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Analysis of Personal Attributes and Skills of Mercer Undergraduate Engineering Students

Dr. R. Radharamanan, Mercer University

Dr. R. Radharamanan is currently working as Professor of Industrial Engineering and Director of Mercer Center for Innovation and Entrepreneurship (MCIE) at Mercer University in Macon, Georgia. He has thirty nine years of teaching, research, and consulting experiences. His previous administrative experiences include: President of International Society for Productivity Enhancement (ISPE), Acting Director of Industrial Engineering as well as Director of Advanced Manufacturing Center at Marquette University, and Research Director of CAM and Robotics Center at San Diego State University. His primary research and teaching interests are in the areas of innovation and entrepreneurship, manufacturing systems, robotics and automation, quality engineering, and product and process development. He has organized and chaired five international conferences, co-chaired two, and organized and chaired three regional conferences. He has received two teaching awards, several research and service awards in the United States and in Brazil. His professional affiliations present and past include ASEE, IIE, ASQ, SME, ASME, and ISPE.

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Abstract

Recent studies conducted by Target Training International, Ltd. (TTI) have discovered that as much as 36% of incoming freshman engineers switch to non-engineering degree programs by the end of their first semester due to lack of academic success. TTI has attributed this downfall as a result of the lack of focus in engineering schools on the personal attributes of students. As a result, TTI has developed a trimetric survey for participating engineering institutions affiliated with the Kern Family Foundation as an assessment tool to determine where their students fall short in terms of their (1) Behavior Styles, (2) Attitudes, and (3) People Skills.

The purpose of this study is to evaluate the trends of undergraduate students enrolled at Mercer University School of Engineering (MUSE) by gender (male and female) and class status (freshman, sophomore, junior, and senior) for TTI's three areas for personal attributes. The study will also quantify the need to initiate a program to reinforce any skills the students' lack.

A total of 104 data point representative of TTI's survey results from (MUSE) undergraduate students were used to carry out the study. Of these 104, 76 were males (35 freshmen, 6 sophomores, 9 juniors, and 26 seniors) and 28 were females (9 freshmen, 2 sophomores, 7 juniors, and 10 seniors). The statistical methods and techniques used in this study include: descriptive statistics, analysis of variance (ANOVA) tables, spider charts, hypothesis testing, regression analyses, percentage change, and percentage difference.

From the sample data analyzed, MUSE students consistently demonstrate higher behavior styles of S-Steadiness and C-Conscientiousness with slightly lower behavior styles of D-Dominance and I-Influence. Most female students possess Social and Aesthetic attitudes, while males are more Utilitarian; both are Traditional and Theoretical. For People Skills, MUSE students improved and/or mastered 19 of the 23 areas by the senior level, but lack mastery of skills in Conflict Management, Creativity/Innovation, Persuasion, and Empathy. Incoming freshmen profile consists of more males than females, poor Problem-Solving skills and Conscientiousness, and a mixture of Individualistic and Utilitarian attitudes.

Introduction

According to TTI, traditional engineering schools and programs typically lose as much as 36% of incoming freshman by the end of the first semester to other academic, non-engineering degree programs largely due to the lack of academic success achieved within the first semester, which is often quantified by the student's effective grade-point-average[1]. In addition, TTI also reports that an institution's lack of success can also be correlated with their lack of adaptation for success. Given this great loss of potential engineers, the Kern Family Foundation (KFF) has partnered with several engineering institutions to implement means by which to raise the success rate of students throughout the course of their engineering career starting at the educational level first by evaluating students with a trimetric analysis tool developed by TTI. As one of the KEEN (Kern Entrepreneurship Education Network) institutions embracing this challenge, MUSE has already begun to make a step forward towards optimizing its level of undergraduate academic achievement by providing 104 enrolled students with TTI's trimetric survey tool in the academic year 2011-2012.

Background

Generally speaking, most institutions only address subject-matter based knowledge and job related skills when preparing engineering students for the professional industry. However, TTI believes that personal attributes are equally as important and thus should also be addressed at the educational level in order to strengthen each student's behaviors, values, and people skills. With the addition of this component, students will be prepared for the industry job not only intellectually and skill-wise, but mentally, emotionally, and creatively. These three personal attributes makeup TTI's trimetric survey tool for students' adaptation towards successful careers.

Behavior Styles – DISC

This attribute focuses on how the individual operates and deals with issues. Four dimensions are often considered when evaluating individual behavior styles. For the purposes of this study raw data were extracted in terms of natural and adapted DISC behaviors, where natural pertains to the student's behavior at the start of a semester and adapted corresponds to the behavior at the completion of a semester. The four DISC behavior styles include the following:

- **D - Dominance:** quantifies how the students deal with and manage problems from start to finish.
- **I - Influence:** quantifies how the students interact with people in our work environment(s).
- **S - Steadiness:** quantifies the pace and timing in which the students deal with tasks and issues.
- **C - Conscientiousness:** quantifies how the students deal with procedure and use them for success.

In addition to the DISC behavior styles, there is a tool known as the Success Insights® Wheel common in Europe used to visualize one's natural behavior or basic behavioral style, as well as the adaptations they make to that style to thrive in the workplace. The plotting of both behaviors in different boxes on the wheel indicates that one is adapting your behavior; the more distance separating the two, the better.

Values – Six Attitudes

The values attribute directly corresponds to the individual's attitude in the work or academic environment and identifies which attitudes drive their actions, decision-making and interactions[2]. The six different attitudes that TTI's survey tests individuals include:

- **Social:** "a passion to eliminate hate and conflict in the world and to assist others."
- **Traditional:** "a passion to pursue the higher meaning of life through a defined system for living."
- **Theoretical:** "a passion to discover, systematize and analyze; a search for knowledge."

- **Aesthetic:** “a passion to add balance and harmony in one’s own life and protect our natural resources.”
- **Utilitarian:** “a passion to gain return on all investment of time, resources and money.”
- **Individualistic:** “a passion to achieve position and to use that position to influence others.”

People Skills – 23 Professional Competencies

The professional competencies (or people skills) analyzed through the TTI survey originate from a DNA inventory of skills frequent in engineering and measure what personal skills the individual has already mastered well versus what skills need mastering and could prove to be useful in either academic or professional engineering environments. Typically the average job requires between three to five professional skills and the average person has mastered a similar number of professional skills from the DNA inventory[3]. The 23 professional skills measured by TTI’s survey tool are listed in Table 1.

Table 1. TTI’s DNA inventory professional skills

Leadership	Diplomacy
Employee Development/Coaching	Personal Effectiveness
Teamwork	Presenting
Conflict Management	Management
Interpersonal Skills	Negotiation
Analytical Problem Solving	Persuasion
Creativity/Innovation	Empathy
Written Communication	Continuous Learning
Customer Service	Futuristic Thinking
Flexibility	Decision Making
Goal Orientation	Self-Management (time and priorities
Planning/Organizing	

In addition to the 23 professional competencies outlined above, TTI has also designated several subgroups ideal for various scenarios in the engineering academic environment at any institution; a few consistent with Mercer engineering students analyzed are outlined in Table 2.

Table 2. Professional competencies for students[3]

TTI Description	Effectively collaborate in a team setting	Applying critical and creative thinking to ambiguous problems	Persist through and learn from failure
Mercer Equivalent	Group projects/assignments (PDR, CDR)	Design phase of senior design, R&D projects	Student’s overall undergraduate success
Professional Competencies	**Teamwork** Interpersonal Skills Negotiation Presenting Persuasion Written Communication	**Creativity/Innovation** Continuous Learning Flexibility Decision Making Persuasion Presenting Problem-Solving Self-Management	**Personal Effectiveness** Goal Orientation Continuous Learning Leadership Decision Making Flexibility

PDR: Preliminary Design Review; CDR: Critical Design Review

The objective of this study is to effectively use the statistical methods and techniques to define, analyze and interpret the data collected from the 104 Mercer engineering students based on their TTI survey results. In particular, the analysis of variance technique, spider charts, regression analysis, confidence intervals, hypothesis testing, interaction plots and population parameters comprise the methods and techniques employed throughout this study. Specifically, the study will address the differences and similarities of the three types of personal attributes by gender (male and female) and class status (freshman, sophomore, junior, and senior). Overall, the development of this analysis will enable to report the profile of incoming freshman, intellectual growth students make from freshmen to seniors, how well Mercer engineering students make adaptations for success, and whether or not there exists a need for the development and implementation of a program at Mercer to help students develop and strengthen skills necessary for their engineering education, career, and future.

Methodology

A data set consisting of 104 Mercer engineering students comprising of two separate subgroups: gender and class status were used to conduct the study. Table 3 provides a numerical breakdown of each subgroup based on the original population. In order to determine any existent statistical significance or correlation within this data set for the three personal attributes statistical methods and techniques were used to analyze the given data.

Table 3. Count and percentage by subgroup – gender and class status

			Female			Male		
Gender	Count	Percent	Class	Count	Percent	Class	Count	Percent
Female	28	26.9231	Freshmen	9	32.1429	Freshmen	35	46.0526
Male	76	73.0769	Sophomore	2	7.1429	Sophomore	6	7.8947
			Junior	7	25.0000	Junior	9	11.8421
			Senior	10	35.7143	Senior	26	34.2105

Statistical Software

Minitab® is a statistical analysis software application often used in various industries to analyze many different real-world problems. Some concepts frequently used include analysis of variance, hypothesis testing, regression and confidence intervals such as those developed throughout this study[4]. Microsoft Excel® is another common data analysis computer application that can be very useful in the development of statistical analyses for large data sets. Excel was used throughout this study for the organization of raw data and the generation of radar charts and other graphs[5].

Descriptive Statistics

Descriptive statistics[6] are often used to analyze the given population data or selected sample data. These parameters commonly include sample size, mean, median, mode, variance, standard deviation, range, skewness, and kurtosis.

ANOVA Technique

The ANOVA technique is a common procedure related to hypothesis testing of means that tests whether or not the means of different samples or subgroups of the same population are equivalent[7]. For this study, the ANOVA technique will use the automated calculations in Minitab for total sum of squares, degrees of freedom, and mean square to compute the F-value, P-value, and significance of each characteristic trait being analyzed.

Spider Charts

Spider chart, or radar charts, is a graphical chart used to plot multivariate data of three or variables on axes that start from the same spot. The chart consists of various data points (taken from some data set) that are connected to show relationships between the different variables. This is often used to show outliers or commonality within the data set. Several groups can be overlaid to show the relationship between different factors. For the purpose of this study, all spider charts were generated in Excel 2010 using the Radar Chart Tool[5].

Percentage Change and Difference

Percentage change and difference[8] are readily used in statistics to illustrate a numerical difference between two values of interest as a percentage, but both bear different meanings. For instance, percentage change is most applicable when comparing an old value to a new value; whereas percentage difference can be used when comparing or disproving the equivalency of two values. Equations 1 and 2 show the mathematical expression for the percentage change and percentage difference respectively.

$$Percentage\ Change = \frac{New\ Value - Old\ Value}{Old\ Value} * 100\% \tag{1}$$

$$Percentage\ Difference = \left|\frac{x_1 - x_2}{(x_1 + x_2)/2}\right| * 100\% \tag{2}$$

Regression Analysis

Regression analysis indicates how a certain dependent variable (response) changes when any one independent variable (predictor) is changed, while all other values remain the same. Regression analysis is often used in forecasting as a way to predict values; however, for the purpose of this study, regression analysis will be used to analyze the DISC values. Many regression problems involve more than one regressor variable. These models are called multiple regression models and they are one of the most widely used statistical technique. A multiple regression model[9] that might describe a relation is:

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \varepsilon \tag{3}$$

Confidence Intervals

Confidence intervals allow statisticians to express how closely the sample estimate matches the true value in the whole population. Often they are expressed as 95% confidence intervals. Formally, a 95% confidence interval for a value is a range where, if the sampling and analysis were repeated under the same conditions (yielding a different dataset), the interval would include the true (population) value 95% of the time. This does *not* imply that the probability that the true value lies within the confidence interval is 95%. However, it is true that, before any data are sampled and given a plan for how the confidence interval will be constructed the probability is 95% that the yet-to-be-calculated interval will cover the true value[10].

Hypothesis Testing
Hypothesis testing is concerned with determining whether or not a statistical hypothesis, or a statement about the population, coincides with the given sample data. The hypothesis tested is the null hypothesis (H_o). The goal is to accept or reject given a statistical test. Usually, the null hypothesis is rejected given some sort of criteria determined by the alternative hypothesis (H_1). Hypothesis testing can test for several different null hypotheses, such as: the mean of a population, the variance of a population, the difference between two separate population means, if the means are equal, and more. While one cannot prove a null hypothesis one can use the power test to test how close the proposed experiment is to being true[6].

- Type I errors, where the null hypothesis is falsely rejected giving a "false positive".
- Type II errors, where the null hypothesis fails to be rejected and an actual difference between populations is missed giving a "false negative".

Results and Discussions[11]

The results presented in this section are arranged by the three personal attributes - behavior (DISC), values (Six Attitudes), people skills (23 Professional Competencies). Results from both subgroups of gender and class status are discussed in lieu of each statistical method performed[11]. It should be noted that not every statistical method was implemented throughout the three personal attributes due to the large number of factors to consider for the 23 people skills.

Behavior - DISC
Several analyses were done on the DISC data. Wheel positions 1 and 2 correspond to adapted and natural behaviors respectively. ANOVA was performed to determine any significant differences between the means of gender and class status. An example of the ANOVA table generated in Minitab for the DISC data [D-adapted (%), wheel position 1] is given in Table 4 showing the total sum of squares, degrees of freedom, mean square values, F-values, and P-values for both gender and class status of 104 student participants. The level of significance level used for ANOVA is α=0.05.

Table 4. Minitab ANOVA test for D-adapted (%) – wheel position 1, α=0.05

Factor	Type	Levels	Values
GENDER	fixed	2	F, M
Class	fixed	4	Freshmen, Sophomore, Junior, Senior

Analysis of Variance for D ADAPTED (%)

Source	DF	Seq SS	Adj SS	Adj MS	F	P
GENDER	1	14.2	14.2	14.2	0.05	0.821
Class	3	984.7	984.7	328.2	1.20	0.315
Error	99	27162.0	27162.0	274.4		
Total	103	28160.9				

For gender, a P-value of 0.821 which is greater than the given α for the ANOVA, 0.05 indicates that there is no significant difference between the average D-Adapted values of males and that of females. For class, a P-value of 0.315 > 0.05 also indicates that there is no significant difference between the average D-adapted values of freshmen, sophomores, juniors, and seniors.

A comprehensive list of the P-values obtained indicated that there is no significant difference between the male and female DISC values, whether the adapted or natural means are considered. Given that it is known the value of the Wheel Position correlates to the DISC values, one could also infer that there is no significant difference between the means of the Wheel Positions. The ANOVA results for the wheel positions 1 and 2 (adapted and natural) indicated that there is no significant difference between genders or classes, an analysis can be done to see if there is any difference between the mean of Wheel Position 1 (Adapted) and Wheel Position 2 (Natural). A two sample hypothesis test can be done to see if $\mu_1=\mu_2$. In this case, this is the null hypothesis, H_o, and the alternative hypothesis is H_1: $\mu_1\neq\mu_2$. The hypothesis test results are shown in Table 5.

Table 5: Minitab output of hypothesis test for $\mu_1=\mu_2$, α =0.05

```
Two-sample T for WHEEL POSITION 1 vs WHEEL POSITION 2

                      N  Mean  StDev  SE Mean
WHEEL POSITION 1    104  25.9   16.1      1.6
WHEEL POSITION 2    104  28.4   15.2      1.5

Difference = mu (WHEEL POSITION 1) - mu (WHEEL POSITION 2)
Estimate for difference:  -2.44
95% CI for difference:  (-6.72, 1.84)
T-Test of difference = 0 (vs not =): T-Value = -1.12  P-Value = 0.262  DF = 205
```

Given that the P-value = 0.262 is greater than the α–value = 0.05, do not reject the null hypothesis that the means are equal. This shows that the natural tendencies of any given engineering student statistically correlate with their adapted tendencies. This correlation can be seen in the spider plots for Steadiness and Conscientiousness (Figures 1 and 2) of the means as well. Table 6 shows the percentage change between adapted and natural behavior styles of DISC data.

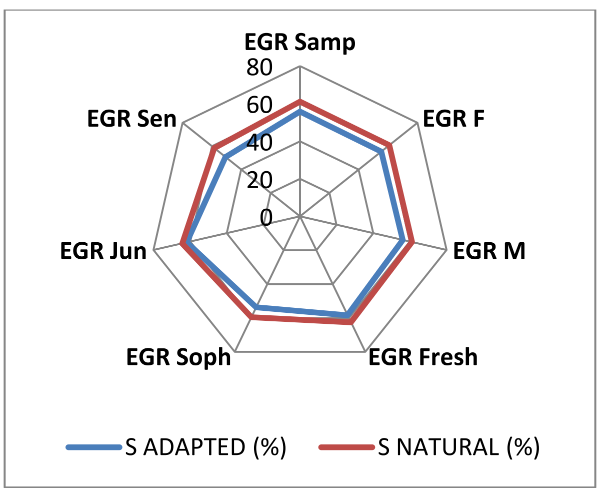

Figure 1. Steadiness

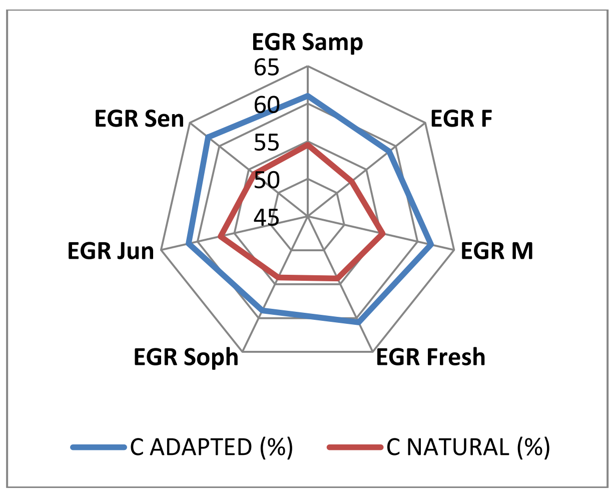

Figure 2. Conscientiousness

Table 6. Percentage change between DISC adapted and natural behavior styles

% Change	Sample	Female	Male	Freshmen	Sophomore	Junior	Senior
D - Dominance	-3.92%	-2.04%	-4.59%	-5.57%	-4.36%	-4.60%	-1.57%
I - Influence	-4.27%	-3.00%	-4.80%	-3.64%	8.89%	24.50%	-1.76%
S - Steadiness	-8.57%	-8.98%	-8.37%	-6.55%	-9.87%	-3.79%	-13.27%
C - Conscientiousness	11.96%	12.17%	11.89%	12.01%	9.04%	7.68%	14.54%

Table 6 shows that two of the traits seem to show a statistical difference, the “Steadiness” trait and the “Conscientiousness” trait. The spider chart (Figure 1) shows that steadiness seems to be more of a natural trait, S-adapted and S-natural values are closer to each other for both gender and class status, and is practiced less in the work/school environment. Figure 2 shows that Conscientiousness is far more adapted than natural, C-adapted and C-natural values are well separated to each other for both gender and class status. However, is there an actual statistical difference between the means? To see if there is a difference, a test on the means is carried out. This is similar to the wheel position tests done earlier. Here, the null hypotheses, H_{os} and H_{oc}, are $\mu_{S\ adapted} = \mu_{Snatural}$ and $\mu_{Cadapted} = \mu_{Cnatural}$. Of course, the rejection criteria are that they are not equal. The results obtained are given in Tables 7 and 8 respectively.

Table 7. Minitab output of hypothesis test for $\mu_{Sadapted} = \mu_{Snatural}$, α=0.05

```
Two-sample T for S ADAPTED (%) vs S NATURAL (%)

                 N  Mean  StDev  SE Mean
S ADAPTED (%)  104  55.9   17.4   1.7
S NATURAL (%)  104  61.1   15.1   1.5

Difference = mu (S ADAPTED (%)) - mu (S NATURAL (%))
Estimate for difference:  -5.24
95% CI for difference:  (-9.70, -0.78)
T-Test of difference = 0 (vs not =): T-Value = -2.32  P-Value = 0.021  DF = 201
```

Table 8. Minitab output of hypothesis test for $\mu_{Cadapted} = \mu_{Cnatural}$, α=0.05

```
Two-sample T for C ADAPTED (%) vs C NATURAL (%)

                 N  Mean  StDev  SE Mean
C ADAPTED (%)  104  61.0   18.6   1.8
C NATURAL (%)  104  54.5   18.1   1.8

Difference = mu (C ADAPTED (%)) - mu (C NATURAL (%))
Estimate for difference:  6.52
95% CI for difference:  (1.50, 11.54)
T-Test of difference = 0 (vs not =): T-Value = 2.56  P-Value = 0.011  DF = 205
```

From looking at these tests results, reject the null hypotheses of both (P-values < 0.05). To ensure accuracy, a hypothesis test was completed on all four comparisons of adapted versus natural behavior styles and Steadiness and Conscientiousness were the two that had significance. Ultimately, this helps to demonstrate the power of spider charts used in this study. In particular, the spider charts suggested that there may be some significant differences which then led to good reasoning for hypothesis testing. Given the results from the ANOVA tables and hypothesis testing on each Wheel Position, a regression analysis is most appropriate to determine which behavior styles have the greatest contribution and influence on Wheel Position 1. In this case the predictors will be the DISC percentages and the response will be the wheel position. The regression equation for wheel position 1 is given by:

$$\text{WHEEL POSITION 1} = -81.3 + 0.304\ \text{D ADAPTED (\%)} + 0.703\ \text{I ADAPTED (\%)} + 0.357\ \text{S ADAPTED (\%)} + 0.680\ \text{C ADAPTED (\%)} \quad (4)$$

The P-value for the Wheel Position 1 from ANOVA indicated that the intercept is not significant (P-value = 0.094); however, two of the regressor variables, I Adapted (%) and C Adapted (%), are statistically significant (P-value < α = 0.05). This is also seen from the regression coefficient values for I-adapted (0.703) and C-adapted (0680) compared to that of D-adapted (0.304) and S-adapted (0.357) in the regression equation (4) indicating Influence and Conscientiousness significantly affect the wheel position compared to that of Dominance and Steadiness for the data analyzed.

Values - Six Attitudes

Similar to the DISC analysis, the ANOVA tables were first used to analyze each of the Six Attitudes. This was done to determine any existing significant differences in the means of the two genders or the four class levels. From the resulting P-values, it is seen that there are three means with significant differences: Utilitarian by class, Aesthetic by gender, and Social by gender as their P-values < α = 0.05. The spider charts in Figures 5 and 6 also help to visualize the significant differences between these values; their corresponding percentage change and differences are presented in Table 9.

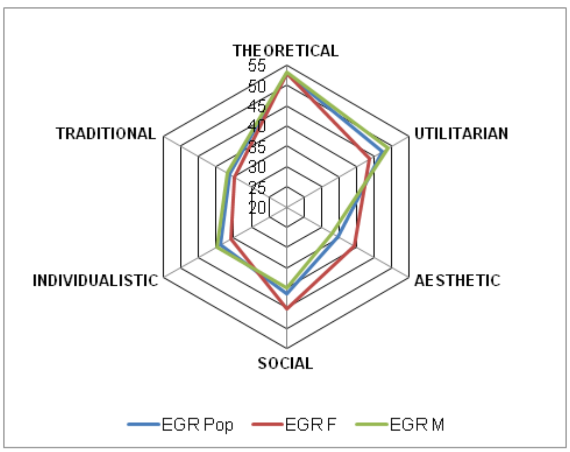

Figure 5. Spider chart by gender

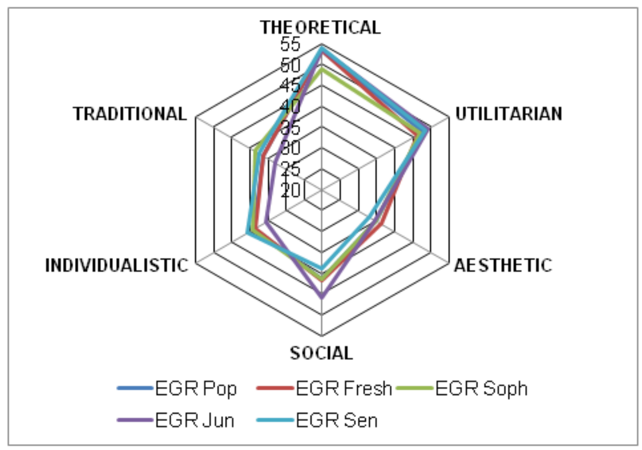

Figure 6. Spider chart by class status

Table 9. % difference between gender and % change between class status

Attitudes	% Difference (Male to Female)	% Change (Freshman to Seniors)
Theoretical	0.40%	1.20%
Utilitarian	11.22%	4.86%
Aesthetic	17.44%	-8.84%
Social	11.82%	-6.93%
Individualistic	10.31%	5.49%
Traditional	5.73%	3.12%

It can be concluded from the spider chart (Figure 5) that both male and female MUSE students share Theoretical attitudes, while females have tendencies towards more Social and Aesthetic attitudes; and males project more Utilitarian, Traditional, and Individualistic attitudes. Also, the spider chart (Figure 6) and percentage difference calculations suggest that students gain more Theoretical, Utilitarian, Individualistic, and Traditional attitudes (positive % change) by the time they reach Senior undergraduate status at MUSE; and significantly decreased their Aesthetic and Social attitudes (negative % change) in the academic environment.

People Skills - Professional Competencies
Similar to the previous sections, the ANOVA tables generated in Minitab for all 23 professional competencies were analyzed to determine any existing differences in the means of the two genders and the four class levels and the P-values. According to the ANOVA tests, three of the people skills analyzed have significant differences between their means all by the class status subgroup. These include: Analytical Problem-Solving, Customer Service, and Planning/ Organizing as their P-values < $\alpha = 0.05$.

A further analysis of the mean values for each professional competency can be visualized in the spider chart generated in Excel (Figures 7) by class status to better illustrate the significant differences between the values of interest in this section. Spider chart by gender was also generated in Excel and the percent changes and differences by gender and class status for the spider plots were also calculated.

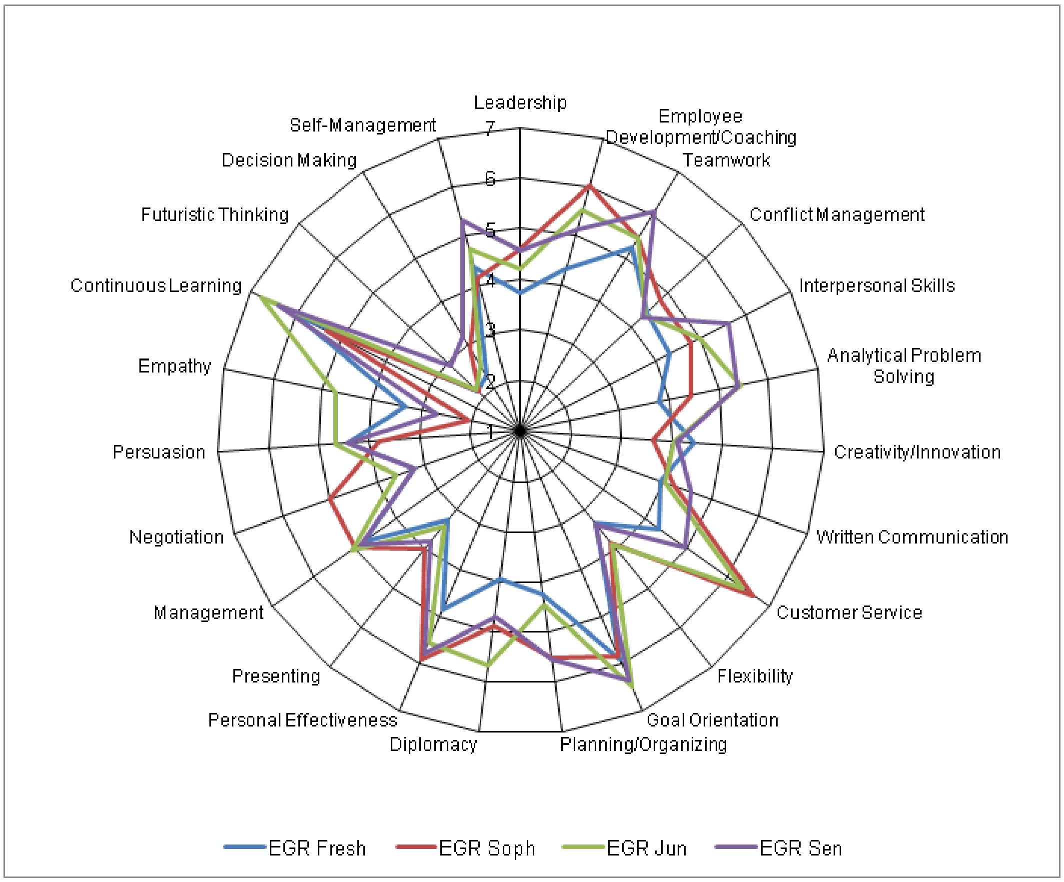

Figure 7. Spider chart for 23 people skills by class status

According to the spider charts and percent differences and percent changes calculated for the people skills by gender and class status, MUSE students tend to improve and/or master all of the people skills by the time they are seniors with the exception of Conflict Management, Creativity/Innovation, Persuasion, and Empathy, which all decrease at the senior level for the data analyzed (Figure 7). It is to be noted that the freshmen and seniors who participated in this study are different individuals, not the same individuals. In terms of comparing people skills by gender, both males and females seem to share the following people skills (≤ 5.0% difference):

Leadership, Interpersonal Skills, Flexibility, Goal Orientation, Negotiation, Persuasion, and Self-Management. All other people skills are significantly different by gender.

In addition, ranking of people skills by gender indicated that both genders at MUSE need improvement on their Futuristic Thinking, while both have mastered Continuous Learning, Goal Orientation, and Teamwork. Also it is apparent that male students need more assistance when it comes to Written Communication, Diplomacy, and Empathy; while females need to focus on improving their Management, Conflict Management, and Employee Development/Coaching in comparison to males.

Lastly, three separate regression analyses were performed that directly correspond to the groups of Professional Competencies and Mercer Equivalents presented in Table 2. The fitted regression equations are:

$$\text{Teamwork} = 3.66 + 0.263\ \text{Interpersonal Skills} + 0.0201\ \text{Written Communication} + 0.0954\ \text{Presenting} + 0.0120\ \text{Negotiation} + 0.0350\ \text{Persuasion} \quad (5)$$

$$\text{Creativity/Innovation} = 1.03 - 0.144\ \text{Analytical Problem Solving} + 0.163\ \text{Flexibility} + 0.0372\ \text{Presenting} + 0.433\ \text{Persuasion} + 0.340\ \text{Continuous Learning} + 0.103\ \text{Decision Making} - 0.247\ \text{Self-Management} \quad (6)$$

$$\text{Personal Effectiveness} = 2.59 + 0.180\ \text{Leadership} - 0.0538\ \text{Flexibility} + 0.380\ \text{Goal Orientation} - 0.0659\ \text{Continuous Learning} + 0.101\ \text{Decision Making} \quad (7)$$

It is seen from the regression equations that for Teamwork (5) the regression coefficients Intercept (3.66) and Interpersonal Skills (0.263) are significant (also $P < 0.05$ from ANOVA table). This suggests MUSE students are most concerned with their interactions with other students while working in groups. For Creativity/Innovation, the skills of Persuasion, Continuous Learning, and Self-Management are most significant with $P < 0.05$ from ANOVA. The regression coefficients indicate that Persuasion and Continuous Learning have positive influence and Self-Management has negative influence on Creativity/Innovation. Personal Effectiveness (7) demonstrates that MUSE students are most successful and effective when Leadership (0.180) and Goal Orientation (0.38) skills are mastered both having positive influence on Personal Effectiveness. Both Leadership and Goal Orientation are significant ($P < 0.05$) from ANOVA.

Conclusions

Statistical Analyses

The objective of this study is to find means by which to implement statistical methods to analyze and interpret data collected from MUSE students while gaining experience with the real-world applications of statistics. The data analyses performed in this study indicate that MUSE is doing well in terms of building a culture that fosters growth for potential engineers. This is evident in the two DISC behaviors that were consistently higher of the four in the DISC analyses; that is S - Steadiness and C - Conscientiousness. This trend is consistent with TTI's DISC assessments; however, TTI would also conclude that Mercer students should strive to lower their levels of D - Dominance and I - Influence in order to achieve the ideal DISC balance of lower DI and higher SC. Table 10 outlines several points that TTI suggests for achieving the low D and I in

DISC Behavior Styles. Students at Mercer should try to implement these habits into their academic routine for success[11].

Table 10. Recommendation for students with high D and high I[3]

Help for High D Students	Help for High I Students
• Plan ahead – don't put off completing assignments until the last minute. • Set up an area in your room for studying only. • Work on your listening skills. • Organize your study area and keep it organized. • Break big assignments into smaller units. • Think visually – convert words into pictures.	• Don't doodle • Use short sentences when taking notes – leave out unnecessary words. • Review your notes after class. • Listen for ideas and the facts to support the idea. • Review notes from previous classes to prepare yourself for a new class. • Take vigorous notes. • Analyze your time and see how you are spending it. • Socialize after studying – not before.

In terms of the Six Attitudes, trends were most noticeable by gender where females seem to demonstrate more Social and Aesthetic attitudes, while males projected obvious Utilitarian attitudes. One might digress that the females at MUSE are more concerned with how they can contribute to the engineering industry while males are more intrigued by probable success as a result of the work they put in. Both genders did however demonstrate Traditional and Theoretical attitudes. MUSE is also helping students grow and adapt new tendencies and traits.

The study completed on the 23 People Skills demonstrated that most MUSE students improve in 19 of the 23 areas by the time they are seniors, but lose mastery of skills in Conflict Management, Creativity/Innovation, Persuasion, and Empathy. This finding proves that there exists a recognizable need for the implementation of a program(s) to help enhance the People Skills of MUSE students. Additionally, it can be concluded that the profile of incoming freshmen consists of the more males than females, poor problem-solving skills and conscientiousness, and a mixture of individualistic and utilitarian attitudes[11].

Discrepancies

Throughout this study several discrepancies were taken into account when concluding the results. Most of those were attributed to the small population size acquired and the even small sample sizes for the sophomore and junior class, which were six and nine, respectively. Given these figures, much of the response data associated with the sophomore and junior classes behaved similar to outliers in any statistical analysis; thus making the data skewed to either freshmen, seniors, or somewhere in between depending on their outlaying positions for any given study.

No major discrepancies were noted in terms of gender, seeing as the 3:1 male to female ratio (approximated from 73% male to 27% female population in this study) was realistic in contrast to most co-educational engineering institutions.

Shortcomings

In this paper, comparisons were made between freshmen and seniors in terms of changes in their personal attributes and skills (results presented in Table 9 and Figures 7). It is to be noted that

Mercer freshmen and seniors who participated in this study are different individuals, not the same individuals. This is not a longitudinal study of individuals who experienced engineering education at MUSE. Therefore it is difficult to draw proper conclusions about changes in personal attributes and skills given the fact that this is not the same student cohort.

Learning Experience

Given the analyses conducted throughout this study, it was possible to explore the depths and effectiveness of statistical techniques used, such as the Spider Charts and how they enable easy visualization for comparing multiple variables. Additionally, one was able to see the benefits of ANOVA tables as a preliminary test to rule out unnecessary statistical methods and proceed with those most appropriate.

Recommendations and Future Work

The study results indicate that MUSE should focus on:

- Identifying high DI students at freshmen level from TTI survey results and helping those individuals to lower their levels of DI by improving their study habits to increase the retention rate of freshmen engineering students;
- Developing and implementing methods to lower the levels of DI among the incoming freshmen in order to achieve the ideal DISC balance of lower DI and higher SC;
- Conducting longitudinal study of individuals who experience engineering education at MUSE to identify real changes in personal attributes and skills of individual students;
- Developing and offering courses and course modules on innovation and entrepreneurship throughout the engineering curriculum (freshman through senior years) and promoting extra-curricular activities to instill entrepreneurial mindset and improve the needed personal attributes and professional skills of both male and female MUSE students.

There are several things that can be done to improve this experiment in the future. In some cases, such as female sophomores, the data seems to be skewed by low sample sizes while the overall data is more skewed towards males as well. This is to be expected, as a higher percentage of students that come through MUSE are male. However, it may be optimal to collect data over a period of years to obtain a larger sample size and reduce the variance. Based on the conclusions for the people skills, it is recommended that Mercer proceed with setup of academic-based programs to strengthen the low-ranking people skills as highlighted previously. Other studies could include comparisons between the intellectual growth patterns of undergraduate and graduate students at MUSE, what personal attributes are emphasized in certain engineering disciplines, and determine any significant differences between incoming students with and without prior engineering related work/internship experiences.

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