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Engineering Technology Graduates: A Survey of Demographics and Mentoring

Anne M. Lucietto
Purdue University, lucietto@purdue.edu

Elizabeth Dell
Rochester Institute of Technology

Elaine M. Cooney
Indiana University Purdue University Indianapolis

Lisa Ann Russel
Purdue University

Emily Schott
Purdue University

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Engineering Technology Graduates: A Survey of Demographics and Mentoring

Dr. Anne M. Lucietto, Purdue Polytechnic Institute

Dr. Lucietto has focused her research in engineering technology education and the understanding of engineering technology students. She teaches in an active learning style which engages and develops practical skills in the students. Currently she is exploring the performance and attributes of engineering technology students and using that knowledge to engage them in their studies.

Prof. Elizabeth Dell, Rochester Institute of Technology

Professor Dell is an associate professor in the Manufacturing & Mechanical Engineering Technology department at RIT. She serves as the Faculty Associate to the Provost for Women Faculty. Her research interests include: characterization of biodegradable plastics and environmental consideration in materials selection for production design, and effective strategies for increasing diversity in STEM disciplines.

Prof. Elaine M. Cooney, Indiana University Purdue University, Indianapolis

Elaine Cooney is a Professor and Program Director of Electrical Engineering Technology at Indiana University Purdue University Indianapolis. Elaine is a leader in the development of core competency documents for Engineering Technology for State of Indiana's Transfer Single Articulation legislation. She is also a Senior IDEAL Scholar with ABET, which means that she presents assessment workshops with other Senior IDEAL Scholars.

Liza Ann Russell, Purdue University

Liza Russell is an Undergraduate Researcher working under Dr. Lucietto. She is a student at Purdue University, pursuing a Bachelors of Science in Mechanical Engineering. She began working under Dr. Lucietto in the summer of 2017 as a part of Purdue's Summer Stay Scholars program and has thus far continued her work. In addition to her Mechanical Engineering coursework, Liza is pursuing minors in Physics and Anthropology. Outside of class, she serves as Treasurer of Convocations Volunteer Network (CVN) and is a member of Tau Beta Pi.

Emily Schott, Purdue University

Emily Schott is an Undergraduate Researcher working under Dr. Lucietto. She began working for Dr. Lucietto in the summer of 2018 as part of Purdue's Summer Stay Scholars Program. She is a junior in Aerospace Engineering and is pursuing a Certificate in Entrepreneurship and Innovation. Emily is also a member of the Purdue Society of Professional Engineers Chain Reaction Machine Team and is helping to plan next year's Amelia Earhart Aerospace Summit at Purdue.

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Abstract

Early in 2017, a team of engineering technology practitioners along with others interested in the state of engineering technology published a report entitled "Engineering Technology Education in the United States." This report garnered a list of recommendations and things that needed to be investigated to further our understanding of this student population; specifically focusing on the students and how they relate to other students studying both similar and different material.

A team of like-minded engineering technology education researchers have been working together to ascertain the answers to the findings. They prepared two surveys, obtained institutional approval, and distributed it throughout the United States. One survey was designed to query undergraduate students and the other student graduates or those who have already graduated. This paper is intended to provide a high-level review of what was found in the graduate survey, while future journal publications will take a deeper look into some of the prevailing issues identified by the report.

The survey was designed to address issues described in the report as "loose coupling" of completed degrees and employment. In this case, we are examining the demographics of graduates and potential influences of their career and academic choices. Later work will focus more on salaries and other factors that influence engineering technology graduates and their lives post-graduation.

Responding graduates are closely aligned to the graduate demographic with nearly 57% male and nearly 42% female. Since STEAM (Science, Technology, Engineering, Arts, and Mathematics) graduates were polled, the number is expected to be closer to par, representing the general graduate population. Most students were white, followed by Hispanic and Asian; other races are far fewer in number. Nearly 17% of the graduates began their studies in a two-year institution, and the balance at a 4-year institution. Thirty-three percent of the respondents stated they had a graduate degree. This paper will focus on the engineering technology graduate subset of the STEAM graduate survey respondents.

Key Words: Graduate, matriculation, retention, graduation, engineering technology

Introduction

This paper is intended to address recommendations 3 and 4 from the National Academy of Engineering (NAE) report published in 2017 [1], "Engineering Technology in the United States". This report suggests that research addressing the engineering technology student population is underrepresented in certain areas. Specifically, this work supports furthering our understanding of what influences student choice of major, how socioeconomic factors influence student choice, and how mentoring, peer support, and differences between 2- and 4-year schools impact student progress and choice. Recommendation 4 suggests that research is needed to understand the variety of programs found in engineering technology and resulting employment following

graduation. It also supports investigation into pay differences between disciplines and how that impacts students' choice of discipline. This paper will address many of these issues and how graduates responded to the survey.

Literature Review

To clarify the terminology and history of the group of disciplines known as STEM or STEAM, this paper will cover the history of this grouping. Providing a brief review of engineering technology as a discipline follows with another discussion of how pre-college education relates to higher education. Consideration of how community support and mentoring of students provides a basis for their decision making along with how the community college or two-year model supports the 4-year baccalaureate program in similar/same fields is discussed. Further support in college and its impact on student choice and success as they move into their profession is also reviewed.

History of SMET, STEM & STEAM

In 2001, the acronym formally known as SMET turned into STEM (Science, Engineering, Technology, and Mathematics)[2]. However, this grouping has been recognized in educational reports since the 1980's [2]. STEM had been developed by the National Science Foundation (NSF) to group together these disciplines based on the common use of critical thinking and problem-solving skills [2, 3]. The disciplines that make up STEM are distinct but linked, with those in engineering also studying physics, chemistry and other sciences and math being studied in all disciplines [4]. Noticeably absent from this group is the arts, which is not recognized to be part of STEM.

In order to compare ET students to their peers, the researchers considered the broader population of students in STEAM (Science, Technology, Engineering, Arts, and Mathematics). The acronym is a result of the Arts-National Policy Roundtable in 2007, which suggested adding the "A" for arts to improve creativity and innovation in STEM students [5]. There is some argument over whether the A refers to education in visual arts, performing arts, or liberal arts and humanities[5]. For the purpose of this paper, the researchers took arts to include all of these disciplines since there is no established precedence. While encouraging creative thinking, the incorporation of the A into STEM helps to underscore the importance of the arts for creating well-rounded individuals [5].

Engineering Technology Students

Limited literature exists concerning different aspects of ET students. This survey addresses the recommendations promoting research into these students. What work that has been done suggests that engineering technology students, while very concrete and logical in their thinking, also utilize intuition when making decisions. As compared to engineering students, who show an affinity to working in teams, formally documenting work, and using calculation to solve

problems, ET students prefer working individually, taking risks and using trial and error to solve problems [6].

A prior survey of ET graduates shows that engineering technology is often misunderstood by employers, resulting in confusion in what ET graduates are capable of [7]. This misunderstanding contributes to the employer perception that ET degrees represent an associate's or technical degree and leading to the need for these graduates to explain their qualifications to potential employers and coworkers [8]. This supports the "loose coupling" of degree and employment suggested by the NAE. However, work does not exist documenting why ET students choose their major, their demographics, or their confidence in their preparation for college and their career.

Community Support and Mentoring

Little literature focuses on the community support and mentoring students receive before entering college. Work that exists suggests that low-cost methods such as text-messaging and peer mentoring can encourage students of low-socioeconomic status to complete financial aid applications, enroll in college, and access professional assistance [9]. Religious institutions also can provide support, though research suggests a negative relationship between mental health and religious doubt in college students [10]. Negative mental health can affect academic performance.

Two-year Versus Four-year Institutions

Literature focused on the cost of beginning education in a two-year institution as a route to a bachelor's degree is widespread [11]. The literature also suggests that obtaining an associate degree before beginning a bachelor's has no negative effect on bachelor's attainment or GPA, suggesting that community college can be a beneficial place to begin higher education [12]. When considering student commitment, defined as the "student's overall impression, satisfaction, sense of belonging, and perception of quality, match with, and attraction to a particular institution", the experience in the classroom plays a larger role in two-year students' commitment while the opportunity for social experiences in residence halls and on-campus play a larger role for four-year students [13]. The commitment to the institution is strongly connected to student success and retention [13].

For STEM students, of which ET students are a subset, federal programs in recent years have focused on making it easier to transfer credits from a two-year to four-year institution [14]. In order to encourage more students in community colleges to pursue a bachelors in a STEM discipline, more preparation in mathematics is needed [14]. Furthermore, the development of effective mentoring programs and dual enrollment programs is suggested to increase student interest in STEM and encourage enrollment in both types of institutions [14].

Support in College

The support students receive while in college can affect their decisions when considering switching majors. A survey from Jaradat and Mustafa suggests that academic advisors often do not provide enough support to students when selecting majors, despite the knowledge that relationships with faculty are important for student success[15]. The quality of advising received also impacts student retention in their major [16]. The reasons for changing majors vary by student but can also be linked to career availability for certain degree programs, an issue especially important for ET students due to the “loose coupling” of degree and employment [17].

Where retention of students is concerned, peer mentoring has been shown to increase retention and self-esteem among students [18]. Among first-generation college students, campus mentors can provide meaningful messages that influence their decisions throughout their college careers and equipping them with the ability to deal with academic challenges [19]. Therefore, the support students receive from both faculty and peers can affect decisions to remain in their major, their confidence, and their decision to remain in college. By asking graduates about the support they received through their college education, areas for improvement can be identified and addressed, likely resulting in increased confidence and retention among future students.

Employment and Degree

Matching degree with employment plays a role in earnings among college graduates. A study of college graduates showed that engineering and engineering technology majors tend to have lower levels of employment mismatch as these majors provide occupational-specific skills while liberal arts degrees have a higher level of mismatch [20]. Further, those in mismatched careers tend to earn less than their peers with matched degrees, especially those in occupational-specific majors such as engineering and ET [20].

Among scientists in the United States, it has been shown that a mismatch between degree and employment is more likely later in their careers [21]. Mismatched employment also impacts the self-employed, with more self-employed individuals reporting a mismatch and those who are moderately mismatched experiencing a significant decrease in earnings [22]. Therefore, the perception of availability of employment in a student’s field of study plays a significant role in the success that the student can expect after graduation.

Research Question

For a high-level review, understanding who engineering technology students are, what influences them, and any characteristics that set them apart from other students is critical. A survey was sent to STEAM students nationwide, with the intent of collecting data from students in all of the encompassed disciplines. This paper will focus on the subset of these students who have graduated with an undergraduate degree in engineering technology or who majored in

engineering technology during some point in their studies. To capture that information, the following research question is intended to document these findings.

Who are engineering technology graduates?

Methodology

To answer this and other questions, a Qualtrics survey was developed. The survey covered in this publication was aimed at graduates and gathered information concerning demographics, information about education, mentoring, and religious commitment prior to college and in college. The survey also gathered information about how confident the students were in their academic ability, preparedness for career, support during college, among other subjects. The team obtained Institutional Review Board (IRB) approval and distributed the survey through personal networks, social media channels, professional educator networks and other methods to distribute the survey to STEAM graduates across the United States. A separate survey was distributed to undergraduate STEAM students.

After the survey collection period, the anonymous and voluntary survey data was compiled in a Qualtrics-generated report for study. The data set was accessed to sort out those participants listing engineering technology as their major for the focus of this paper. The questions relevant for this paper were extracted and responses were tallied using Microsoft Excel. Clear graphics were produced and formatted for inclusion in this paper.

Findings

This paper focuses on a sample of the survey questions from the graduate STEAM survey. While the survey was distributed to graduates in STEAM, the findings in this paper represent the subset of graduate engineering technology (ET) students. There were 42 reporting individual ET graduates, and thus, this smaller sample size is used to guide rather than provide strong conclusions.

Demographics

Figures 1 and 2 present the gender identification, race identification, and age distribution of the survey respondents.

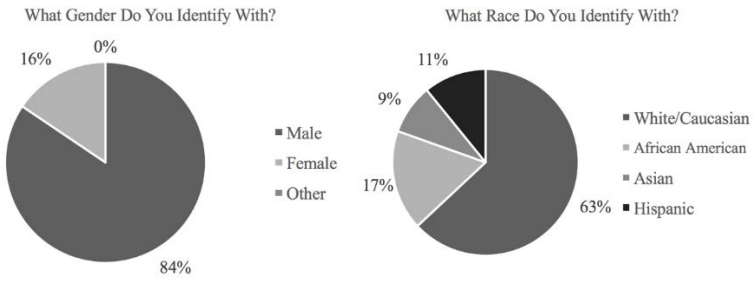

Figure 1. Gender and Race Identification of Survey Respondents

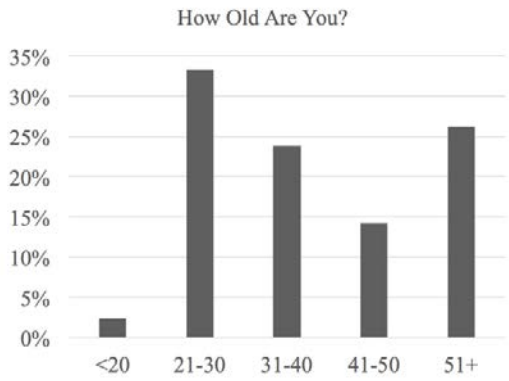

Figure 2. Age Distribution of Survey Respondents

It is generally recognized that the field of ET (and STEM in general) tend to be dominated by white males, as reported by universities [23]. However, the survey respondents provide a more diverse population than provided in those reports. Figure 2 shows a wider age distribution, with many graduates pursuing graduate education early in their academic careers with others more advanced in their careers and nearing retirement age.

Grade School and Community Support

A series of questions sought to analyze how presecondary educational experiences influenced graduates' choices of major or career. Figures 3 presents the results of the question concerning which type of elementary survey respondents attended.

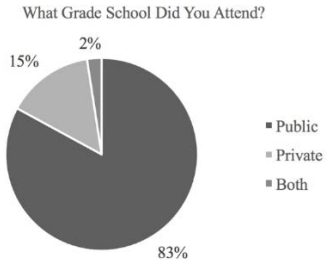

Figure 3. Types of Grade School Attended

Most participants reported attending public school, with around 15% reporting private school attendance and far fewer reporting that they had attended both.

Respondents were also asked to describe their high school experiences in two different ways. First, they were asked whether they attended a public or private high school. Next, they were asked if they came from a rural, urban, suburban, college prep, or a trade school. The responses are illustrated in Figure 4.

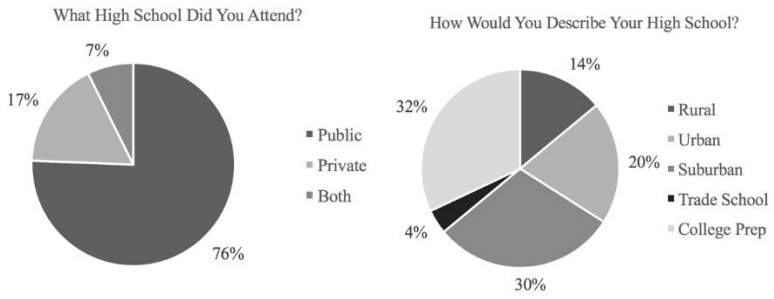

Figure 4. Types of High School Attended

Most participants reported attending a suburban or college prep school, and the vast majority went to a public high school. The respondents reporting attending public school for high school is lower than those who attended a public school for elementary, suggesting that some respondents transitioned to a private school or other type for high school. Few reporting graduates of ET attended a trade school before transitioning to college.

Twenty-nine percent of survey respondents said they were the first person in their family to go to college (first-generation student). The respondents were asked if they felt as though they received adequate support in preparing for college. Support in the contest of this question includes emotional, academic, and financial aspects of college preparation and matriculation. Figure 5 presents responses divided into first-generation and non-first-generation graduates.

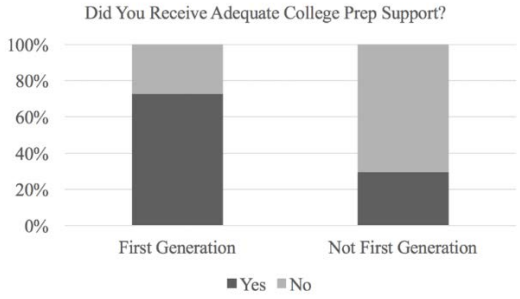

Figure 5. First Generation and Non-First-Generation Students College Preparation Support

First-generation student respondents reported receiving over twice the support that non-first-generation student respondents did. These experiences span over 30 years, but the frequency of first-generation students was consistent with each decade. About one-sixth of respondents in each age group were first-generation, but that number jumps to three-fifths for those over 50 years old.

Career Experiences

This survey also sought to analyze the career experiences of ET graduates by asking a series of questions related to their first job after graduation. First, participants were asked if they felt they were respected by their coworkers in their first job. Figure 6 below shows responses broken down by both gender and race identification.

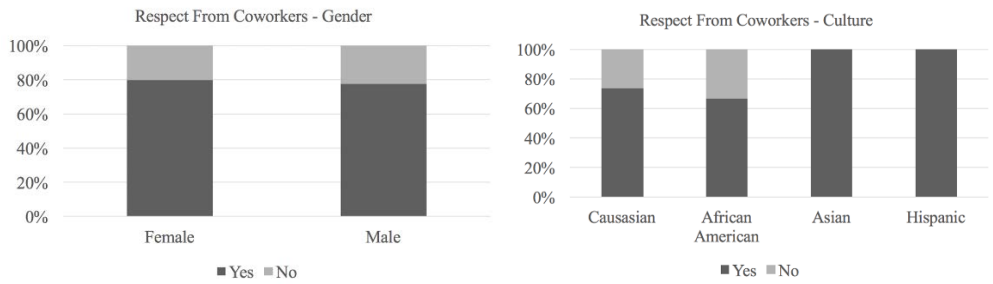

Figure 6. Respect from Coworkers at Respondents' First Jobs by Gender and Race

While men and women felt equally respected, the variance by culture is more prominent. African American participants felt the least respected, followed closely by white participants. Asian and Hispanic participants felt completely respected by their coworkers at their first jobs. This result requires further study as the survey reached a small number of Asian and Hispanic participants. The respondents were also asked to report how respected they felt by their superiors at their first job after college, with the results presented as Figure 7.

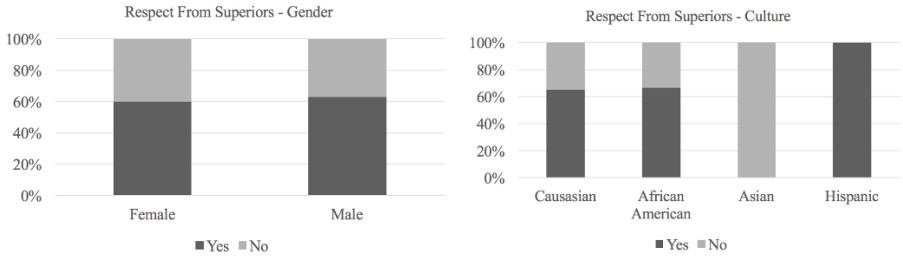

Figure 7. Respect from Superiors as Respondents' First Jobs by Gender and Race

On average, respondents reported feeling less respected by their superiors than by their coworkers. Female respondents felt less respected than men in general, and men over 30 reported being treated equally three times as often as men younger than 30. All of these respondents indicated that they felt respected by their coworkers, but none felt respected by their superiors. This discrepancy requires further research.

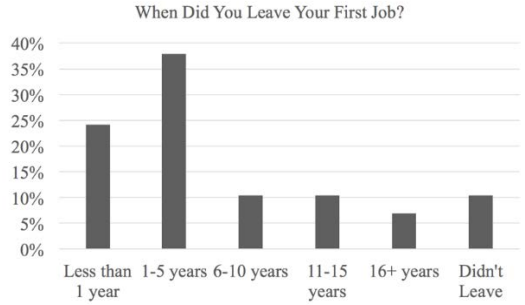

Figure 8. Time Spent at First Job Post-College

Figure 8 shows how long graduates stayed at their first job. Over half of participants spent less than six years before leaving their first position. In follow-up questions, graduates were asked

why they left and why they stayed. Those who left provided a multitude of reasons, spanning from going back to school or deciding to become a professor to changing careers or even layoffs. Those who stayed cited two reasons: either they had just started the job, or they stayed because they genuinely enjoyed the work.

Previous work suggests that the Engineering Technology population is often overlooked or misunderstood, with employers unfamiliar with the qualifications ET graduates possess [24]. Therefore, the researchers chose to ask respondents if they felt that people outside their area of expertise understood what they did. The results of this question are presented as Figure 9.

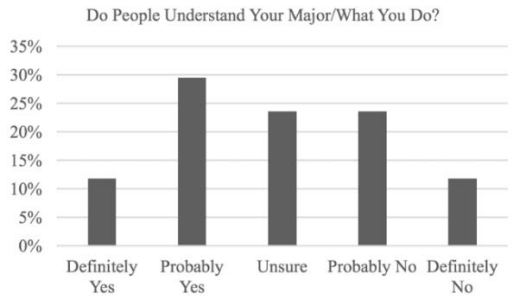

Figure 9. Level of Understanding of Major Perceived by ET Graduates

Few respondents expressed with confidence that they felt that individuals outside their area knew what they did. The remainder were either mostly sure or not confident that their field made sense to the general public. “Unsure,” “Probably No,” and “Definitely No” made up over half of the responses to this question. This finding supports the “loose coupling” of degree and employment noted by the NAE and supports the assertion that more widespread education on what constitutes ET is necessary for the general public.

Discussion

The results of the STEAM graduate survey, with engineering technology student data extracted for examination provided an opportunity to examine data with more gender and racial diversity than found in most studies. When examining the self-reported demographics, the percentage of female graduates and those reporting nonwhite racial identity is higher than reported by universities [23] and in previous studies [7, 24, 25]. Examination of the respondents ages also indicate that there were graduates spanning various phases of their lives from those that transition directly into graduate school and those that are returning throughout their careers.

The researchers intended to learn more about how presecondary experiences influenced graduates’ choice of major and/or career path. Most respondents indicated that they attended public grade schools for their elementary education, with fewer attending private school. The learning environment is known to differ between public and private education, and consideration of this impact on later student choices may be of interest. Here it is shown that the majority of engineering technology graduates began education in a public-school system. By considering the age of the respondent and type of school attended, broader trends in emphasis on private

versus public education over time among this group may be identified. Similar questions were asked about high school experiences, most respondents indicated that they attended a public suburban or college preparatory high school. However, after examining all the data focused on types of schooling the data suggests that while many of the respondents may have attended public grade schools many may have moved to private schools for the later part of their K-12 educational experience.

Relying on anecdotal observations, the researchers asked about first generation status and community support. In the case of the first-generation students, respondents reported receiving more than twice the community support than the other students. When examining the data in detail, it was found that more community support was reported by graduates over 50 years old than those that are younger, supporting a concern that younger first-generation students are not receiving the community support older students received. This also supports suggestions made by other studies that there is a gap in support students receive while preparing for and choosing college majors.

Previous studies investigated student and professional perception of who or what someone with and engineering technology degree does or can do [7]. The data gathered in this study supports that assertion and further supports that those outside of engineering technology, in the general public, don't know what someone with an engineering technology degree does or can do. This supports the assertion the NAE made regarding the "loose coupling" of employment and degree and supports increasing the quantity and breadth of marketing needed to educate the general public about engineering technology.

Conclusion

This study represents a higher number of female and minority graduate engineering technology students than what is reported by universities throughout the United States [23]. The respondents ranged in age from those matriculating right after graduation with a bachelors' degree and throughout their careers. Many of the respondents were over 50 years old.

Overall, the engineering technology graduates responding to the survey represent a higher population of female and minority students than what is reported by universities [24,25]. Based on their response to age, indications are that respondents are primarily traditional students matriculating right after or within a short time of high school graduation. Most of these students attended public schools, while a shift was seen from public grade schools to high schools in all respondents. Consideration of type of school attended of this impact on these graduate's reported college success will be covered in future work through comparison with other survey questions. The type of school attended may be indicative of the type of career selected later by the student. Older first-generation students received more pre and post-secondary support related to career exposure and support than younger first-generation students. This change should be examined to determine impact on career choice and success. Several studies suggest that this is critical to student success, thus meriting further examination of the study population.

The findings of this study support the need to educate the public regarding engineering technology, what it is and what the graduates can do. Some utilize the following statement to share the sentiment, but more must be done to help everyone understand.

"The degree is engineering technology; the career is engineering."

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