Engineering Technology Graduate Students: Roles Professional Societies Have in Their Formation

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In recent years, there have been several research projects focused on returning graduate students in engineering, those who have significant industry experience before beginning their graduate studies. These projects have focused on both the masters and doctoral levels and have looked at research, coursework, benefits of attending graduate school, and the cost of going back. One of the existing papers has looked at the ways in which professional organizations look on returning students, and how their membership policies affect these students. The issue of how returning students see themselves within professional societies was not addressed. As of yet, none of these studies have focused on returning graduate students in engineering technology.

Overall engineering technology students have not been researched in depth, with most engineering technology practitioners and administrators relying on data obtained from populations of engineering and other STEM students. Faculty and staff that have interacted with both engineering technology and engineering populations of students find the differences marked, thus supporting the need for further research to quantify differences and similarities in these populations. This paper will focus on the intersection of the two gaps, focusing on returning graduate engineering technology students, and their view of professional societies. Furthering initial work done on engineering technology student identity, it will look at the identity of graduate engineering technology returners within professional societies.

The study was carried out through administration of a survey developed to learn more about engineering technology returners. The survey asks participants about the societies to which they belong, and how they see themselves with those organizations. Grounded theory will be used to analyze the survey data. The flexibility and adaptability of grounded theory generated method provides results that are continuous and nascent. The process is well defined and begins with identification of a substantive area, for this study this is the returning engineering technology graduate student. The survey questions are designed to collect data focused on the two areas of concern and following the survey will be coded as it is collected. As the coding takes place, memos will be made to capture extraneous thoughts and information that was not already designed into the survey questions. The memos will be sorted with the coded data and as themes emerge from the data observations are written and disseminated through this conference paper.

Introduction

In recent years, several researchers have begun to investigate a specific group of non-traditional engineering graduate students called “returners”. These students, after receiving their undergraduate degree in engineering, enter the workforce and practice their profession for a period of at least five years, before choosing to pursue a graduate degree in engineering. While

they share many commonalities with typical, direct-pathway graduate students, there are some differences, which have not been fully explored. One of these differences is in their interaction with professional societies.

Previous work on returners, further discussed in the literature review, has focused exclusively on those in engineering graduate degree programs. Graduate students in engineering technology were not included in that work. Returners as previously defined include those with five or more years of work or other experience, and return to graduate study with the intent of furthering their academic study. Earlier work in engineering graduate students provides evidence of a very small population[1,1], while searches for work on engineering technology student returners show an even smaller population that is not represented in the literature.

Literature Review

The engineering technology graduate student population is small. The engineering technology undergraduate, upon graduation, often moves into the workforce and does not pursue graduate education [3,4]. Therefore, research is generally not available and has been pursued by these authors in their quest to further understand this population.

The identity of engineering technology students has changed over the last couple of decades [4]. Two groups of engineering technology undergraduate graduates were studied. The first group graduated in the five years prior to the study and the second group 10-15 years prior to the study. The number of self-reporting graduates that pursued, considered pursuing, or may pursue graduate degrees in the first group was nearly 50%, which is the same for the second group of graduates studied. These percentages include degrees such as business administration, and engineering. Considering the data provided in that paper the number of engineering technology graduates who were either pursuing or had pursued graduate study in engineering technology was less than 5% of the overall population. Similar statistics are not available for engineering; however, it is known that in 2014, 164,488 students were enrolled in graduate programs in the engineering disciplines in the United States.[5]

This relatively unknown population is also relatively obscure. The lack of knowledge is obvious when one undertakes a literature search. Thus the use of grounded theory, which provides a continuous or constant comparison is the appropriate method by which to analyze the data provided by respondents to the survey associated with this study, is appropriate for this study. [6-10]

Grounded Theory, used in the way Glaser and others [8] suggest, allows the authors to choose a method that allows for the emergence of patterns in the survey data, and ultimately a means by which to explain what is important to the study participants. As a constructivist like theory, knowledge is actively constructed [11-13], and this is often used to develop a knowledge area such

as learning more about returning engineering technology graduate students. As the methodology chosen to analyze the survey data, further explanation of appropriate steps and use can be found in the methods section of this paper.

Much of the existing work on returners was based on previous research on the more general population of older, or non-traditional, students. This research has shown that older students are more motivated and mature[14,15]. They are also characterized by better teamwork skills[14] and work-related skills with tools and equipment[15]. Their ethical awareness is higher[14], as is their work ethic[15], and they have more experience and skill with time management[16]. However, they do face certain challenges. They often have personal and family responsibilities that younger students do not have, and may have difficulty fitting into the graduate student community[17-19]. Finding the appropriate graduate program, getting admitted, and finding funding may be more challenging due to their time away from the university environment[17,18]. Once admitted, they may find that their computer skills and ability to use higher-level mathematics are insufficient, due to changes in computer programs and the length of time since they had to use their higher-level math skills[15].

One existing study, specifically focused on returners, examined the value of their "experience capital" as they went into a particular field; the participants were all pursuing a doctoral degree in Engineering Education at a major research university[20]. It was found that returners felt that their experiences, while valuable, were not fully valued by the university or by their program, resulting in a detachment or distancing of students from their classmates and at times program. Another study was conducted at another major Midwestern university, and included returners across a range of STEM disciplines in both masters' and doctoral programs[1,2,21]. That study examined the changes in identity seen by participants as they returned to school[2], and used Expectancy Value Theory (EVT) as a theoretical framework to examine the value of the graduate degree. In EVT, the decision to pursue a path is due to the expectancy of success, together with the value of succeeding. Value consists of four elements: Utility, Interest, and Attainment are positive elements of value, and Cost is the negative element[22,23]. The majority of the participants in that study pursued a graduate degree due to Utility value, with the Utility taking different forms for different participants[1,21]. Cost was also studied in detail, and was found to take different forms: Intellectual, Financial, Cultural/Environmental, and Balance[1].
Further work looked in detail at doctoral students in engineering programs, and compared returners and direct-pathway students[24-27] . This study involved both a survey phase and an interview. It looked at the characteristics of returners[24], their experiences with graduate advisors[26], and looked further at the value of the graduate degree. In the interview phase, the intersection between work experience and education was studied, in order to gain insight into its effects on a student's research processes[27].

The issue of professionals going back to school, and the intersection of this transition with their involvement in professional societies, was briefly mentioned by Schilling[17]. In 2015, Lucietto & Peters examined the characteristics of professional societies and how they affect returner student status. They found that most professional societies, while they had different types of membership for students and professionals, were not aware of some of the issues faced by returning students, and did not make provisions for them in their organizational structure [28].

Professional societies are beneficial to members, in both intangible and tangible ways. They provide means for members to interact, learn new materials, provide venues to promote engineering as a learned field [29], and develop leadership skills through leadership opportunities within the organizations. Some of the societies provide mentoring opportunities, and almost all surveyed in a previous study found that progression through the membership grades aligns with a linear relationship of school, work, etc. Lucietto and Peters [28] found that the returning student experiences with student membership in professional societies were by no means uniform, thus leading the authors to ask questions about this population and the experience they have with professional society membership during their return to the academe.

Research Questions

The questions addressed by this work follow:

- How do graduate engineering technology students view professional societies?
- Who are the graduate engineering technology students?

Both questions contributed to the development of the survey, and responses are analyzed using grounded theory techniques.

Methods

Non-invasive measures were chosen to survey returning graduate engineering technology students. A survey was developed using an assortment of survey tools [30-32], all of which are grounded in the referenced literature and focused on furthering the understanding of the thoughts regarding professional societies and their identity. The survey questions may be found in Appendix A.

The survey was distributed to the Society of Women Engineers' student list-serve and through ASEE's Engineering Technology list serve. Although the number of respondents was not expected to be large, 22 engineering technology graduate students responded to the survey. When reviewing data for engineering technology graduate students it should be noted that programs offering graduate degrees are most frequently masters as few universities offer Ph.D.'s

in engineering technology. The number of students in engineering technology masters programs throughout the United States as reported by ASEE numbers less than 1,500 total.[33] Based upon the number of responses and the number of students accessed through the means noted previously, the response rate is at the level expected for this size of population.[34,35]

Grounded theory is a way of conceptualizing and thinking about data, in a very general manner. Data is reviewed, and based on what is found hypothesis is generated that explains the generalized behavior with the primary focal point of the data providing evidence that the hypothesis is true.[8]

Based upon guidance provided by Charmaz [36,37] the raw data was reviewed. In larger data sets the data is coded and placed into categories. Because the over data population is based on 17 respondents, this part of the analysis was not required. However, the authors did review for trends and refinement of the information provided by the graduate engineering technology students. This step was followed by the first draft of the findings section and then subsequent updates and changes to data as further research in this area was contemplated.

Findings

Slightly over 75% of the responding group of returning engineering technology graduate students meets the criteria set for nearly a five-year gap between graduating with a baccalaureate and returning for an advanced degree. An increase in females was represented in the responding population from 6% undergraduate population[33] to 12% in this study of the graduate student population. Baccalaureate majors in the graduate group were self-reported as including mechanical, electrical, and manufacturing engineering technology, organizational leadership, automation, as well as civil and mechanical engineering technology. Graduate majors include engineering technology, industrial engineering technology, mechanical engineering, computer graphics technology, robotics, and computer science.

Approximately 50% of the respondents belong to one professional society, while the balance belongs to two to five different societies. The societies that were mentioned more than once include ASME, IEEE, ASHRAE, and ASEE, while three respondents indicated that they did not belong to a professional society at all. Most of those with memberships with professional societies indicated more than two years of membership. When asked which of the societies was their primary society, those noted previously were also most frequently noted as a primary society.

Fifty percent of the returning graduate engineering technology students first joined their professional societies while in graduate school and 42% of this population while working on their undergraduate degree. One respondent indicated that they joined their primary society later in their career.

When asked about experiences these students have had with their primary society, the response varies and is polarized. Those that have a primary society either do not have an opinion as they have been too busy to be involved, shared that societies were all about membership and products they could sell, while others value them for conferences and the opportunity to interact with individuals doing similar things as they.

The responses to the question regarding the benefit that the respondents saw in initially joining these societies focused primarily on conferences, networking, and colleague interaction and publishing. These students indicated that they continue their membership due to the ability to get help finding a post-graduation position, offering opportunities with conferences and publications to stay up to date, and ability to access key resources in their area of concentration. When asked what they can do to serve students better the answers basically fit three categories – no they are doing well, cost of membership is prohibitive, and nothing.

Six of the respondents had academic positions in their previous or current title, two were engineers, and the balance a flight instructor and tech support. All respondents indicated they enjoyed that position and shared why. Most liked teaching, in particular engineering while solving problems and being challenged were also mentioned. When asked if the companies they worked for valued professional society membership half the group responded yes, and the other half, no.

When these returning graduate engineering technology students were asked what recommendations they had for undergraduates they shared that internships were imperative, membership in societies allows connection to the professional world, networking, diversify one's background, and always network. An issue that often plagues engineering technology students is the understanding of what an engineering technology degree is.[4] These graduate students indicated at nearly 50% that some understand and others do not understand the degree. In the same percentages, they responded that they were working for the same company as they did upon graduation. When asked how long they had worked there, only five respondents answered, with one indicating they were reeducating after a 31.5-year career.

Discussion

Little work has been done in this area, in particular the influence or impact professional societies have on the engineering technology graduate student. Research focused on returning students is limited, with much of it being done on engineering students[1,2]. Additionally, work on the professional society and its impact on returning students, specifically the ability to accommodate returners is also limited[28]. The majority of this work has been done by and with the researchers involved in this study. Previous work initiated the interest in how professional societies participate in the formation of engineering technology graduate students, specifically those with a gap of five years or more between graduation and initiation of graduate studies.

As the results of the survey were reviewed, it became evident the professional societies are not as supportive nor provide returning students with an identity as an engineer. Past work[28] indicates that returning students do not have consistently supportive environments from one professional society to another. Further, the survey results indicate that returning students do not find them supportive other than in a networking role, or as a job hunting resource. Therefore, it is evident that professional societies are not fundamental in the development of the engineering technology professional as a returning student.

Maintaining and increasing membership is a major issue for professional societies, as mentioned in Lucietto and Peters work in 2015 [28]. In order to do this, professional societies need to ensure that they provide value to their members. One way in which they currently do this is by offering a variety of products and services. These can include discounted admission to conferences, free or reduced cost access to papers and technical standards, or products such as life insurance or auto insurance. While these are of value to some members, they fail to attract other potential members. Some of these other potential members, however, may be attracted to professional societies if they provide a sense of belonging and contribute to a professional's identity. By becoming part of how a person sees him or herself as a professional, professional societies may increase their perceived value and relevance, and be better able to retain their members than if they rely strictly on economic arguments.

Additional study is needed on this topic. Future work should include open-ended interviews, in order to explore more fully how professional societies do and can fit into professional formation of graduate students. Some exploration is already being carried out on the engagement of professional societies in undergraduate engineering education, e.g., the NAE Workshop on Engagement of Engineering Society in Undergraduate Education[38]. However, to this point there has not been work done on the engagement of these societies in graduate education of any type, nor has their interaction with returning students been considered. There are, therefore, many research questions that could be explored in this area.

Conclusion

Returning students shared that they valued professional societies for their ability to enhance the professional network, and stay in touch with the professional material they value in an industrial position. At the same time, they also found professional societies are focused on selling standards and other products to increase the society revenues. It is important to restate that these students find their professional society supports their needs, or they no longer belong due to the prohibitive cost of membership.

A lack of understanding surrounding the nature of their degree continues to plague engineering technology graduate students[3,4]. This issue was reported by 50% of these students. This issue,

combined with a lack of understanding of the returner's pathway, means that professional societies are missing the opportunity to better connect with these students.

Future work in this area should be undertaken, both on returners in general and on the larger population of engineering technology graduate students, as well as on the intersection of these groups. This work should aim to understand the full range of their experiences, with the goal of better enabling universities, professional societies, and other interested stakeholders to support and encourage these students. Some of the factors that should be studied include their motivation for pursuing a graduate degree, the value they see in that degree, and the ways in which their work experience affects their education. This will add to the growing body of engineering technology, as well as education literature on returners, and facilitate their success in graduate school.

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Appendix A

The purpose of this survey is to further our understanding of your experiences as a returning graduate student as a member of technical or professional societies, both as a professional and as a graduate student.

Demographic Questions

- How old are you?
- What is your gender?
- How many years have passed between the time you received your bachelor's degree and the time you returned to school?
- What was your undergraduate program?
- What is your graduate program?

Previous Experiences within Professional Societies

- What professional societies do you belong to?
- How long have you been a member of these societies?
- Which professional society do you consider your primary organization? Why?
- Has your primary society changed, either while you were in industry or while you were in school?
- When did you first join your primary society?
- Tell us about the experiences you have had within your primary society?
- When did you first choose to join your primary society? What benefit did you see in joining?
- What are the reasons you continue to belong to this organization? What benefits do you receive for your membership, either tangible or intangible?
- Are there benefits you would like to receive, that professional societies do no provide?

Identity

- In your last/current position, what was your title?
- Did you enjoy your position? Why?
- Does your company respect membership in professional societies? Please explain your answer.
- Knowing what you know now, what recommendations, would you give to new graduates?
- Knowing what you know now, what recommendations, would you give to current students?
- Do others understand your degree and the things you studies?
- Are you working for the same company you did when you graduated? If so, how long have you worked there? If not, why did you change employers? If so, how long have you worked there?