

Understanding General Engineering Students' Identification as Engineers

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Work in Progress – Understanding General Engineering Students’ Identification as Engineers

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Abstract - This paper is a work in progress analysis of major choices by first year engineering students in the General Engineering (GE) program at Virginia Tech. The first year engineering courses are designed to equip students with problem solving skills, inquiry skills, and integration of learning skills necessary for navigating college level curricula. Domain identification theory is the extent to which one defines themselves through a role or performance in a domain, such as engineering. At the conclusion of the academic year, most first year engineering students will have completed three surveys that inquire about the usefulness of engineering as a field, and their experience in and sense of belonging to the GE program at Virginia Tech. Using domain identification as the theoretical underpinnings for this paper, we seek to gain a better understanding of the relationships between being a student who is undecided about their major, belonging to the GE community at Virginia Tech, and identifying as an engineer.

Index Terms – First Year Engineering, General Engineering, Identity, Major Choice.

INTRODUCTION

This paper is a work in progress analysis of the development of engineering identity by first year engineering students in the General Engineering (GE) program at Virginia Tech who are undecided about their engineering major choice. Students are admitted to the Virginia Tech College of Engineering as General Engineering (GE) majors and enroll in Foundations of Engineering I and II in fall and spring respectively. Foundations of Engineering I is a Virginia Tech First Year Experience course designed to equip students with problem solving skills, inquiry skills, and integration of learning skills necessary for navigating college level curricula [1].

A series of surveys are administered to GE students at three times over the course of their first year: in August at the beginning of the fall semester; in December at the end of the fall semester; and in April at the end of the spring semester. All three surveys collect data about which majors GE students are interested in pursuing at the time of administration. Survey responses used in this study are from students who were admitted as GE students for the 2015-16 academic year, completed all three surveys and consented to

participate in the study. This represents a 67% total response rate amongst the 1743 2015-16 first year GE students. Students are required to take these surveys and submit their confirmation of survey completion as a homework assignment in the first year courses; however, their participation in research is voluntary. The goal of this study is to answer the following research question:

Does the environment of the first year engineering program affect domain identification as an engineer in first year students who are undecided about which engineering major to pursue?

Thus our hypothesis for this research question is as follows:

H₁: The environment of the first year engineering program will affect the development of domain identification for first year students who are undecided about which engineering major to pursue.

THEORY

Domain identification theory is the extent to which one defines themselves through a role or performance in a domain, such as engineering [2]. Most adults have multiple things they identify with whether it be their race, gender, occupation, or even relationship status to a spouse, offspring, or other family member. Having social identities provides a person with social validation and a framework by which they navigate the world. These identities are usually beneficial but can also be challenging if one has difficulty incorporating one or more of their identities in their life [3]. The value that one places on a domain identity reflects the extent to which a person believes that domain is an important part of who they are [3].

The model of domain identification by Osborne and Jones explains the process by which a set of social and academic background factors can affect one's domain identification and motivation beliefs, and thus, affect behavioral and academic outcomes [2]. Therefore, understanding how engineering identification is developed in first year students may provide insight to a student's academic decisions such as major choice, persistence in engineering, or the decision to leave the College of Engineering altogether.

ENGINEERING IDENTITY

The first year surveys administered to the GE students include validated measures of constructs related to engineering identity and belonging created by the first year engineering courses [4]; 10 survey items are related to identity and utility and may infer students' identification as engineers, and 9 items are related to belonging to the GE community [4]. On each survey, students' responses were recorded on a 6-point Likert scale.

Over the course of the academic year, the number of students who are undecided about their major declines. Due to the fact that our survey currently does not have an "other/non-engineering" major choice option, we have not explicitly captured students who decide to leave engineering at the end of the first year. However, by looking at the responses of students who choose *Undecided* as their major, we may be able to gain insight into the importance of the environment of the first year engineering program and whether it influences students' engineering identity and potentially their major choice.

PRELIMINARY ANALYSIS AND RESULTS

To understand whether the general engineering program may influence the engineering identity for undecided students, we did a preliminary analysis of students who were undecided and their responses to the following survey items:

1. Being good at engineering is an important part of who I am.
2. I feel like a real part of the General Engineering program.
3. Sometimes I feel as if I don't belong in the General Engineering program.
4. I feel very different from most other students in the General Engineering program.
5. I wish I were in a major other than engineering.

Each question had the following answer choices: (1) Strongly Disagree, (2) Disagree, (3) Somewhat Disagree, (4) Somewhat Agree, (5) Agree, and (6) Strongly Agree. For the purpose of this analysis, we focused on students who had a "negative" response to these prompts, that is a level of disagreement for questions 1 and 2, and a level of agreement for questions 3, 4 and 5. There were a total of 180 undecided students in the beginning of the fall semester, 95 undecided students at the end of the fall semester, and 30 undecided students at the end of spring semester. The averages of the responses for undecided students who had a negative response to the questions on each survey, are listed below in Table 1. The number of undecided students who responded negatively to each prompt is provided in Table 2.

TABLE 1
MEAN RESPONSE FOR UNDECIDED STUDENTS RESPONDING "NEGATIVELY"

	Beginning of Fall	End of Fall	End of Spring
Q1	2.37	2.20	0
Q2	2.55	2.40	1.78
Q3	4.43	4.74	5.09
Q4	5.13	5.18	5.19
Q5	5.25	5.08	5.25

TABLE 2
NUMBER (PERCENT) OF UNDECIDED STUDENTS RESPONDING "NEGATIVELY"

	Beginning of Fall n=180	End of Fall n=95	End of Spring n=30
Q1	19 (11%)	15 (16%)	0
Q2	20 (11%)	15 (16%)	9 (30%)
Q3	47 (26%)	32 (34%)	11 (37%)
Q4	114 (63%)	88 (93%)	27 (90%)
Q5	173 (95%)	90 (95%)	24 (80%)

I. Statistical Test

After conducting an independent sample t-test on the responses to compare 1) responses at the beginning of the fall semester and the end of the fall semester, and 2) responses at the end of the fall semester and the end of the spring semester, we found that there was no statistically significant difference in an undecided student's domain identity across the first year. Therefore, the results of this preliminary analysis may indicate that the environment of the first year program has no affect on a student's domain identification for our sample population and that this may be typical for the broader first year engineering student population [5]. The statistical significance (p-value) for the survey responses of undecided students are displayed in Table 3 and Table 4. Please note that the reason for the "n/a" value in Table 4 is due to the fact that there were no students who had a level of disagreement with Q1 at the end of the spring semester.

TABLE 3
BEGINNING OF FALL SEMESTER VERSUS END OF FALL SEMESTER

	Q1	Q2	Q3	Q4	Q5
p-value	0.962	0.971	0.959	0.997	0.988

TABLE 4
END OF FALL SEMESTER VERSUS END OF SPRING SEMESTER

	Q1	Q2	Q3	Q4	Q5
p-value	n/a	0.844	0.952	0.999	0.988

II. Discussion

Domain identification is often mentioned in conversations surrounding interest, in that, the former tends to begin taking place once a person's interest shifts from being situational to becoming individualized [2]. When students are disinterested and/or express negative reactions to activities related to a domain, the likelihood of them identifying with that domain is more likely to decrease. However, given the results of the preliminary analysis, we

must accept the null hypothesis that there is no difference of the domain identity for students who are undecided at different points in the first year [5].

Despite the fact that our results proved to be insignificant, there is a larger pool of data underexplored from the students who completed all three surveys in 2015-16. While this preliminary analysis focused only on undecided students, there are 14 engineering majors at Virginia Tech that students may choose from. The responses of students who are interested in these majors may provide more insight on whether there is a difference between students' responses on selected survey items and their identification in engineering. We also looked at all students who were undecided at each point of the semester as opposed to those who were consistently undecided over the course of the first year. This could also be a factor to look at more closely as we progress with this research. Lastly, we inferred that students who disagreed with these questions were more likely to have lower domain identification in pursuing engineering; while having low domain identification may influence one's choice to leave engineering [2], there may be outlying cases that we are not capturing due to the population we selected.

CONCLUSION AND FUTURE WORK

As we work to learn more about what institutions can do to better retain engineering students, it is important to explore and understand as much as possible about the many factors that can influence a student's decision to stay or leave engineering. At Virginia Tech we collect data while students are in engineering and also ask students who leave the college of engineering to complete an optional exit survey. Future plans for this work may include gathering more qualitative data to further unpack the significance of the data.

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