Preliminary Results from a Survey to Understand the Motivations Behind Choosing & Staying in an Engineering Major

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WIP: Preliminary Results from a Survey to Understand the Motivations Behind Choosing and Staying in an Engineering Major

Introduction

This Work-in-Progress (WIP) paper examines the factors influencing students' decisions to pursue an engineering major, unveils the problems that may have led to their hesitance to persist, and explores why they choose to persist within the field. Retention challenges in engineering are well-documented, with studies reporting that nearly 50% of students leave the major before graduation [1], [2]. Factors such as classroom and academic climate, academic rigor, lack of mentorship, interest, and career goals contribute to these attrition rates [2]. These challenges disproportionately affect minoritized students, including first-generation and low-income individuals, who often experience systemic barriers such as limited access to resources and feelings of isolation [3], [4], [5]. Prior research has also highlighted key intrinsic and extrinsic motivators for choosing engineering, including passion for problem-solving, interest, financial stability, and family expectations [6], [7], [8], [9].

This paper builds upon a previous study by the author team, which drew on qualitative interview data to identify themes that explained why students chose engineering, debated leaving, and decided to stay [10]. This study adds a quantitative survey, which was developed to explore these themes in greater depth, with particular focus on differences between first-generation and non-first-generation students. Through targeted questions, the survey aims to uncover key drivers of engineering students' success and persistence. The objectives of this study are threefold: (1) to understand why students choose to study engineering, (2) to identify the reasons some students consider leaving the major, and (3) to examine the factors that solidify their commitment to engineering. A special emphasis is placed on how the experiences of first-generation students differ from those of the general student population.

This study was conducted at a large public land-grant university in the Midwest. Limitations of this study include the restriction of data collection to a single institution and incomplete survey responses. This WIP paper first explains the methodology used to create, distribute, and analyze the survey. The results section presents an overview of the participation demographics, preliminary data analysis, and key findings. The discussion explores the implications of these findings, particularly for supporting minoritized students, and lays the groundwork for future research aimed at improving retention strategies in engineering education.

Methods

This paper presents the quantitative strand of an exploratory mixed-methods study [11] aimed at understanding why students persist in engineering. The quantitative survey was developed from the results of 21 qualitative interviews, which were originally conducted to understand how engineering culture impacts student mental health and included two questions about persistence in engineering: (1) "why did you choose an engineering major," and (2) "have you ever considered leaving engineering." Author 1, a first-generation undergraduate engineering student herself, was interested in understanding why students, particularly those from first-generation and low-income backgrounds, choose to stay in engineering. Her interest led to an analysis of the

persistence and choice questions listed above and resulted in the themes shown in Table 1. A detailed description of the qualitative analysis and results is provided in [10]. These results led us to pursue an exploratory mixed-methods design [11], wherein the qualitative findings were used to inform the development of a quantitative survey. Specifically, we were interested in more robustly understand how students' decisions to pursue and persist in engineering were related to their first-generation status, income level, and need to work to meet their basic needs.

Table 1. Themes found in Qualitative Phase that led to Survey Development

Theme	**Subtheme**
Reasons for Choosing Engineering	Extrinsic Motivation (Outcome)
	Intrinsic Motivation
Reasons for Debating Leaving	Lack of Passion
	Other Career Interest
	Course Challenge
Enduring Commitment	Total Investment
	Original Reasons for Choosing Engineering
	Growing to Love Engineering

The quantitative survey included demographic items (including family income, first-generation status, employment and motivation for working), yes/no questions about major changes, a ranking question about why they chose an engineering degree, Likert style questions about why they chose an engineering degree, and three open-ended questions. The full survey is provided in Appendix I. The survey was advertised via flyers and emails at the same university where qualitative data collection occurred. A total of 73 students completed the full survey. First generation status was self-identified by the participants; however, the research team defines first-generation status as someone whose parents did not complete a bachelor's degree.

Positionality of Authors

Author 1 is a junior civil engineering student with one year of research experience. Author 2 is a PhD candidate in the department of mechanical and materials engineering specializing in engineering education research. Author 3 is an Assistant Professor of Mechanical Engineering who received her Ph.D. in Engineering Education and conducts engineering education research. Authors 1 and 3 identify as white women while Author 2 identifies as an African male. Author 1's positionality as a first-generation undergraduate student allows an in-depth perspective on the similar positionality as the research participants being studied. Authors 1 and 2 performed most of the data analysis. Authors 1 and 2 met frequently to form the findings and conclusions drawn within the paper while checking in with Author 3 with their progress.

Results

Choosing Engineering. Participants in this study were asked to rank their reasons for choosing an engineering major. We calculated the percentage of students that ranked each reason as one of

the top three reasons that they chose engineering. Table 2 shows results for first-gen participants, all participants, and Non-First-Generation participants. Results show that passion for engineering, financial stability, and career opportunities were the largest factors for all students in this study. This consistency suggests that while first-generation students may face unique challenges, their core motivators align closely with those of the broader student population.

Table 2. Top Three Choices for Ranking Question

Top Three Choices	All Participants	First Generation	Non-First-Generation
Passion for Engineering	73%	78%	74%
Financial Stability	74%	83%	74%
Career Opportunities	73%	72%	75%
Making Family/Friends Proud	37%	33%	40%
Had Strength in Math & Science in High School	26%	17%	30%
Random Pick	8%	11%	8%

In this preliminary analysis phase, heat maps are used to indicate the percentage of participants who selected each Likert Scale option for the questions regarding why they chose engineering. The heat map, shown in Table 3, reveal that the most common reasons for choosing engineering were financial stability and employment options, followed by having a passion for problem solving. These results align with the results from the ranking questions. In the Likert questions, the most common reasons for choosing engineering were fairly consistent across the first-generation participants and all participants. However, wanting an education and longing for innovation and new ideas were both more frequently rated as "strongly agree" for first-generation participants than for all participants. Subsequently, it is notable that first-generation participants were less likely to "strongly agree" that they chose an engineering degree because they are smart and more likely to "strongly disagree" to the same question.

Debating Leaving Engineering. In examining the reasons students debate leaving engineering, as shown in Table 4, financial concerns during college emerged as a large factor for both groups. A majority of all participants (62%) and an even larger proportion of first-generation participants (72%) agreed with the statement, "I have worried about my financial situation while attending college (combining somewhat agree and strongly agree responses)". Subsequently, a majority of first-generation students (61%) agree that they worry about what their financial situation will look like after college, while only half of all participants agreed to the same question. However, this data remains inconclusive upon other struggles that were brought up in a previous study. Having a passion for another career that is not as financially steady as an engineering career was across the board with all participants. Passion for a career that calls for a longer educational journey was dismissed as a predominant motivator for debating leaving, with most participants disagreeing. Moreover, most participants also have not thought about leaving engineering, nor do they wish they had the financial freedom to choose another major.

Table 3. Reasons for Choosing Engineering

Reasons for Choosing Engineering		Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I chose my major because I have a passion for engineering	All Participants	0.0%	5.5%	15.1%	50.7%	28.8%
	First Generation	0%	0%	22%	44%	33%
I chose my major because I have a passion for problem solving	All Participants	0.0%	2.7%	6.8%	37.0%	53.4%
	First Generation	0%	6%	11%	44%	39%
I chose my major because I am good at problem solving	All Participants	1.4%	2.7%	13.7%	42.5%	39.7%
	First Generation	0%	6%	17%	50%	28%
I chose my major because I long for innovation and new ideas within the world	All Participants	2.7%	5.5%	15.1%	32.9%	43.8%
	First Generation	0%	6%	17%	28%	50%
I chose my major because I long for financial stability	All Participants	1.4%	1.4%	9.6%	23.3%	64.4%
	First Generation	0%	0%	22%	22%	56%
I chose my major because of the consistent employment opportunities	All Participants	1.4%	1.4%	12.3%	28.8%	56.2%
	First Generation	0%	0%	22%	28%	50%
I chose my major because I wanted an education	All Participants	6.8%	5.5%	19.2%	32.9%	35.6%
	First Generation	6%	6%	17%	22%	50%
I chose my major to make my family/friends proud	All Participants	2.7%	11.0%	30.1%	32.9%	23.3%
	First Generation	6%	0%	44%	33%	17%
I chose my major because I am smart	All Participants	8.2%	11.0%	24.7%	32.9%	23.3%
	First Generation	11%	0%	39%	44%	6%
I chose my major because I love Math	All Participants	2.7%	24.7%	19.2%	24.7%	28.8%
	First Generation	0%	39%	28%	17%	17%
I chose my major because I love science	All Participants	2.7%	15.1%	21.9%	34.2%	26.0%
	First Generation	0%	22%	22%	33%	22%
I have no reason for choosing my major	All Participants	72.6%	13.7%	9.6%	2.7%	1.4%
	First Generation	56%	17%	22%	6%	0%

Table 4. Debating Leaving Engineering

Debating Leaving Engineering		Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I have a passion for another career that is not as financially steady as an engineering career	All Participants	21%	15%	13%	23%	31%
	First Generation	17%	17%	22%	17%	28%
I have a passion for another career that would take a longer education process than an engineering career	All Participants	42%	21%	11%	13%	14%
	First Generation	44%	11%	17%	22%	6%
I dislike my major	All Participants	38%	31%	23%	10%	0%
	First Generation	39%	22%	28%	11%	0%
I have thought about switching out of engineering entirely	All Participants	38%	18%	4%	21%	20%
	First Generation	39%	17%	0%	22%	22%
I worry about what my financial situation will look like after college	All Participants	23%	17%	10%	39%	13%
	First Generation	17%	17%	6%	44%	17%
I have worried about my financial situation while attending college	All Participants	15%	14%	11%	28%	34%
	First Generation	6%	6%	17%	22%	50%
I wish I had the financial freedom to choose another major	All Participants	41%	23%	15%	15%	7%
	First Generation	33%	28%	17%	17%	6%

Table 5. Enduring Commitment

First-Generation Participants		Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I have a passion for my major	All Participants	1%	7%	5%	52%	34%
	First Generation	0%	0%	11%	61%	28%
I do not plan on focusing on an engineering career after graduation	All Participants	53%	21%	16%	10%	0%
	First Generation	61%	11%	17%	11%	0%
I wish to attend graduate school	All Participants	26%	15%	23%	23%	15%
	First Generation	17%	11%	22%	28%	22%
I enjoy my major	All Participants	0%	4%	15%	47%	33%
	First Generation	0%	0%	11%	56%	28%
I have grown to appreciate my major	All Participants	1%	4%	14%	47%	34%
	First Generation	0%	0%	17%	33%	50%
I was hesitant about my major at first, but now I love it	All Participants	11%	30%	27%	23%	8%
	First Generation	11%	28%	33%	22%	6%
I loved my major at first, now I am unsure of my major	All Participants	34%	27%	21%	13%	7%
	First Generation	28%	28%	22%	17%	6%

Enduring Commitment

From the results in Table 2, passion, growth and financial stability of the major are clear motivators for both all participants and first-generation participants, which likely contribute to their persistence. Table 5, shown below, displays the results from Likert-scale questions that were asked to inquire what motivations push students to show commitment to engineering. Results show that most engineering students plan on focusing on an engineering career after graduation; and most students agreeing that they have a passion for their major. Moreover, the results comparing first-generation participants, and all participants were fairly consistent when discussing passion and enjoyment with an engineering major.

Conclusion

The results indicate that the engineering students in this study possess a strong passion for engineering, enjoy problem-solving, and are motivated by the prospect of achieving financial stability, aligning with findings in Abelló et al. [9]. While concerns about leaving engineering were largely tied to financial burdens [12], persistence was strongly linked to personal growth, passion for the field, and enjoyment of the major. These findings suggest that if educators focus on identifying and nurturing students' passion, they can enhance retention efforts in engineering programs. Prior research suggests that first-generation students may face slower intellectual growth, often attributed to lower educational aspirations [13]. However, our findings demonstrate that first-generation students are as motivated and driven as their peers. This statement should not be misconstrued as implying that first-generation students do not require support; rather, it highlights that first-generation students are as highly motivated and driven as their peers, despite facing additional challenges. Therefore, it is crucial for researchers and educators to avoid deficit-based approaches when working with first-generation students [14]. Instead, their strengths and abilities should be acknowledged, with efforts directed toward fostering supportive learning environments that enhance their educational experiences. Finally, while we acknowledge that the sample size limits the generalizability of these findings, we believe the insights gained from this study are valuable. Future research should expand on this work by including a larger sample size and analyzing the open-ended questions included in the survey. Additionally, we recommend revising some of the survey questions, particularly through reverse-framing, to ensure greater clarity and depth in future studies.

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Appendix I. Survey Items

Demographic Questions
1. I am in my ____ year of college
2. What is your major?
3. Are you a first-generation student
4. What is your gender identity
5. What is your race or ethnicity
6. What best describes your family's annual income
7. Are you currently employed by one or more jobs
a. Approximately how many hours do you work at a paid job per week?
b. What is you primary motivation for working a paid job?
8. Have you changed your major to switch to the College of Engineering from another college
9. Have you changed your major to switch to a different major within the College of Engineering
10. Have you changed your major to switch out of the College of Engineering to Another College?

Corresponding Theme	**Likert Scale Survey Questions**
Reasons for Choosing Engineering:	1. I chose my major because I have a passion for engineering
	2. I chose my major because I have a passion for problem solving
	3. I chose my major because I am good at problem solving
	4. I chose my major because I long for innovation and new ideas within the world
	5. I chose my major because I long for financial stability
	6. I chose my major because of the consistent employment opportunities
	7. I chose my major because I wanted an education
	8. I chose my major to make my family/friends proud
	9. I chose my major because I am smart
	10. I chose my major because I love math
	11. I chose my major because I love science
	12. I have no reason for choosing my major
Reasons for Debating Leaving	1. I have a passion for another career that is not as financially steady as an engineering career
	2. I have a passion for another career that would take a longer education process than an engineering career
	3. I dislike my major
	4. I have thought about switching out of engineering entirely
	5. I worry about what my financial situation will look like after college
	6. I have worried about my financial situation while attending college

	7. I wish I had the financial freedom to choose another major
Enduring Commitment	1. I have a passion for my major
	2. I do not plan on focusing on an engineering career after graduation
	3. I wish to attend graduate school
	4. I enjoy my major
	5. I have grown to appreciate my major
	6. I was hesitant about my major at first, but now I love it
	7. I loved my major at first, now I am unsure of my major

Ranking Style Question	
Please rank the reasons behind choosing an engineering-focused major. If no "other" please put last.	1. Passion for Engineering
	2. Financial Stability
	3. Career Opportunities
	4. Making family/friends proud
	5. Had strength in math & science in high school
	6. Random pick
	7. Other

Open Ended Questions
1. What is your plan for after graduation
2. Have you thought about changing your major? If so, why? If not, why not?
3. Please describe, in detail, the reason for choosing your major.

Appendix II: Demographics of Participants

Year In School	**First**	**Second**	**Third**	**Fourth**	**Other**
	5	22	27	14	5
Gender	**Male**	**Female**	**Non-Binary/Third Gender**	**Prefer not to say**	
	41	26	3	3	
First Generation Student	**Yes**		**No**		
	18		55		