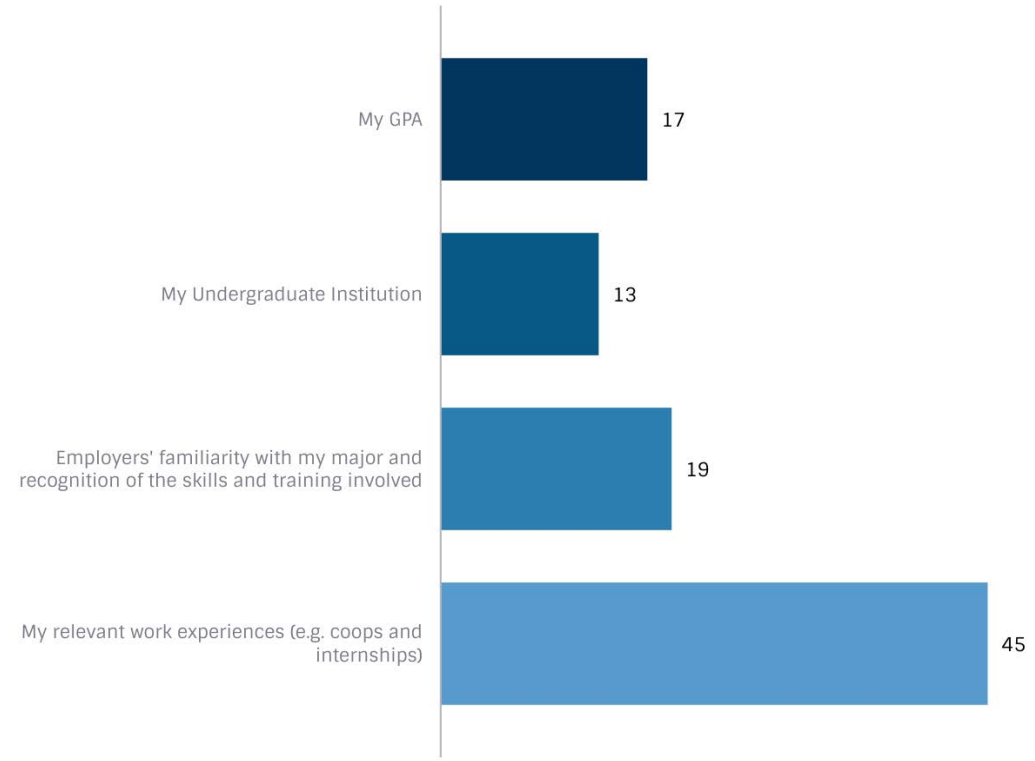

Figure 10 What do you perceive as potential advantages to obtaining an internship/coop or permanent employment in your field?

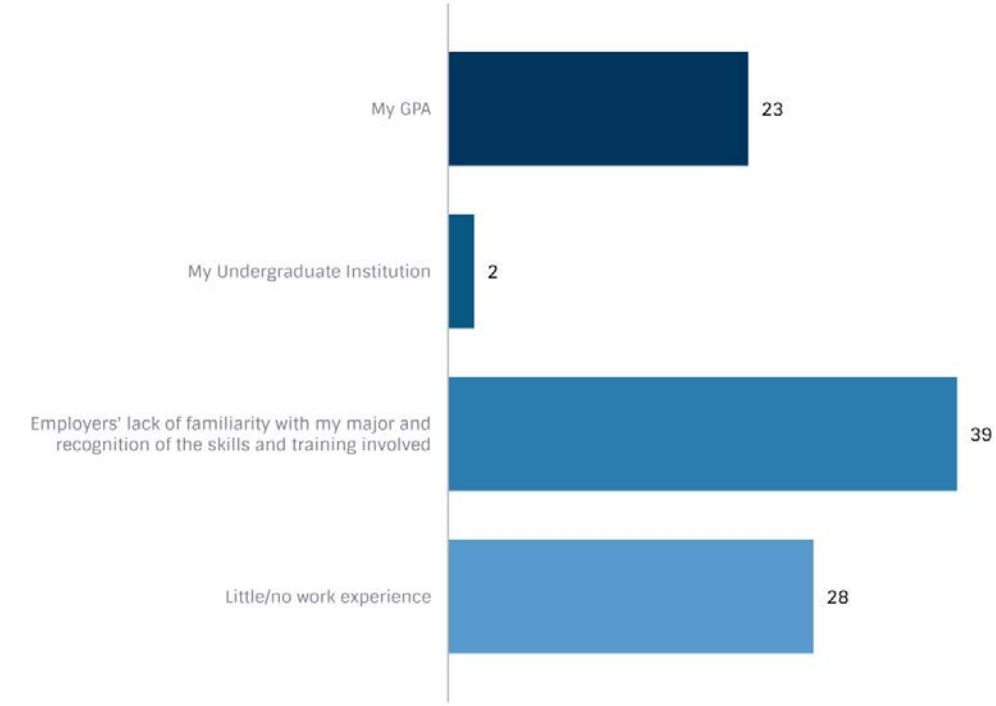

Figure 11 What do you perceive as potential obstacles to obtaining an internship/coop or permanent employment in your field?

When asked to identify the most rewarding aspect of their undergraduate experience, the most frequent response was internship and coop opportunities, followed by the hands on learning experiences and laboratory time. Students also reported that they enjoyed what they were learning, working in groups, networking, and gaining computing knowledge. Some students noted experiences that distinguished them from engineering students as being the most rewarding. These are quoted below;

> "The amount of skills I have gained that put me above engineering students."
>
> "The massive amount of hands on experience and background knowledge I have learned or know over that of a regular engineering student."

In response to the question "What has been the most challenging aspect of your educational experience" many students cited specific subjects such as chemistry or mathematics courses and the transition from high school to college. Several students noted that the most challenging aspect of their experience was directly related to their pursuit of engineering technology and not engineering. These responses are reported below;

> "People telling me I chose engineering technology because I'm a woman and am not intelligent enough to do "real engineering".
>
> "Having companies not even consider me simply because of my major."
>
> "Transitioning to technology from Bioengineering since I really wanted to get my BIOE degree."
>
> "People think less of me because I am a Technology student."
>
> "Switching majors, because i felt that i was stepping down, however now that i am in my current major i feel that it is an improvement."
>
> "Being compared to engineering students."

E. Future Plans

Students were asked the following questions in the final section of the survey

1. What do you plan to do after graduation?
2. Is a professional engineer's license (PE license) required or highly recommended to advance in your field?
3. Is becoming a licensed PE one of your career goals?

In response to the first question, 87.4% of the 95 respondents to that question plan to work in their field or a closely related area after graduation. 8.4% (8 students) plan to go to graduate school and 4.2% plan to work in a field not directly related to their course of study.

Ninety-four students responded to the questions related to professional licensure. 43 students (45.7%) were not sure whether a professional engineer's (PE) license was required or highly recommended to advance in their field. 21.3% of respondents responded that a PE was required or recommended. 48% of respondents list becoming a licensed professional engineer as one of their career goals. 28.7% of respondents are not sure whether they plan to pursue PE licensure.

Discussion

Results of the survey provided an intriguing look into the population of respondents. The gender demographic as well as racial did not match the reported demographic CITE ASEE RESULTS with far more female students responding than in the general population, and far more white students than anticipated considering the survey distribution. Further, considering the population of responding students and the gender and racial split the availability of math in high school preparation is most disconcerting. Only 84% of the students had AP courses offered in their programs, and approximately 14% of the students took four or fewer semesters of math in high school in preparation for a STEM career. Many studies focused on students majoring in engineering show a much higher availability of AP courses and most students preparing for such a career take far more math courses.

When asked about preparation for college math courses, sixty one percent felt they were prepared. The balance of respondents did not indicate they were well prepared. Reasons cited included that they did not feel the high school courses were paced in the same manner as college courses, focus was not adequate, and did not have an adequate transition into the college math courses. Some of these comments were provided by students that felt they were well prepared by their courses, suggesting that high school math courses need a more consistent pedagogy and classroom experience to support student transition into higher level college math.

The survey respondents were divided closely over the 4 year program, with less than 5% in their 5^{th} year or longer. Nearly 60% of these students were direct admit from high school and 16% had transferred from other programs. Slightly more than 60% of the students indicated that they chose engineering technology because of the hands on aspect of the program, while 25% of the students indicated they were first influenced by an advisor or college staff member. 19% of the student's shared that they didn't know anything about engineering technology until they were admitted to the program and another 20% of the students first learned about engineering technology from students in the program or someone that had graduated.

Conclusion

The survey results provide some valuable insight into students' pathways to and experiences in four-year ET programs. The fact that a large share of students first heard about their ET major when they were admitted to the program, and that many students were admitted to ET after having applied to another major suggest that the admission practices of some institutions may effectively be making the choice of major for the student. The results also confirm the need for

the recommendations made by the National Academies of Engineering in their report [1]. Specifically, the need for leaders of ET programs to have meaningful dialog with leaders of EN programs about the similarities and differences between ET and EN, and that the ET community should find ways to educate employers as well as K-12 teachers, students, students' parents about ET.

It is clear from the survey results that ET students feel that their program of study is not well understood and considered not as rigorous for prestigious as EN majors by employers and peers in EN. There is also some indication that the students themselves are not fully aware of the differences between ET and EN.

In addition, there are several institutional factors that potentially impact the career pathway choices of African American students and which might present barriers to engineering degrees. Here we briefly discuss some of these potential barriers in the context of the University of Toledo. We hypothesize that similar barriers exist at other institutions which offer both engineering and engineering technology although we were unable to validate these directly with the preliminary survey.

Community College Pathway to Engineering

Many African American students choose to begin their college study at community colleges. Students interested in pursuing a career in engineering may pursue the community college option for a variety of reasons including financial cost, and not having the adequate preparation for a four-year engineering program direct from high school [10]. Malcom-Piqueux and Malcom posit that the barriers to the bachelor's degree in engineering that a student from a community college might face include the lack of articulation agreements between two year and four year colleges, a lack of transferable courses, and inadequate academic preparation [10]. We note that many community colleges offer two-year associate's degrees in engineering technology. There is usually not a pathway to a four-year engineering program from a two year technology degree, but there is often a pathway to a four year engineering technology degree from an associate's degree in technology at universities where there are offered. This policy is often not communicated to students who are interested in ultimately pursuing an engineering degree who decide to pursue an associate's degree in engineering technology, assuming that it provides a direct path to a bachelor's degree in engineering.

Part Time vs. Full Time Options

For some students, the choice of engineering technology versus engineering may be decided based on the ability to enroll as a part-time student and pursue the degree. At many institutions, engineering is only offered through day-time classes which engineering technology programs are more flexible. This can be significant for students who must work full-time while pursuing their degree.

Lack of knowledge of existing pathways from engineering to technology

At institutions that offer degrees in both engineering and engineering technology, there is often a pathway to engineering via engineering technology. For example, at the University of Toledo, if a student applies to one of the engineering science departments and does not meet all of the entry requirement (high school math requirement and GPA, ACT/SAT score, and high school chemistry), the student is automatically reviewed for engineering technology and is admitted once they met the entry requirements. Once in an engineering technology program a student can transfer to an engineering department by completing the requisite courses and maintaining a certain GPA; however African American students rarely pursue this pathway- either due to lack of information, or due to the psychological and motivational barriers.

Future Work

For the next phase of the project the survey will be disseminated more broadly to students in four-year ET programs across the country. The participation of African American students will be specifically encouraged through dissemination the survey through organization such as the National Society of Black Engineers (NSBE). Once more responses are obtained including a statistically significant number of responses from African American students, the survey results will be reanalyzed for any trends related to ethnicity. Individual in person interviews will be conducted of ET students after data collection and analysis of the online survey. The individual interview protocol will be informed by the survey results and will be developed to obtain more in depth information regarding students' preparation, pathways, program, and institution.

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