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Work in Progress: Insight into the strengths and personality types of those involved in a first-year engineering program

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Work in Progress: Insight into the strengths and personality types of those involved in a first-year engineering program

Introduction

This Work in Progress paper aims to gain insight into the diverse group of engineering students involved in Binghamton University's first-year engineering program so we can better serve them in the future. First-year students enter their college engineering programs with different backgrounds and varying levels of engineering knowledge. The goal of the first-year engineering program at Binghamton University is to equip all students with the same fundamental knowledge they will need to choose an engineering field and to be successful in that field. The first-year program also has a special interest in developing future educators; students who have completed the program can serve as undergraduate course assistants (UCAs) where they help students during their first-year engineering classes and have opportunities to develop and teach workshops on additional engineering topics. From an overall perspective, the first-year program appears to be successful at achieving its goals; however, a more detailed analysis of the demographics in the program could elucidate areas in need of improvement.

Strength tests are commonly used by companies for team and personal development purposes. One such test is the High5 Test, which combined theoretical and empirical approaches into one test to ensure both conceptual validity and real-world applicability [1]. It outputs five strengths based on recurring patterns of thoughts, decisions, actions, and feelings that satisfy five criteria: "1. You feel natural at using and developing your ability; 2. You get positive energy when using your strengths; 3. Others also perceive it as your strength; 4. It goes along with your values and understanding of a strength; 5. It satisfies your inner needs" [1]. Many other strength tests only address the first two criteria and do not account for social interactions and perceptions, cultural context, and one's environment.

Similarly, countless studies have used the Myers-Briggs Type Indicator (MBTI) to quantify and study personality types. It is recommended that the MBTI only be used for a few specific purposes, some of which include: increasing self-understanding and promoting "understanding of the appeal of academic and career options indicated as congruent by interest measures" [2, 3]. For these reasons, it is common for employers to use these types of tests for pre-employment assessment, team-building, personal development, and coaching [4]. The Jung Typology Test™ (JTT) is a free version of the test that is "based on Carl Jung's and Isabel Briggs Myers' personality type theory" [5].

Given the applicability and reliability of strength and personality assessments for personal understanding and development, this study aims to investigate two research questions: 1) Is there a significant relationship between the students' strengths or personality types and the engineering discipline they choose to pursue?; and 2) Is there a certain subset of strengths or personality types that are more drawn to teaching? A preliminary analysis was conducted by administering the High5 Test and the JTT to five-teaching faculty in the first-year engineering program at Binghamton University. This analysis of the teaching faculty showed that the "Coach" strength was shared among the faculty and was the most prevalent trait. The High5 Test defines a

"Coach" as one who enjoys "discovering the potential in other people and supporting their personal growth. They find it hard to accept when this potential is getting wasted" [1]. Additionally, all of the faculty members had JTT personality types with the "iNtuitive" and "Judging" traits, with two faculty members having the complete ENFJ type which has been referred to as the "Teacher" personality type "because of their interest in helping others develop and grow" [6].

Based on these preliminary results, it is hypothesized that there will be a few strengths and personality types that are predominant for students in each academic major and that the "Coach" strength and the "N" and "J" personality traits will be dominant in the subset of students that expressed interest in teaching.

Project Approach

Data Collection

Quantitative data was collected from the first-year engineering students at Binghamton University during the Fall 2022 semester using Google Forms. There were 339 student responses resulting in response rates of 96%. The Google Forms collected each individual's strengths, personality type, interest in teaching or going into academia in the future, and declared academic major.

All participants took the High5 Test which is a free online test used to assess their strengths [1]. The High5 Test consists of 120 questions and provides the students with a list of their top 5 strengths out of 20 possible options as shown in Appendix A. Five dropdown questions were asked in the Google Form where students selected their top five strengths, respectively. This is referred to as the Strengths.

All participants also took the Humanmetrics Jung Typology Test (JTT) which is a free online test to assess their personality type [5]. The JTT consists of 64 questions and results in a 4-letter personality type as follows: Extraverted (E) or Introverted (I); Sensing (S) or iNtuition (N); Thinking (T) or Feeling (F); and Judging (J) or Perceiving (P). Each of these criteria represents "a continuum between two opposite poles" [5]; therefore, a percentage is also given for each letter to indicate how marginal or extreme a given trait is to one's personality. Appendix B defines the four criteria. In the Google Form, participants were given four multiple-choice questions where they selected (E) or (I), (S) or (N), (T) or (F), and (J) or (P), for each criterion respectively. Participants were asked to enter the percentage they received for each criterion in four separate short answer questions. Responses were limited to whole numbers between 0-100. This is referred to as the Personality Type.

The students were asked to indicate their declared academic major from the following multiple-choice options: Biomedical Engineering (BME), Computer Engineering (CE), Electrical Engineering (EE), Industrial Systems Engineering (ISE), Mechanical Engineering (ME), or Other. This is referred to as the Academic Major. Lastly, they were asked an additional multiple-choice question: "How interested are you in teaching or going into academia in the future?" They

could respond, “I am definitely interested!”, “I am somewhat interested.”, “I am not sure or haven’t thought about it.” or “ I am not interested.” This is referred to as the Interest in Teaching.

Data Analysis

The Strengths and Academic Major results were both categorical with no specific order. The Personality Type results consisted of four sets of continuous data ranging from -100 to 100. The Interest in Teaching data was categorical with an order from “definitely interested” to “not interested.”

A nominal logistic regression was fitted to the top Strengths and Academic Major data to model the relationship between predictors and a response that has three or more outcomes that do not have an order. An ordinal logistic regression was fitted to the top Strength result and Interest in Teaching data to model the relationship between predictors and a response that has there or more outcomes that have an order. In both cases, the model failed to converge producing unreliable results. A chi-square test for association was also used to determine whether two categorical variables are associated; however, there was insufficient data to produce reliable results.

Instead of statistical analyses, weighted averages were calculated for the 20 possible strengths based on Academic Major and Interest in Teaching. This was done by assigning 5 points to each participant’s top strength, 4 points to the second strength, 3 points to the third strength, 2 points to the fourth strength, 1 point to the fifth strength, and 0 points to every other item. Additionally, Strengths were grouped into four domains as specified by the High5 Test: Doing, Feeling, Motivating, and Thinking [1] as shown in Table 1. The data was tabulated, graphed, and analyzed for interesting trends and anomalies.

Table 1. The four strength domains and the five strengths that comprise each of them.

Doing	**Feeling**	**Motivating**	**Thinking**
Believer	Chameleon	Catalyst	Analyst
Deliverer	Coach	Commander	Brainstormer
Focus Expert	Empathizer	Self-Believer	Philomath
Problem Solver	Optimist	Storyteller	Strategist
Time Keeper	Peace Keeper	Winner	Thinker

A One-Way ANOVA was performed on each Personality Type criteria and Academic Major data and again for each Personality Type criteria and Interest in Teaching data. In all cases, the model was a poor fit producing unreliable results. Instead of statistical analyses, the data were tabulated, graphed, and analyzed for interesting trends and anomalies.

Results and Discussion

Academic Major

It was hypothesized that there will be a few strengths and personality types that are predominant for each academic major. This hypothesis was partially supported by the data. As seen in Table

2, in general students in all engineering majors were strongest at "Doing," followed by "Thinking" except for ISE majors who were stronger at "Feeling" than "Thinking." Similarly, students in all engineering majors, in general, had the lowest number of strengths in the "Motivating" domain (Table 2). Appendix C has a detailed breakdown for each strength and shows a difference between students that declared an ISE major compared to the other engineering majors. This is especially clear for the Empathizer strength which was much more prevalent in ISE majors and contributed to the higher percentage for the "Feeling" domain (Appendix C).

Table 2. Summary of Strengths results by domain for each Academic Major. The darker the green shading, the higher the weighted average is above 25%. The darker the red shading, the lower the weighted average is below 25%.

Academic Major	Doing	Feeling	Motivating	Thinking
BME (n = 75)	31%	22%	20%	27%
CE (n = 56)	28%	23%	22%	27%
EE (n = 36)	28%	25%	21%	26%
ISE (n = 26)	34%	27%	19%	20%
ME (n = 140)	26%	25%	19%	30%
Other (n = 6)	27%	24%	23%	26%
All Engineering Majors (n = 333)	28%	25%	20%	27%

Figure 1 shows the first-year engineering student's Personality Types broken down by letter and organized by their declared Academic Major. The mean and median of the individual traits are relatively close to one another and are only marginally to slightly skewed towards one trait.

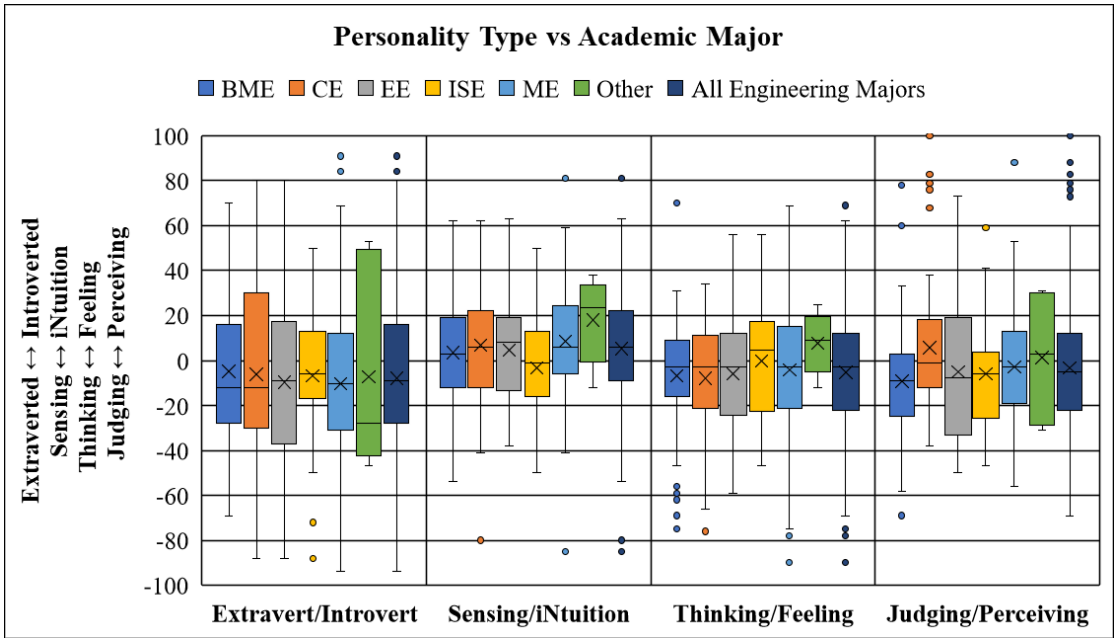

Figure 1. Summary of first-year engineering students' Personality Types broken down by letter and organized by their declared Academic Major.

Contrary to the engineering stereotype, the students were marginal to slightly more "Extraverted" independent of the Academic Major they chose (Figure 1). Additionally, except for ISE majors, the students were slightly more "iNtuitive" and "Thinking" (Figure 1). Lastly, "Judging" was slightly more predominant (Figure 1). Moreover, when the traits are combined into a 4-letter personality type (Table 3), there does not appear to be a dominant type; although, there are a couple that are less common including "ISFP," "INFP," and "ISTP." This could indicate that those with both an "Introverted" and "Perceiving" personality type are less drawn to the engineering program at Binghamton University.

Table 3. Summary of 4-letter Personality Type results for each Academic Major. The darker the green shading, the more prevalent the type.

	BME (n = 75)	**CE** (n = 56)	**EE** (n = 36)	**ISE** (n = 26)	**ME** (n = 140)	**Other** (n = 6)	**All Engineering Majors** (n = 333)
ESTJ	7	3	2	5	12	0	29
ESTP	5	4	2	0	8	0	19
ESFJ	6	2	3	2	10	0	23
ESFP	1	7	0	2	6	1	16
ENTJ	9	7	4	1	19	1	40
ENTP	5	4	4	2	13	1	28
ENFJ	6	8	2	2	12	0	30
ENFP	4	2	3	3	9	1	21
ISTJ	6	4	4	2	3	0	19
ISTP	2	2	1	0	6	0	11
ISFJ	3	2	1	3	8	0	17
ISFP	2	0	2	1	2	0	7
INTJ	10	5	4	1	14	0	34
INTP	1	4	0	1	9	0	15
INFJ	6	1	2	0	5	2	14
INFP	2	1	2	1	4	0	10

These results fit with those from a previous study that analyzed the personality types of students in a Canadian engineering program compared to an American one; that study found that American engineering students were more "Extraverted" and "Judging" than their Canadian counterparts who had a high prevalence of the I_TJ types [7]. Furthermore, the author found that female students were primarily the ENFP personality type [7] which could be an additional factor in the higher level of extraversion seen in the current analysis which takes place over 20 years later when women in engineering are more common. Moreover, that same study found that both programs seemed to attract and graduate higher numbers of students with a "_TJ" personality type, and the S/N component varied based on the engineering major [7] which is somewhat consistent with the current study's findings (Figure 1).

It was hypothesized that there will be a few strengths and personality types that are predominant for students in each academic major in response to the research question, "Is there a significant relationship between the students' strengths or personality types and the engineering discipline they choose to pursue?" Overall, the hypothesis was not fully supported by the data since the surveyed students had a broad range of personality traits, with no clear trend in personality type

based on major or interest in engineering in general. Although this was not expected, it is encouraging to see that engineering attracts all personality types.

Interest in Teaching

It was hypothesized that the "Coach" strength will be dominant in the subset of individuals that expressed interest in teaching. This hypothesis was partially supported by the data where there was not a clear relationship between individual strengths and interest in teaching (Appendix D), including the "Coach" strength; however, those that indicated they were definitely interested in teaching were noticeably stronger in "Motivating" compared to other groups (Table 4). The strengths in the "Motivating" domain mainly involve having the confidence to lead, communicate and create momentum in a stagnant environment. This seems to correlate with the skills that a teacher [8, 9] would need to lead a classroom and is something that should continue to be investigated in the future.

Table 4. Summary of Strengths results by domain for each Interest in Teaching. The darker the green shading, the higher the weighted average is above 25%. The darker the red shading, the lower the weighted average is below 25%.

Interest in Teaching	Doing	Feeling	Motivating	Thinking
I am definitely interested! (n = 15)	23%	27%	28%	23%
I am somewhat interested. (n = 98)	28%	25%	17%	29%
I am not sure or haven't thought about it. (n = 79)	28%	28%	16%	28%
I am not interested. (n = 147)	29%	22%	23%	26%

It was also hypothesized that the "N" and "J" personality traits will be dominant in the subset of individuals that expressed interest in teaching. The data does not support this hypothesis with the "P" personality trait being slightly more pronounced over "J" for the group that was definitely interested in teaching and the "N" trait being more subjective; the mean favors iNtuition over Sensing, but the median and distribution of responses show no noticeable differences (Figure 2). Another study found that students in education majors had "E" as their most prevalent trait [8] which is somewhat consistent with this study; however, extraversion was more prevalent in general for the surveyed students (Figure 2) and is not an accurate indicator of who may be interested in teaching. It is important to note that only 15 students indicated they were definitely interested in teaching so more data is needed for this analysis.

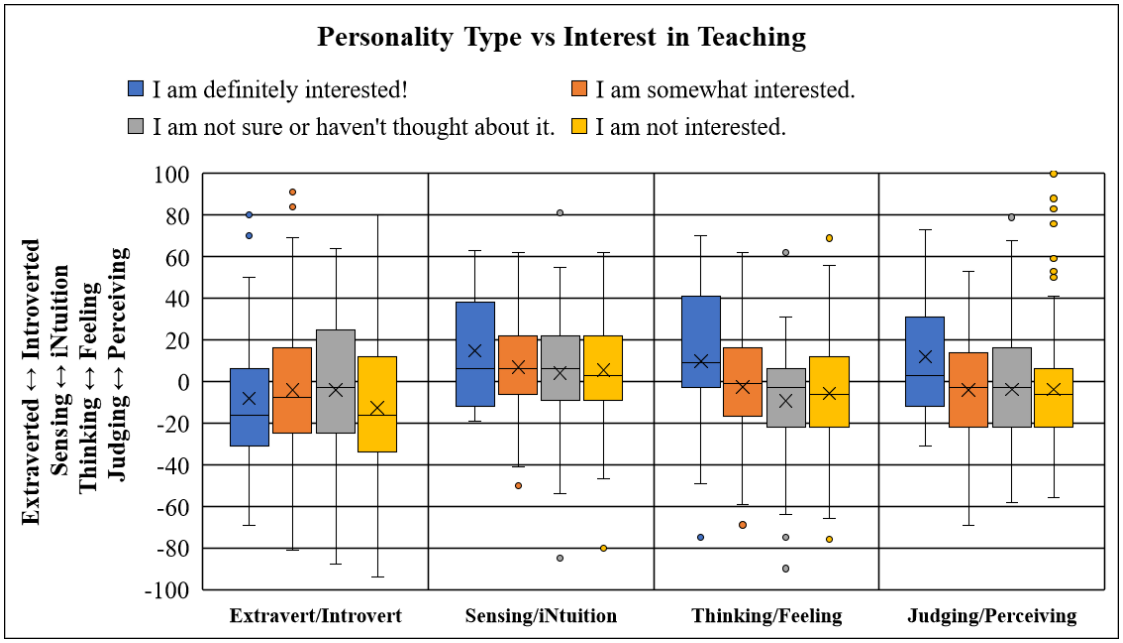

Figure 2. Summary of first-year engineering students' Personality Types broken down by letter and organized by their Interest in Teaching.

When the traits are combined into a 4-letter personality type (Table 5), there does not appear to be a dominant type that is drawn to teaching. The ENFJ personality type which has been referred to as the "Teacher" personality type "because of their interest in helping others develop and grow," did not stand out in the data shown in Table 5 [6]. Again, this analysis is limited by the number of respondents that indicated they are definitely interested in teaching.

Table 5. Summary of 4-letter Personality Type results for each level of Interest in Teaching. The darker the green shading, the more prevalent the type.

	I am definitely interested! (n = 15)	**I am somewhat interested.** (n = 98)	**I am not sure or haven't thought about it.** (n = 79)	**I am not interested.** (n = 147)
ESTJ	1	7	8	13
ESTP	0	5	5	9
ESFJ	0	6	5	12
ESFP	4	7	3	3
ENTJ	4	10	7	20
ENTP	0	7	8	14
ENFJ	1	11	7	11
ENFP	1	5	2	14
ISTJ	0	4	3	12
ISTP	0	4	2	5
ISFJ	1	5	5	6
ISFP	0	4	1	2
INTJ	0	12	9	13
INTP	0	2	9	4
INFJ	0	5	4	7
INFP	3	4	1	2

In response to the research question, “Is there a certain subset of strengths or personality types that are more drawn to teaching?” the data showed a higher prevalence of “Motivation” strengths in individuals that indicated they were definitely interested in teaching. An interesting thing to note is that the “Motivation” strength domain had the lowest prevalence among the engineering students surveyed (Table 2), making it a potentially good indicator for identifying a subset of students that would enjoy being undergraduate course assistants in the first-year engineering program at Binghamton University. No relationship was found between personality type and interest in teaching; however, it is something that can continue to be investigated as more data is collected.

Limitations and Future Work

This study had a very high response rate, but the statistical analyses that were performed failed. Data will continue to be collected from first-year engineering students in the future to see if more drastic trends develop with a larger dataset and alternate analyses could be explored; however, the descriptive statistics presented in this study are still useful independent of statistical analyses.

The data from this study showed that the engineering program at Binghamton University attracts students with a broad range of strengths and personality types. Future studies can investigate students that end up graduating from each major to determine if those with certain strengths or personality types are more likely to persist in engineering to graduation. Depending on the results of that analysis, institutions and departments could consider reassessing their engineering programs to retain the diverse group of students that they initially attract.

Additionally, the data showed a high prevalence of “Motivating” strengths in students that indicated they were definitely interested in teaching in the future, which was the one strength domain that was less prevalent in engineering majors as a whole. Future studies could look at the strengths of students that become undergraduate course assistants and current engineering educators to determine if that trend continues from interest level to career level.

Acknowledgment

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Appendix A: High5 Strengths Test

Table A1. Names and descriptions for the 20 strengths included in the High5 Test [1].

Strength Name	Strength Description
Analyst	Analysts are energized by getting to look for simplicity and clarity through a large amount of data. Analysts are frustrated when someone asks them to follow their heart rather than logic and proven facts.
Believer	Actions of Believers are driven by the core higher values that cannot be compromised at expense of the success. Believers are drained if their beliefs and values are getting questioned or misaligned with what they have to do.
Brainstormer	Brainstormers are excited when asked to come up with new no-limits ideas and to connect seemingly unconnectable. Brainstormers get quickly bored by standard practices or closed-minded people.
Catalyst	Catalysts enjoy getting things started and creating momentum in a stagnant environment. Catalysts cannot stand waiting and wasting time when they could be getting things off the ground.
Chameleon	Chameleons draw excitement from constantly changing environments, surprises, unexpected detours, and working 'on the fly'. They are bored to tears by predictability and routine.
Coach	Coaches enjoy discovering the potential in other people and supporting their personal growth. They find it hard to accept when this potential is getting wasted.
Commander	Commanders love to be in charge, to speak up, and to be asked for a direct opinion. They do not avoid conflicts and cannot understand 'beating around the bush' mentality.
Deliverer	Deliverers follow through on their commitments and they enjoy seeing how it builds more trust and respect among others. They feel horrible if promises get broken - both on the receiving and on the giving side.
Empathizer	Empathizers are great at noticing how others feel and using this understanding to do something good. They are frustrated when asked to disregard feelings and emotions and follow strict logic instead.
Focus Expert	Focus Experts enjoy getting one project until the finish line rather than changing course regularly. They cannot stand distractions that can interrupt them from focusing on one thing at a time.
Optimist	Optimists enjoy giving praise on what's right about people and being grateful for what they have. They find it hard to be around people who constantly pick out what's wrong with everything.
Peace Keeper	Peace Keepers are masters of balance, finding alignment and building bridges among people to get to the best outcome. They feel emotionally drained by constant friction among people, who do not look for common ground.
Philomath	Philomaths are in love with learning - exploring many interests, following new paths, and learning as many things as possible. They do not enjoy companies of 'know-it-all' people who are not curious to learn something new or to explore new ideas.
Problem Solver	Problem Solvers love finding bugs, uncovering flaws, diagnosing problems, and finding solutions to them. They find it hard to sweep problems under the rug and keep going while ignoring unsolved issues.

Self-Believer	Self-Believers are independent and self-sufficient people, inspiring others with their certainty and confidence. They cannot stand when others tell them what to do or control their actions.
Storyteller	Storytellers are masters of communication. They like to host, speak in public, and be listened to. They drain in situations that do not allow expressing themselves through words.
Strategist	Strategists have the skill to see the big picture, which enables them to find the best route through the clutter. Because connecting the dots comes so naturally for them, they get impatient with people who make slow decisions.
Thinker	Thinkers enjoy the mental activity, intellectual discussions, and spending time alone thinking. They find it hard to work in teams where acting before thinking is the norm.
Time Keeper	Nothing excites Time Keeper more than meeting the deadline. They enjoy setting up processes, timelines, and plans. Time Keepers get confused in chaos where neither outcomes nor ways to achieve them are clear.
Winner	Winners can turn any mundane task into a game or challenge because the feeling of competition is essential for them. They feel lost in environments with no defined measure of success.

Appendix B: Jung Typology Test™ Personality Test

Table B1. Criterion descriptions for the Jung Typology Test™ [5]**.**

Criterion	Description
Extraversion – Introversion	Signifies the source and direction of a person's energy expression. An extravert's source and direction of energy expression is mainly in the external world, while an introvert has a source of energy mainly in their own internal world.
Sensing – iNtuition	Represents the method by which someone perceives information. Sensing means that a person mainly believes information he or she receives directly from the external world. Intuition means that a person believes mainly in information he or she receives from the internal or imaginative world.
Thinking – Feeling	Represents how a person processes information. Thinking means that a person makes a decision mainly through logic. Feeling means that, as a rule, he or she makes a decision based on emotion, i.e. based on what they feel they or should do.
Judging – Perceiving	Reflects how a person implements the information he or she has processed. Judging means that a person organizes all of his life events and, as a rule, sticks to his plans. Perceiving means that he or she is inclined to improvise and explore alternative options.

Appendix C: Strength Results by Academic Major

Table C1. Student Strengths results by Academic Major. The darker the green shading, the higher the weighted average of the strength.

Strength Domain	**Strength Name**	**BME** (n = 75)	**CE** (n = 56)	**EE** (n = 36)	**ISE** (n = 26)	**ME** (n = 140)	**Other** (n = 6)	**All Engineering Majors** (n = 333)
Doing	Believer	3%	3%	2%	4%	2%	0%	2%
	Deliverer	9%	6%	7%	12%	7%	11%	8%
	Focus Expert	2%	2%	3%	4%	2%	4%	2%
	Problem Solver	10%	13%	11%	7%	10%	4%	10%
	Time Keeper	8%	4%	5%	7%	5%	7%	6%
Feeling	Chameleon	1%	2%	3%	1%	3%	4%	2%
	Coach	7%	5%	6%	8%	8%	11%	7%
	Empathizer	8%	9%	9%	14%	9%	6%	9%
	Optimist	2%	2%	3%	1%	2%	1%	2%
	Peace Keeper	3%	4%	4%	4%	3%	2%	4%
Motivating	Catalyst	5%	8%	8%	3%	6%	8%	6%
	Commander	7%	5%	4%	4%	5%	8%	5%
	Self-Believer	4%	4%	4%	4%	3%	2%	4%
	Storyteller	1%	1%	1%	3%	1%	0%	1%
	Winner	4%	4%	4%	6%	4%	6%	4%
Thinking	Analyst	3%	5%	5%	6%	4%	2%	5%
	Brainstormer	1%	0%	1%	1%	2%	3%	1%
	Philomath	10%	7%	7%	6%	10%	2%	9%
	Strategist	7%	7%	7%	3%	8%	12%	7%
	Thinker	6%	8%	6%	5%	6%	6%	6%

Appendix D: Strength Results by Interest in Teaching

Table D1. Student Strengths results by Interest in Teaching. The darker the green shading, the higher the weighted average of the strength.

Strength Domain	Strength Name	I am definitely interested! (n = 15)	I am somewhat interested. (n = 98)	I am not sure or haven't thought about it. (n = 79)	I am not interested. (n = 147)
Doing	Believer	0%	4%	2%	1%
	Deliverer	5%	7%	8%	9%
	Focus Expert	2%	2%	3%	3%
	Problem Solver	11%	10%	9%	11%
	Time Keeper	5%	6%	6%	5%
Feeling	Chameleon	5%	1%	3%	2%
	Coach	5%	8%	9%	6%
	Empathizer	12%	10%	10%	8%
	Optimist	2%	3%	2%	1%
	Peace Keeper	1%	3%	4%	4%
Motivating	Catalyst	9%	6%	4%	7%
	Commander	8%	4%	3%	7%
	Self-Believer	4%	3%	4%	4%
	Storyteller	2%	1%	1%	1%
	Winner	4%	4%	4%	5%
Thinking	Analyst	2%	4%	6%	4%
	Brainstormer	1%	1%	1%	1%
	Philomath	4%	11%	9%	7%
	Strategist	8%	6%	6%	8%
	Thinker	8%	7%	5%	6%