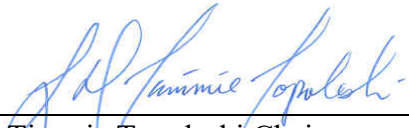


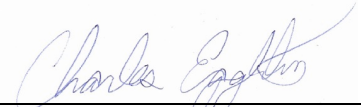
APPROVAL SHEET

Title of Dissertation: Engineering State of Mind Instrument: A tool for Self-Assessment

Name of Candidate: Jamie Rebecca Gurganus
Doctorate of Philosophy in Mechanical Engineering, 2020

Dissertation and Abstract Approved: ()

L.D. Timmie Topoleski Chair
Professor
Mechanical Engineering

()

Charles Eggleton Co-Chair
Professor
Mechanical Engineering

Date Approved: 30 July 2020

ABSTRACT

Title of Document: **ENGINEERING STATE OF MIND INSTRUMENT: A TOOL FOR SELF-ASSESSMENT**

Jamie Rebecca Gurganus, Doctorate of Philosophy in
Mechanical Engineering, 2020

Directed By: Professor L.D. Timmie Topoleski – Chair
Mechanical Engineering Department

Professor Charles Eggleton Co-Chair
Mechanical Engineering Department

Students in their first and second year in an engineering major often experience an internal struggle. They wonder if they are meant to be an engineer and if they will be successful in their program, even if they are in good academic standing. Sometimes students seek advice from an advisor, peer, or mentor, and often they do nothing at all. This has shown to unfortunately cause students to switch or leave the STEM field all together. To contribute to improving retention and increase the likelihood of success for students in engineering programs, an instrument was developed that would allow students to self-assess their “Engineering State of Mind,” and then provide them with intervention recommendations based on their assessment. This Engineering State of Mind Instrument (ESMI) was developed from validated surveys and includes a student’s attitudes, perceptions, and self-efficacy toward engineering. The Social Cognitive Career theory was used as the framework in the development of the ESMI. To assess the instrument, juniors and seniors, and freshmen in the college’s first year engineering course (Engineering 101 with ~280 students) were evaluated. Engineering 101 is a required course and exposes the students to all of the engineering disciplines offered at UMBC (mechanical, computer, and chemical engineering). To assess the impact of the instrument, discussion sections in Engineering 101 were divided into four experimental groups, each receiving a different treatment to compare potential effects of the ESMI and subsequent interventions. Students who received the ESMI at the beginning and end of the semester and had interventions, displayed improvement in all variables. The students who didn’t participate in the ESMI at the beginning or have interventions showed some or no improvement at all. These results were consistent across gender, ethnicity, and/or program affiliations. A follow-up impact survey supported these results, reiterating the benefit from and need for an engineering self-assessing instrument.

ENGINEERING STATE OF MIND INSTRUMENT: A TOOL FOR SELF-ASSESSMENT

By

Jamie Rebecca Gurganus

Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, Baltimore County, in partial fulfillment
of the requirements for the degree of
Doctorate in Mechanical Engineering
2020

© Copyright by
Jamie Rebecca Gurganus
2020

Dedication

I first dedicate this dissertation to the memory of my Father, favorite engineer and rockin' roller, Wayne H. Medoff, an engineer for over 45 years who never failed to believe in my capabilities.

Thank you, Dad, for inspiring me to be an engineer. I will miss you always.

Additionally, to the Memory of Mr. James Malini, Assistant Dean to the College of Engineering and Information Technology who served as my personal cheerleader/mentor/friend and inspired so many at UMBC.

Acknowledgements

It takes a community and the encouragement of many to be able to accomplish the biggest challenges. There are so many individuals I wish to acknowledge that have helped me achieve such an amazing goal. I must first give thanks and glory to my Father God in Heaven. He has been my solid rock and never fails. I am so grateful for the favor and blessings and how I have developed by going through this challenge in completing my doctorate.

I would like to thank my Committee which consisted of my advisors, mentors, colleagues, and friends. Each one of you truly inspires me and has helped me become the researcher and instructor I am today. Dr. Tim Topoleski, and Dr. Charles Eggleton, Chair and Co-Chair. Tim and Chuck, I cannot thank you enough in how you both stood with me and believed in my abilities and this work. Without your persistence and faith in me, this would not have come to completion. I adore and value you. Tim, you not only jumped in, but you enhanced and cared for the invaluable nature of what this work represents. Chuck, even as an undergraduate student, you always supported my love for this field and never questioned its worth. I know it has been a long journey, but it would not have been the same without you fighting by my side.

Dr. Liang Zhu, who has shown such passion in engineering education and is making such a difference in our community. Thank you for how you are changing the face and representation through your work.

Dr. Matt Ohland who is just an incredible inspiration in the engineering education field. You, without hesitation, opened your arms to me and have been nothing but an essential resource and wonderful friend. Your joy is so infectious, and I am looking forward to continuing to learn from you.

Dr. Anne Spence, you recognized my passion for this field even in my undergraduate years. I am honored to have worked under you, with you, and to continue the fight in changing minds and culture in this essential field. Thank you for providing me with such a strong foundation so that my house will always be growing and never falter. You will always be Wonder Woman to me!

To my family. My Father, Wayne Medoff, who I unfortunately lost before he could see this completed document. You were my rock; my true fan and I will miss you always. I am tearing up just writing this message. I can't wait to see you again. I know you were and are so very proud of me and I was always so proud of you. Thank you for the silly, hard, and deep conversations. Even before I defended, I was crying on your shoulder and you told me with great confidence, I was going to be great. There was never a doubt in your mind. My Mom, Meg Medoff, thank you for being that role model in how women can persevere through anything. You climbed your mountain and raised two strong girls. You dealt with the pressure of being a woman in a male dominated field. That left a lasting impression in my life. Because of your example, I am that independent perseverant woman. To my sister Colleen. Thank you for your support and love. I admire that you continue to live and love to the fullest despite any challenges. You are raising a wonderful and inspirational daughter who is strong, brilliant, and creative like her Mom. Alyssa, my niece, keep going and take those chances. You have a story to share and you are already making an impact on the world. I am so very proud of you.

Damian Doyle, I am so grateful God blessed you in my life. You were my cheerleader, counselor, editor, and sounding board. I will not forget the very long nights and how you brought me food and counsel. The continued long nights and how you helped with adjustments

throughout. You encouraged me and continued to believe in my abilities. Thank you for showing love for my work, research and even when I had hard teaching days. Thank you for your unfailing support and sacrifice.

James Gurganus, your friendship and constant support and love has meant everything to me. The days and nights when I was on the phone with you crying and stressed. How you spoke life into me and prayed for me. How you told me you knew I could do this, and was meant to do this. I am so proud of you in what you are doing for God and his people.

Dr. Maria Sanchez, thank you for your continuing support and belief in my work and the field. Thank you for making accommodations when I needed the time to write the dissertation. You are a wonderful colleague and friend and inspiration to so many!

Dr. Neil Rothman, thank you for asking all the hard questions! I love your authentic nature and rational thinking. Thank you for being there to listen on my days that were tough and giving me the ‘hug’ that I needed.

Dr. Chuck LaBerge, I have learned and grown since working with you. You’ve made such a legacy. Thank you for showing support and care and believing in my work. I am honored to work with such a fun, creative and fantastic individual. I couldn’t have been more honored the day you told the class to call me “Dr. Prof. G.”

Dean Keith Bowman, words cannot express my thanks for how much your support and mentorship has meant to me. I am grateful for such an amazing Dean who shows care towards students, staff, and faculty alike. You are such an authentic and empowering force in our university. I have learned and grown so much, and I hope to continue to support the mission of creating a thriving culture that is inclusive to engineering and computing education research.

Dr. Ruey Chen, I could not have asked for such a caring supportive chair. Thank you for not only supporting and believing in this work and the engineering education field but also for wanting the best for our students and our community. I am so grateful to work with a chair who wants to better the experiences for our faculty, staff and students.

Dr. Ronghui Ma, we make a great team! You are a great friend to me, and I cherish our time and talks. I look forward to continuing to make mechanical engineering the best environment for our students.

Karen Roulette, without you I would never have had the time to be able to accomplish this work! You made it so easy. You checked up on me, took care of the details and made sure my classes and programs ran as smooth and free of error. You are such a great friend to me.

Diane Zeenny Ghorayeb, I am so grateful you came into our department! I couldn’t have asked for a more incredible friend and cheerleader. You make the department thrive and shine! Thank you for believing in me.

Connie Bailey, as with Diane, I am so grateful for you and how easy you have made our lives. Thank you for also being there and covering for me while completing this important task.

Chuck Smithson, thank you for the long-time support and friendship. You always were a big fan and you were never failing whenever I needed assistance or last-minute details. You were such an encouragement to many.

Rehana Shafi, you were there in the beginning when I fell in love with engineering education. Thank you for leading the TEPP program. I am so grateful to continue to have you as a friend and colleague after all this time!

Kristen Suggs and Stacey Stevens who never failed to cheer me on and believe in my crazy ways. I could not have met better friends 7 years ago. We don’t see much of each other,

but we never fail to pick up where we left off. Your text messages and prayers always got me through. I love you both forever!

Nes Robinson (Coleman), my longest and best friend from college. You are such an incredible woman. I adore you and admire how you love. Thank you for just being there, especially during the hardest times in my life, including the loss of my Father.

FLL Committee, who adjusted their time so I could study for qualifiers, write this dissertation and so much more.

A special big thank you to Shannon Clancy who just continued to show passion and love toward this work even after graduation. I am so proud of you and I can't wait to call you Dr. Clancy.

Also, to Ryan Reinhardt and Richard Blorstad who spent hours helping to develop the algorithms and code of the ESMI. Thank you for showing your love and care for this research.

My AE3 research group who has become a big part of my life, Dr. Greg Strimmel, Dr. Tanner Huffman and Dr. Michael Grubbs. Thank you for continuing to encourage and support me throughout this entire process.

De'Shaunna Scott, Alli Warner, Julianna Posey, Juliet Schiek. I am so proud of all of you amazing women. I cannot wait to see you thrive and make your dent in this world. I am and was so honored to have had you as students and now colleagues and friends. You are so special to me.

I know I am missing so many others who never failed me and always stood by my side. Robin and Jim Gurganus, Sharyn and Ed Doyle, Meyerhoff family, Mechanical Engineering Family and the UMBC community.

Table of Contents

Chapter 1: Introduction	1
1.1 Background and Statement of the Problem	1
1.1.1 National Best Practices to Retain Students in Their First Year	3
1.1.2 Current strategies at UMBC to help students in their First Year	3
1.1.3 Honors College	5
1.1.4 Center for Women in Technology and Meyerhoff Scholar Program.....	6
1.1.4.1 The Center for Women in Technology	6
1.1.4.2 Meyerhoff Scholar Program	8
1.1.5 Major Scholar Programs	8
1.2 Context of the Study	9
1.2.1 Self-Assessment and Anxiety	9
1.3 Research Questions	12
1.4 Foundations of the Study.....	14
1.5 Terms and Definitions	15
Chapter 2: Review of Literature	20
2.1 Introduction	20
2.2 Social Cognitive Career Theory: Influences of Career Choices.	20
2.3 Retention and Engineering.....	21
2.4 Constructs of engineering students and why they leave their program; Self-efficacy, Engineering Self-efficacy, Motivation.....	23
2.4.1 Self-efficacy.....	24
2.4.2 Engineering self-efficacy.....	25
2.4.3 Engineering Self-efficacy and Persistence	25
2.4.4 Anxiety and its effect on self-efficacy	26
2.4.5 Motivation	27
2.5 Self-Assessment.....	28
2.5.1 Rationale for Enhancing Self- Assessment	29
2.6 Current high impact practices that help retain students in engineering.....	31
2.6.1 Current Engineering Interventions - High Impact Practices	31
2.6.2 Mentoring & Advising.....	32
2.6.3 Peer Mentoring	33
2.6.4 Undergraduate Research	34
2.6.5 Engineering Co-ops and Internships.....	35
2.6.6 Co-Ops	36
2.6.7 Internships	36
2.6.8 Living Learning Communities and Centers.....	37
2.6.9 Summer Bridge Programs.....	38
2.6.10 Service and Community Based Learning	39
2.6.11 Tutoring	41
2.6.12 First Year Experiences	41
2.7 Summary	43
Chapter 3: Methods.....	45

3.1 Research Design.....	47
3.2 Population	49
3.2.1 College of Engineering and Information Technology (COEIT) Population	49
3.2.2 Participants	51
3.2.3 Introduction to Engineering 101 Students	52
3.2.4 Sophomore Mechanical Engineering 204 Students:.....	55
3.2.5 Qualitative Survey Information.	57
3.3 Research Instruments	58
3.3.1 Engineering State of Mind Instrument (ESMI)	58
3.3.2 Description of the Five Instruments in ESMI	59
3.3.3 Measurement in Engineering State of Mind Instrument: Rationale for Psychometrics	61
3.3.4 Reliability.....	62
3.3.5 Construction of the Instrument and Website	66
3.3.6 Qualitative Impact Survey (Post-ESMI).....	68
3.3.8 Coding.....	69
3.4 Procedure	70
3.4.1 Dissemination of the ESMI	71
3.4.2 Juniors and Seniors Aim #1	71
3.4.3 Engineering Science 101 Fall 2019 Aim #2.....	72
3.4.4 Follow-up Impact Survey Aim #3.....	75
3.4.5 Mechanical Engineering Sophomore Class	76
3.5 Data Analysis	76
3.5.1 Quantitative	76
3.5.2 Qualitative	78
3.6 Summary	78
Chapter 4 – Results	79
4.1 Introduction	79
4.2 Data Assessment - Juniors and Seniors (Table E1)	79
4.2.1 Social Persuasion and Vicarious Experiences (SPVE) Assessment (Table E2)	80
81	
4.2.2 Gender Social Persuasion and Vicarious Experiences (SPVE) Assessment (Table E3)	81
4.2.3 Ethnic (SPVE) Junior and Seniors Assessment (Table E4)	81
4.2.4 Program Affiliation (SPVE) Assessment (Table E5)	82
4.2.5 Correlations of SPVE Relationships and Assessment (Table E6)	83
4.2.6 Mastery Experiences (ME) Assessment (Table E7).....	83
4.2.7 Gender Mastery Experiences (ME) Assessment (Table E8).....	84
4.2.8 Ethnic Mastery Experiences (ME) Assessment Juniors and Seniors (Table E9).....	85
4.2.9 Program Affiliation Mastery Experiences (ME) (Table E10)	86
4.2.10 Correlations Mastery Experiences (ME) Assessment Juniors and Seniors (Table E11).....	86
4.2.11 Emotional States Experiences Assessment Juniors and Seniors (Table E12)	87
4.2.12 Gender Emotional States Assessment Juniors and Seniors (Table E13)	87
4.2.13 Ethnic Emotional States Assessment Juniors and Seniors (Table E14)	88
4.2.14 Program Affiliation Emotional States Assessment Juniors and Seniors (Table E15)	88
4.2.15 Correlations Emotional States Assessment Juniors and Seniors (Table E16)	88
4.3 Engineering 101 (ENES 101) Fall 2019 Pre-Assessment Data.....	88
4.3.1 Confidence in completing an Engineering Degree ENES 101 (Table E17).....	89
4.3.2 Social Persuasion and Vicarious Experiences (SPVE): Overall (Table E18).....	90

4.3.3 Social Persuasion and Vicarious Experiences (SPVE) Gender (Table E19)	90
4.3.4 Social Persuasion and Vicarious Experiences (SPVE: Ethnic Pre-Assessment for ENES 101 (Table E20)	92
4.3.5 SPVE: Program Affiliation Pre- Assessment ENES 101 (Table E21)	93
4.3.6 Correlations for the Population SPVE Variables (Table E22)	95
4.3.7 Mastery Experiences: Pre-Assessment ENES 101 (Table E23)	95
4.3.8 Mastery Experiences: Gender Pre- Assessment ENES 101 (Table E24)	96
4.3.9 Mastery Experiences: Ethnic Pre- Assessment ENES 101 (Table E25)	98
4.3.10 Mastery Experiences: Program Affiliation Pre- Assessment ENES 101 (Table E26)	98
4.3.11 Correlations Between the Population Mastery Experiences Variables (Table E27)	98
4.3.12 Emotional States Pre-Assessment ENES 101 (Table E28)	99
4.3.13 Emotional States: Gender Pre-Assessment ENES 101 (Table E29)	100
4.3.14 Emotional States Ethnic Pre-Assessment (Table E30)	101
4.3.15 Emotional States: Program Affiliation Pre-Assessment ENES 101 (Table E31)	103
4.3.16 Correlations for the Population Emotional States (Table E32)	104
4.4 Engineering 101 Post-Assessment Data	105
4.4.1 Confidence in Completing an Engineering Degree (Table E33)	105
4.4.2 Social Persuasion and Vicarious Experiences (SPVE): Overall (Table E34)	106
Intrinsic Psychological $\eta^2=.038$	107
4.4.3 SPVE: Gender Between Groups (Table E35)	107
4.4.4 SPVE: Overall Gender (Table E36)	108
4.4.5 SPVE: Ethnic Between Groups (Table E37)	110
4.4.6 SPVE: Overall Ethnic (Table E38)	113
4.4.7 SPVE: Program Affiliation Between Groups (Table E39)	114
4.4.8 SPVE: Overall Program Affiliation (Table E40)	116
4.4.9 SPVE: Correlations Between the Population Variables (Table E41-E45)	118
4.4.10 Mastery Experiences (ME) (Table E46)	120
4.4.11 Mastery Experiences (ME): Gender Between Groups (Table E47)	121
4.4.12 ME: Overall Population (Table E48)	123
4.4.13 ME: Ethnic Between Groups (Table E49)	124
4.4.14 ME: Overall Ethnic (Table E50)	126
4.4.15 ME: Program Affiliation (Table E51)	127
4.4.16 ME: Overall Program Affiliation (Table E52)	129
4.4.17 ME: Mastery Experiences Correlations for the Population (Table E53-E56)	130
4.4.18 ME: Overall Population Correlations Mastery Experiences (Table E57)	130
4.4.19 Emotional States Post Assessment ENES 101 (Table E58)	131
4.4.20 Emotional States: Gender (Table E59)	132
4.4.21 Emotional States: Overall Gender (Table E60)	133
4.4.22 Emotional States: Ethnic Between Groups (Table E61)	135
4.4.23 Emotional States: Overall (Table E61)	137
4.4.24 Emotional States: Program Affiliation Between Groups (Table E62)	137
4.4.25 Emotional States: Overall Program Affiliation (Table E63)	139
4.4.26 Emotional States: Correlations for the Population (Tables E64- E68)	139
4.5 Comparison of Pre-Semester and Post-Semester Group #1 and #2 (Table E69 and E70)	140
4.5.1 SPVE: Pre and Post Responses (Table E71 and E72)	142
4.5.2 SPVE: Gender (Table E73 and E74)	144
4.5.3 SPVE: Ethnic (Table E75 and E76)	146
4.5.4 SPVE: Program Affiliation (Tables E77 and E78)	150
4.5.5. Mastery Experiences (ME): Overall (Table E79 and E80)	152
4.5.6 ME: Gender (Table E81 and E82)	154
4.5.7 ME: Ethnic (Tables E83 and E84)	156

4.5.8 ME: Pre and Post Mastery Experiences (ME) Program Affiliation (Tables E85 and E86).....	158
4.5.9 Emotional States: Overall (Table E87 and E88).....	160
4.5.10 Emotional States: Gender (Tables E89 and E90)	162
4.5.11 Emotional States: Ethnic (Table E91 and E92)	164
4.5.12 Emotional States: Program Affiliation (Tables E93 and E94)	168
4.6 Follow-up Impact Survey.....	170
4.7 Case Study Mechanical Engineering Sophomores and Post Freshman	174
4.7.1 ENME 204 and ENES 101 Mechanical Engineering Confidence	174
4.7.2 ENME 204 and ENES 101 Mechanical Engineering SPVE.....	175
4.7.3 Correlations SPVE ENME 204	176
4.7.4 ENME 204 and ENES 101 Mechanical Engineering Mastery Experiences.....	176
4.7.5 Correlations Mastery Experiences ENME 204.....	177
4.7.6 ENME 204 and ENES 101 Mechanical Engineering Emotional States	178
4.7.7 Correlations Emotional States ENME 204	179
Chapter V: Discussion.....	180
5.1 Junior & Senior Engineering State of Mind – Aim #1	181
5.1.1 Confidence in Completing an Engineering Degree.....	181
5.1.2 Social Persuasion and Vicarious Experiences (SPVE): Motivations to Pursue Engineering	182
5.1.3: SPVE: Correlations	184
5.1.4 Mastery Experiences: Overall.....	184
5.1.5 Mastery Experience: Correlations.	185
5.1.6 Emotional State: Overall	185
5.1.7 Emotional State: Correlations.	186
5.2 Engineering 101 population Engineering State of Mind - Aim #2	187
5.2.1 Pre-Assessment of Engineering 101(ENES 101): Group #1 and Group #2.....	187
5.2.1.1 SPVE: Pre-Assessment	187
5.2.1.2 SPVE: Pre-Assessment Correlations	189
5.2.1.3 Mastery Experiences Pre-Assessment.....	190
5.2.1.4 Mastery Experience: Pre-Assessment Correlations.....	191
5.2.1.5 Emotional States: Pre-Assessment.....	191
5.2.1.6 Emotional States: Pre-Assessment Correlations	193
5.2.1.7 Confidence in Completing Engineering Degree Beginning and Present.....	193
5.2.2 Engineering 101 Post-Assessment Data	193
5.2.2.1 Social Persuasion and Vicarious Experiences (SPVE) Post Assessment (All Groups).....	193
5.2.2.2.1 SPVE Post Assessment: Gender.....	194
5.2.2.2.2 SPVE Post Assessment: Ethnic	196
5.2.2.2.3 SPVE Post Assessment: Program Affiliation	196
5.2.2.2.4 SPVE Post Assessment: Correlations	198
5.2.2.3 Mastery Experiences Variables: Post-Assessment.....	200
5.2.2.3.1 Mastery Experiences Variables: Gender	201
5.2.2.3.2 Mastery Experiences Variables: Ethnic.....	201
5.2.2.3.3 Mastery Experiences Variables: Program Affiliation.....	202
5.2.2.3.4 Mastery Experience Post Assessment: Correlations.....	203
5.2.2.4 Emotional State Variables: Post-Assessment	203
5.2.2.4.1 Emotional State Variables: Post-Assessment Gender.....	203
5.2.2.4.2 Emotional State Variables: Post-Assessment Ethnic	205
5.2.2.3.3 Emotional State Variables: Post-Assessment Program Affiliation	206
5.2.2.3.4 Emotional States Post Assessment: Correlations.....	207

5.3 How do first year engineering students' perceptions change after a gained understanding of their Engineering State of Mind? – Aim #3	208
5.3.1 Pre-Post Group #1 and Group #2 Comparison -Aim#3	208
5.3.2 Pre and Post Social Persuasion and Vicarious Experiences (SPVE)	208
5.3.2.1 Pre and Post SPVE: Gender	209
5.3.2.2 Pre and Post SPVE: Ethnic	210
5.3.2.3 Pre and Post SPVE: Program Affiliation	212
5.3.3 Pre and Post Mastery Experiences (ME) – Group #1 and Group #2	213
5.3.3.1 Pre and Post Mastery Experiences (ME): Gender	213
5.3.3.2 Pre and Post Mastery Experiences (ME): Ethnic	214
5.3.3.3 Pre and Post Mastery Experiences (ME): Program Affiliation	216
5.3.4 Pre and Post Emotional States	217
5.3.4.1 Pre and Post Emotional States: Gender	217
5.3.4.2 Pre and Post Emotional States: Ethnic	218
5.3.4.3 Pre and Post Emotional States: Program Affiliation	219
5.3.5 Confidence in Completing Engineering Degree	219
5.4 Qualitative Impact Post- Survey	220
5.4.1 Profiles helped relate to engineers with difficulties – AIM #1	221
5.4.2 Value and connection of engineering skills and practices (professional and technical skills) to themselves beyond the classroom – AIM #2	222
5.4.3 ESMI – Reflection of attitude, perception, and value - AIM #2	224
5.4.4 Reinforcement as Engineer (Retention) - AIM #2 & #3	226
5.4.5 Expanded understanding of Engineering - AIM #2 & #3	227
5.4.6 Feedback on Survey	228
5.5 Sophomore Mechanical Engineering and Post-Freshman	231
Chapter 6: Conclusions, Future Work and Limitations	233
6.1 Summary of Findings and Conclusions	233
6.1.1 Confidence in Graduation	234
6.1.2 Social Persuasion and Vicarious Experiences	235
6.1.3 Master Experiences	237
6.1.4 Emotional States	238
6.2 Limitations of Study.....	240
6.3 Future Work.....	241
6.3.1 Further Development of the ESMI	242
6.3.2 Linear Regression Analysis to Predict Confidence	242
6.3.3 Enhancing Engineering Advising to Consider the “Complete Student”	242
6.3.4 Analyzing and Evaluating the Engineering Mindset of Non-Traditional Students	243
6.3.5 Final Thoughts	244
Appendix A.....	246
Appendix B.....	281
Appendix C.....	287
Appendix D.....	292
Appendix E	295
Appendix F	393

<i>Appendix G.....</i>	<i>413</i>
<i>References.....</i>	<i>427</i>

List of Tables

<i>Table 1: Definitions and Rationale behind Survey</i>	17
<i>Table 3.1: Revealed Themes from Interviews 2011</i>	48
<i>Table 3.2 Variables in Social Cognitive Career Theory Framework.</i>	48
<i>Table 3.3 COEIT Student Demographics</i>	50
<i>Table 3.4: Profiles of Junior and Senior Profiled Engineering Students</i>	52
<i>Table 3.5 Engineering 101 Fall 2019 Demographics</i>	53
<i>Table 3.6 Pre and Post Collection Demographics Introduction Engineering 101</i>	54
<i>Table 3.7 Sophomore Introduction to Engineering Design Demographics</i>	56
<i>Table 3.8 Impact Follow-up Survey Demographics</i>	58
<i>Table 3.9 Survey Items and Internal Consistency</i>	63
<i>Table 3.10: Change in Variable Language</i>	67
<i>Table 3.11: Research Model for ENES 101 Discussions.</i>	74
<i>Table 3.12: Research Model for ENES 101 Discussions.</i>	74
<i>Table 4.2.1 Pairwise Comparison of Beginning Confidence in Junior and Seniors</i>	80
<i>Table 4.2.3a Post Hoc Pairwise Comparisons for Parental Influence between Program Affiliations</i>	83
<i>Table 4.2.3b Post Hoc Mentor Influence Program Affiliation Pairwise Comparisons</i>	83
<i>Table 4.2.4a Post Hoc Perceived Importance of Professional and Interpersonal Pairwise Comparisons</i>	86
<i>Table 4.2.4b Post Hoc Perceived Importance of Math and Science Pairwise Comparisons</i>	86
<i>Table 4.2.4c Post Hoc Mastery Experiences Pairwise Comparisons</i>	86
<i>Table 4.3.1 Post Hoc SPVE Gender Intrinsic Behavioral Pre-Assessment</i>	91
<i>Table 4.3.2a Post Hoc Ethnic Parent Influence</i>	92
<i>Table 4.3.2b Post Hoc Ethnic Intrinsic Psychological</i>	93
<i>Table 4.3.2c Post Hoc Ethnic Intrinsic Behavioral</i>	93
<i>Table 4.3.3a Mentor Influence Pairwise Comparisons Program Affiliation</i>	95
<i>Table 4.3.3b SPVE Pairwise Comparisons Program Affiliation</i>	95
<i>Table 4.3.4a Post Hoc Gender Perceived Importance of Math and Science Skills</i>	97
<i>Table 4.3.4b Post Hoc Gender Mastery Experiences Math and Science Skills</i>	98
<i>Table 4.3.5a Post Hoc Gender Coping Self-Efficacy</i>	101
<i>Table 4.3.5b Post Hoc Gender Emotional Gender</i>	101
<i>Table 4.3.6 Post Hoc Comparisons Coping Self-Efficacy Ethnic</i>	102
<i>Table 4.3.7 Post Hoc Pairwise Comparisons Engineering Career Expectations Program Affiliation</i>	104
<i>Table 4.4.1 Post Hoc Pairwise Comparison Intrinsic Psychological</i>	107
<i>Table 4.4.2a Post Hoc Post-Assessment Gender Mentor Influence</i>	109
<i>Table 4.4.2b Post Hoc Post-Assessment Gender Intrinsic Behavioral</i>	110
<i>Table 4.4.3a Pairwise Comparisons of Parent Influence Ethnic Group</i>	112
<i>Table 4.4.3b Pairwise Comparisons of Motivation - Social Good Ethnic Group</i>	112
<i>Table 4.4.4a Post Hoc Pairwise Comparisons of Parent Influence - Ethnic group entire population</i>	114

<i>Table 4.4.4b Post Hoc Pairwise Comparisons of General Impressions- Ethnic group entire population</i>	114
<i>Table 4.4.5a Post Hoc Pairwise Comparisons of Mentor Influence</i>	116
<i>Table 4.4.5b Pairwise Comparisons of Group Affiliate Program: Intrinsic Psychological</i>	116
<i>Table 4.4.6a Post Hoc Pairwise Comparisons Mentor Influence Program Affiliation</i>	118
<i>Table 4.4.6b Post Hoc Pairwise Comparisons General Impressions Program Affiliation</i>	118
<i>Table 4.4.6c Post Hoc Pairwise Comparisons SVPE Program Affiliation</i>	118
<i>Table 4.4.7a Post Hoc Gender Perceived Importance of Math and Science Skills</i>	122
<i>Table 4.4.7b Post Hoc Gender Mastery Experiences</i>	123
<i>Table 4.4.8 Post Hoc Overall Population Perceived Importance of Math and Science Skills</i>	124
<i>Table 4.4.9a Post Hoc Ethnic Perceived Importance Math and Science Skills</i>	127
<i>Table 4.4.9b Post Hoc Ethnic Mastery Experiences</i>	127
<i>Table 4.4.10 Post Hoc Coping Self-Efficacy Gender Groups</i>	133
<i>Table 4.4.11a Pairwise Comparisons of Gender: Coping Self-Efficacy</i>	134
<i>Table 4.4.11b Pairwise Comparisons of Gender: Emotional States</i>	135
<i>Table 4.4.12a Pairwise Comparisons of Ethnic Group Coping Self-Efficacy</i>	136
<i>Table 4.4.12b Pairwise Comparisons of Ethnic Group Feelings of Inclusion</i>	137
<i>Table 4.4.12c Pairwise Comparisons of Ethnic Group Emotional States</i>	137
<i>Table 4.5.1a Group #2, Social Good Gender Pre & Post</i>	146
<i>Table 4.5.1b Pairwise Comparisons Intrinsic Behavioral Gender Pre & Post Group #2</i>	146
<i>Table 4.5.1c Group #2, SPVE Gender Pre & Post</i>	146
<i>Table 4.5.2a Group #1 SPVE Ethnic Social Good Pre & Post</i>	148
<i>Table 4.5.2b Group #1 SPVE Ethnic Intrinsic Psychological Pre & Post</i>	149
<i>Table 4.5.2c LSD SPVE Ethnic General Impressions of Engineering Pre & Post Group #1</i>	149
<i>Table 4.5.3a Group #2, Ethnic Parent Influence</i>	149
<i>Table 4.5.3b Group #2 Ethnic Social Good</i>	150
<i>Table 4.5.3c Group #2 Ethnic Intrinsic Behavioral</i>	150
<i>Table 4.5.4a Mentor Influence Program Affiliation</i>	152
<i>Table 4.5.4b Intrinsic Behavioral Program Affiliation</i>	152
<i>Table 4.5.5a Pairwise Comparison Gender Perceived Importance of Professional and Interpersonal Skills</i>	155
<i>Table 4.5.5b Pairwise Comparison Gender Perceived Importance of Math and Science Skills</i>	156
<i>Table 4.5.6c Pairwise Comparison Gender Mastery Experiences</i>	156
<i>Table 4.5.7 LSD Perceived Importance of Professional and Interpersonal Skills</i>	158
<i>Table 4.5.8 Professional and Interpersonal Skills Group #1, Pre & Post</i>	159
<i>Table 4.5.9 Pairwise Comparison Professional and Interpersonal Skills Group #2 Pre & Post</i>	160
<i>Table 4.5.10a Pairwise Comparisons of Coping Self-Efficacy</i>	164
<i>Table 4.5.10b Pairwise Comparisons of Feelings of Inclusion Group #2</i>	164
<i>Table 4.5.10c Pairwise Comparisons of Emotional States Group #2</i>	164
<i>Table 4.5.11a Pairwise Comparisons of Coping Self-Efficacy Ethnic Group #1</i>	166
<i>Table 4.5.11b Pairwise Comparisons of Engineering Career Success Expectations Group #1</i>	166

<i>Table 4.5.11c Pairwise Comparisons of Feelings of Inclusion Ethnic Group #1</i>	167
<i>Table 4.5.11d Pairwise Comparisons of Emotional States Ethnic Group #1</i>	167
<i>Table 4.5.12 Pairwise Comparisons of Feelings of Inclusion Ethnic Group #2</i>	167
<i>Table 4.6.1 Open ended Questions and Themes Impact Survey</i>	172
<i>Table 4.7.1 Post Hoc Pairwise Comparison Feelings of Inclusion ENME 204 and ENES 101</i>	178

List of Figures

<i>Figure 1: T-Shaped Engineer</i>	11
<i>Figure 4.2.1 Confidence level of Profiled Junior and Senior Students</i>	80
<i>Figure 4.2.2 SPVE Means of Juniors and Seniors</i>	81
<i>Figure 4.2.3 Program Affiliation Means of Juniors and Seniors</i>	82
<i>Figure 4.2.4 Mastery Experiences Means of Juniors and Seniors</i>	84
<i>Figure 4.2.5 Ethnic Means Mastery Experiences of Junior & Seniors</i>	85
<i>Figure 4.2.6 Gender Emotional State Means of Junior & Seniors</i>	87
<i>Figure 4.3.1 Pre-ENES 101 Confidence in Completing and Engineering Degree</i>	89
<i>Figure 4.3.2 SPVE Means for SPVE Pre-Assessment (Group#1 and Group#2)</i>	90
<i>Figure 4.3.3 SPVE Gender Means ENES 101 Pre-Assessment</i>	91
<i>Figure 4.3.4 Ethnic Means ENES 101 Pre-Assessment</i>	92
<i>Figure 4.3.5 Program Affiliation Means ENES 101 Pre-Assessment</i>	94
<i>Figure 4.3.6 Mastery Experiences Means Pre-Assessment ENES 101</i>	96
<i>Figure 4.3.7 Mastery Experiences Gender Pre-Assessment ENES 101</i>	97
<i>Figure 4.3.8 Emotional States Means Pre-Assessment</i>	99
<i>Figure 4.3.9 Emotional States Gender Means Pre-Assessment</i>	100
<i>Figure 4.3.10 Emotional Ethnic Pre-Assessment ENES 101</i>	102
<i>Figure 4.3.11 Emotional Program Affiliation Pre-Assessment ENES 101</i>	103
<i>Figure 4.4.1 Group#1 - #4 Beginning & Present Confidence Post -Assessment</i>	105
<i>Figure 4.4.2 Post-Assessment SPVE Groups</i>	106
<i>Figure 4.4.3a Group#1 & #3 SPVE Gender Means Post-Assessment (without interventions)</i>	107
<i>Figure 4.4.3b Group#2 & #4 SPVE Gender Means Post-Assessment (with interventions)</i>	108
<i>Figure 4.4.4 SPVE Gender Means ENES 101 Post-Assessment</i>	109
<i>Figure 4.4.5a Group #1 & Group #3 Means ENES 101 Post-Assessment</i>	111
<i>Figure 4.4.5b Group #2 & Group #4 Means ENES 101 Post-Assessment</i>	111
<i>Figure 4.4.6 Post-Assessment ENES 101 Ethnic Group</i>	113
<i>Figure 4.4.7a Group#1 & Group#3 Means SPVE Program Affiliation</i>	115
<i>Figure 4.4.7b Group#2 & Group#4 Means SPVE Program Affiliation</i>	115
<i>Figure 4.4.8 SPVE ENES 101 Program Affiliation Post-Assessment</i>	117
<i>Figure 4.4.9 Mastery Experiences ENES 101 Post-Assessment</i>	120
<i>Figure 4.4.10a Gender Mastery Experiences ENES 101 Post-Assessment</i>	121
<i>Figure 4.4.10b Group Two and Four Gender Mastery Experiences ENES 101 Post-Assessment</i>	122
<i>Figure 4.4.11 ENES 101 Gender Mastery Experiences,</i>	123
<i>Figure 4.4.12a Group #1 and #3 Mastery Experiences Ethnic Affiliation</i>	124
<i>Figure 4.4.12b Group #2 and #4 Mastery Experiences Ethnic Affiliation</i>	125
<i>Figure 4.4.13 Mastery Experiences Means Ethnic Affiliation ENES 101</i>	126

<i>Figure 4.4.14a Group#1 & Group#3 Mastery Experiences Means Program Affiliation ENES 101</i>	128
<i>Figure 4.4.14b Group#2 & Group#4 Mastery Experiences Means Program Affiliation ENES 101</i>	128
<i>Figure 4.4.15 Mastery Experiences Means Program Affiliation ENES 101</i>	129
<i>Figure 4.4.16 Emotional States Groups ENES 101 Post-Assessment ENES 101</i>	131
<i>Figure 4.4.17a Emotional States Gender Group#1 & #3 Post-Assessment</i>	132
<i>Figure 4.4.17b Emotional States Gender Group#2 & #4 Post-Assessment</i>	133
<i>Figure 4.4.18 Emotional States Gender, ENES 101 Post-Assessment</i>	134
<i>Figure 4.4.19a Emotional States Ethnic Affiliation Group #1 and #3</i>	135
<i>Figure 4.4.19b Emotional States Ethnic Affiliation Group #2 and #4</i>	136
<i>Figure 4.4.20a Emotional States Program Affiliation Group #1 and #3</i>	138
<i>Figure 4.4.20b Emotional States Program Affiliation Group #2 and #4</i>	138
<i>Figure 4.5.1a Pre-Post Comparison Confidence Group #1</i>	141
<i>Figure 4.5.1b Pre and Post Confidence in Graduating Group #2</i>	142
<i>Figure 4.5.2a Pre & Post SPVE Tuesday Group #1</i>	143
<i>Figure 4.5.2b Pre & Post SPVE Group#2</i>	144
<i>Figure 4.5.3a Pre& Post Gender SPVE Group #1 SVPE</i>	145
<i>Figure 4.5.3b Pre & Post Gender Group #2 SVPE</i>	145
<i>Figure 4.5.4a Group #1 Ethnic Groups SPVE Means</i>	147
<i>Figure 4.5.4b Group #2 Ethnic Groups SPVE</i>	148
<i>Figure 4.5.5a Group #1 Program Affiliation Groups SPVE Means</i>	151
<i>Figure 4.5.5b Group #2 Program Affiliation Groups SPVE Means</i>	151
<i>Figure 4.5.6a Mastery Experiences Pre & Post Group #1</i>	153
<i>Figure 4.5.6b Mastery Experiences Pre & Post Group #2</i>	153
<i>Figure 4.5.7a Pre& Post Mastery Experiences Group #1 Gender</i>	154
<i>Figure 4.5.7b Pre& Post Mastery Experiences Group #2 Gender</i>	155
<i>Figure 4.5.8a Pre& Post Mastery Experiences Group #1 Ethnic</i>	157
<i>Figure 4.5.8b Pre& Post Mastery Experiences Group #2 Ethnic</i>	157
<i>Figure 4.5.9a Mastery Experiences Program Affiliation Pre & Post Group #1</i>	159
<i>Figure 4.5.9b Mastery Experiences Program Affiliation Pre & Post Group #2</i>	160
<i>Figure 4.5.10a Emotional States Pre & Post Group #1</i>	161
<i>Figure 4.5.10b Emotional States Pre & Post Group #2</i>	162
<i>Figure 4.5.11a Emotional States Pre & Post Gender Group #1</i>	163
<i>Figure 4.5.11b Emotional States Pre & Post Gender Group #1</i>	163
<i>Figure 4.5.12a Emotional States Pre & Post Ethnic Group #1</i>	165
<i>Figure 4.5.12b Emotional States Pre & Post Ethnic Group #2</i>	165
<i>Figure 4.5.13a Emotional States Pre & Post Program Affiliation Group #1</i>	168
<i>Figure 4.5.13b Emotional States Pre & Post Program Affiliation Group#2</i>	169
<i>Figure 4.6.1 Meet with Adviser Impact Survey</i>	170
<i>Figure 4.6.2 Informative Impact Survey</i>	171

<i>Figure 4.6.3 Interesting Impact Survey</i>	171
<i>Figure 4.7.1 ENES 101 and ENME 204 Confidence in Completing Engineering Degree</i>	174
<i>Figure 4.7.2 ENES 101 and ENME 204 SPVE Means</i>	175
<i>Figure 4.7.3 ENES 101 and ENME 204 Mastery Experiences Means</i>	177
<i>Figure 4.7.4 ENES 101 and ENME 204 Emotional States</i>	178

Chapter 1: Introduction

The purpose of this research was to evaluate and explore an engineering student's self-assessment instrument that measures a student's Engineering State of Mind (ESM) and how the ESM impacts engineering students' attitudes, perceptions, and motivations to study engineering.

This dissertation is organized in five chapters. Chapter One introduces the topic of study, the research questions and the significance of the study. The Chapter 2 presents a critical review of literature relevant to the study. Chapter 3 describes the methodology of the study, including the sampling techniques and the procedures used to collect and analyze the data. Chapter 4 presents the results of the study. Chapter 5 is a discussion of the results. Chapter 6 describes the implications for future practice, research and policy as well as the limitations of the study. The study's design and the statistical analyses are discussed in relation to the research question.

In this chapter, the relevance and need to assist engineering students with self-assessing, specifically in their first year, is introduced. The background and statement of the problem, purpose of the current study, research aims, and definitions of the study are reviewed.

1.1 Background and Statement of the Problem

Undergraduate student recruitment and retention in engineering continues to be an important topic in higher education. In 2016 about 45% of freshmen indicated they planned to major in a Science and/or Engineering field (up from about 8% in 2000) (National Science Board 2018). While the number of degrees awarded in the Science, Technology, Engineering, and Math (STEM) fields has increased steadily in the past 10 years, only 16% of bachelor's degrees awarded nationally were engineering degrees. This is a concern, for example, as baby boomers and even some older members of Generation X are retiring, their knowledge and skills go with

them. “The shortage [of engineers] affects various industries, with the manufacturing sector alone predicted to need about 3.5 million jobs by 2025 -- but up to 2 million of these positions might go unfilled due to the difficulty of finding qualified workers”(Radu 2018).

Best practices in retaining engineering students, including mentorship, pedagogical changes, climate change, and awareness, have been identified and implemented throughout the country at engineering colleges and universities, providing enhanced outcomes including increased retention and diversification of the student population and meeting societal objectives of producing more engineers (Yoder 2012, Atkin, Green and McLaughlin 2002, Wallace and Haines 2004, Campbell and Skoog 2004). Despite recent positive outcomes, universities continue to struggle to provide the amount of qualified engineering talent to fulfill the need in industry and research spaces.

The initial perceptions and attitudes of engineering students affect retention (Besterfield-Scare, Shuman and Atman 2001, Seymour and Hewitt 2000). These attitudes change across gender and ethnicity. Seymour and Hewitt found that students who left engineering programs were academically similar to those who remained in the program. Students left because they had different perceptions of the institutional culture and their career aspects compared to their peers who persisted (Seymour and Hewitt 2000). Seymour and Hewitt demonstrated that a student’s attitudes toward engineering and the sciences, as well as a student’s perceptions of his/her abilities, impacts persistence in engineering degree programs.

There has been little study of a student’s ability to self-assess their engineering education success in relation to their attitudes and perceptions. Students may use academics (i.e, grades) and/or professors or advisors to validate their success, but they lack the ability to intrinsically understand what empowers them to succeed in their pursuit of an engineering career. This study

was designed to contribute to increasing retention of engineering students by developing an instrument, that uses existing validated assessments, that supports a student's abilities to self-assess their engineering academic career.

1.1.1 National Best Practices to Retain Students in Their First Year

In 2012, the American Society of Engineering Education (ASEE) produced a report entitled *Going the Distance*, detailing “Best Practices and Strategies for Retaining Engineering, Engineering Technology and Computing Students”(ASEE 2012). In this report, a literature review and survey documented over 60 strategies and best practices in retaining engineering students. These strategies were divided into three categories: student-focused strategies and practices; faculty-focused strategies and practices; and institutional and departmental-focused strategies and practices (ASEE 2012). Common practices mentioned at universities included “tutoring, mentoring, learning centers, programs specifically developed for at-risk students, programs specifically for first-year students, academic advising and career awareness” (ASEE 2012). These practices are discussed further in the literature review high impact practices.

1.1.2 Current strategies at UMBC to help students in their First Year

The University of Maryland Baltimore County (UMBC) has prioritized changing the culture of first year classes from being traditional ‘weed out’ courses to being retention focused. In the last decade, UMBC has invested in new initiatives, formulated through committees made up of university faculty and staff, to enhance student success. The committees included focus areas around advising & graduation, applied learning, first year experience, academic progression (persistence), student engagement, student wellness and student finances. In “The Empowered

University: Shared Leadership, Culture Change, and Academic Success” UMBC’s President, Freeman Hrabowski, discusses that UMBC’s six-year graduation rate had climbed from 33% to 55%, 1990 to 2005. However, UMBC’s goal was to increase the graduation rate to 67% (Hrabowski III 2019). Focusing on first-year students, including first time fulltime freshman and transfer students, initiatives included the creation of First Year Experience (FYE) courses and a Student Success Center, under the Division of Undergraduate Academic Affairs.

First Year Experience courses focus on connecting students to their academic work and co-curricular opportunities. “Students enrolled in FYE’s connect with faculty, staff, and peers who are supportive of new students, as they learn how the academic expectations of the University may differ from their prior educational experiences” (UMBC 2019a). Students can use one FYE course toward their general education program requirements. FYE courses are not required for graduation.

In the Fall of 2019, the UMBC Division of Undergraduate Academic Affairs established the Academic Success Center for all undergraduate students.

The Academic Success Center provides centralized support services to all undergraduate students at UMBC. The center serves as the hub for three units within the Division of Undergraduate Academic Affairs including Academic Standards and Policy Administration, the Learning Resources Center, and the Office of Academic Advocacy. Through a coordinated approach and an unwavering commitment to student success, the Academic Success Center fosters a welcoming environment that provides a one-stop opportunity through Academic Policy, Academic Resources, and Academic Advocacy for students to achieve

their academic goals and claim their future with a UMBC degree (UMBC 2019a).

Examples of services and initiatives in the center include tutoring, a writing center, grading method petitions, and helping students navigate barriers to graduation.

Embedded in the Academic Success Center is a division of “Academic Advocates.” The purpose of the Academic Advocate is to assist and serve first-time, full-time undergraduate freshman students.

First-time, full-time undergraduate students in freshmen cohorts identified, or those referred, as experiencing barriers to graduation will receive direct outreach from the Office of Academic Advocacy to address issues in a timely manner. No matter how complex the concerns (i.e., personal, academic, or financial), Academic Advocates will work together with students to review their progress, present options toward graduation, and facilitate communication and connections with the appropriate resources (UMBC 2019b).

1.1.3 Honors College

In 1988, the Honors College formulated a program to support high achieving students and offer “a challenging interdisciplinary academic program within the broader university” (Hrabowski III 2019). The Honors College offers benefits to students affiliated with their program, as stated on the Honors College website:

- **Curriculum:** *You'll thrive in an interdisciplinary and intellectually stimulating academic program, with small classes featuring unique, specially designed content.*
- **Community:** *You'll work alongside dedicated, talented, and interesting students like yourself—students who flourish as readers, writers, thinkers, speakers, researchers, and active members of the UMBC community.*
- **Connection:** *Through special coursework and holistic advising and mentoring, you'll have the opportunity to build relationships with faculty and staff to cultivate your longer-term ambitions. (UMBC)*

Through the Honors College, students have the opportunity to engage in a supplemental course entitled Introduction to an Honors University (IHU). This seminar class provides students the opportunity to further develop their academic success skills.

1.1.4 Center for Women in Technology and Meyerhoff Scholar Program

UMBC is nationally known for its sustained dedication to diversity and inclusion as exhibited through their Scholar programs. Two of the most successful are the Center for Women in Technology (CWIT) and Meyerhoff Scholars programs.

1.1.4.1 The Center for Women in Technology

The Center for Women in Technology was created in 1998 to promote, support, and encourage women in technology fields. In 2006, the program expanded to include the engineering population. Their mission states:

The UMBC Center for Women in Technology (CWIT) enables success for all women and other underrepresented groups in technology fields. In the College of Engineering & Information Technology, CWIT supports students with a nurturing and challenging community, transformative leadership experiences, and professional development opportunities (CWIT 2019).

CWIT has three different classification of students associated with the center.

“[The first is designated] a scholar where they will receive some type of tuition remission. The second is known as a SITE scholar. The SITE (Scholarships in Information Technology and Engineering) Scholars Program is a National Science Foundation funded grant that aims to benefit academically talented students showing financial need. Lastly, the Affiliates are students who receive all the opportunities without financial incentive” (RHEINGANS et al. 2011, Rheigans et al. 2011).

CWIT scholars and affiliates are supported through their undergraduate academic career by various means, including a faculty/peer mentors, an individual advisor, and staff advisor from the Center. In addition, Scholars and Affiliates may choose to live on campus on a Living Learning Community floor with other CWIT participants. Each of these components contributes to the success of the student until they graduate (Rheigans et al. 2011). Before entering college, students go through a CWIT Summer retreat where they will meet other affiliates and scholars in the program.

1.1.4.2 Meyerhoff Scholar Program

The Meyerhoff Scholar Program was created in 1988. It initially supported African American males (later opened to other minorities and prospective undergraduate students of all backgrounds) who planned to pursue doctoral study in the sciences or engineering and who were interested in the advancement of minorities in those fields.

“The program’s success is built on the premise that, among like-minded students who work closely together, positive energy is contagious. By assembling such a high concentration of high-achieving students in a tightly knit learning community, students continually inspire one another to do more and better” (Meyerhoff 2011).

Meyerhoff scholars and affiliates, during their academic career, will receive an advisor in the Meyerhoff office, career specific faculty mentor, peer mentor and a faculty advisor for their major. In addition, the students will live on campus with other Meyerhoff students on a “Meyerhoff” dormitory floor. Scholars are required to attend an 8-week “summer bridge” camp where they build a community of friends, learn scholarly and professional practices, and take several rigorous credit college classes taught by faculty in their specific major.

1.1.5 Major Scholar Programs

In the mechanical engineering department at UMBC, freshman through senior year students can apply for the S-STEM scholarship sponsored by the National Science Foundation (NSF). The focus of this initiative is on:

“recruitment, retention, graduation and post-graduation for mechanical engineering students with specific emphasis on underrepresented groups.

Additionally, relationships with 14 local community colleges were established to serve the transfer student population” (Gurganus and Zhu 2019).

Support services for the S-STEM students include faculty mentoring, peer support, summer orientation, access to tutoring, and help with identifying careers and research immersions

1.2 Context of the Study

Despite the efforts found nationally and those specific to UMBC, engineering students in their first and second year of engineering school, despite receiving good grades or being part of a scholar program, may struggle with their perception and understanding of whether they are suitable to pursue an engineering degree and whether they will graduate. They may seek help from an advisor, peer, mentor, their affiliated program, or do nothing at all.

1.2.1 Self-Assessment and Anxiety

In the fall of 2018, the American College Health Association published the National College Health Assessment, indicating that

“63% of college students in the US felt overwhelming anxiety in the past year. In the same survey, 23% reported being diagnosed or treated by a mental health professional for anxiety in the past year. The sharpest increase in anxiety occurs during the initial transition to college” (Marques and LeBlanc 2019).

Conley et al. (2018) conducted a study that demonstrated that psychological distress (i.e. levels of anxiety, depression, and stress) among “college students rises steadily during the first

semester of college and remains elevated throughout the second semester,” This suggests that the first year of college is an especially high-risk time for the onset or worsening of anxiety.

A possible contributing factor to this anxiety increase is a student’s inability to self-assess, guided by misconceptions and having unrealistic expectations in their own abilities and performance (Saboonchi and Lundh 1997, Breuning 2016). Students feel they are failing and incapable of overcoming the challenges that engineering, as a discipline, introduces (Hutchison et al. 2006, Vitasari et al. 2010, Carberry, Lee and Ohland 2010). Students, prior to entering higher education, have heard and believed misconceptions about the definition and understanding of what it means to look, think, and act like an engineer. Furthermore, despite the increased advancements and innovation of technology and new challenges in the world, traditional engineering education pedagogical practices continue to be implemented. These new challenges require different teaching approaches and methods. Therefore, there is a substantial need to explore and implement innovative and effective data-motivated practices (Huffman and T. J. 2018), especially to address the student in a cultural and social context.

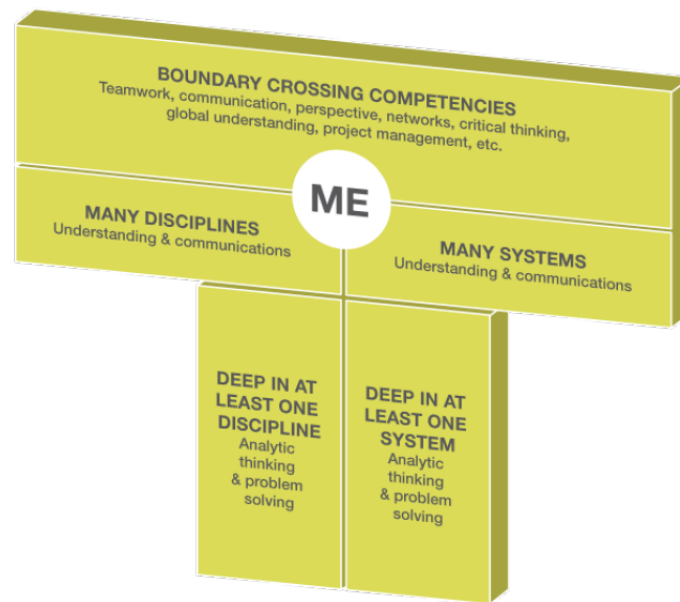
To this end, the American Society for Engineering Education (ASEE), with the support from National Science foundation, launched an initiative called Transforming Undergraduate Education in Engineering (TUEE).

“This initiative is designed to develop a clear understanding of the knowledge, skills, and abilities next generation engineering graduates should possess and the changes in curricula, pedagogy, and academic culture that will be needed to instill those qualities”(ASEE 2018).

The Phase IV report of TUEE discussed refining the ‘T-Shaped’ (See Figure 1) engineer to reflect the current needs of society. The engineering graduate should be “both technically accomplished and able to succeed in a team-driven, culturally and ethnically diverse, and

globally oriented workforce” (ASEE 2018). This philosophy parallels the call for more intentional development of the Engineering Habit of Mind which includes “systems-thinking, adapting, problem finding, creative problem-solving, visualizing, and improving” (Lucas and Hanson 2016). Other researchers include optimism, persistence, and conscientiousness as a part of the Engineering Habit of Mind (linkengineering.org 2019).

Figure 1: T-Shaped Engineer



“The two halves of the vertical bar of the “T” represent the disciplinary specialization and the deep understanding of one system. Systems describe major services, such as transportation, energy, education, food, and healthcare, that impact quality of life. These systems are comprised of interconnected components of people, technology, and services. To understand a system, one must know how it functions from the bottom to top in order to address challenges. The defining characteristic of the T-shaped professional is the horizontal stroke, which represents their ability to collaborate across a variety of different disciplines. To contribute to a creative and innovative process, one has to fully engage in a wide range of activities within a community that acknowledges their expertise in a particular craft or discipline and share information competently with those who are not experts. (Rogers and Freuler 2015)

Rolheiser and Ross 2001 explain that “Students who are taught self-evaluation skills are more likely to persist on a difficult task, be more confident about their ability, and take greater responsibility for their work.” To enable the engineering student as they work to develop their

Engineering Habit of Mind, this the primary goal of this study was to develop and investigate an instrument that will help enable a student's ability to self-assess their engineering state of mind at UMBC.

The instrument is a feedback tool that will give students an opportunity to gauge how they perceive the field engineering as it relates to their engineering academic career. The instrument was developed from previously validated surveys (Appendix Table 3), and using the Social Cognitive Career theory (SCCT) coupled with commonly accepted variables, such as motivation, self-efficacy and value of engineering skills, that contribute to a student's engineering success..

1.3 Research Questions

This study explored three research questions concerning self-assessment within the undergraduate mechanical engineering population:

1. What defines a UMBC student's (Junior and Senior) engineering state of mind?

Juniors and Seniors in mechanical, computer and chemical engineering were asked to take the Engineering State of Mind Instrument (ESMI) prior to releasing the tool to freshmen or sophomores. This information led to the creation of upperclassmen profiles. Those profiles were placed on engineeringed.umbc.edu for the freshman and sophomore students to use as a reference based on their ESMI scores. The assumption is Juniors and Seniors will likely show characteristics and traits of positive attitudes and strong self-efficacy compared to the freshmen and sophomores.

2. What are common Engineering State of Mind themes among freshmen engineering students and what are attitudes and perceptions of the different population groups of study; specifically in gender, ethnic affiliation, and mentorship programs (program affiliations) in engineering?

The data generated will be separated according to groups of study (discussed further in chapter 3), gender, ethnic affiliation, and program affiliation. There are three hypotheses that will be tested:

- 1) Males will show higher scores for attitudes, perceptions, and motivations toward engineering than female and other gender affiliated colleagues.
- 2) White American and Black/African American students will show higher scores for attitudes, perceptions, and motivations in engineering than their other ethnic affiliated colleagues.
- 3) Students in a scholar program will show stronger attitudes, perceptions and motivation toward engineering as compared to their non-programmed colleagues.

3. How do first year engineering students' perceptions change after they have gained an understanding of their perceptions and attitudes of engineering?

Each of the Introduction to Engineering (ENES 101) students in their freshman year, will be asked to take the ESMI. The first hypothesis tested was that students who take the instrument at the beginning of the semester will have low attitudes and perceptions about their engineering education. A second hypothesis was that after using this instrument, and providing recommended interventions, the

students' attitudes, perceptions, and motivations will increase. Students who do not receive intentional recommendations, but use the tool, are also expected to increase in attitudes, perceptions and motivations in engineering.

1.4 Foundations of the Study

The work presented in this dissertation is built upon a study conducted in 2011 on UMBC's mechanical engineering population (Gurganus 2011). That study investigated how mentoring programs and other variables (intrinsic and extrinsic) impacted a student's ability to succeed in mechanical engineering. Utilizing a mixed methods approach (quantitative and qualitative), data from the study revealed significant variables that motivate students to continue in the engineering field (Table 1) (Gurganus 2011). Interviews were conducted with students (freshmen to seniors) from specific Scholar programs (CWIT, Meyerhoff, Non-programmed (see 1.5 Appendix Terms and definitions)). From those interviews, themes were extracted that related to common attitudes, perceptions, challenges, and motivations (Appendix Table 1)., From those themes, a survey was developed. This survey was administered to the entire mechanical engineering population, collecting 240 valid responses. The results of the survey identified factors in the students' engineering self-efficacy and their perceptions of their major and field of engineering. Significant correlations were discovered between variables showing characterization of attitudes and perceptions between scholarly affiliated groups and non-affiliated groups (eg. Meyerhoff, CWIT, non-programmed) (Gurganus 2011).

This current study expanded on the 2011 study and contributed a novel approach toward increasing the retention of engineering students through self-assessment.

1.5 Terms and Definitions

The following terms and their definitions were used throughout this study:

Advisee: An undergraduate engineering student who is pursuing an undergraduate degree in engineering and has a relationship with a faculty advisor.

Advising: A positive or negative relationship in which guidance may or may not be provided with regard to professional skill development (Schlosser and Gelsco 2001).

Advisor: The unique faculty person who is responsible for guiding an engineering student.

CWIT scholar/affiliate: Student scholar or affiliate involved with the Center of Women in Technology (CWIT) program at UMBC in the College of Engineering Information Technology.

Engineering Habit of Mind: “Habits of mind are traits or ways of thinking that affect how a person looks at the world or reacts to a challenge” (linkengineering.org 2019).

Mentor: A person or friend who guides a less experienced person by building trust and modeling positive behaviors. In this study, a mentor is a person in either the Meyerhoff program or CWIT center.

Mentoring: A positive relationship in which protégé learns professional skills (Cronan-Hillix et al. 1986, Russell and Adams 1997).

Meyerhoff scholar/friend: Student scholar or affiliate (friend), who is engaged with the Meyerhoff program at UMBC.

Non-programmed Student: Students not affiliated with a scholar program. This expression was borrowed from a study dealing with STEM majors in their freshmen year, comparing freshmen students in a program for women in science, engineering and mathematics to students in an honors program (Kahveci et al. 2006)

Peer mentor: A student who provides advice and support and serve as a role model for younger students who may need help. Students in Meyerhoff and CWIT in their freshman and sophomore year will be matched with a peer mentor who is in the same major.

Self-assessment: Assessment or evaluation of oneself or one's actions and attitudes, in particular, of one's performance at a job or learning task considered in relation to an objective standard (Dictionary.com 2018).

Self-efficacy: as defined by Albert Bandura:

Beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments. Bandura claims that self-efficacy determines:

the courses of action people choose to pursue, how much effort they put forth in given endeavors, how long they will persevere in the face of obstacles and failures, their resilience to adversity, whether their thought patterns are self-hindering or self-aiding, how much stress and depression they experience in coping with taxing environmental demands, and the level of accomplishments they realize. (Bandura 1986)

S-STEM scholar: A student scholar who is in the Mechanical Engineering program at UMBC and supported by the NSF S-STEM grant.

Table 1: Definitions and Rationale behind Survey

Variable	Variable Definition and Rationale
1. Motivation to Study Engineering: Financial (APPLES)	<p>Motivation to study engineering due to the belief that engineering will provide a financially rewarding career.</p> <p>Rationale: Astin (1993) found that engineering majors frequently reported that the —chief benefit of college is making money. Seymour found that the belief that “science, mathematics and engineering career options and rewards are not worth the effort to get the degree” influenced the decision to leave engineering (Adelman, 1998; Seymour & Hewitt, 1997). This variable was adapted from the Pittsburgh Freshmen Engineering Attitudes Survey (PFEAS)” (Besterfield-Scare, Shuman and Atman 2001), (Sheppard et al. 2010)</p>
2. Motivation to Study Engineering: Parental Influence (APPLES)	<p>Motivation to study engineering due to parental influences.</p> <p>Rationale: Astin found that having a father who is an engineer was an indicator for engineering as a career choice (Adelman, 1998). However, Seymour and Hewitt’s findings (1994, 1997) suggest that men leaving science and engineering majors are those most likely to have followed a “ family career tradition” into science and engineering fields. This variable was adapted from the PFEAS.” (Sheppard et al. 2010)</p>
3. Motivation to Study Engineering: Social Good *(APPLES)	<p>Motivation to study engineering due to the belief that engineers improve the welfare of society.</p> <p>Rationale: Students who leave engineering might respond more strongly to this variable than the ones who stay. This variable was adapted from the PFEAS. (Sheppard et al. 2010)</p>
4. Motivation to Study Engineering: Mentor Influence (APPLES)	<p>Motivation to study engineering due to the influence of mentor(s) while in college.</p> <p>Rationale: Schuman et al. (1999) suggested that students who drop out of engineering do not seek counseling services that are offered by the institutions. This is an original question about a student’s program, i.e. Meyerhoff, CWIT, was contributing to their motivation to study engineering. (Sheppard et al. 2010)</p>
5. Motivation to Study Engineering: Intrinsic Psychological (APPLES)	<p>Motivation to study engineering for its own sake, to experience enjoyment that is inherent in the activity.</p> <p>Rationale: This variable is a modified version of the intrinsic motivation subscale of the Situational Motivation Scale (SIMS) (Guay, Vallerand and Blanchard 2000). (Sheppard et al. 2010)</p>

6. Motivation to Study Engineering: Intrinsic Behavioral (APPLES)	<p>Motivation related to practical and hands-on aspects of engineering, e.g., “I like to figure out how things work,” “I like to build stuff.”</p> <p>Rationale: This Variable was adapted from the Academic Pathways of People Learning Engineering Survey (APPLES)(Sheppard et al. 2010)</p>
7. Perceived Importance of Math and Science Skills (APPLES)	<p>Perceived importance of math and science skills in a successful engineer.</p> <p>Rationale: This variable was adapted from the Academic Pathways of People Learning Engineering Survey (APPLES) (Sheppard et al. 2010)</p>
8. Perceived Importance of Professional and Interpersonal Skills (APPLES)	<p>Perceived importance of professional and interpersonal engineering knowledge and skills in becoming a successful engineer.</p> <p>Rationale: This variable was adapted from the Academic Pathways of People Learning Engineering Survey (APPLES) (Sheppard et al. 2010)</p>
9. Engineering Career Success Expectations (LEASE)	<p>How students view themselves “fitting” into the engineering career. (i.e. someone like “me” can succeed in an engineering career; I expect to be treated fairly).</p> <p>Rationale: A measure of Engineering Self-efficacy. This variable was adapted from the Longitudinal Assessment of engineering self-efficacy (LEASE) (see aweonline.org)</p>
10. Feeling of Inclusion (LEASE)	<p>Students understanding of how they relate to the people in their class and extra-curricular activities.</p> <p>Rationale: This variable was adapted from the Longitudinal Assessment of engineering self-efficacy (LEASE) (see aweonline.org)</p>
11. Coping Self-Efficacy (LEASE)	<p>Student ability to deal with and attempt to overcome problems and difficulties (i.e. doing well on an exam, friends disapproval, etc).</p> <p>Rationale: This variable was borrowed from the Longitudinal Assessment of engineering self-efficacy (LEASE) (see aweonline.org)</p>
12. General Impressions of Engineering	<p>How much a student values engineering.</p> <p>Rationale: This variable was adapted from the Pittsburgh Freshmen Engineering Attitudes Survey (PFEAS) (Besterfield-Sacre et al, 1995; 1997).</p>

13. Confidence Beginning (Complete) Engineering Degree (SLE)	<p>When a student begins their engineering degree, how confident were they that they would complete it?</p> <p>Rationale: This variable was adapted from the Students Leaving Engineering (SLE) (see www.aweonline.org)</p>
14. Confidence Present (Complete) Engineering Degree (SLE)	<p>At the present time, how confident is the student that they will complete an engineering degree at this institution?</p> <p>Rationale: This variable was adapted from the Students Leaving Engineering (SLE) (see www.aweonline.org)</p>
15. Advisor	<p>Overall assessment on how a student's advisor contributes their continuing to their study of engineering.</p> <p>Rationale: Based on (Kram 1985)'s Career, Psychosocial, Role Modeling framework. Variable was adapted from Mentoring Functions Questionnaire (Pellegrini and Scandura 2005)</p>
16. Mentor	<p>Overall assessment on how a student's advisor contributes their continuing to their study of engineering.</p> <p>Rationale: This variable is based on (Kram 1985)'s Career, Psychosocial, Role Modeling framework. Variable was adapted from Mentoring Functions Questionnaire (Pellegrini and Scandura 2005)</p>
17. Peer mentor	<p>Overall assessment on how a student's peer mentor contributes their continuing to their study of engineering.</p> <p>Based on (Kram and Isabella 1988) Peer mentoring roles and Career, Psychosocial, Role Modeling framework (Kram 1985) . Variable was Modeled from Mentoring Functions Questionnaire (Pellegrini and Scandura 2005a).</p>

Chapter 2: Review of Literature

2.1 Introduction

Among the areas of research interests in an engineering student's development are strategies that increase their chance of success in the program. Initiatives may include changes in pedagogy, programmatic support, supplemental classes, and informal assistance outside the classroom (i.e. tutoring, mentorship).

This chapter presents a critical review of relevant literature, focusing on factors that affect an engineering student's academic career. The chapter is organized by the specific topics related to 1) factors that contribute to a person's rationale for choosing engineering, 2) why students leave engineering, 3) self-efficacy in engineering, anxiety, and the need for self-assessment, and 4) current interventions and high impact practices that are being used help retain engineering students.

2.2 Social Cognitive Career Theory: Influences of Career Choices.

As an important foundation of this research, the Social Cognitive Career Theory (SCCT) was used as the framework for developing the survey instrument. SCCT proposes that career choice is influenced by the beliefs the individual develops and refines through four major sources: mastery experiences (personal performance accomplishments), vicarious learning, social persuasion, and physiological states and reactions (Bandura 1986, Creamer 2011).

Mastery Experiences affect "students' perceptions and actual preparation for success in engineering and other STEM fields through their perceptions of their chances of completing their engineering degree, particularly if they appear less prepared than their classmates (Marra et al. 2009)." These experiences are opportunities to learn and apply strategies learned to perform a task successfully. If the student performs a task successfully, it is likely this person will not

doubt their ability. Social persuasions refer to a student's feelings of efficacy as a result of the encouragement from others who are significant in their lives (i.e, parents, friends, faculty), and vicarious experiences are based on learning through observation of others (Marra et al. 2009). "The value of social persuasion and vicarious experiences appear in the engineering literature regarding the importance of social support and role models to success in STEM fields (Marra et al. 2009)." Social persuasion refers to how others' judgments, feedback, and support either enhances or hurts self-efficacy (Rittmayer and Beier 2008). "Emotional and physiological states as a source of efficacy expectation are evidenced in the disruptive anxiety associated with phenomena such as stereotype threat (Steele 1995)." Stereotype threat occurs when an individual is aware of a negative stereotype that exists about a group to which she or he belongs, in a specific environment, and the knowledge of this stereotype incites anxiety which can hinder performance (Marra et al. 2009). In this research, physiological states from the Emotional and Physiological classification are not examined, only the emotional constructs.

2.3 Retention and Engineering

Literature addressing low retention has traditionally concentrated on student preparation and academic results. "Until the early 1990's, the focus of research on the issue of successfully recruiting and retaining women, and men, in technical fields focused on the students themselves" (Brainard 1998). Constructs to evaluate the retention success of the engineering students focused on high school preparation and competences in math and science. Faculty and administrative personnel in science and engineering (S&E) undergraduate programs traditionally viewed students that left engineering as simply not competent, and it was an advantage for all those involved to remove these students from the S&E programs (Seymour E. & Hewitt 1994). More recent research shows that "researchers have demonstrated that although many engineering

educators believe high attrition rates among engineering students are evidence that weaker students are being weeded-out, this concept is flawed” (Felder and Brent 2005, Hilpert 2008). Additional research showed that the grade distribution of students who drop out is similar to those who persist. Instead of GPA, attitudinal differences between minority and majority students were discovered that were related to a student’s likelihood of remaining in the program (Hilpert 2008, Besterfield-Scare et al. 2001) (Vogt, D.Hocevar and Hagedorn 2007).

In their benchmark 1994 study comparing students persisting in Science & Engineering undergraduate degree programs with those who chose to switch to another field of study or drop out of college altogether, Seymour and Hewitt found that there were no real differences in high-school preparation, ability, or effort expended in their coursework between students who remain and those who switch. Students who left engineering did so because of different perceptions of the institutional culture (e.g. disappointed or bored with their curriculum) and career aspects (a loss of academic self-confidence in the competitive environment) in comparison to students who persevered (Marra et al. 2009). This study was confirmed and evident in Tinto (1993 and 2010) as it related to college students in all majors. More specific studies showed that female Science and Engineering undergraduates left engineering for these same reasons (Brainard, Laurich-McIntyre and Carlin 1995, Ginorio 1995).

Further studies examined indicators that impact retention. The National Action Council for Minorities in Engineering (Morrison, Griffin and Marcotullio 1994) discovered five characteristics related to retention, including institutional control, college cost, selectivity of applicants, number of accredited engineering programs and number of student support programs. Based on the data, selectivity was found to be a strong predictor of degree attainment for both minority and non-minority engineering students. “Selectivity ratings are self-assessments made

by each college based on three criteria: percentage of applicants accepted, high school class rank and standardized test scores of freshmen who actually enrolled in the institution. The more selective the institution, the higher the graduation rate is for both minority and non-minority students” (Anderson-Rowland 2001).

After interviewing administrators at institutions with the highest retention rates, Morrison, Griffin and Marcotullio 1994, found six key actions that impacted retention:

“(1) strong institutional commitment as measured by attitudes of the faculty and staff, integral minority engineering programs, and allocation of resources; (2) focus on removing barriers to student success; (3) involvement of the corporate community; (4) precollege development of potential engineering students; (5) summer bridge programs; and (6) special attention to early success of freshmen” (Morrison et al. 1994).

They found that schools attributed their success to specifically designed programs. These institutions “looked inward to analyze and better understand their own culture, to focus on their undergraduate education mission, and to develop specific adaptations to make their institutions more effective with all students” (Morrison et al. 1994).

2.4 Constructs of engineering students and why they leave their program; Self-efficacy, Engineering Self-efficacy, Motivation

Seymour and Hewitt’s work on why engineering students leave their programs was notable due to its holistic approach and qualitative understanding. They categorized reasons for engineering students leaving to include: (1) losing interest in science, (2) believing that a major other than science and engineering offers a better education, (3) being overwhelmed by the curricular demands, and (4) feeling that the quality of teaching science and engineering is poor at the institution (Seymour and Hewitt 2000). These constructs can be directly attributed to a

student's self-efficacy and motivation. These constructs are explored more thoroughly in the next few sections.

2.4.1 Self-efficacy

As defined by Bandura (1986), self-efficacy “refers to beliefs in one’s capabilities to organize and execute the courses of action required to produce given attainments.” Bandura claims that self-efficacy determines “the courses of action people choose to pursue, how much effort they put forth in given endeavors, how long they will persevere in the face of obstacles and failures, their resilience to adversity, whether their thought patterns are self-hindering or self-aiding, how much stress and depression they experience in coping with taxing environmental demands, and the level of accomplishments they realize.” Current self-efficacy research literature makes a convincing case that a strong sense of self-efficacy is integral to all student’s entries and persistence in engineering (Rittmayer and Beier 2008, Amelink 2008, Sheppard et al. 2010).

Confidence is sometimes used interchangeably with self-efficacy. However, confidence refers only to the strength of one’s beliefs, it does not necessarily require a positive outcome to remain high. Self-efficacy beliefs are developed through the “interpretation of task outcomes and the circumstances surrounding task experiences (Rittmayer and Beier 2008).” Self-efficacy beliefs are based on mastery experience, vicarious experience, social persuasion (including verbal), and physiological reaction (Bandura 1997, Gist and Mitchell 1992, Pajares 2005).

Studies show the most influential source of STEM self-efficacy for boys and men is mastery experience and the most influential for girls and women are vicarious experience and social persuasion (Zeldin and Pajares 2000).

2.4.2 Engineering self-efficacy

Extending Bandura's (1986) definition of self-efficacy to engineering helps clarify that engineering self-efficacy is a person's belief that he or she can successfully navigate the engineering curriculum and eventually become a practicing engineer. Marra et al (2005) created and validated an instrument, the Longitudinal Assessment of Engineering Self-Efficacy (LAESE), that measures self-efficacy, feelings of inclusion, and outcome expectations, all of which are significant when understanding a student's engineering self-efficacy (Marra et al. 2005). If students are leaving because of a low engineering self-efficacy, then increasing the engineering self-efficacy in women and men could improve recruitment and retention.

2.4.3 Engineering Self-efficacy and Persistence

Several investigations show the relationship between self-efficacy and persistence in engineering. Schafers et al (1997) and Eris et al (2010), showed that a student's perceived value of math and science, their confidence, and self-efficacy in mathematics and science significantly predicated an engineering student's persistence. Throughout these studies, a positive self-efficacy led to more positive outcomes in terms of persistence and retention, whereas a negative self-efficacy led to a higher chance the students would leave the program and not continue on to practice engineering.

Various definitions of persistence have been presented in research. Lent et al. 1994 measured persistence by the number of quarters (length of term) the student completed, and others discussed persistence as it relates to the current enrollment status (Schafers, Epperson and Nauta 1997)). Eris et al. (2010) defined "persistence in relation to the engineering domain in two dimensions: academic persistence and professional persistence. Academic persistence meant

graduating with an undergraduate engineering degree, whereas professional persistence referred to the intention to practice engineering for at least three years after graduation” (Mamaril et al. 2016). This research focusses specifically on academic persistence with the hope of and connection to long-term professional persistence.

2.4.4 Anxiety and its effect on self-efficacy

Anxiety levels of college students continue to be a problem for colleges nationally. “In 2016, nearly two-thirds of college students reported “overwhelming anxiety,” up from 50 percent just five years earlier, according to the National College Health Assessment” (FLANNERY 2018). “Mental health experts, advocacy groups and public health organizations describe the incidence of anxiety and depression among college students and college-age young adults as an epidemic” (Saloman 2019, Scheffler April 2019, Scheffler 2019). This anxiety is also evident in engineering students (Yanik et al. 2016). However, the source may come from both academic and non-academic demands or internal concerns regarding their future as an engineer. This anxiety can compromise the amount of self-efficacy a student possesses, “manifesting itself as reduced motivation, concentration, or reasoning capability. These symptoms often lead to a loss of confidence in engineering abilities and may reduce commitment to engineering degree programs, resulting in lower retention” (Yanik et al. 2016, Carberry et al. 2010, Hutchison et al. 2006, Vitasari et al. 2010, Sullivan and Davis 2007).

Faculty or staff who encounter a student in this state found the student might “question their preparedness for the program they have undertaken, their ability and level of commitment to meet the demands of a challenging curriculum, their capability to be competitive in their field after graduation, and whether their academic workload leading to diminishing quality of life in other areas” (Yanik et al. 2016). First generation students, which account for 27% of the

population at UMBC (U.S.NEWS 2019), may exhibit more of these characteristics due to language, financial, and challenges adjusting to a new environment at the university (Yanik et al. 2016, Gregg 2019).

2.4.5 Motivation

Motivation, as described by (Eccles et al. 1983), is the result of the interaction of expectancy of success and the value placed on the task; “Motivation = Expectancy x Value.” Eccles et al. 1983 described four components of value: (1) cost which is what one must give up to engage in a task, (2) interest value, (3) utility value or usefulness of the task, and (4) attainment value which is the value placed on the results of completing the task (Marra et al. 2009). In engineering, the “expectancy for success” is focused on self-efficacy (Marra et al. 2009).

The Academic Pathways of People Learning Engineering Survey (APPLES) examined areas that, based on survey results and interviews, contribute to the understanding of the engineering design experience (Sheppard et al. 2010). These areas included skills and knowledge, identity, education, and workplace. They discovered, as a part of the motivation construct for a student to continue in engineering, that mentor influence has a “relatively modest role ... in student’s reasons for pursuing engineering studies (Sheppard et al. 2010).” However, without understanding their mentoring relationships, it was stated that “there was a need for more study towards the role of mentoring in developing student’s motivation to continue” in engineering. This study examined other variables that contribute to a student’s motivation to include, Intrinsic Behavioral, Intrinsic Psychological, Financial Rewards, and Parent Influence.

The above ideas are echoed in the National Academies of Sciences and Engineering Medicine book, *How People Learn II*. To support a learner's motivation, an educational environment should attend to a student's "engagement, persistence, and performance" by

- helping them to set desired learning goals and appropriately challenging goals for performance
- creating learning experiences that they value;
- supporting their sense of control and autonomy;
- developing their sense of competency by helping them to recognize, monitor, and strategize about their learning progress; and
- creating an emotionally supportive and nonthreatening learning environment where learners feel safe and valued (National Academies of Sciences 2018).

2.5 Self-Assessment

To better support all of the above points, an engineering student should have the ability to self-assess their own state of mind. A student's ability to self-assess can promote meaningful and authentic learning, intrinsic motivation, internally controlled effort and more (McMillan and Hearn 2008, Bruce 2001, Kitsantas, Robert and Doster 2004, Rolheiser 1996, Rolheiser and Ross 2001). It has also been found that by "enhancing one's self-awareness, an individual's performance is directly influenced in a positive direction" (Panganiban Jul 18, 2017, McCarthy and Garavan 1999). McCarthy and Garvan (1999) examined learners' perceptions of the effectiveness of two instruments, Meyers Briggs and 360 Feedback, that are used to enhance self-awareness of career-development, specifically for managerial effectiveness. The findings of

this study showed that both instruments were effective in enhancing self-awareness and career development process.

The assessment process involves self-monitoring, self-judgement, identifying learning targets, and making and receiving instructional correctives. The process cycle then begins again with the evaluation of the student's corrections. Self-monitoring involves focusing attention on an aspect of behavior or thinking (Schunk 2012). Self-Judgment involves identifying standards or criteria that give a student awareness of what they know and what is needed to grow (Bruce 2001). Rolheiser and Ross (2001) explain, through a literature review of research and practice, that common outcomes showed that "students who are taught self-evaluation skills are more likely to persist on a difficult task, be more confident about their ability, and take greater responsibility for their work." Instructional correcting involves another person providing skills or resources to help a student improve or correct misunderstandings. With this step, awareness of options or recommendations need to be made available.

2.5.1 Rationale for Enhancing Self- Assessment

Studies performed to evaluate self-assessment draw on three theories of learning to justify nurturing this ability in students. These include the cognitive and constructivist theories of learning and motivation, metacognition theory, and self-efficacy theory (McMillan and Hearn 2008).

The cognitive and constructivist theory of learning and motivation postulates that students learn through discovery. Students learn new material by having access to resources and being guided as they "assimilate new knowledge to old and to modify the old to accommodate the new" (Center 2019a). Additionally, students are motivated more intrinsically, rather than receiving external affirmation. This theory requires engagement on the part of the learner (Perry

1999). “Without some kind of internal drive on the part of the learner to do so, external rewards and punishments such as grades are unlikely to be sufficient”(Center 2019a) .

Metacognition, an awareness and understanding of one’s own thought processes, has widely been investigated in both educational and psychological literature (National Academies of Sciences 2018, Biggs 1988, Price-Mitchell 2015, McMillan and Hearn 2008) . This concept relates to all learning and life experiences. “Beyond academic learning, when students gain awareness of their own mental states, they begin to answer important questions:

- How do I live a happy life?
- How do I become a respected human being?
- How do I feel good about myself?

Through these reflections, they also begin to understand other people's perspectives” (Price-Mitchell 2015). Although not directly tied to this work, it is hoped that the students will start to think beyond their own academic learning answering questions on why they are doing engineering.

At workshop held in Denmark in 2014, philosophers and neuroscientists discussed self-awareness and how it is linked to metacognition. Scientists believe that “self-awareness, associated with the paralimbic network of the brain, serves as a tool for monitoring and controlling our behavior and adjusting our beliefs of the world, not only within ourselves, but, importantly, between individuals.” “This higher-order thinking strategy actually changes the structure of the brain, making it more flexible and open to even greater learning” (Price-Mitchell 2015, Weil et al. 2013, Lou 2015). Self-efficacy plays a significant role in a retaining engineering students. Self-awareness also contributes largely to self-efficacy in “developing self-perceptions that lead to greater motivation” (McMillan and Hearn 2008). Schunk (2012) and

Pintrich and Schuck (2002) explain that student engagement is heavily dependent on their “perceptions of their ability to do well on a specific task.”

For this study, the theories of cognition, metacognition and self-efficacy theory form the basis of a method to help engineering students become more self-aware of their own state of mind as it relates to their persistence and success in engineering. Each of these theories will help to serve the student in self-assessment as they take ESMI.

2.6 Current high impact practices that help retain students in engineering

2.6.1 Current Engineering Interventions - High Impact Practices

In this study, engineering students will utilize a self-assessment instrument to gauge their attitudes, perceptions and motivations to study engineering. Recommendations are provided on the instrument’s website as a resource to help support students as they progress through their engineering program. In the following section, each recommendation is discussed in detail, including what defines it as a high impact practice, why it can be beneficial, as well as the potential drawbacks. These practices have shown to help students persist in their major and increase their self-efficacy.

In 2008, the Association of American Colleges and Universities (AACU) released a report on High Impact Educational Practices detailing a list of curricular, co-curricular, and pedagogical educational practices and experiences that were “widely tested and shown to be beneficial for college students from many backgrounds” (Kuh 2008). These findings are continually assessed and verified through findings from the National Survey of Student Engagement (NSSE)(NSSE 2019).

In 2014, The American Society of Engineering Education (ASEE) also released a report in which many of these high impact practices were mentioned because they affected the retention of engineering students. High impact practices include tutoring, mentoring, living-learning communities, collaborative assignments and projects, undergraduate research, service and community-based learning, and career awareness (engineering co-ops and internships). These practices are said to be “high impact” because they facilitate engagement and improve retention in college (Henderson 2017, ASEE 2012, Kuh 2008). Kuh’s (2008) argument for increasing student success is simple: “make it possible for every student to participate in at least two high-impact activities during his or her undergraduate program, one in the first year, and one taken later in relation to the major field” (Kuh 2008). These high impact practices are reviewed in the following paragraphs.

2.6.2 Mentoring & Advising

Mentoring and advising tend to be used interchangeably in Higher Education (The National Academy of Sciences and Medicine. 1997). A useful explanation or differentiation, as given by Farrelly (2006), is derived from Schlosser et al. (2003): *mentoring* refers to a positive relationship through which protégés learn professional skills, whereas *advising* refers to a positive or negative relationship in which guidance may or may not be provided with regard to professional skill development.

An advisor might or might not act in the role of a mentor, depending on the quality of the relationship. “Mentoring is not just advising, for example, although advising is certainly part of mentoring” (Vesilind 2001) . For this discussion, Farrelly’s (2006), definition will be adopted.

There is a substantial research indicating the need for female students to connect with a mentor or a support program to increase their likelihood of success within engineering. However,

several studies support the need for male students to also engage in similar support programs. Men and women show a potential need for different types of mentoring; however, both men and women indicate that mentoring improves their confidence to continue within the engineering program (Kahveci, Southerland and Gilmer 2006).

Literature indicates that more research is necessary to determine the role that the gender of the mentor and mentee can play in STEM mentoring, “particularly whether cross-gender mentoring relationships encourage positive socialization and retention in the field in the same manner as within gender mentoring relationships. Future research should explore the role of gender in different types of mentoring models. For instance, studies could examine whether males and females in STEM fields receive the same benefits through mentoring programs” (Amelink 2008).

According to Kram and Ragins (2007), “even as mentoring is accessible when framed within our own experience, scholars continue to struggle, with understanding the complexity of this pivotal, life altering relationship. In a nutshell, we know it works; we are still grappling with why, when and how.”

2.6.3 Peer Mentoring

Peer mentoring de-emphasizes seniority and hierarchy. Different individuals can take on the role of a peer mentor. Peer mentoring may even consist of a group of peers, providing emotional and professional support to one another. Each peer mentor will provide support based on their expertise and experiences, and according the circumstance of the relationship (Hadjioannou 2007). Kram and Isabella (1988) pointed out that peer mentors can provide self-acceptance and confirmation to their peers, sharing their perceptions and experiences.

Educational institutions often implement peer mentoring with formal determined goals (Amelink 2008).

There are potential drawbacks to peer mentoring, however. Unidentified hierarchal relationships may exist with little or no diversity, and the peer mentor may draw from a limited pool of information (Angelique, Kyle and Taylor 2002, Amelink 2008). Chandler has described three main obstacles to the long-term success of peer mentoring that may arise from the elimination of the traditional hierarchy: “The competitive position that peers often find themselves in, lack of experience, and the difficulty that may arise if their careers advance at different rates” (Chandler 1996). Confusion over whose needs are being met is also another complication. Etkowitz et. al (2000) emphasize that peer-generated strategies will be successful only if senior faculty and departmental leaders support such efforts and provide peer mentors with necessary resources and affirmation. Chesler (2002) explains peer mentoring strategies are worth further study.

2.6.4 Undergraduate Research

Offering research experiences for undergraduate students helps not only to encourage undergraduate engineering students in their research self-efficacy, i.e., the belief they can succeed and are capable of research, by encouraging them to pursue a graduate degree, but provides them with the “understanding how scientists and engineers work on real-world problems” (Henderson , Henderson 2017, Lopatto 2004). These research experiences for undergraduates (REU) can be offered in the form of a “structured REU program with a specific cohort to an individually designed experience” (Powers et al. 2018). The research experience can occur at an academic institution, in industry or at national laboratories. Further investigations show that students “...develop expertise in a specific area of specialization, gain a better

understanding and appreciation of the research process, and acquire team, communication, problem-solving, and critical thinking skills” (Zydney et al. 2002). Alumni who had a REU “reported enhanced ability to speak effectively, understand scientific findings, know literature of merit in the field, analyze literature clearly, and possess clear career goals.”

The National Science Foundation explained that “it is clear that the academic community regards the involvement of undergraduate students in meaningful research...with faculty members as one of the most powerful instructional tools” (NSF 1989). Additionally, the Boyer Commission Report recommended to “make research-based learning the standard” for the education of their undergraduates (Boyer Commission on Educating Undergraduates in the Research University 1998).

Hrabowski’s “The Empowered University” explains how the UMBC Meyerhoff program utilized undergraduate research experiences as part of a proven program for developing and retaining the students, especially into a graduate program. Due to this success, they “extended this idea to the larger student population through programs that support both research and creative activities. We established the Undergraduate Research Awards (URA) program in 1996, the Undergraduate Research and Creative Achievement Day (URCAD) in 1997, and the UMBC Review in 2000” (Hrabowski III 2019).

This high impact practice will help students gain further understanding into the life and practice of engineering. Additionally, participating in research as an undergraduate will provide them with more understanding of professional and technical skills.

2.6.5 Engineering Co-ops and Internships

Engineering students can further their professional experiences and deepen their engineering knowledge by earning and participating in a co-op or internship within industry.

These experiences are “particularly beneficial because, when well executed, they involve the development of practical skills, opportunities to apply those skills, and the acquisition of knowledge regarding when and how to apply skills, which are critical to developing expertise” (Henderson 2017, Kuh 2008, Litzinger et al. 2011, Ambrose et al. 2010). The goal behind recommending a coop or internship is that it will help students further develop and connect to the engineering field. Also, highlighting these opportunities to freshman will encourage them to start seeking internships or co-ops early, and to reinforce persistence in their engineering field.

2.6.6 Co-Ops

Cooperative education or co-op experiences often are a first step that convert into opportunities for the student that last for more than one semester. These opportunities can be offered between the university, employer, and student and provide companies developing relationships with possible future employees. Further studies are needed to determine whether co-ops increased a student’s motivation, career awareness, and even GPA (Baber and Fortenberry 2008, Blair, Millea and Hammer 2004, Sheppard et al. 2010, Schuurman, Pangborn and McClintic 2008). Impacts from the co-ops were measured based on “whether or not the co-op made a difference in the organization, whether the student worked in a team, and whether the co-op applied knowledge from the student’s major significantly predicted work self-efficacy” (Raelin et al. 2014, Powers et al. 2018) . It was found that students “experienced a significant increase in their work self-efficacy from their sophomore to senior year, whereas non-co-op/intern students experienced a decrease” (Powers et al. 2018, Raelin et al. 2014).

2.6.7 Internships

The National Association of Colleges and Employers (NACE), created both a definition and the parameters to describe what classifies as an internship. They recommend that “an

internship is a form of experiential learning that integrates knowledge and theory learned in the classroom with practical application and skills development in a professional setting. Internships give students the opportunity to gain valuable applied experience and make connections in professional fields they are considering for career paths; and give employers the opportunity to guide and evaluate talent” (NACE 2012). Internship experiences should include “transferable skills and knowledge, a defined beginning and end for the internship, a job description with qualifications, clear learning objectives or goals connecting professional goals to academic coursework, supervision by a professional, routine feedback from the supervisor, and a setting that supports the learning objectives” (Brush 2013, NACE 2012).

Surprisingly, only limited research discusses the immediate effects of an internship on an engineering student. However a study conducted at Stanford University in 2018 showed that students who had internship experiences “were more committed to engineering and to working at medium or large-size company” (Powers et al. 2018).

2.6.8 Living Learning Communities and Centers

In this research, many of our students are affiliated with programs that include what is known as a living learning community. This section will discuss how this is high impact practice and its effect on students and their development.

There are many different types of living learning communities (LLC) among higher education institutions. Shapiro and Levine (1999) identified “four types to include parties of clustered courses, cohorts in large courses or first- year interest groups, team- taught courses and residence-based programs (aka, living-learning programs)” (Inoue 2006, Shapiro and Levine 1999). The goals of a learning community are to focus on a group’s identity, integrate student academic and social experiences, offer connections between disciplines, foster critical thinking

skills, and regularly assess learning outcomes (Brower & Dettinger, 1998). The benefits to students who participate in learning communities include “higher academic achievement, better retention rates, greater satisfaction with college life, improved quality of thinking and communicating, a better understanding of self and others, and a greater ability to bridge the gap between academic and social worlds” (Lenning and Ebbers 1999).

A study conducted at Baylor University (Shushok and Sriram 2009) explored the impacts of living learning communities on engineering and computer science students. The results showed a significant difference between LLC students and non-LLC students. LLC students had more positive and higher levels of satisfaction in interactions with faculty informally, as well as and socially and academically, who showed support for their professional skills. Additionally, peer academic interactions increased by two hundred and fifty percent compared to non-LLC students (Shushok and Sriram 2009). At UMBC many of our engineering-associated Scholar programs have adopted the living learning community model requiring First Year Students, both affiliate and scholar student members, to live on the same floor of a residence hall on campus.

2.6.9 Summer Bridge Programs

In this research, many of our students are affiliated with programs that require participation in a Summer Bridge Program. This section will discuss this is high impact practice and its effect on students and their development.

Summer Bridge Programs have been used successfully to assist in persistence and retention of students. Summer bridge initiatives are implemented with students between the time they are admitted and their first semester of enrollment, to assist with their transition to college life with the goal of both matriculation and retention (Hermond 1995, Glenn and Landis 1985).

Programs vary in length from a few days to 10 weeks. Bridge programs may also concentrate on specific disciplines, orientation to the institutional culture, help to develop social networks, assist in preparing for college life, academic advising, developing professional skills and more (Stolle-McAllister 2011, Shishineh 2019). Many summer bridge programs are scholarship based or may include a stipend, depending on the nature of the program (Budny 1995, Hanidu et al. 1996, Shields, Grodsky and Darby 1996, Reichert and Absher 1997). These programs have “been found to positively affect participants’ perceived social fit, coping skills, and college preparation, and to decrease student anxiety in addition to providing a familiarity with the campus and a review of STEM content” (York and Tross 1994, Fletcher et al. 2001, Stolle-McAllister 2011, Shishineh 2019).

At UMBC, both our Meyerhoff scholarship program and the Center for Women in Technology (CWIT) offer summer bridge activities. The Meyerhoff summer bridge is an intensive six-week residential program that takes place on campus. “Not only do students take college level courses for credit and receive an introduction to campus and college life, but they also engage in structured group bonding activities, attend site visits, and become fully integrated into the Meyerhoff scholars program” (Stolle-McAllister 2011). The CWIT scholars program introduces students to one another through a new scholar retreat. The retreat is “is a three-day on-campus residential retreat for all incoming first-year Scholars. The Retreat includes sessions about transitioning to college, gender issues in technology, diversity, networking, campus resources, team-building, and opportunities to meet College faculty” (Rheingans et al. 2018).

2.6.10 Service and Community Based Learning

Service-learning has been integrated with varying degrees of success into engineering pedagogy at universities (Kleinhenz et al. 2005, Eyler and Giles Jr 1999). Service learning is

defined as “a form of experiential education in which students engage in activities that address human and community needs together with structured opportunities intentionally designed to promote student learning and development. Reciprocity and reflection are key concepts of service-learning” (Jacoby 1996). Highly successful engineering service and service-learning programs include the Engineering Practice In Community Service (EPICS) and Engineers Without Borders (EWB) programs (Coyle et al. 2000, Oakes et al. 2002). Service learning in engineering usually associates with a design problem and has a focus of “learning for the student and service to the community” (Duffy, Tsang and Lord 2000).

Service-learning projects in engineering education fall under the classification of Problem Based Service Learning (PBSL). “...PBSL experiences frequently impart professional and personal development beyond conventional learning objectives, yet which are nonetheless important for engineers” (Bielefeldt, Paterson and Swan 2010). PBSL experiences also address some specific Accreditation Board for Engineering and Technology, Inc (ABET) requirements, including developing a student’s professional skills and giving the student an opportunity to learn to work in teams, gain an understanding of ethical responsibility, broaden their knowledge of the impact of engineering solutions in a global and societal context (ABET 2019).

For example, in a study conducted by McCormick and Swan 2008, students lived in a rural community in Ecuador for a month as a part of an EWB project. Their goal was to develop and install a water collection treatment system for the community. By examining the students’ journals the researchers observed that “the students showed evidence that they learned about leadership and teamwork, bonded with community members, gained confidence in applying engineering technology, and began to perceive their ability to positively impact others” (Bielefeldt et al. 2010, McCormick, Swan and Matson 2008).

2.6.11 Tutoring

Although tutoring can be useful for any age group, for this study we examined the impact of tutoring as it relates to the engineering student, especially in the first year. Most tutoring that occurs at colleges and universities is peer tutoring. Peer tutoring has shown a positive impact on both student achievement and retention (Baillie 1998, Bender 2001, Lidren, Meier and Brigham 1991). Powell (1997) described “four general positive outcomes of tutoring programs: (a) tutoring can improve student performance and skills, and provoke student interest in participating fully in the educational process, (b) tutoring benefits can improve the learning of both the tutor and the tutee, (c) tutoring can relieve the strain on teachers trying to teach large, often mixed ability classes, and (d) tutoring is relatively inexpensive and greatly enriches education.” Henderson (2002) found that engineering students in their first year “...who had ever received tutoring felt it was a positive experience, and the majority of those who had previously tutored others also felt it was a positive experience” (Henderson, Fadali and Johnson 2002).

2.6.12 First Year Experiences

As colleges and universities continue to discover, implement, and refine successful high impact practices, educational research argues for a combination of efforts and supports to ensure student success for a broad variety of students (Campbell and Skoog 2004). It is important to consider and understand that a student will have a unique background, and that all students will “start from diverse places” (Pipeline 2011). Therefore, there will likely be a need to have different types of support available and to encourage engagement and motivation through different sources. Because of the wide range of student experiences before college, many institutions are redesigning their first-year programs to be more intentional and strategic to recruit and retain students. Below are examples of these efforts by colleges.

Many of the First-year programs or experiences have the intended “purpose of providing first-year students with specific resources, support, and programming to allow for a successful transition” (Carnegie Mellon University 2019). In 2006, the University of Maryland, College Park formed their Keystone program which is responsible for teaching first- and second-year courses. The most effective teaching faculty for the program were deemed “Keystone Professors” and were selected to teach “one section of a Keystone Course each semester and were responsible for ensuring high-quality offerings. Core math and science courses taught outside of engineering cannot be used to “weed out” prospective students” (ASEE 2012). Due to the introduction of the Keystone program, it was reported that “one-year retention rates up 8.3 percent and two-year retention rates up 13.1 percent between fall 2005 (pre-Keystone) and fall 2010... Four-year graduation rates rose 8.9 percent” (ASEE 2012).

The Thayer School of Engineering at Dartmouth assessed the impact of their first-year Dartmouth Emerging Engineers (DEE) program established in 2016. The aim of the program is to support “students through their prerequisites, both academically and emotionally” (Bonfert-Taylor). The program makes several support structures available to students, including daily drop-in group study sessions, individual tutoring sessions, course selection advising, special events, and specialized TA selection and training. Statistically significant results showed increased retention in the overall engineering population and for women. Other populations, although not statistically significant, also experienced higher retention rates than non-participants in the program.

In 2013, the College of Engineering Student Success Center at Tennessee Tech was established implementing a “three-pronged approach to student success, R³: Recruitment, Retention, and Recognition” (Ingle Jr et al. 2017). To recruit students, the college uses

specialized visits from external experts, outreach programs, and scholarships. Strategies in retention include professional advising, a required first year connections course, peer tutoring, supplemental instruction, service learning and professional development for students to be ambassadors through the college. Finally, the college prioritizes the need for recognizing and rewarding students for both traditional academic accomplishments and non-technical skills, such as leadership and service. Opportunities for recognition include award banquets, ambassador programs, and networking and professional development. “Since the model’s implementation, the center has seen positive impacts on student success, such as an 81% persistence rate from first to second year for first year freshmen in the center’s advising program” (Ingle Jr et al. 2017).

Many of these High Impact practices are currently implemented at UMBC. These practices, although available, tend to be underutilized by our COEIT students. Through this study, some of these practices are highlighted as a recommendation to our engineering students to help increase their state of mind in a positive direction.

2.7 Summary

As examined by this literature review, research shows that students leave engineering due to their perceptions and attitudes, rather than just academics. Although a great deal of work has been done to establish interventions that help students’ retention, there is very little focus on the student’s ability to self-assess their perceptions and attitudes. Therefore, this study will examine the use of an immediate feedback tool designed to promote student self-awareness and assist in the development of a student’s engineering state of mind.

In this study, three research aims concerning engineering students engineering self-assessment were investigated:

1. To define a UMBC student's (Third, Fourth and Fifth year) successful Engineering State of Mind. This was essential to the creation of the Engineering State of Mind Instrument (ESMI) giving students indirect peer mentoring opportunities through online profiles.
2. Determine the common themes of freshman engineering students' Engineering State of Mind and the attitudes and perceptions of the different population groups of the study. Specifically in gender, ethnic affiliation, and mentorship programs in engineering. (Instrument Efficacy)
3. Determine how first year engineering students' perceptions change after they have gained an understanding of their perceptions and attitudes of engineering. (Intervention Efficacy)

By completing the aims and investigating the questions, this work hopes to contribute an effective tool that promotes a student's awareness of their engineering state of mind in perceptions, attitudes, and feelings, with a goal of increased retention in the field. It is believed that by facilitating the education of self-assessment as it relates to both internal and external factors that affect a student's success, self-correction can be made early in their academic career.

Chapter 3: Methods

This chapter describes the details regarding procedures, participants, and data analysis used in the current study. The validity and reliability of the proposed instrument will also be discussed. The study's design and the statistical analyses are discussed in relation to the research question. Briefly, the methods used to achieve the aims the were:

1. The Engineering State of Mind Instrument (ESMI) was developed based on previous work that included a study conducted in 2011 (Gurganus 2011). The previous study identified multiple themes from a qualitative assessment that defined the variables of the dissertation research. The previous work helped to identify the validated tools and methods used in this research.
2. The ESMI was further developed to include feedback scores related to the students' attitudes and perceptions that are given to engineering students. These scores are determined using Social Cognitive Career Theory as the framework.
3. The assessment included a number of different student populations, including Junior and Senior engineering students, Engineering 101 students and Sophomores in Engineering 204. The Junior and Senior student assessments were used to create example student profiles for the website. These profiles from upperclassmen provided the underclassmen a reference for their own scores.
4. IRB approval was sought and granted in April 2019 and website was completed in June 2019.
5. In the Fall 2019 semester, four groups of study were identified within the Engineering 101 population and the ESMI was disseminated according to the group classifications below:

- Group #1: Received ESMI at the start of the semester. No interventions were offered. They received ESMI again toward the end of the semester with follow up questions on the impact of the instrument.
 - Group #2: Received ESMI at the start of the semester. Interventions were offered. They received ESMI again toward the end of the semester with follow up questions on the impact of the instrument.
 - Group #3: Did not received ESMI at the beginning of the semester. No interventions were offered. They received ESMI toward the end of the semester with follow up questions on the impact of the instrument.
 - Group #4: Did not received ESMI at the beginning of the semester. Interventions were offered. They received ESMI toward the end of the semester with follow up questions on the impact of the tool.
6. A follow-up Impact Survey, consisting of open-ended questions, was disseminated to post-analysis participants of the ESMI. This survey helped demonstrate how students' perceptions changed and what impact the ESMI had within the different groups of study. Common themes were found and reported.
7. Once data were collected, statistical analysis was performed to assess significant differences and changes within or between the groups in the study. Additionally, a pre-semester & post-semester assessment was performed between and within groups for the following variables:
- a. Overall population
 - b. Gender
 - c. Ethnic Affiliation
 - d. Program Affiliation

- e. Pre-Post Group #1 and #2, between and within groups:
 - i. Overall
 - ii. Gender
 - iii. Ethnic Affiliation
 - iv. Program Affiliation

3.1 Research Design

The focus of this study was the development of the Engineering State of Mind Instrument and evaluation of an engineering student's ability to self-assess. To verify perception and attitudinal correlations discovered in a previous study of mechanical engineering UMBC students (Gurganus 2011), this study will use the survey that was created and implemented in 2011. The development of this tool used both a qualitative and quantitative approach (Creswell 2003), and had two phases. First, interviews were conducted with mechanical engineering students from various backgrounds and scholar associations including Meyerhoff, CWIT, and S-STEM, as well as non-programmed affiliations. From these interviews, themes were extracted and placed in the Social Cognitive Career Theory (SCCT) construct categories (see Table 3.1). Themes were used to identify specific validated surveying tools related to perceptions, attitudes, and self-efficacy of engineering students that are shown and defined in Table 1 in Chapter 1. The survey tools were combined to create a new survey to understand how various student groups in mechanical engineering perceive engineering retention and success (Gurganus 2011).

Table 3.1: Themes Revealed from Interviews 2011

Social Cognitive Variable	Identifiable Themes/Items
Emotional and Physiological States	<ul style="list-style-type: none"> • Student efficacy in “barrier” situations * • Feelings of isolation/inclusion* • Gender influence • Participant satisfaction with their program • Student coping strategies in difficult situations*. • Having to feel strong, even when not.
Social Persuasion and Vicarious Experiences	<ul style="list-style-type: none"> • Student/parents/friends expectations about work load* • Student process of choosing a major* • Influence of role models on study and career decision* • Influence of Mentor/Advisor/Family/Peers on Academic/social behaviors • Advising issues • Feeling a Need to prove themselves
Mastery Experiences	<ul style="list-style-type: none"> • Outcomes expected from studying engineering * • Career exploration* • Misconceptions of being an engineer • How grades and team projects impact performance • Internship experiences
*AWE identified theme (AWE 2009)	

The variables listed in Table 3.1 are shown in Table 3.2 in relation to the Social Cognitive Career Theory. Neither the Student’s confidence when beginning their engineering degree nor their current confidence in completing their degree are categorized in the SCCT constructs. They were used for comparative analysis with the students engineering mindset.

Table 3.2 Variables in Social Cognitive Career Theory Framework.

Emotional States	Feelings of Inclusion	Coping Self-Efficacy	Engineering Career Expectations
Social Persuasion and Vicarious Experiences	Motivation	Advisor, Mentor, Peer mentor	General Impressions of Engineering
Mastery Experiences	Perceived Importance of Professional and Interpersonal	Perceived Importance of Math and Science Skills	

3.2 Population

UMBC undergraduate freshman engineering students in their first year of the program were assessed in this study. More specifically, students who were enrolled in Engineering 101 (ENES 101) in the Fall 2019 semester were assessed. Junior and Senior engineering students were invited to participate, for both comparison and profile development on the engineeringed.umbc.edu website. Additionally, a small population of 33 mechanical engineering students taking Introduction to Engineering Design (ENME 204) were assessed for comparison. Students were identified as a member of a Scholar program, like the Meyerhoff, CWIT, and S-STEM programs; students not involved with a scholar program were identified as “non-programmed.” This expression was adopted from a study of STEM majors in their freshmen year (Kahveci et al. 2006). The study compared freshmen students in a program for women in science, engineering and mathematics to students in a STEM honors program.

3.2.1 College of Engineering and Information Technology (COEIT) Population

The College of Engineering and Information Technology (COEIT) currently has a total of 1,365 students enrolled in the Fall 2019 semester who are declared as either pre-engineering or engineering depending on their status as a student¹ (see Table 3.2 for COEIT demographics). Students who have not passed the gateway requirements are designated as ‘pre-’ until they have completed the requirements of their specific program. These gateway requirements are typically a set of four classes with minimum threshold of grades or GPA.

In the mechanical engineering department, out of 638 students, 41% are classified pre-mechanical engineering and 60% are mechanical engineering majors. 19.2% have identified as female and 81% have identified as male. Some mechanical engineering students are also

enrolled in formal mentoring programs including: 4.3% Meyerhoff scholars and affiliates, 2.0% CWIT scholars, and 5.8% S-STEM scholars.

In Computer engineering, out of 373 students, 50% are classified pre-computer engineering and 50% computer engineering. 15% have identified as female and 85% as male. Of computer engineering students, 3.4% are Meyerhoff students and 1.6% are CWIT scholars. In Chemical Engineering, out of 276 students, 48.5% are classified as pre-chemical engineering and 51.4% chemical engineering. 43.1% have identified as female and 56.8% as male. Of the chemical engineering students, 7.9% are Meyerhoff scholars and 3.6% are CWIT. Further population data of COEIT at UMBC can be found in Table 3.3 shown below.

Table 3.3 COEIT Student Demographics, Fall 2019

Variable		
Ethnicity/Citizenship		
American Indian/Alaska Native	1	0.1
African/Black American	245	17.9
Asian & Pacific American	279	20.4
Latino/Hispanic American	104	7.6
White American	621	45.5
Two or More	80	5.9
Gender*		
Male	1050	76.9
Female	315	23.1
Plan		
Pre-Engineering	130	9.5
Pre-Computer Engineering	186	13.6
Pre-Mechanical Engineering	261	19.1
Pre-Chemical Engineering	134	9.8
Computer Engineering	187	13.7
Mechanical Engineering	377	27.6
Chemical Engineering	142	10.4
Program Affiliation		
Meyerhoff Scholar	63	4.6
CWIT Scholar	30	2.2
Total	1365	100

**OIA is in process to expand their gender classifications*

3.2.2 Participants

The participants in this study included upperclassman, freshman engineers (for the pre- and post-semester assessments), and sophomore mechanical engineers (case study). Participants were recruited and asked to complete the instrument on a voluntary basis in accordance with the IRB Y19JG23156 (Appendix A). Participants in this study were clearly delineated as voluntary for both the qualitative and quantitative analyses. To prevent coercion, participants were informed that they were not obligated to answer any question and could stop the interview or instrument at any time. If the participants decided to withdrawal, the data was not retained, and all recorded data was deleted from the study.

The study was conducted in three separate phases. Each phase included juniors and seniors in COEIT, Engineering 101 (ENES 101) students, Engineering 101 student follow-up impact survey (qualitative) and Mechanical Engineering sophomores in Introduction to Engineering Design (ENME 204) class. Details of the data collection are presented in the next sections, along with demographic description of the participants in the study.

3.2.2.1 Collecting profile information on Juniors and Seniors

A total of 17 participants for this study consisted of randomly selected undergraduate Junior or Senior men and women in Mechanical, Computer and Chemical Engineering, all of whom were volunteers and invited by email. The breakdown of the group of students can be found in Table 3.4.

Table 3.4: Profiles of Junior and Senior Profiled Engineering Students

Variable		
Ethnicity/Citizenship	Frequency	Percent
American Indian/Alaska Native	0	0.0
African/Black American	4	23.5
Asian & Pacific American	2	11.8
Latino/Hispanic American	0	0.0
White American	10	58.8

Two or More	1	5.9
Gender		
Male	8	47.1
Female	9	52.9
Plan		
Computer Engineering	3	17.6
Mechanical Engineering	10	58.8
Chemical Engineering	4	23.5
Program Affiliation		
Meyerhoff	3	17.6
CWIT Scholar	1	5.9
CWIT Affiliate	3	17.6
S-STEM	1	5.9
Non-Programmed	8	47.1
two or more	1	5.9
Major Program year		
Third-year Student	1	5.9
Fourth-year Student	9	52.9
Fifth-year Student or above	7	41.2
Professional Society		
ASME	2	11.8
NSBE	2	11.8
AICHE	1	5.9
TBP	2	11.8
None	2	11.8
Two or more	8	47.1
Total	17	100

3.2.3 Introduction to Engineering 101 Students

Introduction to Engineering 101 (ENES 101) is a gateway class for all computer, chemical and mechanical engineering students. ENES 101 is offered both in the spring and the fall semesters. The pre- or co-requisite for this class is that students must be enrolled in or completed Calculus I (MATH 151). 282 students registered for the class with 87% majoring in an engineering field. The other 13% were declared computer science or another STEM field majors (Table 3.5). ENES 101 in the fall includes both an Honors section and a Y-Section. Students who are affiliated with the Honors College enroll in the Honors Section to earn credit

toward their Honors College requirements. The Y-section is a part of the First-Year Experiences that is run by the Division of Undergraduate Academic Affairs.

Table 3.5 Engineering 101 Fall 2019 Demographics

Variable	Frequency	Percent
Ethnicity/Citizenship		
African/Black American	54	19.1
Asian & Pacific American	60	21.3
Latino/Hispanic American	20	7.1
White American	134	47.5
Two or More	14	5.0
Gender		
Male	207	73.4
Female	75	26.6
Plan		
Pre-Engineering	28	9.9
Pre-Computer Engineering	39	13.8
Pre-Mechanical Engineering	126	44.7
Pre-Chemical Engineering	52	18.4
Pre-Computer Science	8	2.8
Other	29	10.3
Program Affiliation		
Honors College	21	7.4
Meyerhoff Scholar	10	3.5
CWIT Scholar	12	4.3
Discussion Section ENES 101		
Monday 230	29	10.3
Tuesday 8am (Y-Section)	12	4.3
Tuesday 10am	31	11.0
Tuesday 12pm	29	10.3
Tuesday 2pm	28	9.9
Wednesday 3pm	32	11.3
Thursday 8am (honors section)	26	9.2
Thursday 10am	33	11.7
Thursday 12pm	30	10.6
Thursday 2pm	32	11.3
Total*	282	100

**Note: This data reflects the enrolled students from beginning of Fall 2019. 12 students withdrew from the ENES 101, leaving 270 students completing the course.*

Participants in the study were anonymous undergraduate engineering students in ENES 101.

Table 3.6 displays the demographics of the pre- and post-semester population.

Table 3.6 Pre and Post Collection Demographics Introduction Engineering 101

	Pre - Frequency	Percent	Post - Frequency	Percent
Ethnicity/Citizenship				
Black/African American	34	20.1	29	16.4
American Indian/Alaskan Native	1	0.6	0	0
Asian & Pacific American	30	17.8	33	18.6
Latina/Hispanic American	5	3	6	3.4
White American	87	51.5	88	49.7
Other	12	7.1	21	11.9
Gender				
Male	127	75.1	127	71.8
Female	40	23.7	48	27.1
Other	2	1.2	2	1.1
Program Affiliation				
Meyerhoff Scholar	9	5.3	10	5.6
CWIT Scholar	6	3.6	9	5.1
CWIT Affiliate	***		9	5.1
S-STEM	18	10.7	16	9
Non-Programmed	136	80.5	133	75.1
Plan				
Pre-Computer Engineering*	*		30	16.9
Pre-Mechanical Engineering*	*		93	53
Pre-Chemical Engineering*	*		41	23.2
Other	*		13	7.3
Discussion Section ENES 101				
Monday 230**	**		19	10.7
Tuesday 8am (Y Section)**	**		6	3.4
Tuesday 10am	27	16	17	9.6
Tuesday 12pm	29	17.2	13	7.3
Tuesday 2pm	27	18.9	18	10.2
Wednesday 3pm**	**		23	13
	**			
Thursday 8am (Honors Section)**			22	12.4
Thursday 10am	32	18.9	24	13.6
Thursday 12pm	27	16	19	10.7

Thursday 2pm	27	16	16	9
Before UMBC				
High School	149	88.2	150	84.7
2-year College	12	7.1	11	6.2
4-year College	3	1.8	10	5.6
Military	1	0.6	0	0
Working a full-time job	3	1.8	2	1.1
Other	1	0.6	4	2.3
Enrollment				
Part time	3	1.8	7	4
Full time	166	98.2	170	96
Year in College				
First-year Student	140	82.8	147	83.1
Second-year Student	18	10.7	22	12.4
Third-year Student	8	4.7	7	4
Fourth-year Student	0	0	0	0
Fifth-year Student or above	3	1.8	1	0.6
Total	169	100	177	100

**Pre-assessment instrument did not delineate between the engineering majors but was included on the post-assessment.*

***Discussions with this designation were not included in the pre-assessment portion of the study intentionally. They were included in the post-assessment.*

****No population to report*

3.2.4 Sophomore Mechanical Engineering 204 Students:

Introduction to Engineering Design, with CAD (ENME 204) is a mechanical engineering student's first formal design class. Students are required to have completed Mechanics of Materials (ENME 220) to enroll in ENME 204. As the first introduction to mechanical design, students are introduced into the best practices of engineering design. They are required to design a customer driven product using computer aided tools such as Solidworks. This class also contributes toward an entrepreneurship minor offered through the university. Students learn to innovate and compete in the market leading to a potential patented product.

According to the UMBC mechanical engineering 4-year curriculum plan, it is recommended that students take ENME 204 in the spring semester of their sophomore year. However, this class is offered twice a year, in both the fall and spring. The fall tends to have a smaller population. Students who take this class in the fall general have either switched their academic major field into mechanical engineering, are a semester behind, or recently transferred into the university.

At the end of Fall 2019 semester, the students were offered the opportunity to take the Engineering State of Mind Instrument. In Table 3.7, depicts the participant demographics.

Table 3.7 Sophomore Introduction to Engineering Design Demographics

Variable	Frequency	Percent
Ethnicity/Citizenship		
American Indian/Alaska Native	0	0
African/Black American	6	18.2
Asian & Pacific American	9	27.3
Latino/Hispanic American	3	9.1
White American	10	30.3
Two or More	5	15.2
Gender		
Male	25	75.8
Female	7	21.2
other	1	3
Plan		
Mechanical Engineering	32	97.0
Other	1	3.0
Program Affiliation		
Meyerhoff	1	3
CWIT Scholar	1	3
CWIT Affiliate	1	3
S-STEM	6	18.2
Non-Programmed	24	72.7
two or more	0	0
Major Program year		
First-year Student	1	3
Second-year Student	3	9.1

Third-year Student	24	72.7
Fourth-year Student	3	9.1
Fifth-year Student or above	2	6.1
Professional Society		
ASME	2	6.1
SWE	1	3
SHPE	1	3
None	24	72.7
Two or more	5	15.2
Before UMBC		
High School	16	48.5
2-year College	12	36.4
4-year College	3	9.1
Military	2	6.1
Total	33	100

3.2.5 Qualitative Survey Information.

Post analysis of the ESMI included a combined qualitative and quantitative impact follow-up survey. Those who participated in the Post analysis of the ESMI were offered the opportunity to participate in the impact survey. This survey was to assess the attitudes and perceptions of the students in Engineering 101 post-ESMI in more depth and allowing the students to provide a free response answers. In Table 3.8 shows the demographics of the 46 participants who contributed to the data.

Table 3.8 Impact Follow-up Survey Demographics

	Frequency	Percent
Ethnicity/Citizenship		
Black/African American	9	20%
American Indian/Alaskan		
Native	0	0%
Asian & Pacific American	9	20%
Latina/Hispanic American	4	9%
White American	19	41%
Other	5	11%
Gender		
Male	29	63%

Female	15	33%
Other	2	4%
Program Affiliation		
Meyerhoff Scholar	3	7%
CWIT Scholar/Affiliate	7	16%
S-STEM	2	4%
Honors College	5	11%
Non-Programmed	28	62%
No response	1	2%
Plan		
Pre-Computer Engineering	8	17%
Pre-Mechanical Engineering	23	50%
Pre-Chemical Engineering	12	26%
Other	3	7%
Discussion Section ENES 101		
Monday 230	5	11%
Tuesday 8am	2	4%
Tuesday 10am	3	7%
Tuesday 12pm	4	9%
Tuesday 2pm	3	7%
Wednesday 3pm	5	11%
Thursday 8am	9	20%
Thursday 10am	7	15%
Thursday 12pm	4	9%
Thursday 2pm	4	9%
Total	46	100%

3.3 Research Instruments

3.3.1 Engineering State of Mind Instrument (ESMI)

Interviews conducted in 2011 (Gurganus 2011) identified themes that were used to create and develop the survey used in this research (See Table 3.1 & 3.2 & 3.3). The survey (Appendix B) was developed using components from five different instruments including: the Pittsburgh Freshmen Engineering Attitudes Survey (PFEAS) (Besterfield-Scare et al. 2001), Longitudinal Assessment of engineering self-efficacy (LEASE)(AWE 2009), Students Leaving Engineering (SLE) (AWE 2009) (AWE 2009),Academic Pathways of People Learning Engineering Survey

(APPLES) ((Sheppard et al. 2010), and the Mentoring Functions Questionnaire (Pellegrini and Scandura 2005). Each of these instruments have established validity and the ability of drawing correct conclusions based on the data obtained from an assessment (Fraenkel and Wallen 2003). Each of the surveys' authors assured validity with a pilot of a sample size. Then, for example, factor analyses were used to ensure construct validity and external expert reviews to ensure content validity.

3.3.2 Description of the Five Instruments in ESMI

The Pittsburgh Freshmen engineering attitudes survey (PFEAS) was developed in 1993 to evaluate the efforts to improve engineering education at the University of Pittsburgh. "The PFEAS was constructed to measure many of Seymour and Hewitt's primary reasons students leave engineering. The PFEAS attitudinal subscales were administered to assess students' attitudes about engineering (Besterfield-Scare et al. 2001)." Seven factors identified by the original authors (Besterfield-Scare et al. 2001) were postulated to underlie the attitudinal items: general impressions, financial influences, contributions to society, perceptions of work, enjoyment of math and science, engineering as exact science, and family influences.

The LAESE (longitudinal assessment of engineering self-efficacy) instrument was used to measure the self-efficacy of women studying engineering, including feelings of inclusion and outcomes expectations (Marra et al., 2005; Marra, Moore, Schuurman, Bogue, 2004; aweonline.org). Marra et al (2005) state that:

Prior instrument development research has shown that self-efficacy is most validly measured by querying respondents about their feelings of efficaciousness in a very specific context – thus this instrument strives to measure engineering self-efficacy. To construct a self-efficacy instrument, one identifies the typical barriers that stand between the individual and her or his success in the domain. Thus, this self-efficacy

instrument is designed to identify the sources of barriers or obstacles in the task of obtaining an engineering degree and ascertain how capable a person feels in those situations.

The Academic Pathways of People Learning Engineering Survey (APPLES) instrument is one of the research tools developed and used by the National Science Foundation-funded Academic Pathways Study (APS). The 16 multi-item variables in the instrument were designed to expand the understanding of the undergraduate engineering experience and an undergraduate's transition into the workplace. The APS research questions focus on four primary areas that have been suggested to investigate what engineering graduates need to succeed in an increasingly complex world (S. et al. 2010, Sheppard et al. 2010):

- Skills and Knowledge: How do students' engineering skills and knowledge develop and/or change over time?
- Identity: How do students come to identify themselves as engineers? How does student appreciation, confidence, and commitment to engineering change as they navigate their education? How does this, in turn impact how these students make decisions about further participation in engineering after graduation?
- Education: What elements of students' engineering education contribute to changes observed in the questions related to skills, knowledge, and identity? What do students find difficult and how do they deal with the difficulties they face?
- Workplace: How do students and early career engineers conceive of their engineering future? What skills do early career engineers need as they enter the workplace? Where did they obtain these skills? Are there any missing skills?

The Assessing Women in Engineering (AWE) Students Leaving Engineering (SLE) instrument (Marra et al. 2009) is a quantitative instrument used to collect data on the reasons engineering students choose to transfer out of engineering. To fully encompass all influences and background of the student, this instrument includes items related to the reasons for initially pursuing engineering, such as high school preparation, intended transfer destination, career plans, participation in extracurricular activities and factors that impacted respondents' decision to leave engineering.

The Mentoring Functions Questionnaire is a 9-item survey developed by Pellegrini and Sandura (2005b) to measure protégé satisfaction with the mentoring relationship in three dimensions: career, psychosocial, and role modeling.

3.3.3 Measurement in Engineering State of Mind Instrument: Rationale for Psychometrics

For the purpose of this study, psychometrics will be utilized to measure attitudes. One successful and widely discussed method of assessing attitudes and perceptions is the Likert scale approach (Coaley 2014, Price 2016). Likert is advantageous of because it does not require judgement (Selltitz, Wrightsman and Cook 1976a) unlike other scaling methods. In constructing Likert scales, a large number of “favorable and unfavorable” items (or questions) are developed with a large trial group of respondents who rate them on a scale, often from 1 through to 5, sometimes from 1 to 7 (Coaley 2014, Price 2016).

As an example, using a five-point scale, as described in Coaley 2014, “the numbers are given meaning, usually 1 = strongly agree, 2 = agree, 3 = not certain or undecided, 4 = disagree and 5 = strongly disagree. Total scores on this initial set of statements are determined by summing the scores for all the items. From the total scores a discrimination index can be calculated, enabling selection for the final questionnaire of positively and negatively phrased

items which discriminate significantly between respondents. Only those statements, therefore, are used which best differentiate between high and low scorers (Coaley 2014).”

This scale is also regarded as the “scale of summated ratings. The scale is also referred to as the scale of summated ratings because any individual's attitude score is the sum of all the ratings for the different items in the questionnaire. It is ordinal and so can only order the attitudes of individuals on a continuous dimension, being unable to determine the magnitude of differences between scores (Coaley 2014).”

Using the Likert scaling method also allows for a diverse range of items that can be significantly correlated with the total scores. This leads to greater accuracy than other scale tools (Cronbach 1946);(Coaley 2014);(Selltiz et al. 1976b). “Additionally, this approach assumes a linear model, i.e. that the sum of item scores has a linear relationship with the attribute measured, and it should, therefore, be considered with measures constructed on the basis of Classical Test Theory. This means Likert scales have all of the psychometric advantages of CTT measures, for example the more steps (scaled numbers i.e. 1-5, 1-7 etc) there are in a rating scale, the more reliable it is (Cronbach 1946);(Coaley 2014);(Selltiz et al. 1976b).”

3.3.4 Reliability

Table 3.9 describes the 17 multi-item Likert scale variables in the instrument created for this study. Variables were chosen that match closely with the themes derived from the qualitative analysis in 2011 (Gurganus 2011). These variables potentially indicate the influences on a student’s decision to persist and major in engineering and eventually, to continue working in an engineering field (S. et al. 2010, Sheppard et al. 2010). Included in the table for each variable are the Cronbach’s alpha scores, which are tested using SPSS. Cronbach’s alpha is a test of internal

consistency of the individual items that comprise each variable. These scores measure the statistical reliability resulting from the similarity of individual item responses. The scores also characterize the degree to which the items in a scale can be treated as measurements for the same underlying construct (such as motivation). Cronbach's alphas of 0.60 and higher are considered to be an acceptable level of internal consistency (Hair, et al, 2006). The Likert scale for each variable is given in the Table footnotes. The final form of the Instrument can be seen in Appendix B.

Table 3.9 Survey Items and Internal Consistency

1. Motivation: Financial¹ ($\alpha=.77$) 3 items
Engineers make more money than most other professionals
Engineers are well paid
An engineering degree will guarantee me a job when I graduate
2. Motivation: Parental Influence¹ ($\alpha=.80$) 2 items
My parents would disapprove if I chose a major other than engineering
My parents want me to be an engineer
3. Motivation: Social Good¹ ($\alpha=.75$) 3 items
Technology plays an important role in solving society's problems
Engineers have contributed greatly to fixing problems in the world
Engineering skills can be used for the good of society
4. Motivation: Mentor Influence¹ ($\alpha=.74$) 4 items
A faculty member, academic advisor, teaching assistant or other university affiliated person has encouraged and/or inspired me to study Engineering
A non-university affiliated mentor has encouraged and/or inspired me to study engineering
A mentor has introduced me to people and opportunities in engineering
Mentoring Program (Meyehoff or CWIT) has encouraged and/or inspired me to study
5. Motivation: Intrinsic Psychological¹ ($\alpha=.83$) 3 items
I feel good when I am doing engineering
I think engineering is fun
I think engineering is interesting
6. Motivation: Intrinsic Behavioral¹ ($\alpha=.61$) 2 items
I like to build stuff
I like to figure out how things work

7. Perceived Importance of Professional and Interpersonal Skills² ($\alpha=.79$) 6 items

Perceived importance: Self-confidence (social)
Perceived importance: Leadership ability
Perceived importance: Public speaking ability
Perceived importance: Communication skills
Perceived importance: Business ability
Perceived importance: Ability to perform in teams

8. Perceived Importance of Math and Science Skills² – 3 items ($\alpha=.84$)

Perceived importance: Math ability
Perceived importance: Science ability
Perceived importance: Ability to apply math and science principles in solving real world problems

9. Engineering career success expectations⁵ – 7 items, ($\alpha=.82$)

Someone like me can succeed in an engineering career
A degree in engineering will allow me to obtain a well-paying job
I expect to be treated fairly on the job. That is, I expect to be given the same opportunities for pay raises and promotions as my fellow workers if I enter engineering
A degree in engineering will give me the kind of lifestyle I want
I expect to feel “part of the group” on my job if I enter engineering
A degree in engineering will allow me to get a job where I can use my talents and creativity
A degree in engineering will allow me to obtain a job that I like

10. Feeling of inclusion⁵ – 4 items, ($\alpha=.75$)

I can relate to the people around me in my class
I have a lot in common with the other students in my classes
The other students in my classes share my personal interests
I can relate to the people around me in my extra-curricular activities

11. Coping self-efficacy⁵– 6 items, ($\alpha=.72$)

I can cope with not doing well on a test
I can make friends with people from different backgrounds and/or values
I can cope with friends’ disapproval of chosen major
I can cope with being the only person of my race/ethnicity in my class
I can approach a faculty or staff member to get assistance
I can adjust to a new campus environment

12. General Impressions of Engineering³– 9 items ($\alpha=.81$)

I expect that engineering will be a rewarding career
I expect that studying engineering will be rewarding
The advantages of studying engineering outweigh the disadvantages
I don't care for this career
The future benefits of studying engineering are worth the effort
I can think of several other majors that would be more rewarding

I have no desire to change to another major
The rewards of getting an engineering degree are not worth the effort
From what I know, engineering is boring

13. Advisor – 5 items³ ($\alpha=.93$)

My advisor takes a personal interest in my career.
My advisor helps me coordinate professional goals.
My advisor has devoted special time and consideration to my career.
I share personal problems with my advisor.
I exchange confidences with my advisor.

14. Mentor- 5 items³ ($\alpha=.93$)

My mentor takes a personal interest in my career.
My mentor helps me coordinate professional goals.
My Mentor has devoted special time and consideration to my career.
I share personal problems with my Mentor.
I exchange confidences with my Mentor. (that which is confided; a secret; trust or faith; i.e. a friend does not betray confidences)

15. Peer mentor – 3 items³ ($\alpha=.91$)

I share personal problems with my Peer mentor.
I exchange confidences with my Peer mentor. (that which is confided; a secret; trust or faith; i.e. a friend does not betray confidences)
My peer mentor helps me coordinate my academic career goals

16-17. Confidence (leaving engineering)⁴ - Independent Variables

When you began your engineering degree, how confident were you that you would complete it?

At the present time, how confident are you that you will complete a engineering degree at this institution?

¹ Four-item scale: 0=Not a reason, 1=Minimal reason, 2=Moderate reason, 3=Majorreason

² Four-point scale: 0=Not important, 1=Somewhat important, 2=Very important, 3=Crucial

³ Five-point scale: 0= Strongly Disagree, 1=Disagree, 2=Neutral 3=Agree, 4= Strongly Agree

⁴ Five-point scale: 0=Not Strongly Confident, 1=Not Confident, 2=Neutral, 3=Confident, 4=Strongly Confident

⁵ Six-point scale: 0=Strongly Disagree, 1= Disagree; 2=Slightly Disagree 3=Neither Disagree nor Agree, 4=Slightly Agree, 5=Agree, 6=Strongly Agree

3.3.5 Construction of the Instrument and Website

The Engineering State of Mind of Instrument was developed starting in the fall of 2017 through the spring 2019. In conjunction with the instrument development, the engineeringed.umbc.edu website was constructed.

To provide the best combination of flexibility and user-friendly output, Qualtrics Survey online software was adopted. This platform allowed the ability to create algorithms that calculated the user's results and provided immediate feedback. Calculation of the overall score combined from the 17 variable measures consisted of a summation of the totals for each participant. For items that were measured on four, five, and six-point scales, the data were first normalized and then averaged. Item scores were summed and multiplied by 100 for reporting. An example of this can be found in Appendix C. The method for computing multi-item variable scores was modeled from Sheppard et. al. (2010). The values obtained from Qualtrics were confirmed with the Statistical Package for the Social Sciences (SPSS) to ensure consistency. A sample of the algorithms, both for Qualtrics and SPSS, can be found in Appendix C.

As a part of the ESMI tool, engineeringed.umbc.edu was developed to help provide convenient interpretation of the user's results to facilitate their understanding of their engineering state of mind. Each of the variables, as it related to the Social Cognitive Career Theory (SCCT) constructs, were explained to the user and detailed scales with recommendations were provided to assist the user in understanding the meaning behind their score. Appendix C shows a sample of one the variables scale and its development.

In the spring and summer of 2019, a small focus group of 7 engineering freshman and sophomore students volunteered to help identify changes needed to increase the user (student) understanding with the instrument. Changes included altering some of the language on the

website to make the variables more readily understandable for the student's self-assessment.

Table 3.10 shows the language changed in each of the variables to include the SCCT constructs.

Table 3.10: Change in Variable Language

Variable	Reworded Variable
SCCT Construct: Social Persuasion and Vicarious Experiences	How Motivated am I study and practice engineering?
Motivation to Study Engineering: Financial (APPLES)	I'm Motivated to Study Engineering because of the Financial Rewards
Motivation to Study Engineering: Parental Influence (APPLES)	I'm Motivated to Study Engineering because of my Parent's Influence
Motivation to Study Engineering: Social Good (Apples)	I'm Motivated to Study Engineering to Improve the Welfare of Society
Motivation to Study Engineering: Mentor Influence (APPLES)	I'm Motivated to Study Engineering because of a Mentor or Mentorship program
Motivation to Study Engineering: Intrinsic Psychological (APPLES)	I'm Motivated to Study Engineering for its Own Purpose
Motivation to Study Engineering: Intrinsic Behavioral (APPLES)	I'm Motivated to Study Engineering for its Practical Uses
General Impressions of Engineering	How do I value Engineering?
SCCT Construct: Mastery Experiences	How do I value skills necessary for engineering?
Perceived Importance of Math and Science Skills (APPLES)	I Feel Math and Science Skills are Essential to Becoming an Engineer
Perceived Importance of Professional and Interpersonal Skills (APPLES)	I feel Professional and Interpersonal Skills are Essential to Becoming an Engineer
SCCT Construct: Emotional States	How do I feel about being an Engineer?
Engineering Career Success Expectations (LEASE)	I feel I can fit into an engineering career and be treated fairly
Feeling of Inclusion (LEASE)	I feel I can relate to people in my class or activities
Coping Self- Efficacy (LEASE)	I feel I can deal with or overcome problems and difficulties
Not reported to the student or Included in Algorithm	
Confidence Beginning (Complete) Engineering Degree (SLE)	
Confidence Present (Complete) Engineering Degree (SLE)	
Advisor	
Mentor	
Peer mentor	

Further changes to the instrument included removing Advisor, Mentor, and Peer Mentor from the algorithm for Social Persuasion and Vicarious Experiences. It was found there was some redundancy within the scoring with these variables and the Motivation Mentor variable. Although still measured, these items were separated and deleted from this algorithm and they were not reported to the student.

3.3.6 Qualitative Impact Survey (Post-ESMI)

Choosing the framework for qualitative analysis, a follow-up impact survey helped develop the questions for the survey (Bondner, G 2004). The framework helped guide the design of the study's data collection and analysis method. This component of the investigation was conducted with both a phenomenology and grounded theory focus as explained further in this section.

Phenomenology will allow the possibility of receiving a full sense of the lived experience of the students. It agrees that there is no single reality, that each individual has their own experience or perspective in their environment. The human experience may be examined through four facets; spatial, corporeal, relational and temporal (Glaser 1992, Bogdan and Biklen 2007). All of these aspects are taken into consideration. It is important to be aware that people, in the case of self-awareness or assessment, have different perceptions of different situations in the company of different people and at different times. Understanding this premise helps inform the development of the open-ended qualitative questions that allow the student to provide feedback as it relates to their reality.

Grounded theory, which has many characteristics in common with phenomenology, explores how people define reality and how their beliefs are related to their actions. This theory proposes reality is created by people through attaching meaning to situations. Meaning is

expressed by symbols such as words, religious objects, and clothing. These symbolic meanings are the basis for actions and interactions. Unfortunately, symbolic meanings are different for everyone (Bogdan and Biklen 2007). Grounded theory analysis, explained in more detail later, will be used to define the codes, and therefore identifying themes, from the qualitative impact survey.

3.3.7 Strategies for coding and analyzing data

Qualitative analyses require a smaller sample size than quantitative analyses. Patton (2002) believes that qualitative inquiry should typically focus on a relatively small sample. Qualitative sample sizes should be large enough to obtain feedback for most or all perceptions. Obtaining most or all of the perceptions will lead to saturation. Saturation occurs when adding more participants to the study does not result in additional perspectives or information.

Glaser and Strauss (1967) recommend the concept of saturation for achieving an appropriate sample size in qualitative studies. For grounded theory, Morse (1994) suggested 30 - 50 interviews, while Creswell (1998) suggests only 20 - 30. And for phenomenological studies, Creswell (1998) recommends 5 to 25 and Morse (1994) suggests at least 6.

3.3.8 Coding

Grounded theory protocol will be used to assess the qualitative data from the survey. The premise of the theory is the discovery of emerging patterns and generating theories from the data (Glaser in Walsh, Holton et al 2015). Strauss and Corbin (1990) describe guidelines of coding

data when utilizing grounded theory analysis to include open coding¹, axial coding² and selective coding³ (Foundation 2008). For this study we used thematic or open coding, in which key themes (or categories) are assigned, through review of each response, using a coding system. Open coding involves forming initial categories of information about the phenomenon being studied from the data. This is “the process of breaking down, examining, comparing, conceptualizing, and categorizing data” (p. 61). An example of the coding scheme can be found in Appendix C. Reading carefully through the survey results, a coding scheme (as explained above) was developed to analyze the data generated in this research. The steps in qualitative analysis included preliminary exploration of the data by reading through the survey responses, coding the data by segmenting and labeling the text, using codes to develop themes aggregating similar codes together, connecting and interrelating themes, and constructing a narrative (Creswell, 2002).

3.4 Procedure

Data collection took place in several phases. First, approval was obtained from the Institutional Review Board for Research Involving Human Subjects (IRB) at UMBC. After IRB approval was obtained, data collection was a multi-step process: 1) Dissemination of ESMI to Junior and Seniors, 2) Dissemination of ESMI to Engineering 101 students (as appropriate for the specifics groups of study) 3) Dissemination to Engineering 101 students (all groups of study)

¹ **open coding** - where the researcher begins to segment or divide the data into similar groupings and forms preliminary categories of information about the phenomenon being examined.

² **axial coding** - following intensive open coding, the researcher begins to bring together the categories he or she has identified into groupings. These groupings resemble themes and are generally new ways of seeing and understanding the phenomenon under study.

³ **3. selective coding** - the researcher organizes and integrates the categories and themes in a way that articulates a coherent understanding or theory of the phenomenon of study.

4) Impact Survey follow-up and Dissemination to Sophomore Mechanical Engineering class (ENME 204).

3.4.1 Dissemination of the ESMI

The survey was approved by the Institutional Review Board (Y19JG23156) in March 2019. The tool was disseminated online for easy accessibility using Qualtrics, a flexible and user-friendly statistical software tool provided through UMBC's Division of Informational Technology (DoIT). A link was also placed on the engineering.umbc.edu website. Before beginning the survey, participants were asked to read the informed consent form. By continuing past this form and clicking the 'next' button, implied consent was given when they began the survey. All information collected remained anonymous.

3.4.2 Juniors and Seniors Aim #1

When the website, engineering.umbc.edu, was complete and working, profiles of Junior and Seniors engineering student volunteers were collected, starting May 2019. These students were contacted by email and asked to take the ESMI. The information collected served in a role similar to a peer mentor, or peer proxy. It provided a model for freshmen and sophomore students to assess their Engineering State of Mind and relate it to their upperclassmen peers.

Additionally, the upperclassmen profiles were divided by their programmatic identification (both disciplinary and CWIT students, Meyerhoff, S-STEM scholars and Non-programmed), to account for the impact these programs have on the student.

To gauge a UMBC Junior and Senior engineering student, questions regarding their academic experience were asked. These free-response questions included:

What other majors or minors are you currently earning?

What on-campus professional societies and/or mentoring programs do you belong to?

Have you had Internships or Research Experiences?

Have you been a part of On-Campus Research?

Please describe any difficulties you experienced through your engineering education.

How did you overcome or what helped you with these challenges?

With permission from the students, the profiles were published on engineeringed.umbc.edu in their respective disciplines. Examples of the profiles can be found in Appendix B.

3.4.3 Engineering Science 101 Fall 2019 Aim #2

The participant population used in this study was the students of the fall 2019 Introduction to Engineering (ENES 101). ENES 101 is required for all three engineering programs and is considered a gateway for all engineering majors. A gateway is a required class for the engineering discipline where a student must attain a specific grade (usually B or C) to be admitted to the major. Most students enroll in this class starting in their first semester of their academic career.

ENES 101 in the fall 2019 semester initially had 282 students registered. Twelve students withdrew from the class leaving a total of 270 students. The class was structured such that the lectures were offered on Monday and Friday at 11am. There were 10 different discussion sections, offered at various times throughout the week, ranging between 20-30 students. For this study, the discussion sections were assigned to one of the four study groups:

- Group#1: Received ESMI at the start of the semester. No interventions were offered. They received ESMI again toward the end of the semester with follow up questions on the impact of the instrument.

- Group#2: Received ESMI at the start of the semester. Interventions were offered. They received ESMI again toward the end of the semester with follow up questions on the impact of the instrument.
- Group#3: Did not received ESMI at the beginning of the semester. No interventions were offered. They received ESMI toward the end of the semester with follow up questions on the impact of the instrument.
- Group#4: Did not received ESMI at the beginning of the semester. Interventions were offered. They received ESMI toward the end of the semester with follow up questions on the impact of the tool.

Table 3.11 provides a timeline for the implementation of the study for each of the groups.

Table 3.11: Research Model for ENES 101 Discussions.

Timeline: Fall 2019	Group #1	Group #2	Group#3	Group # 4
	Tuesday 10am, 12pm & 2pm	Thursday 10am, 12pm, & 2pm	Monday 2:30pm & Wednesday 3pm	Tuesday 8am & Thursday 8am
Beginning of September	Received ESMI	Received ESMI	No ESMI	No ESMI
September-November	No intervention	Intervention	No Intervention	Intervention
Mid-November	Received ESMI	Received ESMI	Received ESMI	Received ESMI

At UMBC, the fall 2019 semester began starting on a Wednesday prior to Labor Day, August 27th. As a result of the Labor Day holiday (university closed September 2nd), Monday section students had to attend one of the 9 offered sections during the week of September 2nd. Therefore, the ESMI tool was not officially launched until the week of September 9th, to avoid inconsistent timing that could possibly have affected the data.

Groups #1 and #2 were visited by the researcher/instructor who described the opportunity to take the ESMI to the participants. The students were informed that participation was voluntary and did not count in any way toward their grade. Students in these groups were allowed time at the end of the discussion to take the ESMI.

Group #2 received interventions¹ that included several discussion visits from the instructor describing best practices for success (going to office hours, tutoring center, visiting student success center etc.), encouraging messages to the class and mechanisms to connect to the campus and other students. Additionally, students received notifications of opportunities related to their career (internships, company visit to campus and co-op's). Group #2 students were also given an opportunity to join a peer mentorship program, hosted through American Society of Mechanical Engineers, but opened to any major. Finally, the students were offered several opportunities to visit an upper level class in their discipline. Instructors in these classes volunteered days for the freshman students to shadow a potential class they will take in the future. Additionally, students were given the opportunity to connect to other faculty in their discipline (email and sample forms Appendix D).

Group #4 consisted of the Honors (Thursday 8am) and Y (Tuesday 8am) sections of ENES 101. The Honors affiliated students are provided with a community that helps navigate their first year of college. Additionally, they receive “through special coursework and holistic advising and mentoring, “... the opportunity to build relationships with faculty and staff to cultivate... longer-term ambitions”(UMBC). The Y section, open to all students in their first year, focuses on “enhancing skills that pertain to college life. For example, students have the opportunity to

¹ Interventions: for this study, engineering education interventions were ongoing, both direct and indirect, activities to encourage, provide a resource, or bring awareness to a help a student's academic career.

improve their writing, test taking, and time management skills by working with staff and faculty who are committed to student success” (FYE). Students in this section carry an additional credit meeting on Wednesday at 11am in addition to their Tuesday 8am discussion time.

All four groups were visited by the researcher in their final full week of discussion, December 2nd. Groups #3 and #4, who were not provided the opportunity to take the instrument in the beginning, were introduced to the instrument and informed that participation was voluntary. Groups #1 and #2, previously provided with the instrument, were reminded of ESMI and again were informed that participation was voluntary. Additionally, further explanation was provided such that by choosing to participate, they had the opportunity to take a follow-up impact survey that entered them into a prize drawing. Details on the follow-up impact survey are explained in the next section.

3.4.4 Follow-up Impact Survey Aim #3

ENES 101 students who opted to participate in the post-ESMI assessment were offered an opportunity to take a follow-up impact qualitative survey. If the students agreed, they were offered a chance to win five cash incentives. The cash incentives included one \$100, two \$50, and two \$25 gift cards. Before beginning the survey, participants were asked to read the informed consent form (Appendix A). If they agreed, implied consent was given when they began the survey. All information collected remained anonymous. If the participant wished to enter their name in a drawing, they filled out their e-mail at the end. This information did not correspond with the data and was destroyed once all selected participants were notified of winning their incentive. The drawing for the incentive was random.

3.4.5 Mechanical Engineering Sophomore Class

During the last day of class, December 10th, the Introduction to Mechanical Engineering Design class (ENME 204), was asked to participate in ESMI. The class was informed that participation was voluntary. This data was used for a small case study comparing freshman to sophomore mechanical engineers ESMI.

3.5 Data Analysis

3.5.1 Quantitative

The data collected from the survey was coded, based on the 17 identified variables, tabulated, and analyzed using the Statistical Package for the Social Sciences (SPSS). Procedures used for the analyses of data included frequency counts, calculations of means and standard deviations, t-test for significance, Shapiro-Wilk test of normality, reliability coefficients (Cronbach's alpha), Spearman's Rho or Pearson correlations, coefficient of determination, effect size, One-way Analysis of Variance (ANOVA), Kruskal-Wallis test, and Mann-Whiney/Wilcox test for significant difference between groups and variables. This analysis provided an understanding of common Engineering State of Mind perceptions among Engineering 101, Engineering 204, and junior and senior students.

The first phase of the descriptive analysis involved computing response frequencies of the total sample for each question. Percentages and means were also calculated for each variable and corresponding group. For the 'general impressions of engineering variable', items that represented the negative (opposite) context from another item were re-coded as a positive. For example, the negative to "I expect that engineering will be a rewarding career" was "I don't care for this career." The value of reverse questioning was to force the participant to carefully read

the questions. Answers that showed inconsistency were removed from the data set. Data were then analyzed by comparing the means for juniors, seniors, ENES 101, and ENME 204.

Data analysis on each of the 17 variable measures consisted of summing the totals for each participant followed by a tabulation of the frequencies and means for the entire sample. Internal consistency for each of the variable measures was tested with a reliability coefficient alpha. To test if the data were normally distributed, the Shapiro-Wilk test was applied for small sample sizes. Differences in means between two groups were measured with a t-test of significance, Mann-Whitney U or Friedman's 2-Way ANOVA by ranks.

Spearman's rho correlations were applied to each of the variables according to their program to assess correlation and significance in the variables and the strength of the relationship was assessed according to Cohen (1988) (see Appendix D). If the data were normally distributed, a one-way ANOVA, utilizing a Fisher's least significant different (LSD) post hoc test, was used to test the mean difference between the three groups. One-way ANOVA analysis was used over multiple t-tests to prevent committing type I error¹. Non-parametric testing was used on data with non-normal distribution. This analysis included a Kruskal-Wallis test and Mann-Whitney/Wilcoxon to test to compare the groups. If a significant difference was found between the groups, the effect size, eta-squared, was found and compared to the Cohen (1988) scale (see Appendix D) to determine the strength of the association.

¹ A type I error occurs when the null hypothesis is actually true, but was rejected as false by the testing

.5.2 Qualitative

Further investigation included a qualitative survey. A deductive coding scheme was developed for purposes of the analysis in this paper (See Appendix C for list of codes).

Coding was conducted through a whole text analysis. Grounded theory analysis was used until constant themes were revealed and all categories in the SCCT were saturated. The aim, as Glasser (1992) states was to discover the themes implicit in the data.

3.6 Summary

This chapter reviewed methodological issues pertaining to the study. Additionally, methods of participant recruitment and characteristics were described. Measures utilized in this study were: 17-item Engineering State of Mind Instrument (ESMI) and Qualitative impact survey. Around 169 students enrolled in Engineering 101 participated in the study at the beginning of the semester and 177 at the end. Each of these students were placed into experimental groups that either received the instrument at the beginning of the semester with interventions, no interventions with instrument, or only received the instrument at the end of the semester. Analysis of attitude, perceptions and self-efficacy were evaluated according to the Social Cognitive Career theory variables. Additionally, a qualitative assessment was given to provide a wholistic picture of the effectiveness of the instrument on the student state of mind.

Chapter 4 – Results

4.1 Introduction

This chapter presents the primary results of this study. Section 4.2 reports the results of the Engineering State of Mind profiles of the Juniors and Seniors who participated in the study. Sections 4.3 and 4.4 present the pre- and post-semester assessments, respectively, of the Engineering State of Mind Instrument (ESMI) as it related to the ENES 101 Freshman population. Section 4.5 presents a pre- and post-semester comparison of the two groups, Group #1 and Group #2, that were given the ESMI before and after the semester. Section 4.6 assesses the data from the qualitative impact survey as it related to the ESMI. Section 4.7 presents the results of the case study of mechanical engineering sophomores compared to mechanical engineering freshman.

4.2 Data Assessment - Juniors and Seniors (Table E1)

For the 3rd and 5th year students, there was a significant increase in confidence levels from the beginning to their present state (where the “beginning” refers to their projections back to when they started, and “present state” refers to when they took the ESMI). For the 4th year students, there was a slight decrease in confidence that was not significant (Figure 4.2.1). A Shapiro-Wilk test of normality revealed that none of the data for any of the populations were normally distributed. A Kruskal-Wallis test revealed significant differences in beginning confidence between 4th and 5th year students ($p=.005$, $\eta^2=.617$). Means, standard deviations, and the significance for all the variables in this section are given in Appendix E.

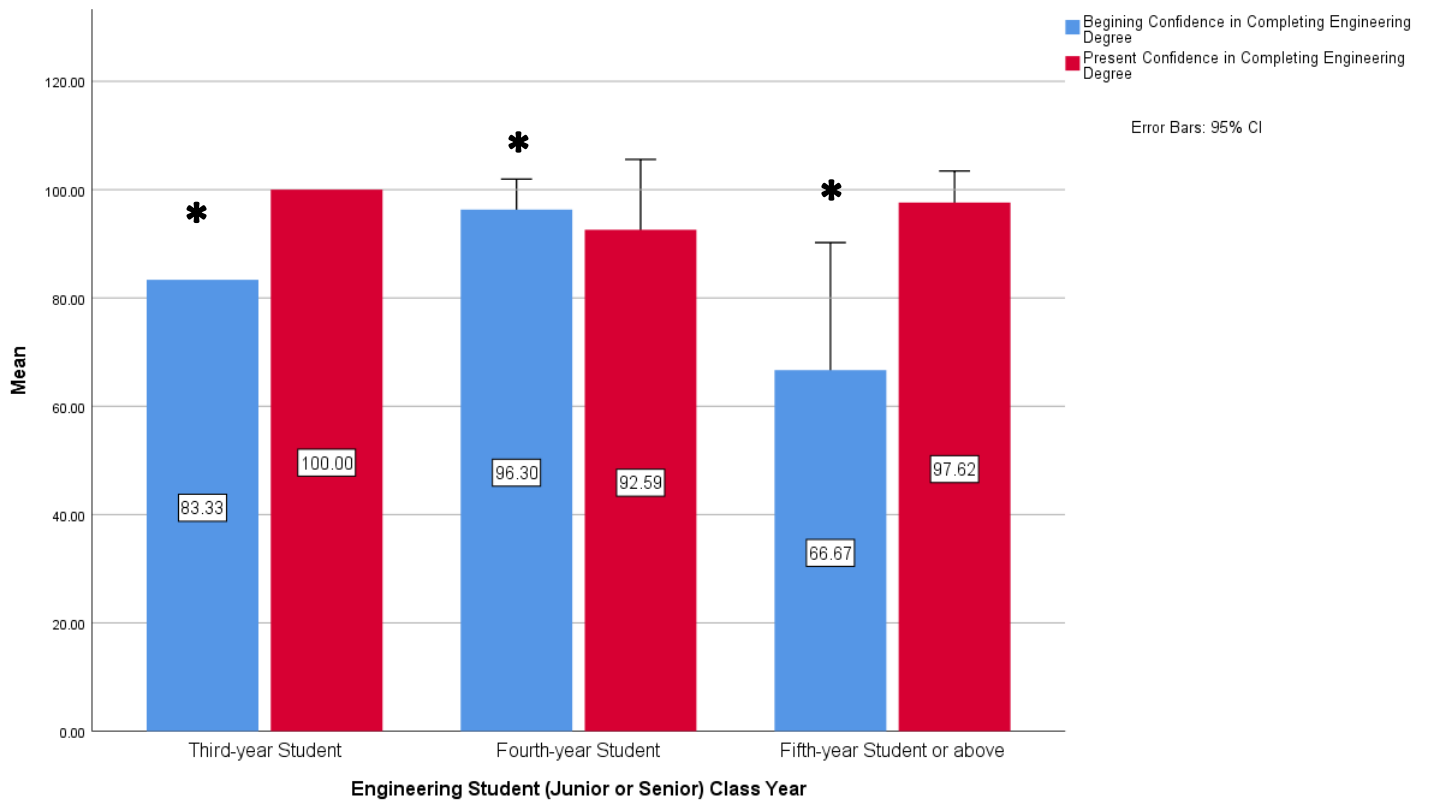


Figure 4.2.1 Confidence level of Profiled Junior and Senior Students.

A post hoc analysis of pairwise comparisons showed the significant differences between groups (Table 4.2.1).

Table 4.2.1 Pairwise Comparison of Beginning Confidence in Junior and Seniors

Beginning Confidence Pairwise Comparisons of Class Year $\eta^2=.617$	
Comparison	p-value
Fifth-year Student or above < Fourth-year Student	0.001
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.	

4.2.1 Social Persuasion and Vicarious Experiences (SPVE) Assessment (Table E2)

The SPVE variables were assessed for the entire Junior and Senior population. A Shapiro-Wilk test revealed that only the data for Mentor Influence, General Impressions of Engineering, and SPVE were

normally distributed; the data for all other variables were not. However, non-parametric measures were used because the group populations were too small for post hoc analysis. A Kruskal-Wallis test revealed no significant 3rd, 4th, and 5th year students.” (Figure 4.2.2).

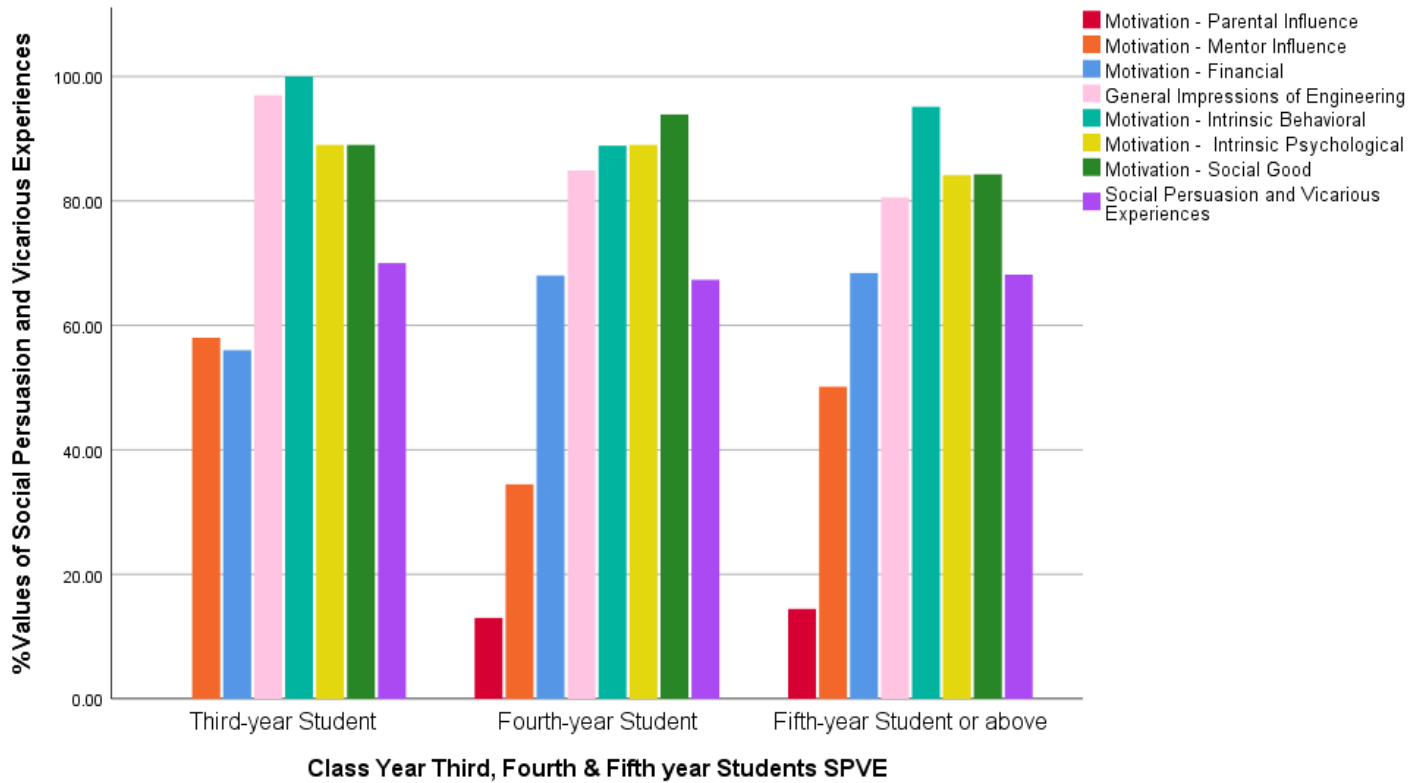


Figure 4.2.2 SPVE Means of Juniors and Seniors. Error bars are omitted for clarity.

4.2.2 Gender Social Persuasion and Vicarious Experiences (SPVE) Assessment (Table E3)

The SPVE variables were assessed for the combined Junior and Senior population with respect to Gender. A Shapiro-Wilk test showed that no variables were normally distributed. An Independent-Samples Mann-Whitney U Test showed no significant difference in the variables across Gender.

4.2.3 Ethnic (SPVE) Junior and Seniors Assessment (Table E4)

The SPVE variables were assessed between the Ethnic groups in the Juniors and Seniors. A Shapiro-Wilk test showed that only Motivation Mentor Influence and General Impressions of

Engineering with respect to the Ethnic groups were normally distributed; the data for all other variables were not. A One-Way ANOVA and Independent-Samples Kruskal-Wallis Test showed no significant difference between the groups.

4.2.4 Program Affiliation (SPVE) Assessment (Table E5)

The variables were assessed between the Program Affiliations. A Shapiro-Wilk test showed that only the Motivation Mentor, Financial, and Social Persuasion and Vicarious Experiences variables with respect to the Program Affiliation groups were normally distributed; the data for all other variables were not. A One-Way ANOVA showed no significant difference among the groups. Non-parametric measures showed significant differences between the groups in Mentor Influence ($p=0.060$) and Parent Influence ($p=0.067$) (Figure 4.2.3).

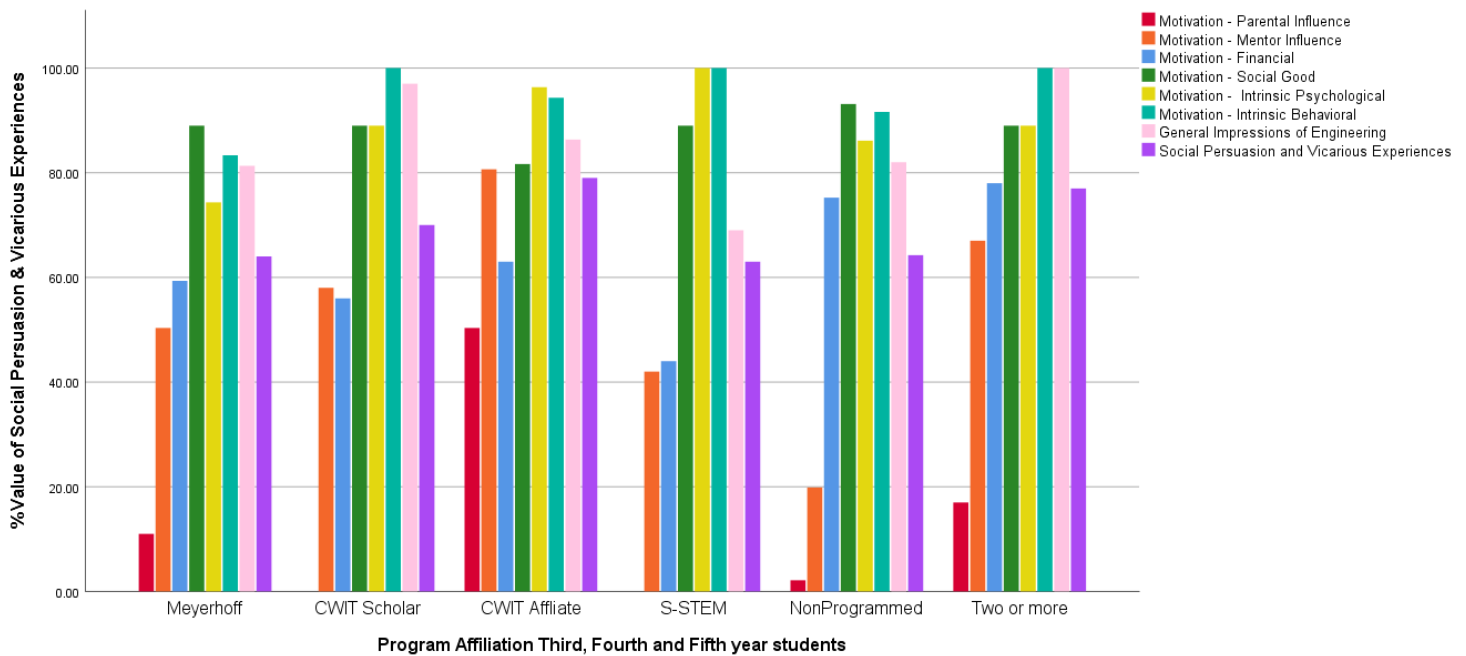


Figure 4.2.3 Program Affiliation Means of Juniors and Seniors. Error bars are omitted for clarity.

A post hoc analysis of pairwise comparisons for parental and mentor influence shows the groups with significant differences (Table 4.2.3a-b).

Table 4.2.3a Post Hoc Pairwise Comparisons for Parental Influence between Program Affiliations

Parent Influence of Program Affiliation	
Comparison	p-value
CWIT Scholar < CWIT Affiliate	0.06
S-STEM < CWIT Affiliate	0.06
Non-Programmed < CWIT Affiliate	0.004
Meyerhoff < CWIT Affiliate	0.071
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.2.3b Post Hoc Mentor Influence Program Affiliation Pairwise Comparisons

Mentor influence of Program Affiliation	
Comparison	p-value.
Non-Programmed <to CWIT Affiliate	0.003
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.2.5 Correlations of SPVE Relationships and Assessment (Table E6)

Correlations were assessed in Junior and Seniors for the SPVE variables. Using a Spearman's Rho test, Social Good and Intrinsic Psychological had a positive significant moderate relationship $r_s(15) = .594$ ($p=0.012$). Therefore, the coefficient of determination suggests that the motivation to practice engineering to help the welfare of society accounts for 35% of the positive motivation to practice engineering for its own sake. Other significant relationships are found in the appendix.

4.2.6 Mastery Experiences (ME) Assessment (Table E7)

The Mastery Experiences variables were assessed for the combined Junior and Senior population. A Shapiro-Wilk test revealed that only the Mastery Experiences variable was normally distributed. However, non-parametric measures were used because the group populations were too

small for post hoc analysis. A Kruskal-Wallis test revealed no significant differences between the groups (Figure 4.2.4).

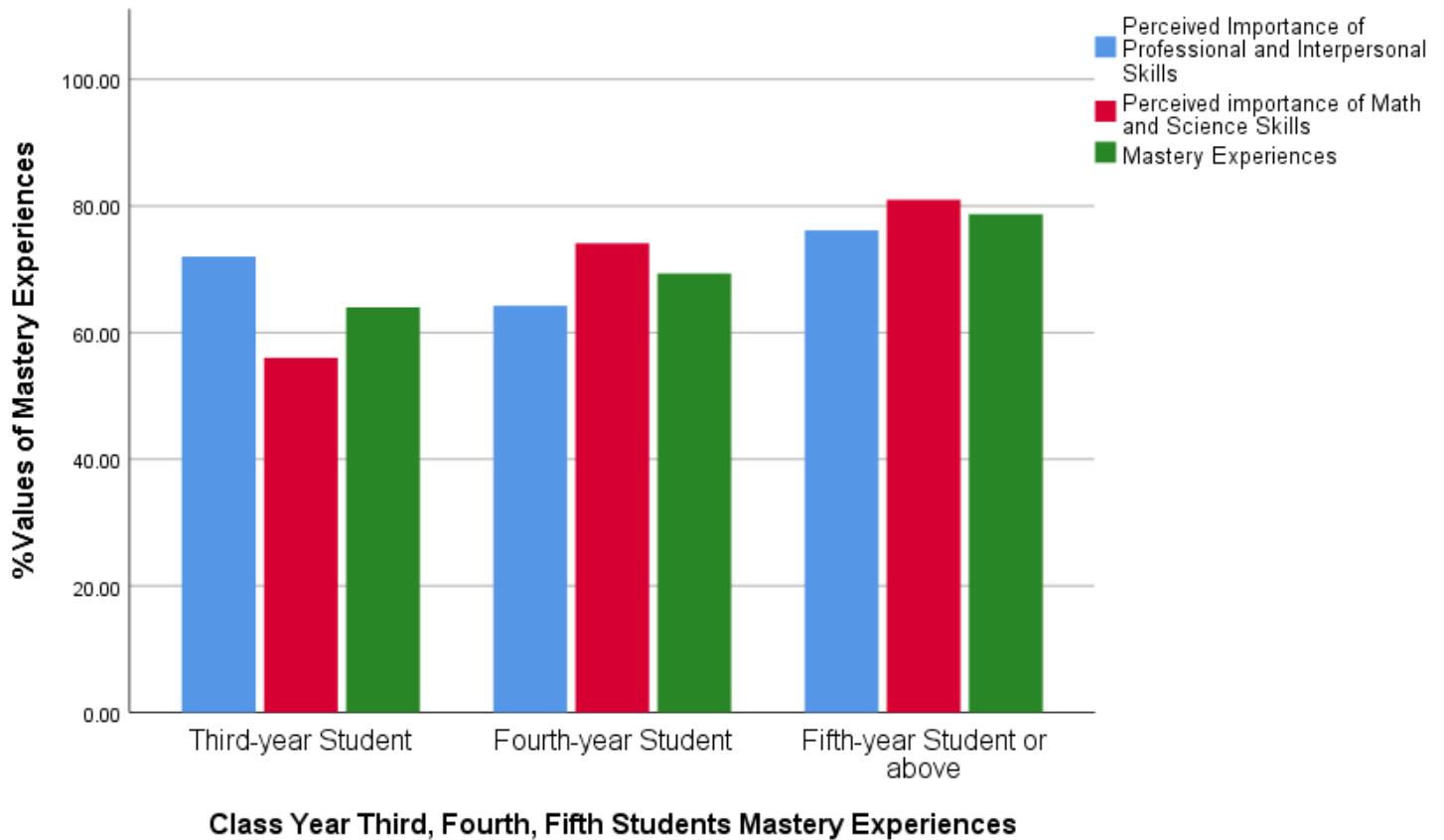


Figure 4.2.4 Mastery Experiences Means of Juniors and Seniors, Error bars are omitted for clarity.

4.2.7 Gender Mastery Experiences (ME) Assessment (Table E8)

The ME variables were assessed for the combined Junior and Senior population with respect to Gender. A Shapiro-Wilk test showed that the variables were normally distributed, except Perceived Importance of Math and Science Skills. One-Way ANOVA and Independent-Samples Mann-Whitney U Tests showed no significant difference in the variables between gender.

4.2.8 Ethnic Mastery Experiences (ME) Assessment Juniors and Seniors (Table E9)

The ME variables were assessed between the Ethnic groups in the Juniors and Seniors. A Shapiro-Wilk test showed that only Perceived Importance of Professional and Interpersonal skills variables were normally distributed; the data for all other variables were not. Because of small sample sizes, non-parametric measures were used. A Kruskal-Wallis Test showed significant difference for all variables between the groups: Perceived Importance of Professional and Interpersonal Skills ($p=.03$), Perceived Importance of Math and Science Skills ($p=.094$), and Mastery Experiences ($p=.045$) (Figure 4.2.5).

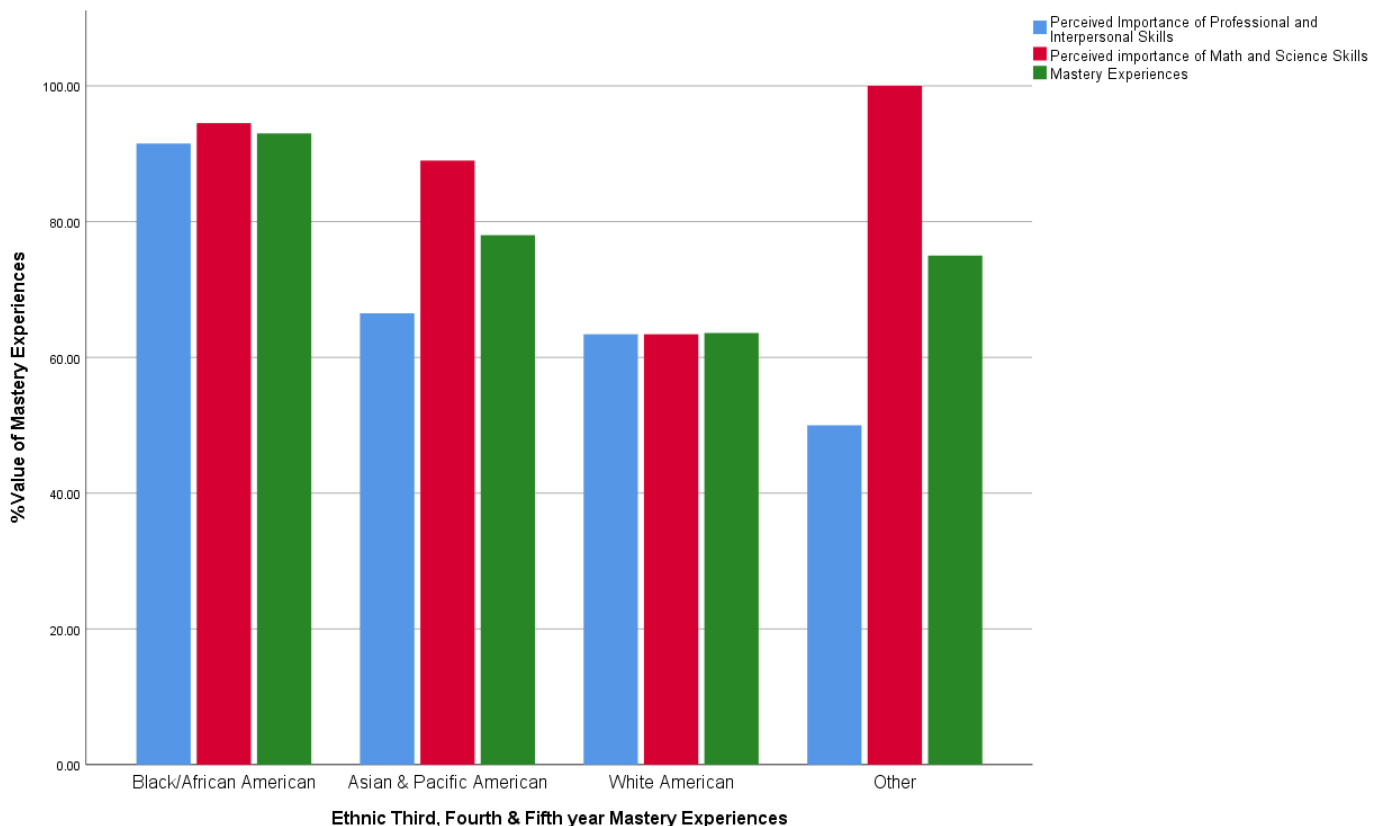


Figure 4.2.5 Ethnic Means of Juniors and Seniors, Error bars are omitted for clarity.

A post hoc analysis of pairwise comparisons shows the groups with significant differences (Table 4.2.4a-c).

Table 4.2.4a Post Hoc Perceived Importance of Professional and Interpersonal Pairwise Comparisons

Perceived Importance of Professional and Interpersonal Skills, Ethnic $\eta^2=.498$	
Comparison	P-value
Other < Black/African American	0.019
White American < Black/African American	0.009
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.2.4b Post Hoc Perceived Importance of Math and Science Pairwise Comparisons

Perceived importance of Math and Science Skills, Ethnic $\eta^2=.199$	
Comparison	P-value
White American< Black/African American	0.033
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.2.4c Post Hoc Mastery Experiences Pairwise Comparisons

Mastery Experiences, Ethnic $\eta^2=.434$	
Comparison	P-value
White American< Black/African American	0.005
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.2.9 Program Affiliation Mastery Experiences (ME) (Table E10)

The Mastery Experience variables were assessed between the Program Affiliations. A Shapiro-Wilk test showed the variables with respect to the program affiliation groups were normally distributed; however, because of the small sample size non-parametric measures were used. A Kruskal-Wallis Test showed no significant difference between the groups.

4.2.10 Correlations Mastery Experiences (ME) Assessment Juniors and Seniors (Table E11)

Correlations were assessed for Juniors and Seniors on the ME SPVE variables. Using Spearman's Rho, significant relationships were found in Mastery Experiences and Perceived Importance

of Math and Science Skills ($r_s(15) = .887$ $p=0$). The coefficient of determination suggests that a Junior and Senior's perspective of their math and science skills accounts for 79% of their overall perception of the skills in engineering. Other significant relationships are found in the appendix.

4.2.11 Emotional States Experiences Assessment Juniors and Seniors (Table E12)

The Emotional States variables were assessed for the combined Junior and Senior population. A Shapiro-Wilk test revealed that only the Emotional States and Feelings of Inclusion data were normally distributed. Non-parametric measures were used because the class groups were too small for post hoc analysis. A Kruskal-Wallis test revealed no significant differences between the groups (Figure 4.2.6).

4.2.12 Gender Emotional States Assessment Juniors and Seniors (Table E13)

The Emotional State variables were assessed for the entire Junior and Senior population with respect to Gender. A Shapiro-Wilk test showed the variables were normally distributed, except for Engineering Career Success Expectations. Because of the small sample size, non-parametric measures were used. An Independent-Samples Mann-Whitney U test showed a significant difference in Coping Self-Efficacy ($p=0.015$, $\eta^2=.345$) (Figure 4.2.6).

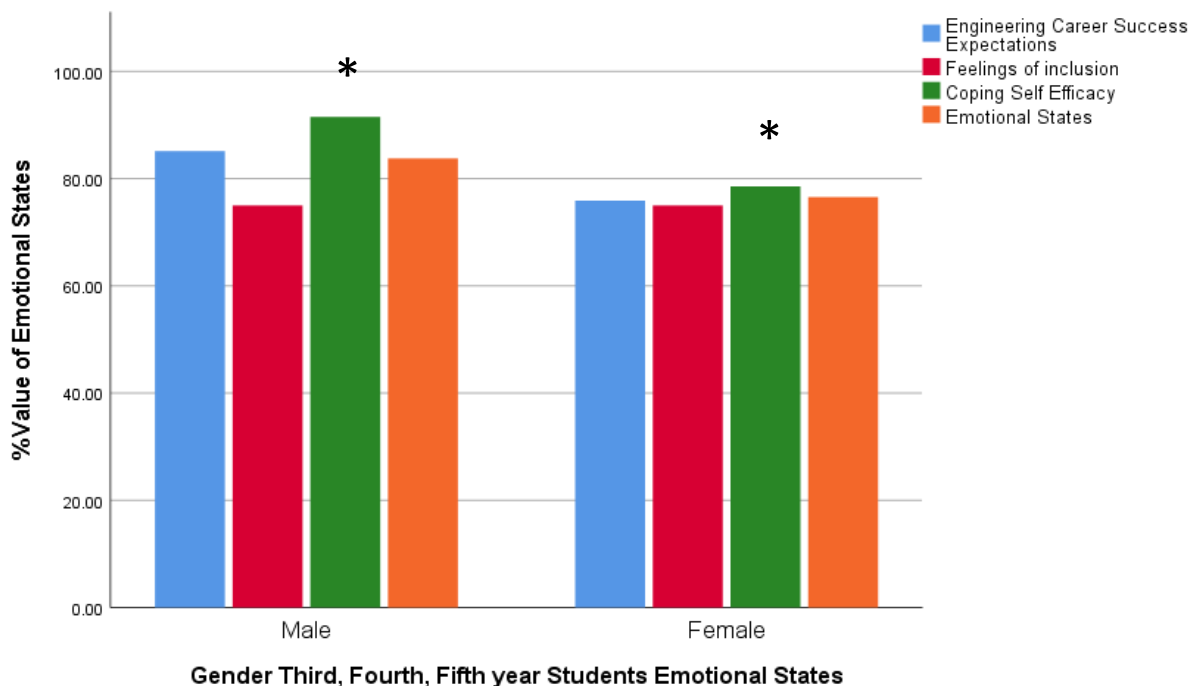


Figure 4.2.6 Gender Emotional State Means of Junior & Seniors, Error bars are omitted for clarity.

4.2.13 Ethnic Emotional States Assessment Juniors and Seniors (Table E14)

The Emotional State variables were assessed between the Ethnic groups for the Juniors and Seniors. A Shapiro-Wilk test showed that all of the variables with respect to the Ethnic groups were normally distributed. A One-Way ANOVA showed no significance between the variables between the groups.

4.2.14 Program Affiliation Emotional States Assessment Juniors and Seniors (Table E15)

The Emotional State variables were assessed between the program affiliation in the Juniors and Seniors. A Shapiro-Wilk test showed that all of the variables with respect to the program affiliation groups were normally distributed, except Feelings of Inclusion. Independent-Samples Kruskal-Wallis and One-Way ANOVA Tests showed no significant difference.

4.2.15 Correlations Emotional States Assessment Juniors and Seniors (Table E16)

Correlations were assessed for Juniors and Seniors on the Emotional variables. Using Spearman's Rho, several significant relationships were discovered. Specifically, Emotional States and Engineering Career Success Expectations has a strong significant relationship $r_s(15) = .837$ $p=0$. The coefficient of determination suggests that a Junior and Senior's expectations to succeed in engineering career accounts for 70% of their emotional state to pursue a degree in engineering.

4.3 Engineering 101 (ENES 101) Fall 2019 Pre-Assessment Data

In this section the results from Group #1 and Group #2 taking the ESMI at the beginning of the semester are presented.

4.3.1 Confidence in completing an Engineering Degree ENES 101 (Table E17)

Students were asked at the beginning of the semester how confident they were about completing their engineering degree. They were asked to rate their confidence at the current time, and how they recalled feeling before they entered UMBC. A Shapiro-Wilk test showed that none of the variables were normally distributed. Independent-Samples Kruskal-Wallis Test showed no significant difference between the groups (Figure 4.3.1)

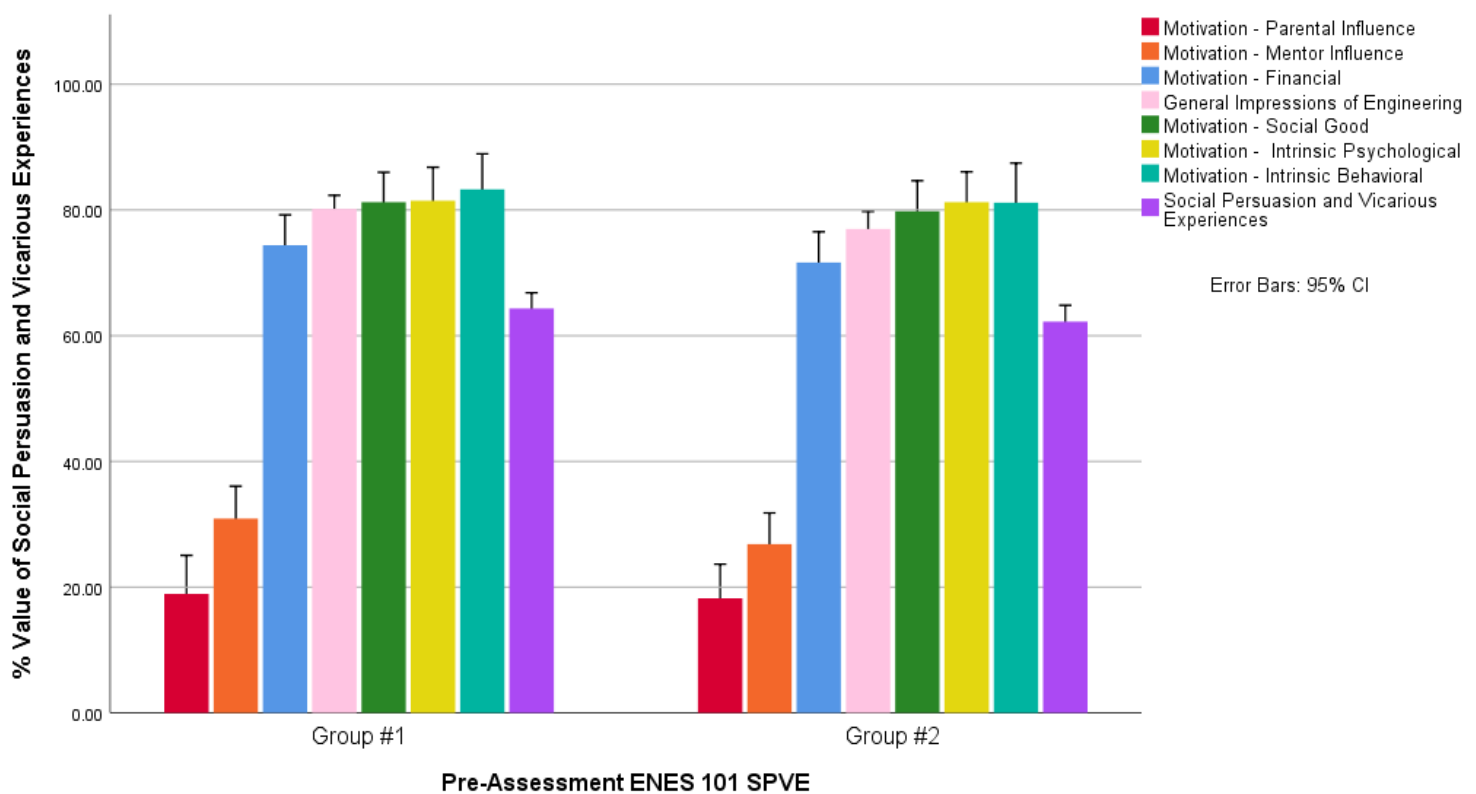


Figure 4.3.1 Pre-ENES 101 Confidence in Completing and Engineering Degree, Error bars are omitted for clarity.

4.3.2 Social Persuasion and Vicarious Experiences (SPVE): Overall (Table E18)

The SPVE variables were assessed for Group #1 and Group #2. A Shapiro-Wilk test revealed that none of the data for the populations were normally distributed. A Kruskal-Wallis test revealed no significant differences (Figure 4.3.2).

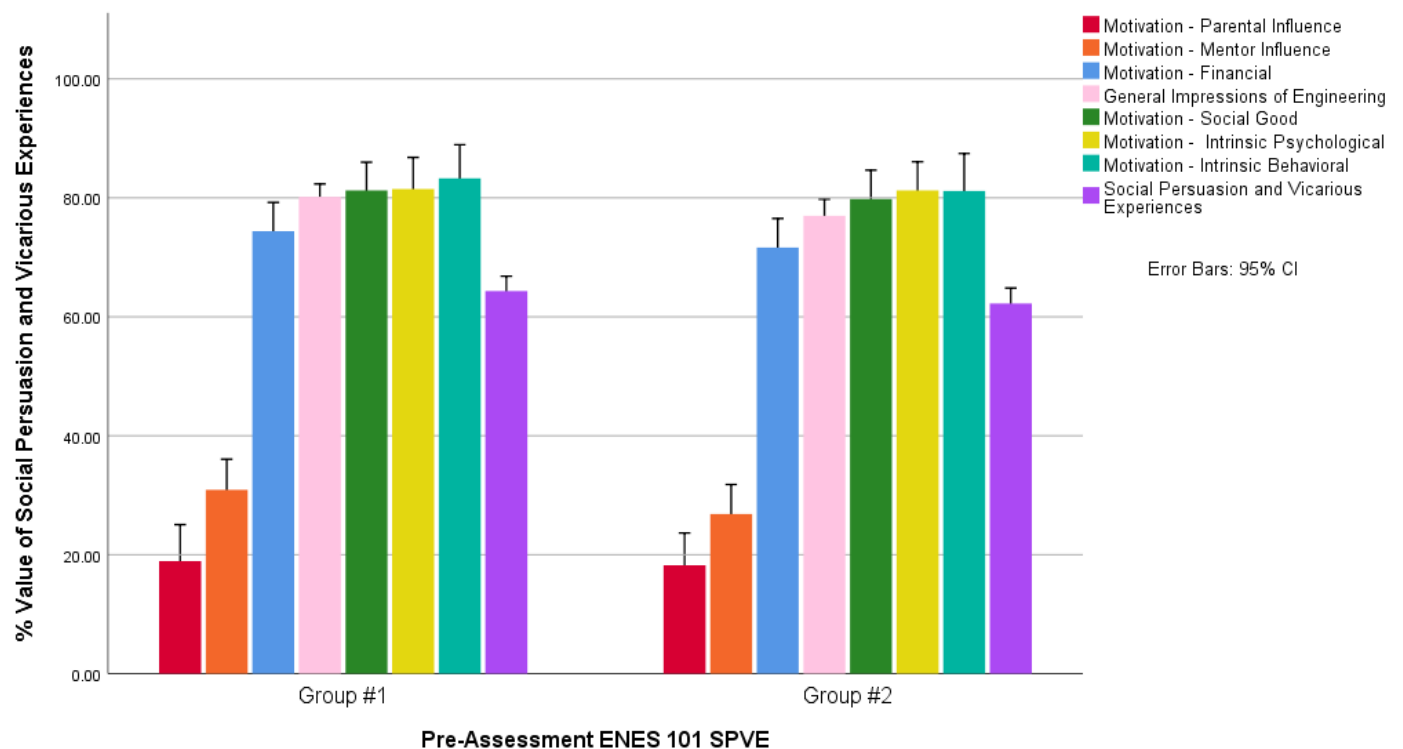


Figure 4.3.2 SPVE Means for SPVE Pre-Assessment (Group#1 and Group#2), Error bars are omitted for clarity.

4.3.3 Social Persuasion and Vicarious Experiences (SPVE) Gender (Table E19)

The SPVE variables were assessed for Gender between Group #1 and Group #2. A Shapiro-Wilk test revealed that none of the data were normally distributed. A Kruskal-Wallis test revealed significant differences in the Intrinsic Behavioral variable ($p = .062$) (Figure 4.3.3).

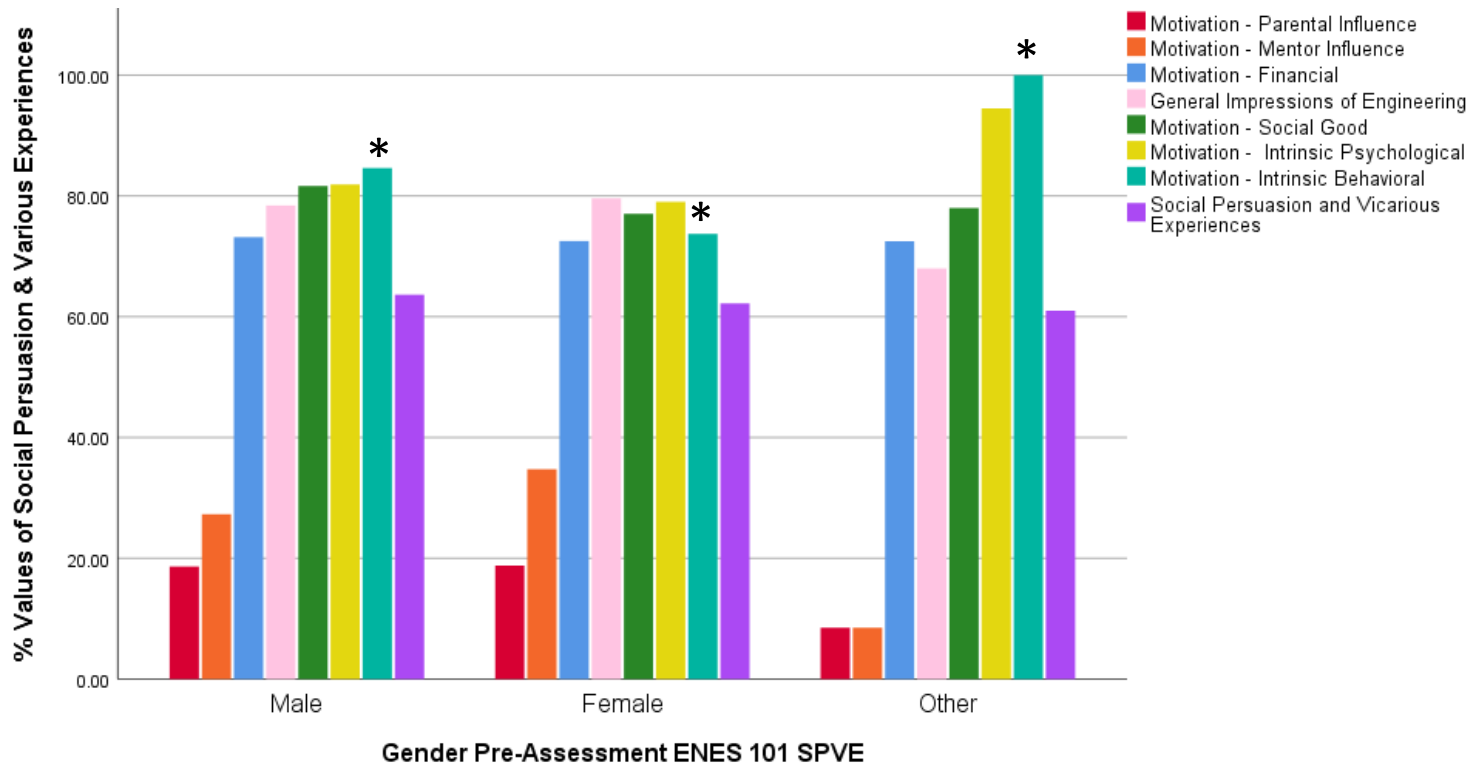


Figure 4.3.3 SPVE Gender Means ENES 101 Pre-Assessment, Error bars are omitted for clarity.

A post hoc analysis showed significant differences between Females and Males (Table 4.3.1).

Table 4.3.1 Post Hoc SPVE Gender Intrinsic Behavioral Pre-Assessment

Gender Pre-Assessment SPVE $\eta^2=.022$	
Comparison	p-value
Female to Male	0.044
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.3.4 Social Persuasion and Vicarious Experiences (SPVE: Ethnic Pre-Assessment for ENES 101 (Table E20))

The SPVE variables were assessed between Ethnic groups. A Shapiro-Wilk test revealed that none of the data were normally distributed. A Kruskal-Wallis test revealed significant differences in Parental Influence ($p=.025$), Intrinsic Psychological ($p=.018$), and Intrinsic Behavioral ($p=0.029$) (Figure 4.3.4).

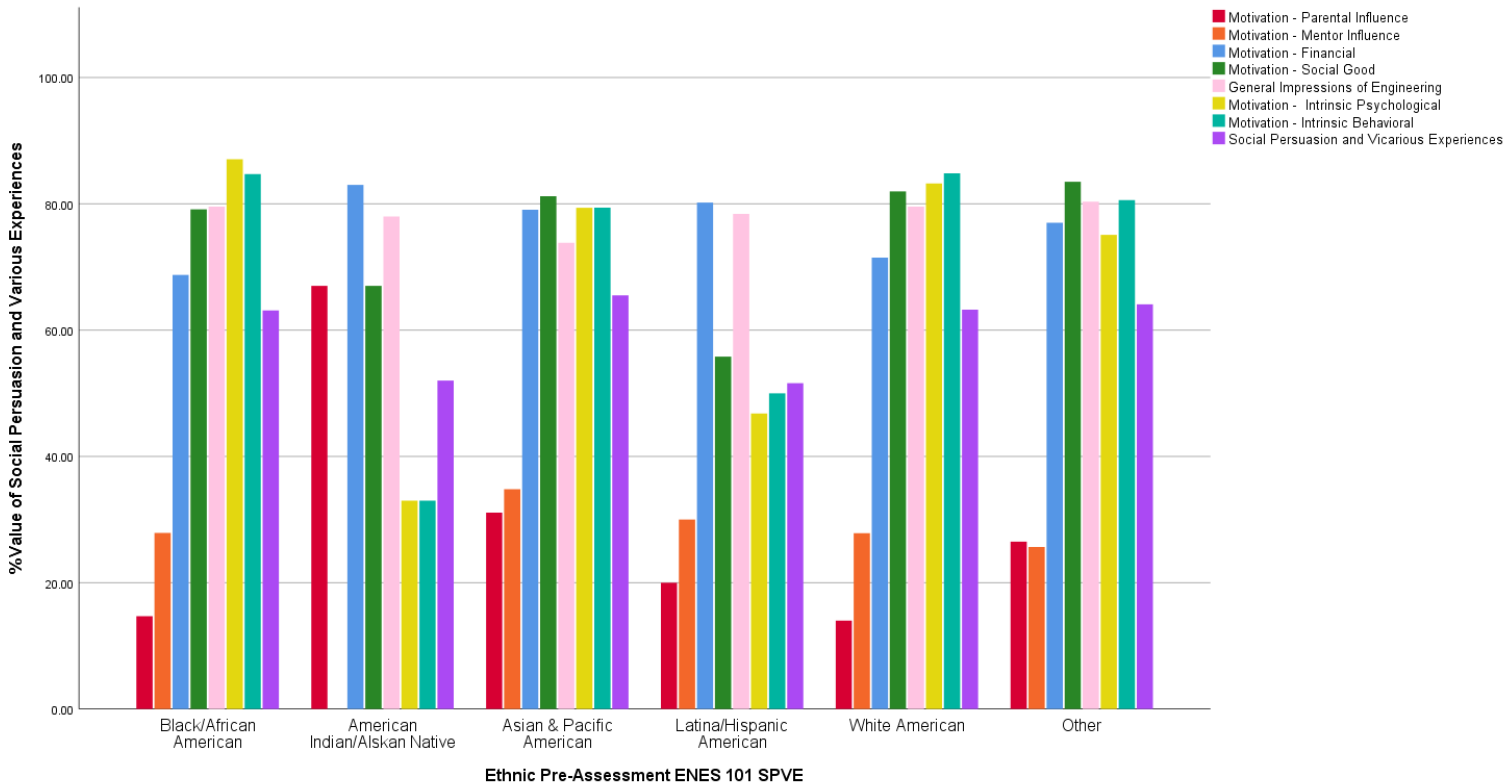


Figure 4.3.4 Ethnic Means ENES 101 Pre-Assessment, Error bars are omitted for clarity.

A post hoc analysis showed significant differences between Ethnic groups (Table 4.3.2 a-c).

Table 4.3.2a Post Hoc Ethnic Parent Influence

Ethnic Parent Influence $\eta^2=.054$	
Comparison	p-value
Black/African American < Other	0.091
Black/African American < Asian & Pacific American	0.01
Black/African American < to American Indian/Alaskan Native	0.072
White American < Asian & Pacific American	0.008

White American < American Indian/Alaskan Native	0.083
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.3.2b Post Hoc Ethnic Intrinsic Psychological

Ethnic Intrinsic Psychological $\eta^2=.06$	
Comparison	p-value
American Indian/Alaskan Native < Black/African American	0.086
American Indian/Alaskan Native < White American	0.083
Latina/Hispanic American < Other	0.041
Latina/Hispanic American < Asian & Pacific American	0.018
Latina/Hispanic American < Black/African American	0.003
Latina/Hispanic American < to White American	0.002
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.3.2c Post Hoc Ethnic Intrinsic Behavioral

Intrinsic Behavioral Ethnic $\eta^2=.051$	
Comparison	p-value
American Indian/Alaskan Native < White American	0.091
Latina/Hispanic American < Asian & Pacific American	0.02
Latina/Hispanic American < Other	0.019
Latina/Hispanic American < Black/African American	0.007
Latina/Hispanic American < White American	0.003
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.3.5 SPVE: Program Affiliation Pre- Assessment ENES 101(Table E21)

The SPVE variables were assessed between Program Affiliation groups. A Shapiro-Wilk test of normality revealed that none of the data were normally distributed. A Kruskal-Wallis test revealed significant differences in Mentor Influence ($p=0.001$) and Social Persuasion and Vicarious Experiences ($p=0.05$) (Figure 4.3.5). A post hoc analysis showed significant differences between Ethnic groups (Table 4.3.3 a & b).

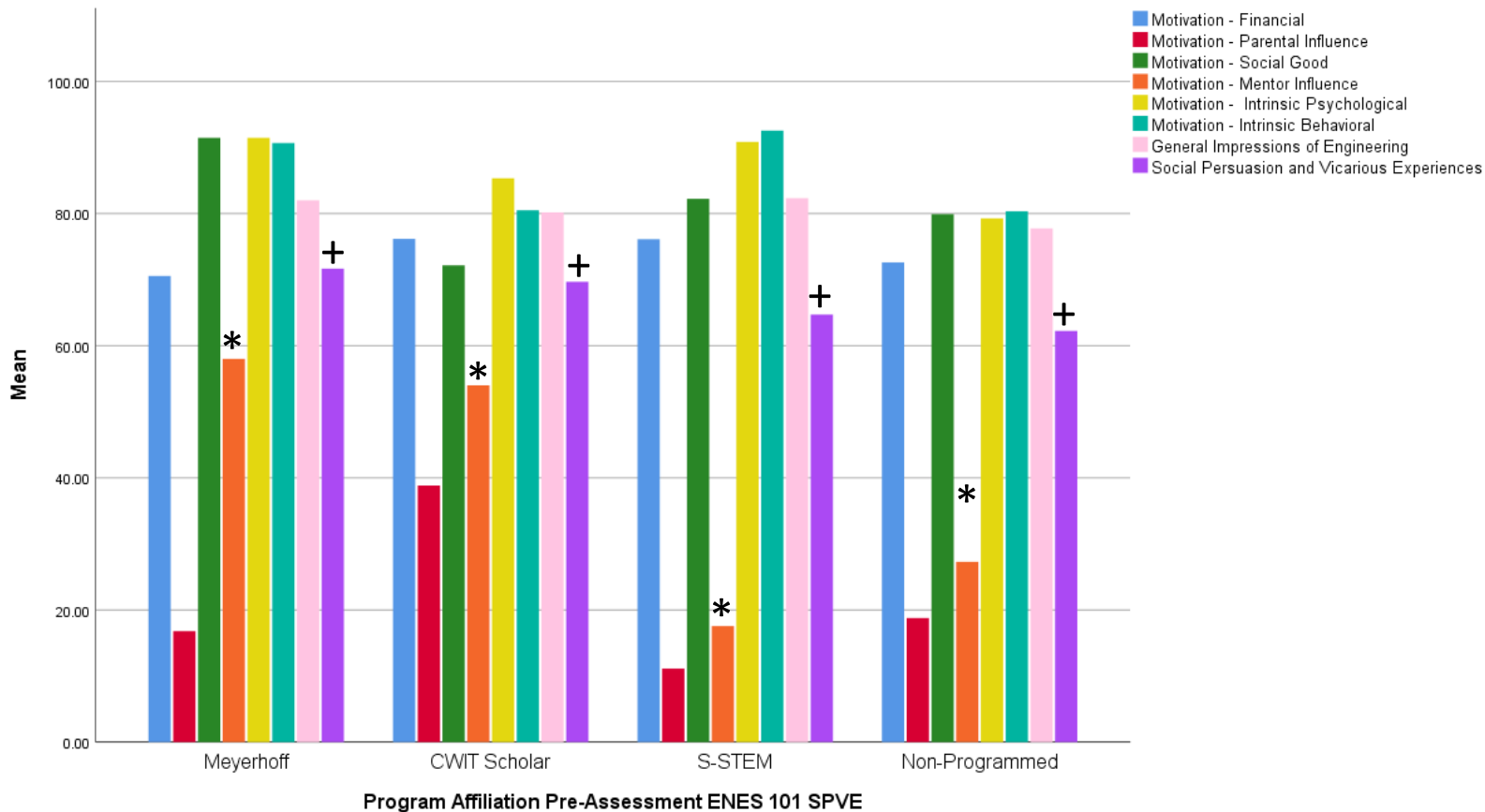


Figure 4.3.5 Program Affiliation Means ENES 101 Pre-Assessment, Error bars are omitted for clarity.

Table 4.3.3a Mentor Influence Pairwise Comparisons Program Affiliation

Mentor Influence Pairwise Comparisons of Program Affiliation $\eta^2=.09$

Sample 1 - Sample 2	p-value
S-STEM <Non-Programmed	0.046
S-STEM <Meyerhoff	0.001
S-STEM < CWIT Scholar	0.002
Non-Programmed < Meyerhoff	0.009
Non-Programmed < CWIT Scholar	0.018
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .05.	

Table 4.3.3b SPVE Pairwise Comparisons Program Affiliation

SVPE Pairwise Comparisons of Program Affiliation $\eta^2=.035$	
Sample 1 < Sample 2	p-value
Non-Programmed <Meyerhoff	0.012
S-STEM < Meyerhoff	0.095
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .05.	

4.3.6 Correlations for the Population SPVE Variables (Table E22)

Correlations were assessed in Group #1 and Group #2 for the SPVE variables. Using Spearman's Rho, significant differences were found in Social Persuasion Vicarious Experiences, which had a positive significant moderate relationship with Social Good $r_s(167) = 0.504$, $p < 0.01$. The coefficient of determination suggests that the motivation to practice engineering to help the welfare of society accounts for 25% of the motivation to be an engineer.

4.3.7 Mastery Experiences: Pre-Assessment ENES 101 (Table E23)

The Mastery variables were assessed for Group #1 and Group #2. A Shapiro-Wilk test revealed that none of the data were normally distributed. A Kruskal-Wallis test revealed no significant differences (Figure 4.3.6).

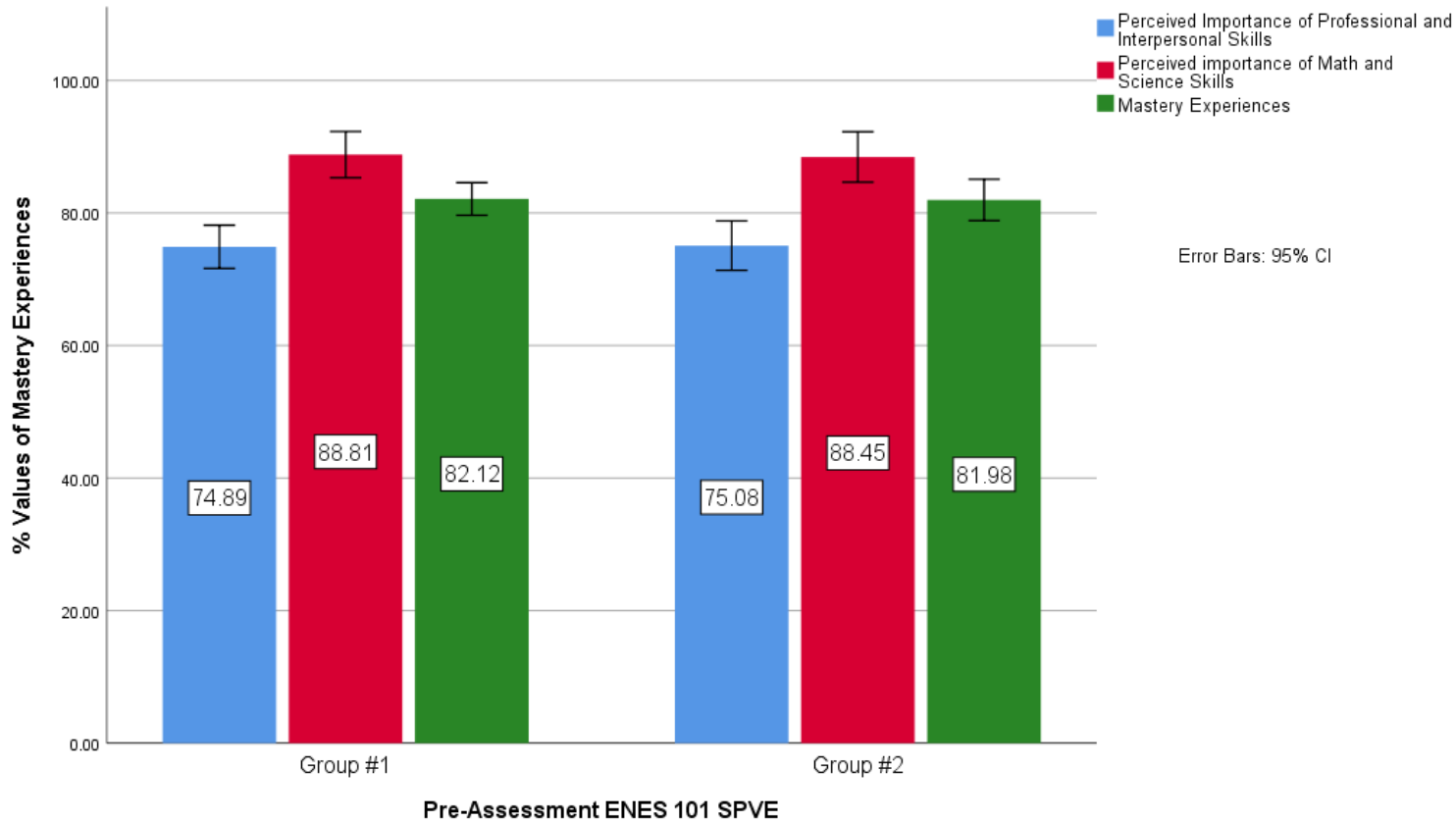


Figure 4.3.6 Mastery Experiences Means Pre-Assessment ENES 101, Error bars are omitted for clarity.

4.3.8 Mastery Experiences: Gender Pre- Assessment ENES 101 (Table E24)

The Mastery Experiences variables were assessed on Gender between Group #1 and Group #2. A Shapiro-Wilk test of normality revealed that none of the data were normally distributed. A Kruskal-Wallis test revealed significant differences in Perceived Importance of Math and Science ($p=0.054$), and Mastery Experience ($p=0.019$) (Figure 4.3.7).

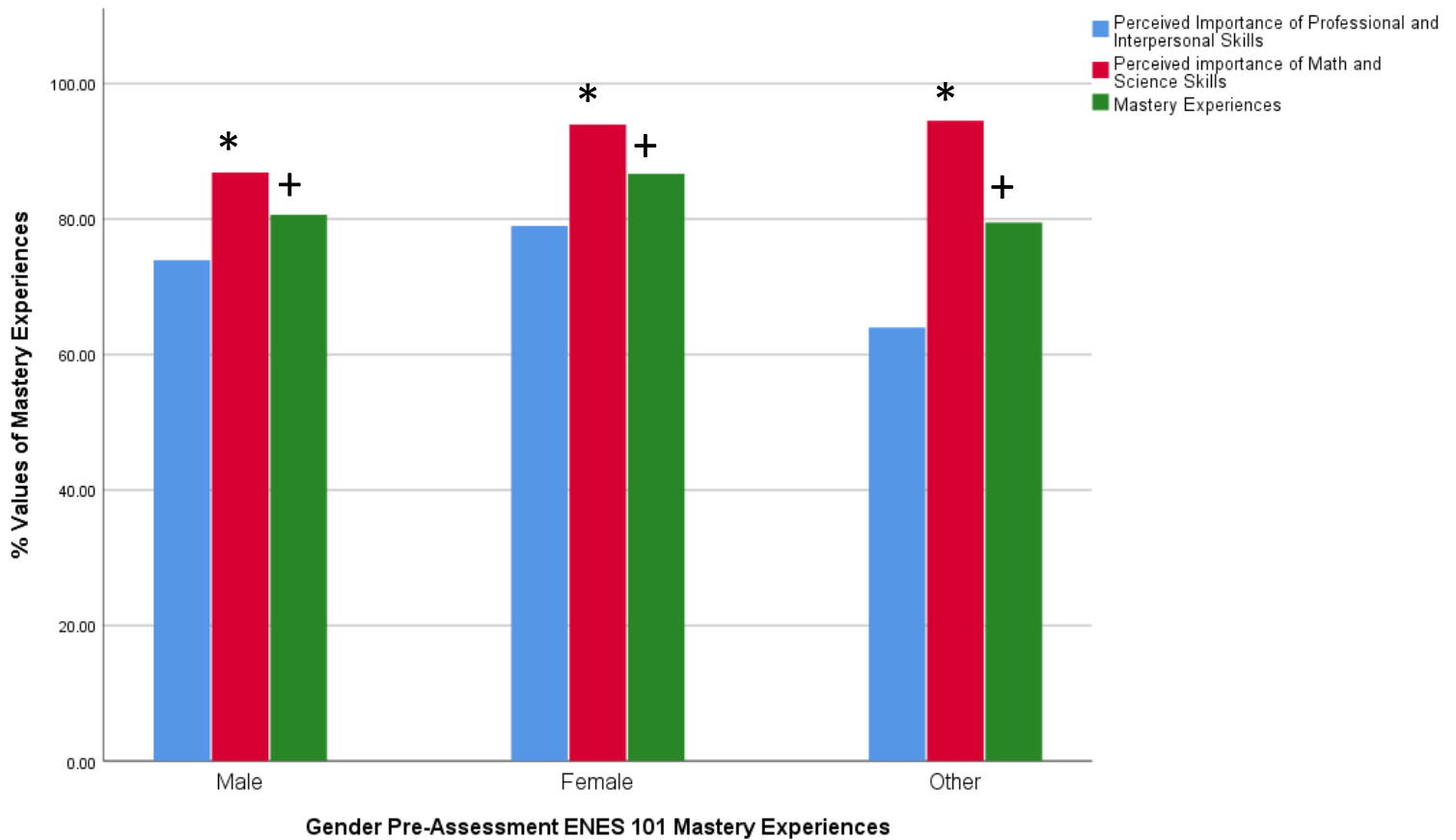


Figure 4.3.7 Mastery Experiences Gender Pre-Assessment ENES 101, Error bars are omitted for clarity.

A post hoc analysis showed significant differences between Female and Male students (Table 4.3.4 a & b).

Table 4.3.4a Post Hoc Gender Perceived Importance of Math and Science Skills

Perceived Importance of Math and Science Skills Gender $\eta^2=.029$	
Comparison	p-value
Female to Male	0.016
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.3.4b Post Hoc Gender Mastery Experiences Math and Science Skills

Mastery Experience Gender $\eta^2=.042$	
Comparison	p-value
Female to Male	0.005
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.3.9 Mastery Experiences: Ethnic Pre- Assessment ENES 101 (Table E25)

The Mastery Experiences variables were assessed on Ethnic affiliation in ENES 101. A Shapiro-Wilk test revealed that none of the data were normally distributed. A Kruskal-Wallis test revealed no significant differences.

4.3.10 Mastery Experiences: Program Affiliation Pre- Assessment ENES 101 (Table E26)

The Mastery Experience variables were assessed between Program Affiliation groups. A Shapiro-Wilk test revealed that none of the data were normally distributed. A Kruskal-Wallis test revealed no significant differences.

4.3.11 Correlations Between the Population Mastery Experiences Variables (Table E27)

Correlations were assessed in Group #1 and Group #2 on the Mastery Experience variables. A Spearman's Rho test revealed several significant relationships. Specifically, Mastery Experiences has a positive significant strong relationship with Perceived Importance of Professional and Interpersonal skills ($p=0.764$). Therefore, the analysis suggests that the value of professional and interpersonal skills accounts for 58% of the overall value of engineering skills in this population.

4.3.12 Emotional States Pre-Assessment ENES 101 (Table E28)

The Emotional States variables were assessed for Group #1 and Group #2. A Shapiro-Wilk test revealed that the data for Coping Self-Efficacy, Feelings of Inclusion and Engineering Career Success Expectation were not normally distributed. Emotional States was normally distributed. A Kruskal-Wallis test revealed significant differences on Feelings of inclusion ($p=0.017$). A One-Way ANOVA revealed significance between the Groups on the overall Emotional States variable ($p=0.019$) (Figure 4.3.8).

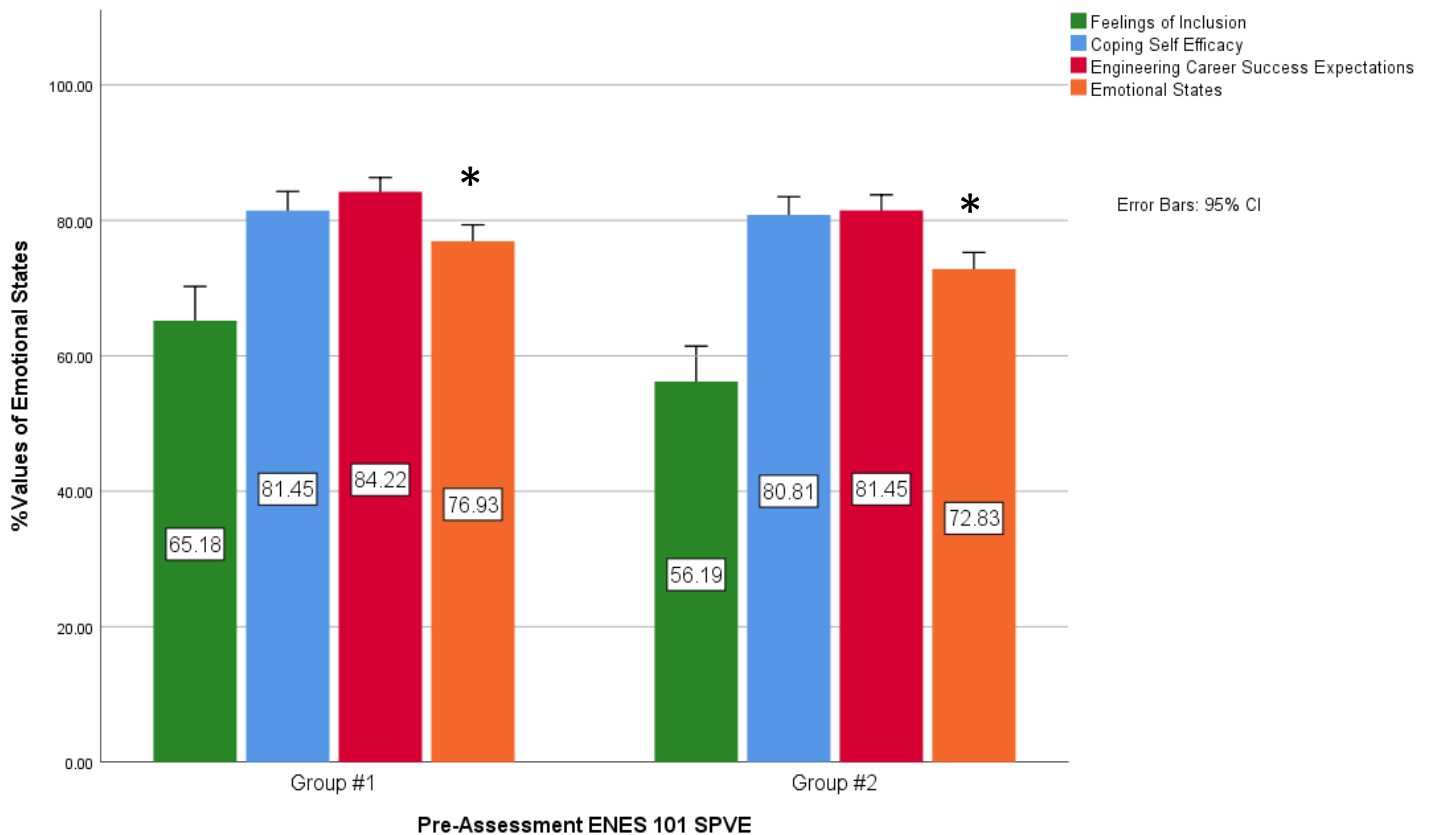


Figure 4.3.8 Emotional States Means Pre-Assessment, Error bars are omitted for clarity.

4.3.13 Emotional States: Gender Pre-Assessment ENES 101 (Table E29)

The Emotional variables were assessed for Gender between Group #1 and Group #2. A Shapiro-Wilk test revealed that none of the data were normally distributed, except for Emotional States. A Kruskal-Wallis test revealed significant differences in Coping Self Efficacy ($p=0.079$) and Emotional States ($p=0.096$) (Figure 4.3.9).

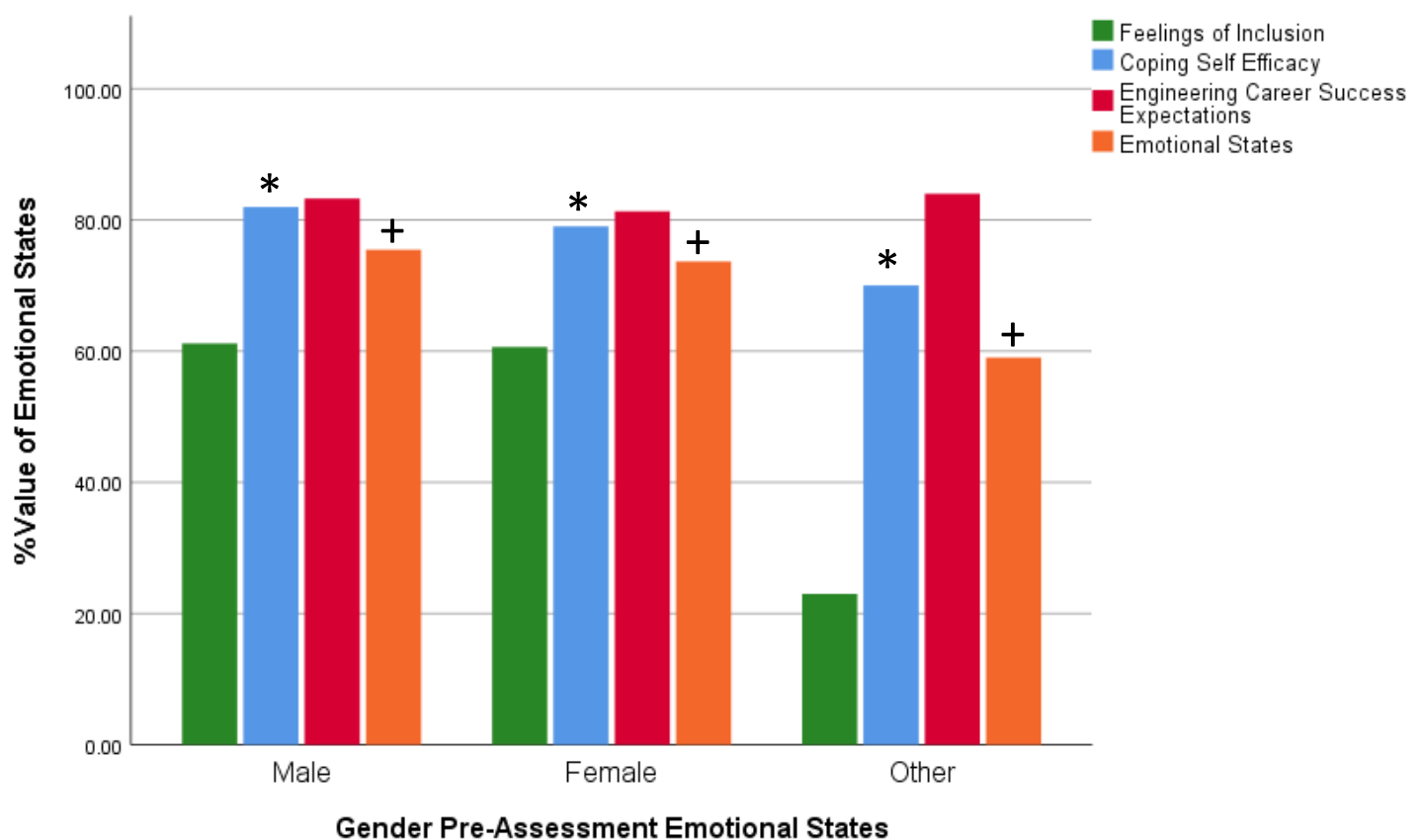


Figure 4.3.9 Emotional States Gender Means Pre-Assessment, Error bars are omitted for clarity.

A post hoc analysis of pairwise comparisons and LSD showed significant differences between Female and Male students (Table 4.3.5 a & b).

Table 4.3.5a Post Hoc Gender Coping Self-Efficacy

Gender Coping Self-Efficacy $\eta^2=.024$	
Comparison	p-value
Other to Male	0.089
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.3.5b Post Hoc Gender Emotional Gender

LSD: Emotional States Gender $\eta^2=.033$		
(I) Gender	(J) Gender	p-value
Male	Other	0.042
Female	Other	0.074
Other	Male	0.042
	Female	0.074
* The mean difference is significant at the 0.1 level.		

4.3.14 Emotional States Ethnic Pre-Assessment (Table E30)

The Emotional variables were assessed for Ethnic affiliation. A Shapiro-Wilk test revealed that none of the data were normally distributed, except for Emotional States. A One-Way ANOVA revealed no significant differences. A Kruskal-Wallis test revealed significant difference on Coping Self-Efficacy ($p=0.062$) (4.3.10).

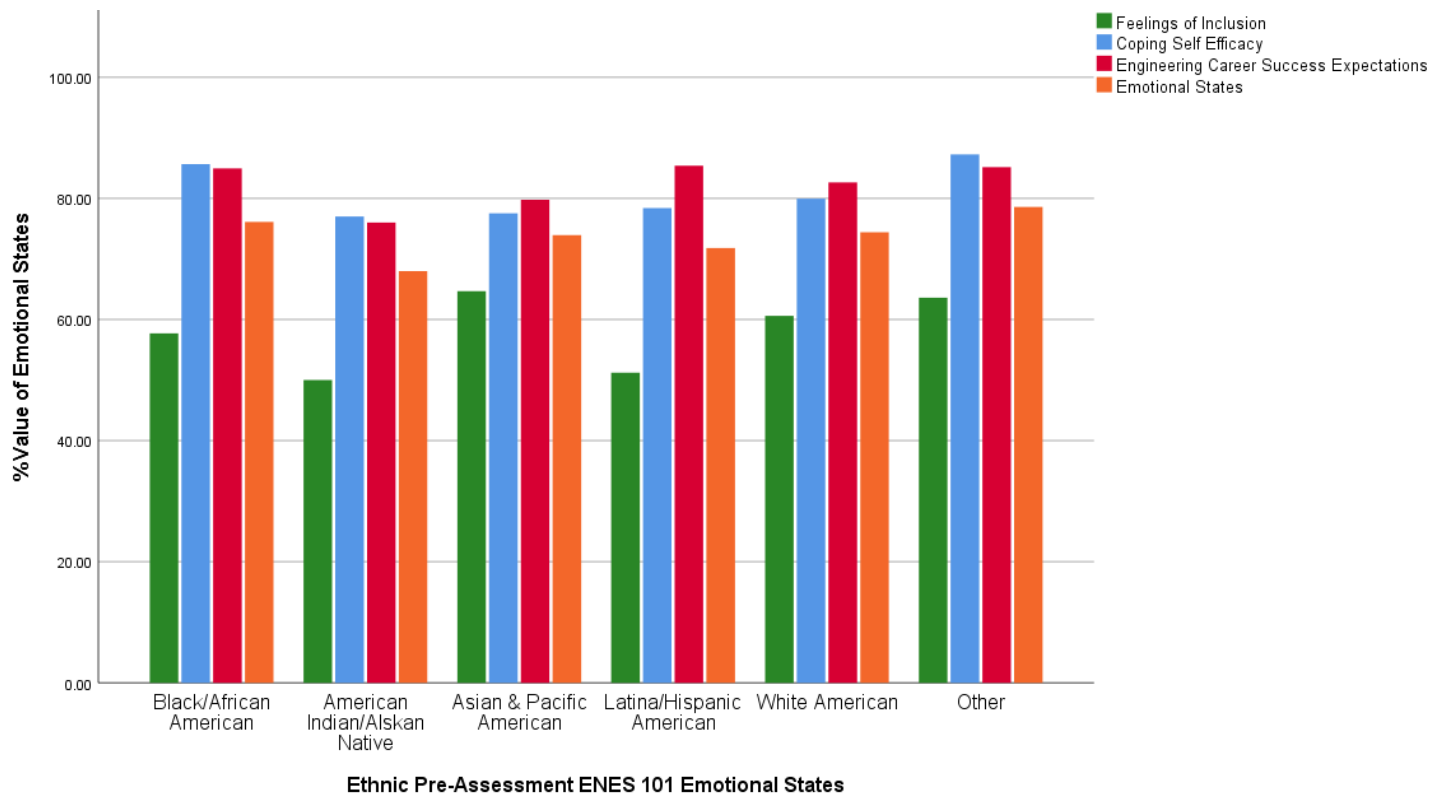


Figure 4.3.10 Emotional Ethnic Pre-Assessment ENES 101, Error bars are omitted for clarity.

A Post hoc analysis of pairwise comparisons showed that there were significant differences between some groups (Table 4.3.6).

Table 4.3.6 Post Hoc Comparisons Coping Self-Efficacy Ethnic

Ethnic Coping Self-Efficacy $\eta^2=.040$	
Comparison	p-value
Asian & Pacific American > Black/African American	0.015
Asian & Pacific American > Other	0.048
White American > Black/African American	0.018
White American > Other	0.076
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.3.15 Emotional States: Program Affiliation Pre-Assessment ENES 101 (Table E31)

The Emotional States variables were assessed between program affiliation groups. A Shapiro-Wilk test revealed that none of the data were normally distributed, except for Emotional States. A Kruskal-Wallis test revealed significant differences Engineering Career Success Expectations ($p=0.038$) (Figure 4.3.11).

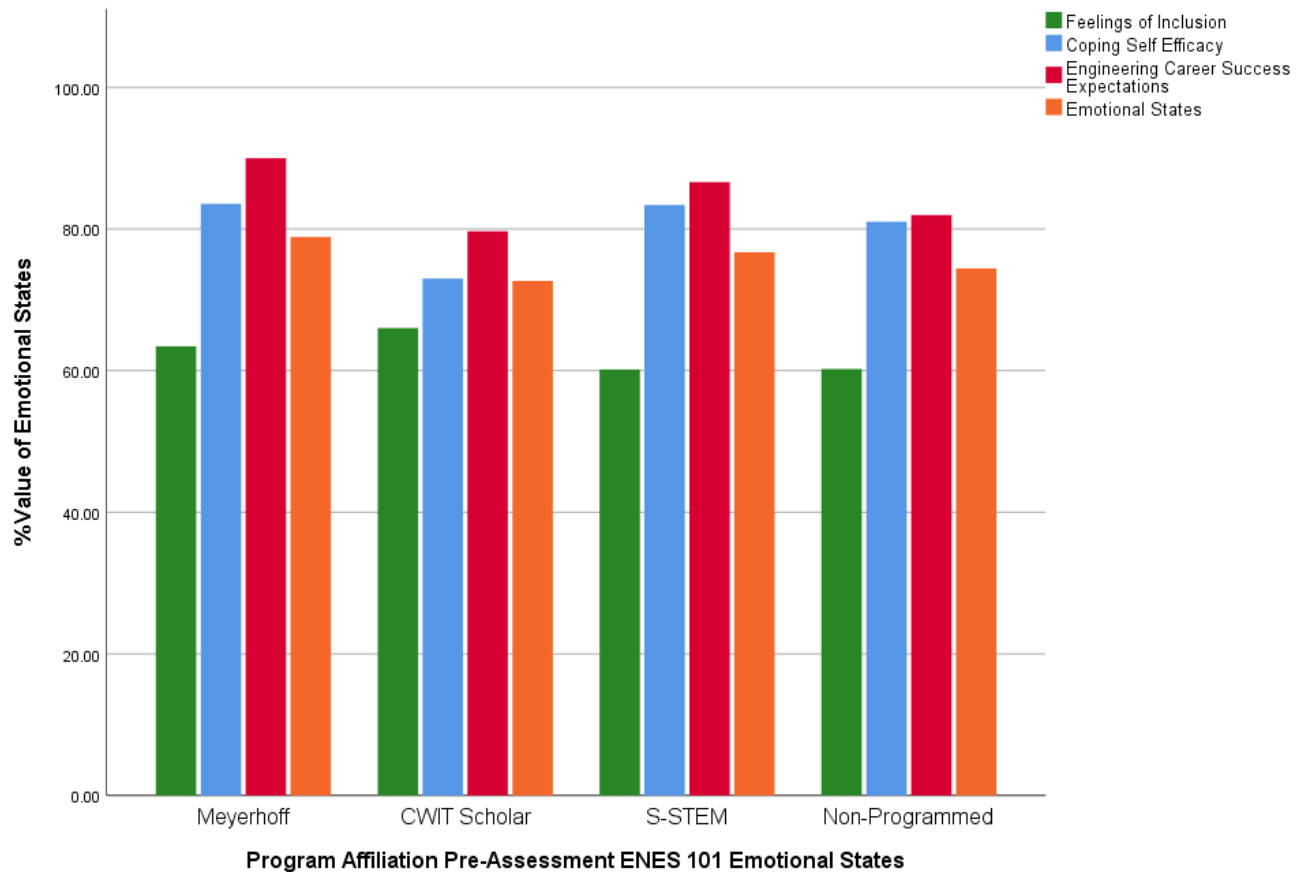


Figure 4.3.11 Emotional Program Affiliation Pre-Assessment ENES 101, Error bars are omitted for clarity.

A post hoc analysis shows the groups with significant differences (Table 4.3.7).

Table 4.3.7 Post Hoc Pairwise Comparisons Engineering Career Expectations Program Affiliation

Engineering Career Success Expectations Program Affiliation $\eta^2=.039$	
Comparison	p-value
Non-Programmed < S-STEM	0.062
Non-Programmed < Meyerhoff	0.019
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.3.16 Correlations for the Population Emotional States (Table E32)

Correlations were assessed on Group #1 and Group #2 on the Emotional States variables. A Spearman's Rho revealed a significant between Emotional States and Feelings of Inclusions $r_s(167) = .867$ $p=0$. The coefficient of determination suggests that Feelings of Inclusion accounts for 75% of the Emotional State of student as it relates to continuing in engineering.

4.4 Engineering 101 Post-Assessment Data

4.4.1 Confidence in Completing an Engineering Degree (Table E33)

Below, Figure 4.4.1, shows the beginning and present confidence of each of the four study Groups. A Shapiro-Wilk test of normality revealed none of the data were normally distributed. A Kruskal-Wallis test revealed no significant differences between the groups.

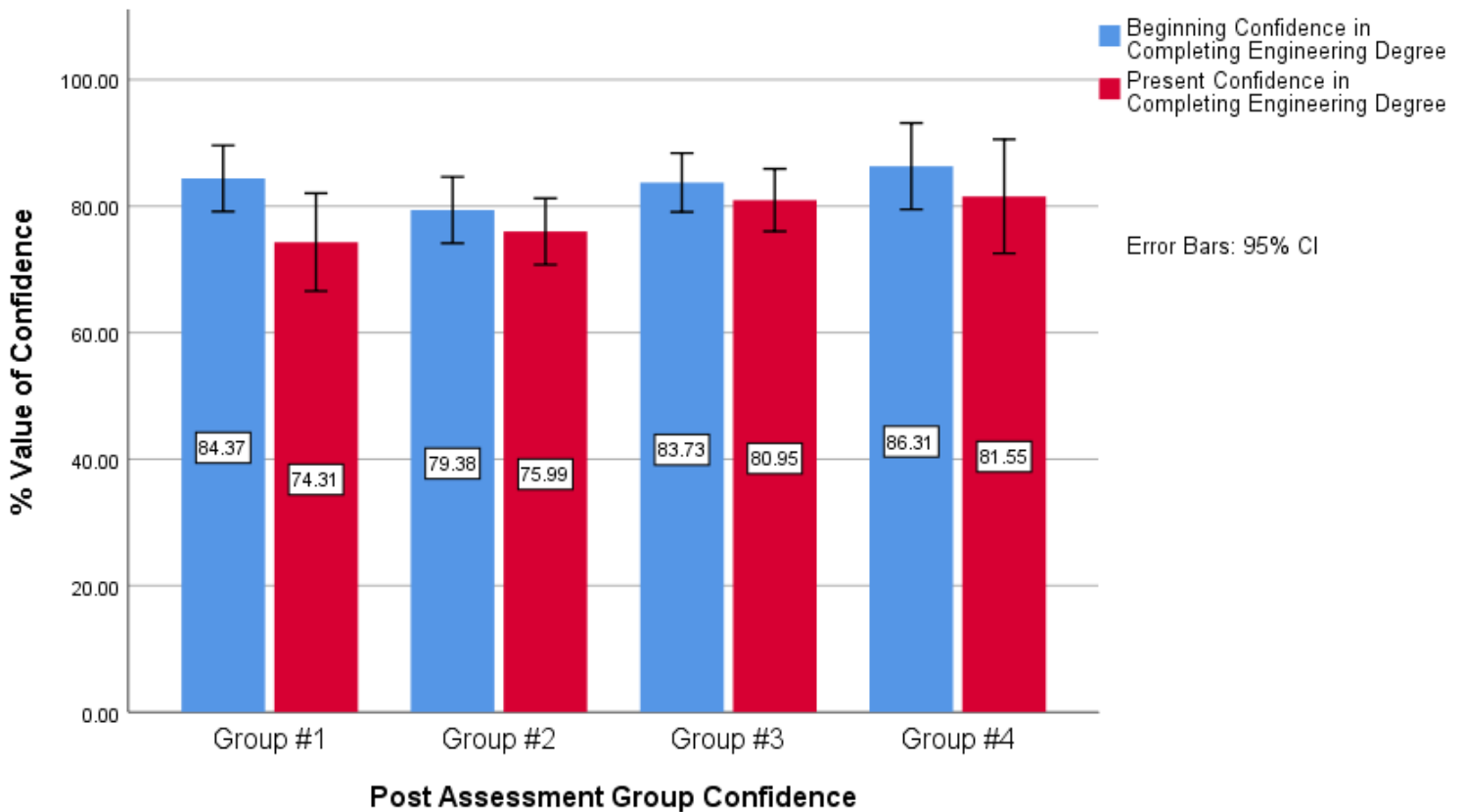


Figure 4.4.1 Group#1 - #4 Beginning & Present Confidence Post -Assessment

4.4.2 Social Persuasion and Vicarious Experiences (SPVE): Overall (Table E34)

The Groups were evaluated on their Social Persuasion and Vicarious Experiences (SPVE) (Figure 4.4.2). This variable explored what motivated students the most and the least. A Shapiro-Wilk test revealed that none of the variables were normally distributed except for Social Persuasion and Vicarious Experience.

A Kruskal Wallis test revealed significant differences between the groups in Motivation - Intrinsic Psychological ($p = 0.076$). A One-Way ANOVA on the Social Persuasion and Vicarious Experiences showed no significant difference between the Groups. However, a post hoc analysis showed that there were some significant differences between the Groups (Table 4.4.1).

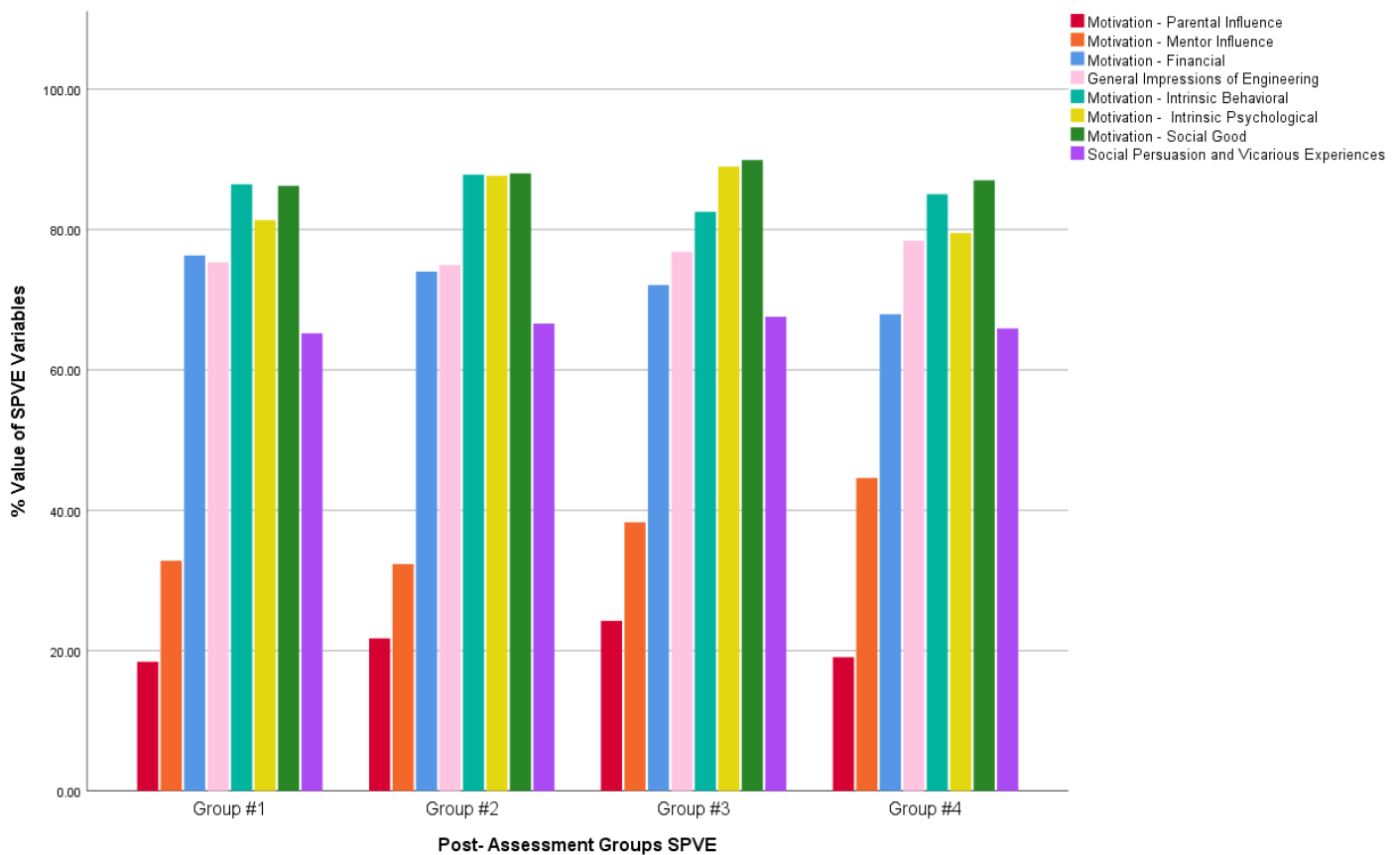


Figure 4.4.2 Post-Assessment SPVE Groups, Error bars are omitted for clarity

Table 4.4.1 Post Hoc Pairwise Comparison Intrinsic Psychological

Intrinsic Psychological $\eta^2=.038$	
Comparison	p-value
Group #2 > Group #4	0.085
Group #1 < Group #3	0.069
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.4.3 SPVE: Gender Between Groups (Table E35)

The variables were assessed between the Groups for Gender. A Shapiro-Wilk test showed that only General Impressions of Engineering and Social Persuasion and Vicarious Experiences were normally distributed. However, all of the motivational variables were tested using non-parametric measures. There was no significant difference between the groups in the variables (Figures 4.4.3 a & b).

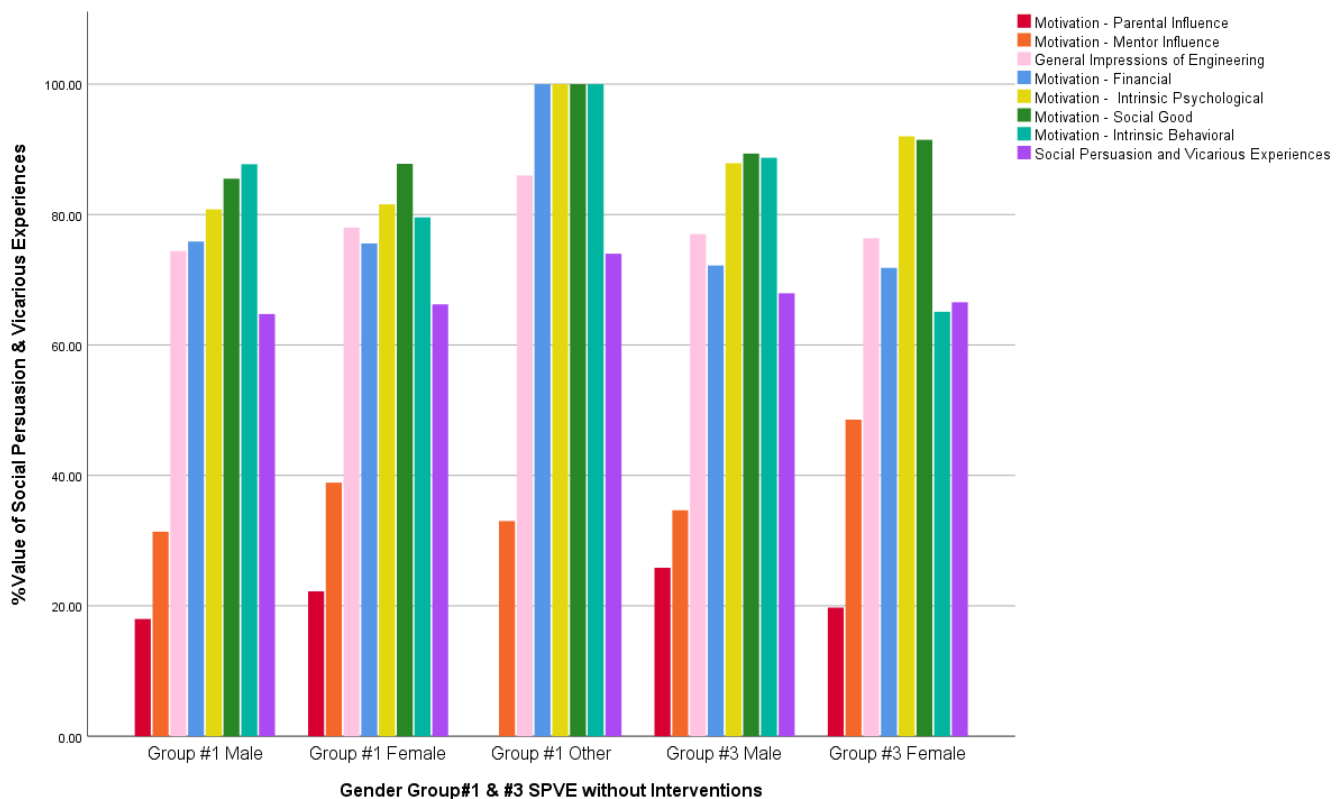


Figure 4.4.3a Group#1 & #3 SPVE Gender Means Post-Assessment (without interventions)
Error bars are omitted for clarity

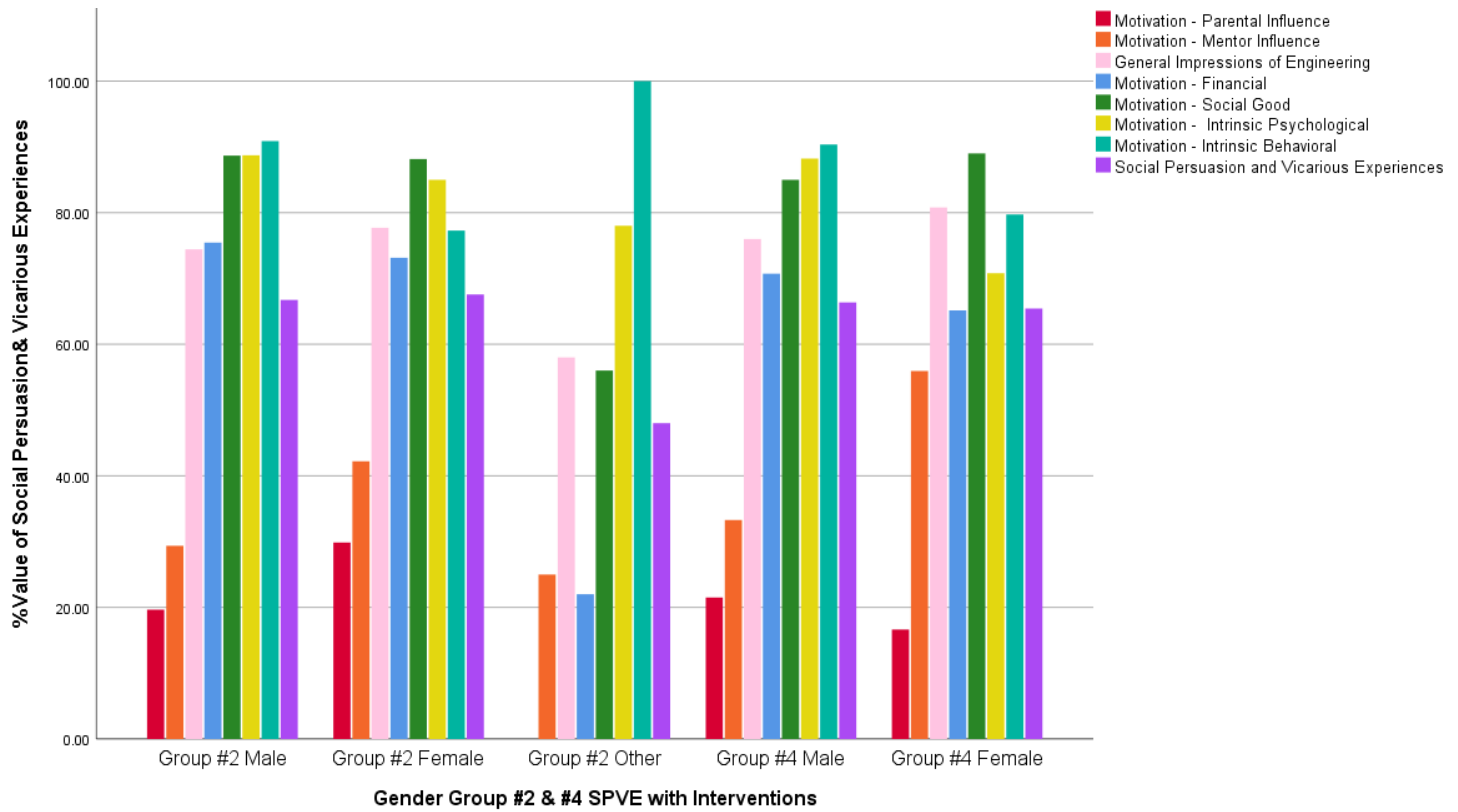


Figure 4.4.3b Group#2 & #4 SPVE Gender Means Post-Assessment (with interventions)
Error bars are omitted for clarity

4.4.4 SPVE: Overall Gender (Table E36)

Examining the post participant population with respect to Gender, a Kruskal Wallis test showed a significant difference in motivation for Mentor Influence ($p=0.022$) and Intrinsic Behavioral ($p=0.002$) (Figure 4.4.4). A post hoc analysis shows the groups with the significant differences (Table 4.4.2a & b).

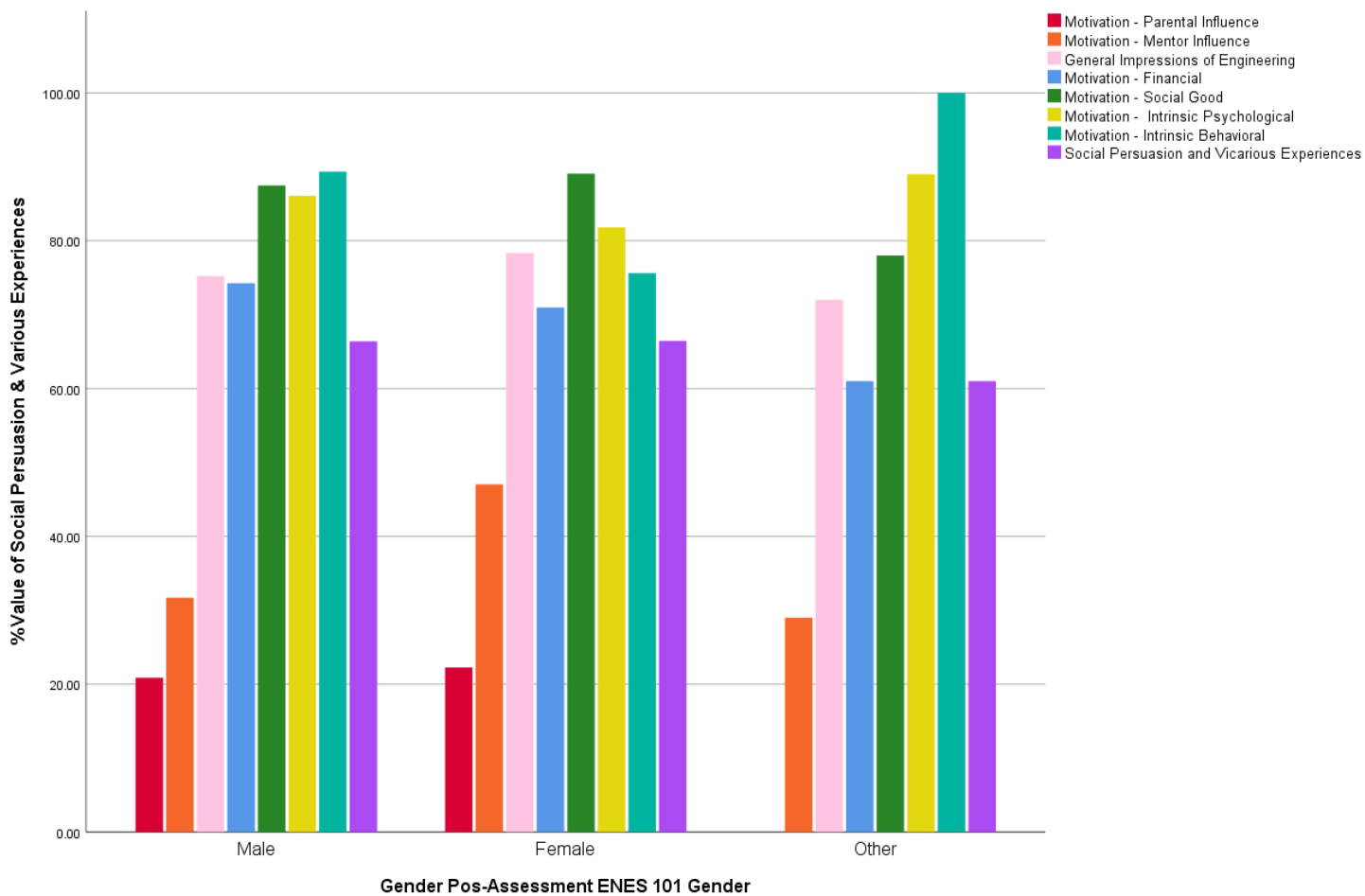


Figure 4.4.4 SPVE Gender Means ENES 101 Post-Assessment, Error bars are omitted for clarity

Table 4.4.2a Post Hoc Post-Assessment Gender Mentor Influence

Mentor Influence Gender ENES 101 $\eta^2=0.43$	
Pairwise Comparisons of Gender:	
Comparison	p-value
Female > Male	0.006
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.4.2b Post Hoc Post-Assessment Gender Intrinsic Behavioral

Intrinsic Behavioral Gender ENES 101 $\eta^2=.072$	
Pairwise Comparisons of Gender:	
Comparison	p-value
Female < Male	0.001
Female < Other	0.093
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Only Group #3 and Group #4 showed a significant difference between Females and Males. Group #3 showed a significant difference in Motivation Intrinsic Behavioral ($p < 0.05$, $\eta^2 = 0.11$). Group #4 showed significant differences in the Motivation Mentor ($p < .1$, $\eta^2 = 0.122$) and Psychological variable ($p < 0.05$, $\eta^2 = 0.16$).

4.4.5 SPVE: Ethnic Between Groups (Table E37)

The SPVE variables were assessed between the Ethnic identifications. A Shapiro-Wilk test showed that only General Impressions of Engineering and Social Persuasion and Vicarious Experiences were normally distributed. All the motivational variables were tested using non-parametric measures. A Kruskal Wallis test showed that there was a significant difference between the Ethnic groups in the Motivation Parent Influence ($p = 0.068$), and Social Good ($p = 0.052$) (Figure 4.4.5a & b). A post hoc analysis showed other significant differences between Ethnic groups (Table 4.4.3 a & b).

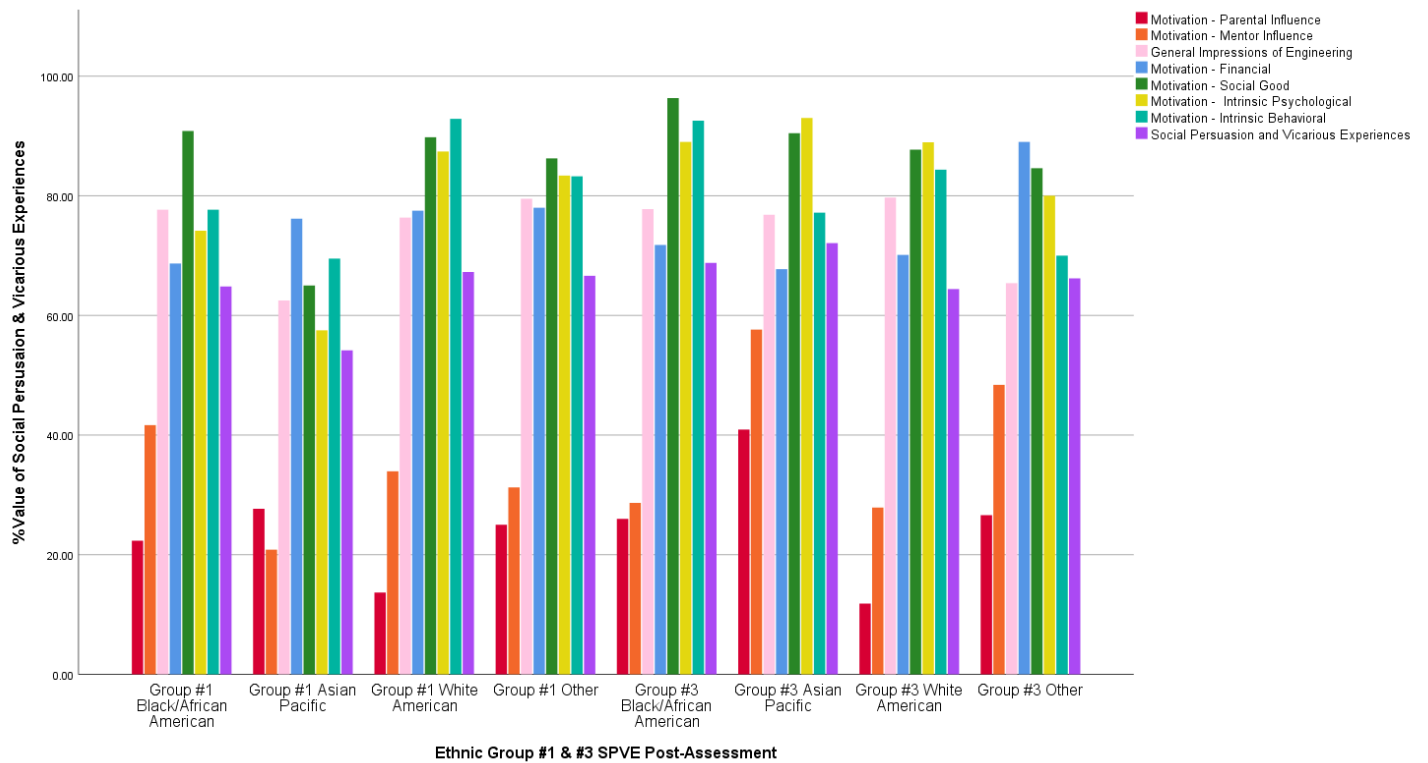


Figure 4.4.5a Group #1 & Group #3 Means ENES 101 Post-Assessment, Error bars are omitted for clarity

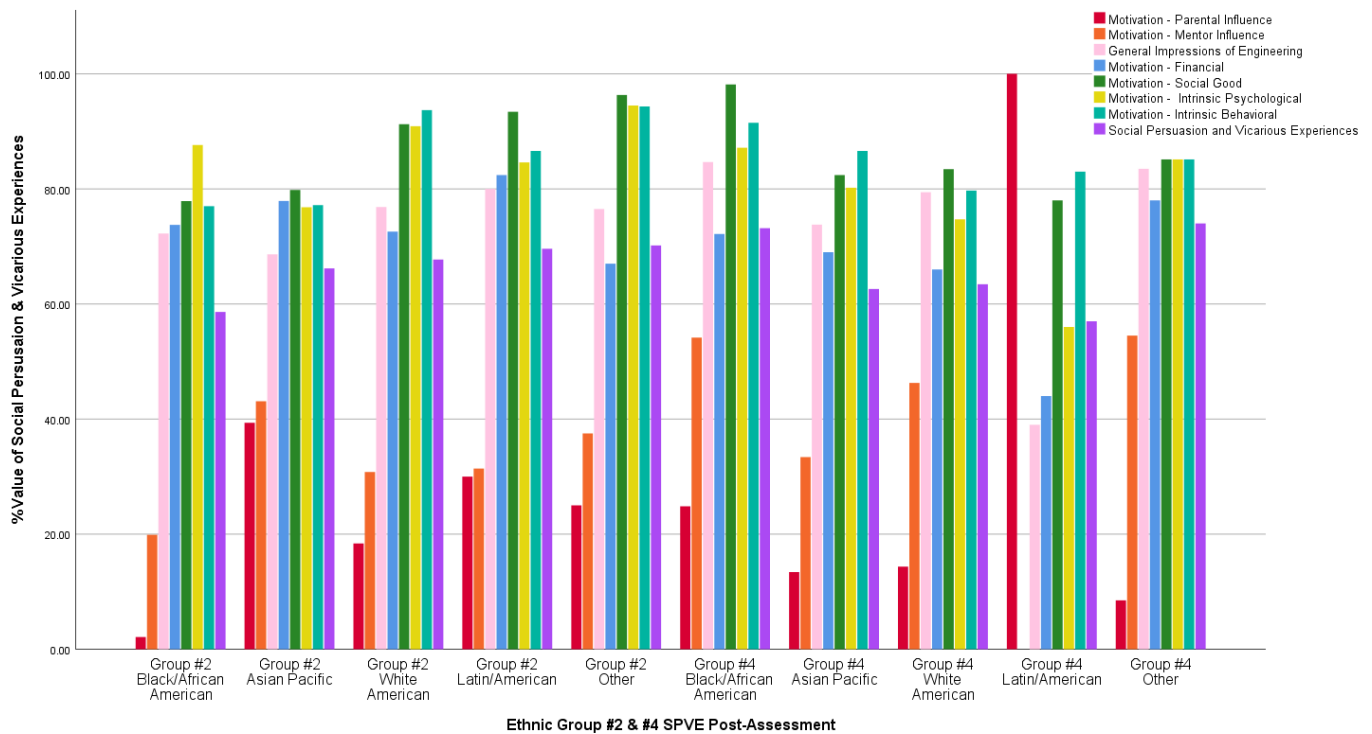


Figure 4.4.5b Group #2 & Group #4 Means ENES 101 Post-Assessment, Error bars are omitted for clarity

Table 4.4.3a Pairwise Comparisons of Parent Influence Ethnic Group

Pairwise Comparisons of Parent Influence Ethnic Group $\eta^2=.14$	
Comparison	p-value
Group #2 B/AA < Group #4 L/A	0.02
Group #1 WA < Group #3 AP	0.00
Group #4 WA > Group #2 AP	0.02
Group #4 AP > Group #2 AP	0.10
Group #2 WA < Group #4 L/A	0.07
Group #1 Other < Group #3 AP	0.06
Group #1 B/AA < Group #3 AP	0.09
Asymptotic significances (2-sided tests) are displayed. The significance level is .10. Group #3 B/A to Group #3 AP	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

*B/AA- Black African American; WA-White American; AP-Asian Pacific; L/A-Latin American

Table 4.4.3b Pairwise Comparisons of Motivation - Social Good Ethnic Group

Pairwise Comparisons of Social Good Ethnic Group, $\eta^2=.15$				
Comparison	Test Statistic	Std. Error	Std. Test Statistic	p-value
Group #1 AP < Group #3 WA	-61.30	22.73	-2.70	0.01
Group #1 AP < Group #3 AP	-67.24	24.30	-2.77	0.01
Group #1 AP to Group #3 B/A	-89.75	25.23	-3.56	0.00
Group #4 AP < Group #2 WA	42.14	23.18	1.82	0.07
Group #4 AP < Group #2 Other	55.57	28.99	1.92	0.06
Group #2 B/AA < Group #4 B/AA	-52.83	25.86	-2.04	0.04
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.				
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.				

*B/AA- Black African American; WA-White American; AP-Asian Pacific; L/A-Latin American

4.4.6 SPVE: Overall Ethnic (Table E38)

The variables were assessed for differences between Ethnic groups. Significant differences were found between the groups in the Motivation Parent Influence ($p=0.004$) and General Impressions of Engineering ($p=0.098$). A Kruskal Wallis test showed that there were no significant differences for any of the variables (Figure 4.4.6). A post hoc analysis showed significant differences between Ethnic groups (Table 4.4.4 a & b).

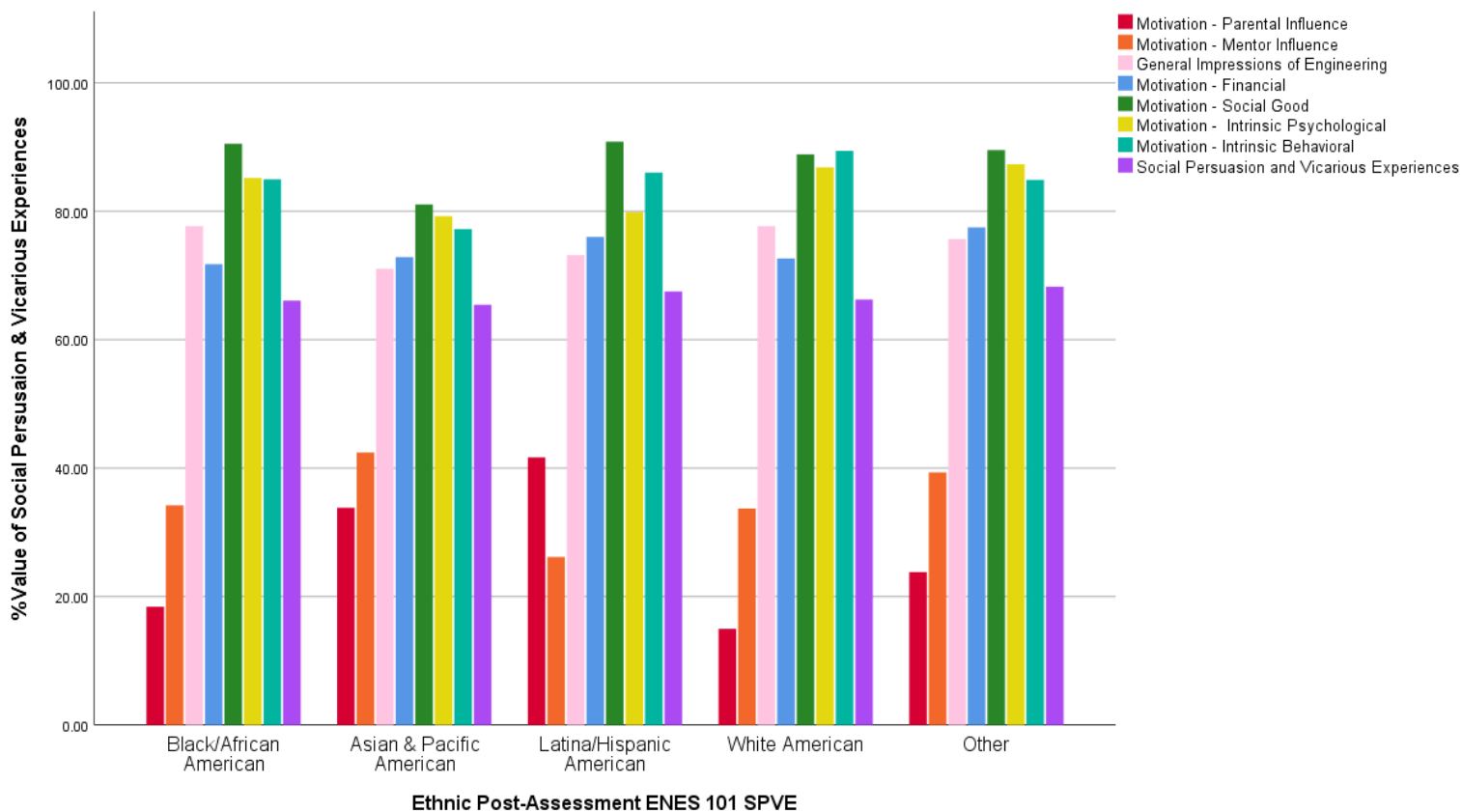


Figure 4.4.6 Post-Assessment ENES 101 Ethnic Group, Error bars are omitted for clarity

Table 4.4.4a Post Hoc Pairwise Comparisons of Parent Influence - Ethnic group entire population

Pairwise Comparisons of Parent Influence Ethnic Groups $\eta^2=.085$	
Comparison	p-value
Black/African American > to Asian & Pacific American	0.004
White American < to Asian & Pacific American	0.000
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.4.4b Post Hoc Pairwise Comparisons of General Impressions- Ethnic group entire population

General Impressions Pairwise Comparisons of Ethnic $\eta^2=.044$	
Comparison	p-value
Asian & Pacific American < White American	0.006
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.4.7 SPVE: Program Affiliation Between Groups (Table E39)

The variables were assessed between Groups with respect to the students' Program Affiliation. A Shapiro-Wilk test showed that only General Impressions of Engineering and Social Persuasion and Vicarious Experiences variables were normally distributed. All the motivational variables were tested using non-parametric measures. A Kruskal Wallis test showed that there was a significant difference between the groups in the Motivation Intrinsic Psychological ($p=0.029$) and Mentor Influence ($p=0.064$) (Figures 4.4.7 a & b). Post hoc analysis showed significant differences between Program Affiliation groups. (Tables 4.4.5 a & b).

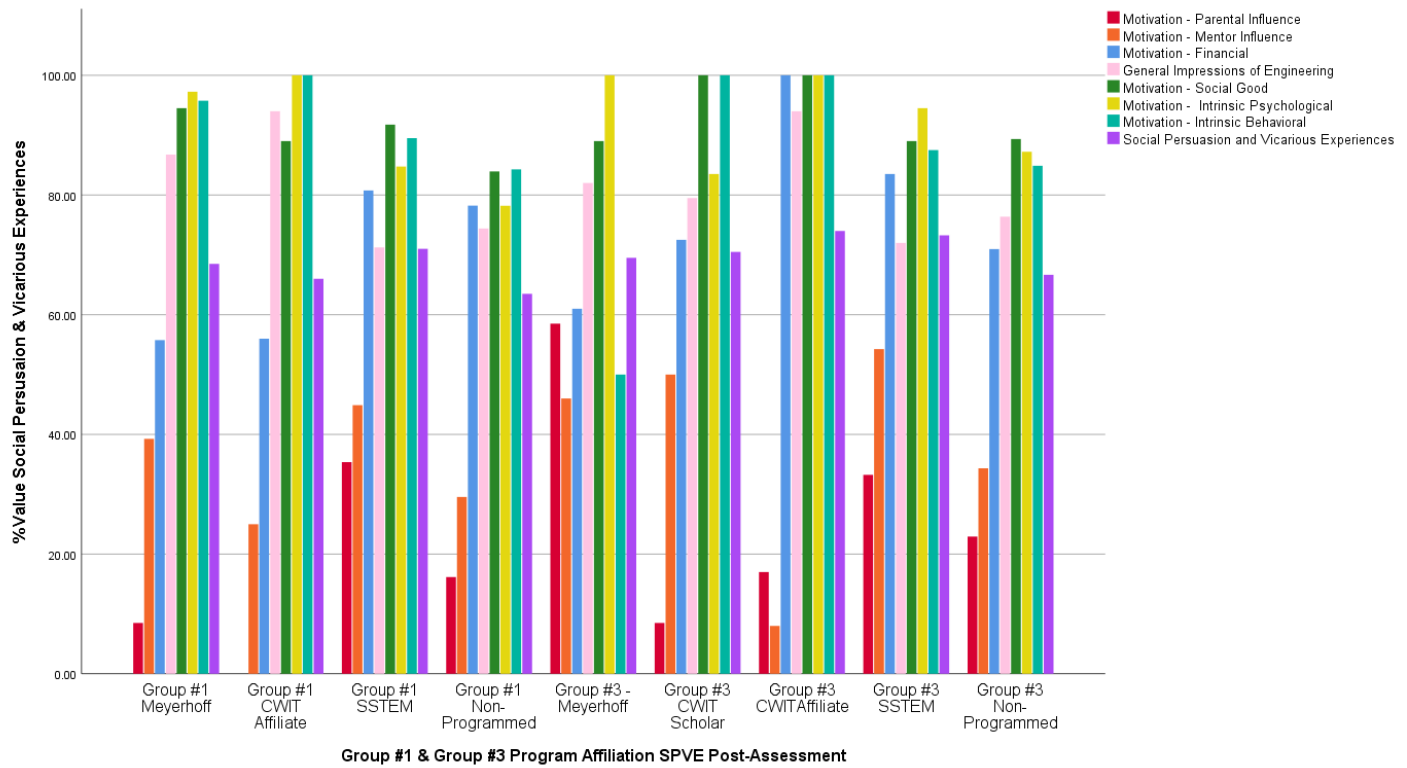


Figure 4.4.7a Group#1 & Group#3 Means SPVE Program Affiliation, Error bars are omitted for clarity

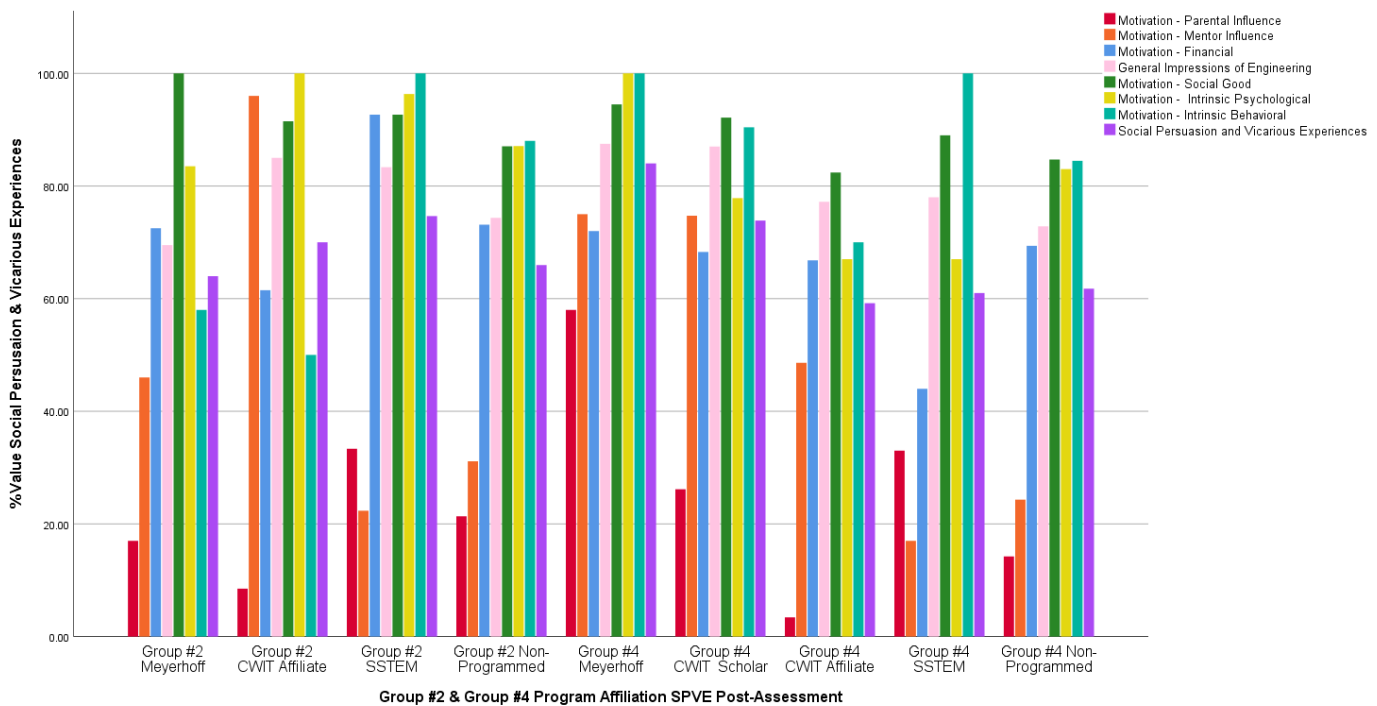


Figure 4.4.7b Group#2 & Group#4 Means SPVE Program Affiliation, Error bars are omitted for clarity

Table 4.4.5a Post Hoc Pairwise Comparisons of Mentor Influence

Comparison $\eta^2=.150$	p-value
Group #4 SSTEM < Group #2 -CWIT A	0.08
Group #2 SSTEM < Group #4 M	0.08
Group #2 SSTEM < Group #4 CWIT S	0.02
Group #4 NP < Group #2 -CWIT A	0.01
Group #2 NP < Group #4 M	0.07
Group #2 NP < Group #4 CWIT S	0.00
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.4.5b Pairwise Comparisons of Group Affiliate Program: Intrinsic Psychological

Comparison $\eta^2=.167$	p-value
Group #4 SSTEM < Group #2 SSTEM	0.10
Group #4 SSTEM < Group #2 -CWIT A	0.06
Group #4 CWIT A < Group #2 - NP	0.01
Group #4 CWIT A < Group #2 SSTEM	0.01
Group #4 CWIT A < Group #2 -CWIT A	0.01
Group #1 NP < Group #3 NP	0.03
Group #1 NP < to Group #3 SSTEM	0.10
Group #1 NP < Group #3 -Meyerhoff	0.06
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.4.8 SPVE: Overall Program Affiliation (Table E40)

The variables were assessed in the overall post-population with respect to the student's Program Affiliation. A Shapiro-Wilk test showed only General Impressions of Engineering and Social Persuasion and Vicarious Experiences variables were normally distributed. All the motivational variables were tested using non-parametric measures. A Kruskal Wallis test showed that there were significant differences between the Program Affiliations in the Mentor Influence ($p=0.004$), General Impressions of Engineering ($p=.04$) and Social Persuasion and Vicarious Experiences ($p=0.04$) (Figure 4.4.8). A post hoc analysis showed significant differences in Mentor Influence, General Impressions of Engineering and Social Persuasion and Vicarious Experiences (Table 4.4.6 a-c).

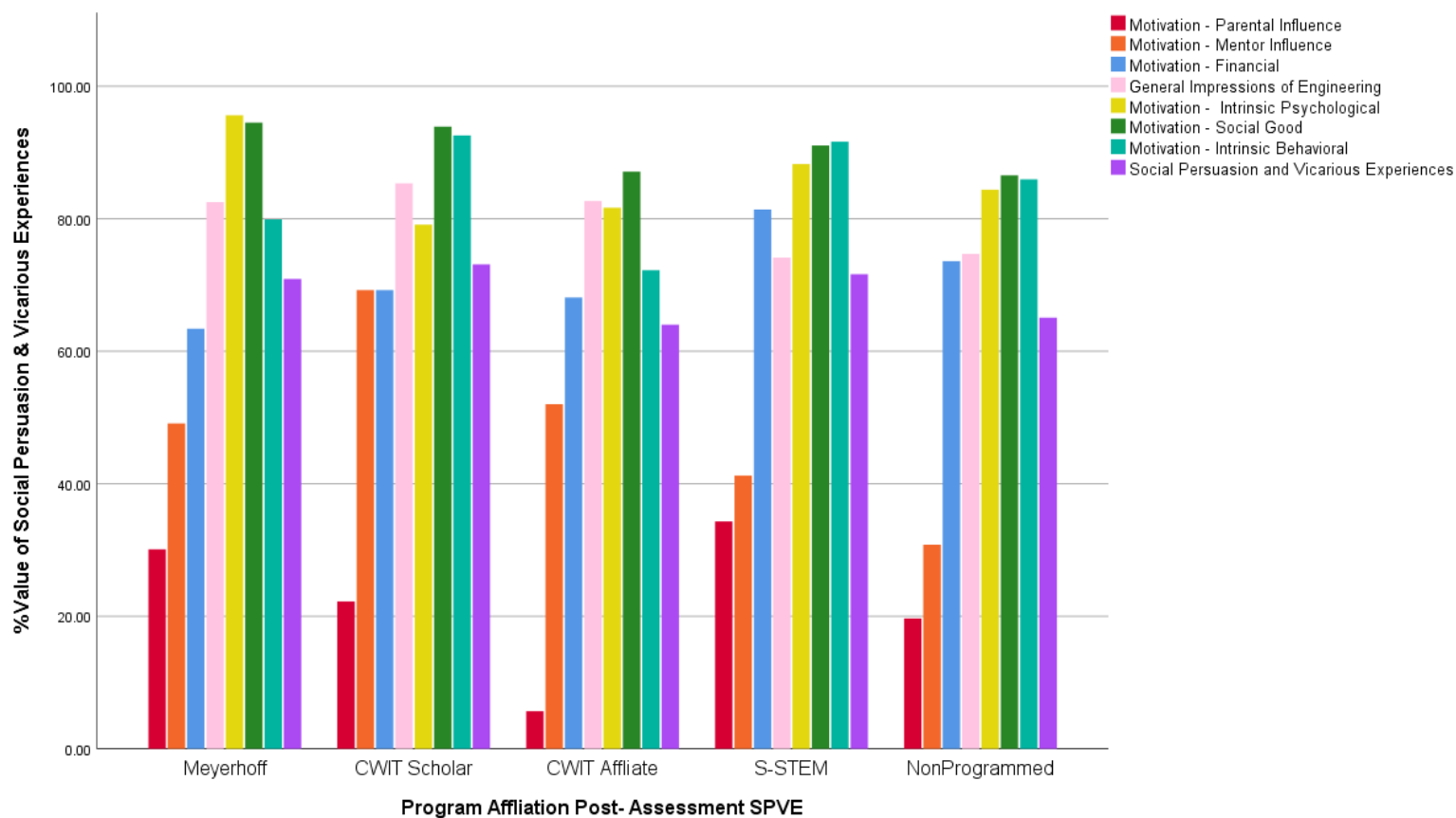


Figure 4.4.8 SPVE ENES 101 Program Affiliation Post-Assessment, Error bars are omitted for clarity

Table 4.4.6a Post Hoc Pairwise Comparisons Mentor Influence Program Affiliation

Mentor Influence Pairwise Comparisons of Program Affiliation $\eta^2=.087$	
Comparison	p-value
Non-Programmed < Meyerhoff	0.098
Non-Programmed < CWIT Affiliate	0.06
Non-Programmed < CWIT Scholar	0.001
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.4.6b Post Hoc Pairwise Comparisons General Impressions Program Affiliation

General Impressions Pairwise Comparisons of Program Affiliation $\eta^2=.087$	
Comparison	p-value
Non-Programmed < Meyerhoff	0.09
Non-Programmed < CWIT Affiliate	0.096
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.4.6c Post Hoc Pairwise Comparisons SVPE Program Affiliation

SVPE Pairwise Comparisons of Program Affiliation $\eta^2=.06$	
Comparison	p-value
CWIT Affiliate < S-STEM	0.052
CWIT Affiliate < CWIT Scholar	0.069
Non-Programmed < S-STEM	0.014
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.4.9 SPVE: Correlations Between the Population Variables (Table E41-E45)

An assessment of the SPVE variables on each Group was evaluated. In the following sections, strong or moderate relationships are highlighted. A Spearman's Rho correlations for Social Persuasion and Vicarious Experiences for each group are shown in Appendix E, Table E41-E45.

Group #1

For Group #1, the SPVE variable had a strong significant relationship to Motivation-Intrinsic Psychological ($p=0.00$). Therefore, the analysis suggests the Group #1's Motivation to do Engineering for its Own Sake accounts for 53% their overall Motivation to Pursue Engineering.

Group #2

For Group #2 the SPVE variable had a strong significant relationship to Motivation-Mentor Influence ($p=0.00$). Therefore, the analysis suggests that Group #2's having a mentor accounts for 49% of their overall Motivation to Pursue Engineering. Additionally, Intrinsic Psychological and Intrinsic Behavioral had a strong significant relationship ($p<0.01$), with $r^2=38\%$ of the variance between the variables.

Group #3

For Group #3 the General Impressions of Engineering has a strong relationship with Intrinsic Psychological ($p=0.00$). Therefore, the analysis suggests that Group #3's Impression of Engineering accounts for 47% of their doing engineering for its own sake.

Group #4

In Group #4 the SPVE variable had a strong significant relationship to Motivation-Intrinsic Psychological ($p=0.00$). Therefore, the analysis suggests that Group #4's motivation to do engineering for its own sake accounts for 52% of their overall motivation.

Overall

For overall populations, the SPVE variable had a moderate significant relationship to Motivation-Mentor Influence ($p=0.00$). Therefore, the analysis suggests that populations having a mentor influences accounts for 35% of their overall motivation to pursue engineering.

4.4.10 Mastery Experiences (ME) (Table E46)

All of the Groups were evaluated for their Mastery Experiences mindset (Figure 4.4.9). In this variable, students indicated whether they perceived science, math, professional and interpersonal skills as important. Testing for normality revealed no variables were normally distributed.

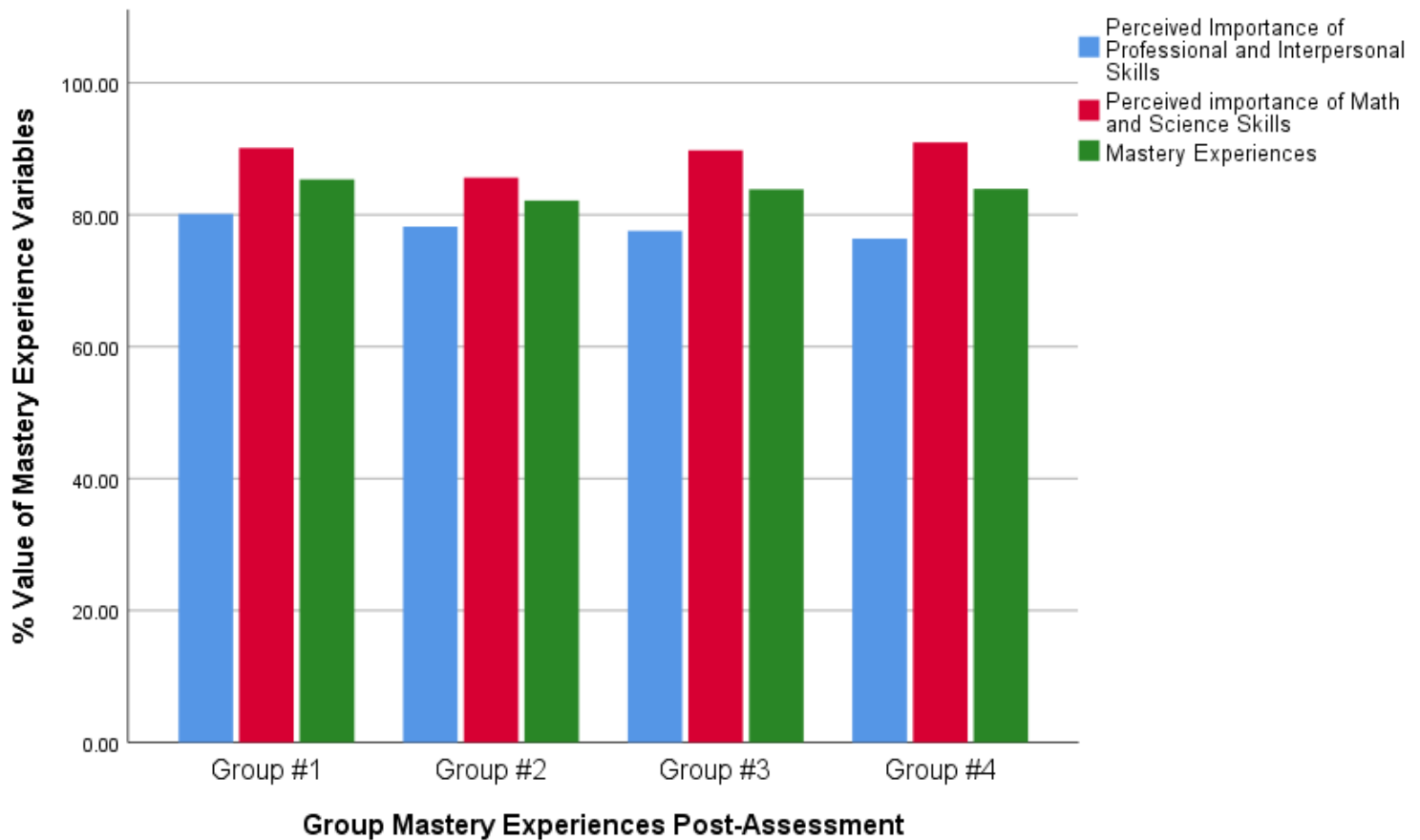


Figure 4.4.9 Mastery Experiences ENES 101 Post-Assessment, Error bars are omitted for clarity

Although an Independent-Samples Kruskal-Wallis test summary showed no significance between the groups, there was a slightly higher average value in Perceived Importance of both Professional and Interpersonal Skills, as well as Perceived Importance Math and Science Skills in Group #1 compared to Group #3 (80.13%, 77.57% and 90.13%, 89.76%, respectively).

4.4.11 Mastery Experiences (ME): Gender Between Groups (Table E47)

The ME variables were assessed based on Gender between the Groups. A Shapiro-Wilk test showed that none of the variables in Mastery Experiences were normally distributed. Therefore, non-parametric assessments were used. Between Genders, significant differences were found in Perceived importance of Math and Science Skills ($p=0.036$), and Mastery Experiences ($p=0.038$) (Figure 4.4.10a&b).

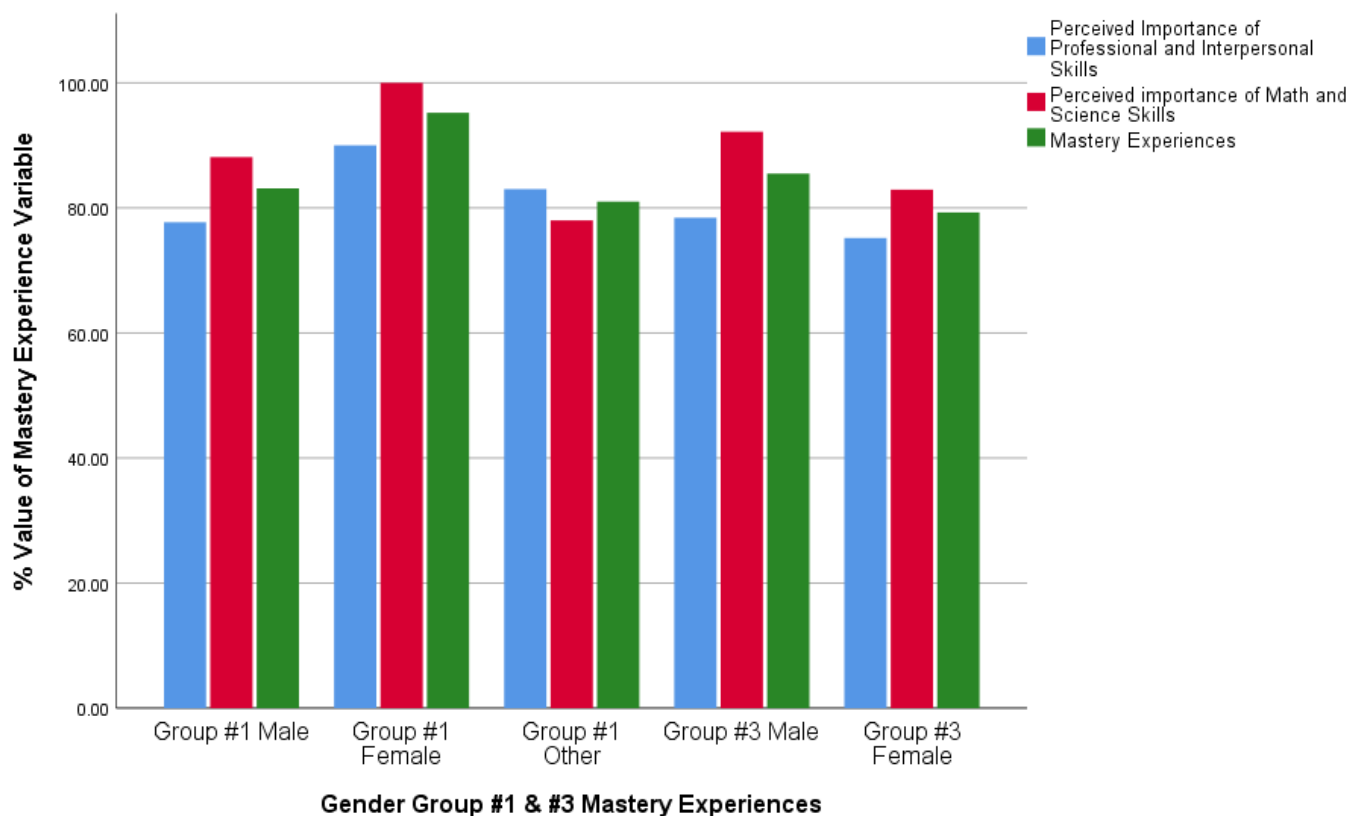


Figure 4.4.10a Gender Mastery Experiences ENES 101 Post-Assessment, Error bars are omitted for clarity

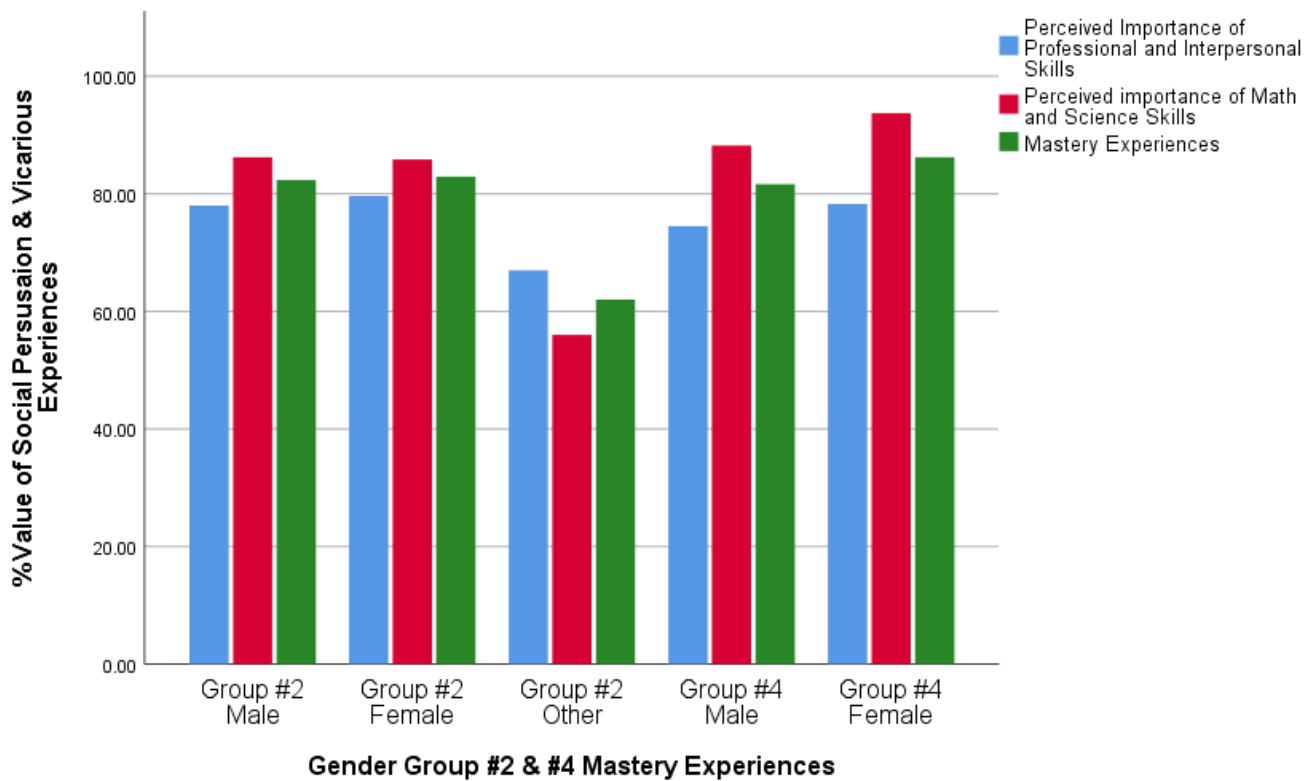


Figure 4.4.10b Group Two and Four Gender Mastery Experiences ENES 101 Post-Assessment, Error bars are omitted for clarity

A Post hoc analysis of pairwise comparisons showed that there were significant differences between some groups (Table 4.4.7a&b).

Table 4.4.7a Post Hoc Gender Perceived Importance of Math and Science Skills

Perceived importance of Math and Science Skills is the same across categories of Group Gender.	
Pairwise Comparisons of Group Gender $\eta^2=.058$	
Comparison	p-value
Group #3 Female < Group #1 Female	0.00
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.4.7b Post Hoc Gender Mastery Experiences

Mastery Experiences	
Pairwise Comparisons of Group Gender $\eta^2=.058$	
Comparison	p-value
Group #2 Other < Group #4 Female	0.08
Group #3 Female < Group #1 Female	0.00
Group #3 Male < Group #1 Female	0.01
<p>Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.</p> <p>Asymptotic significances (2-sided tests) are displayed. The significance level is .10.</p> <p>a Significance values have been adjusted by the Bonferroni correction for multiple tests.</p>	

4.4.12 ME: Overall Population (Table E48)

The ME variables were assessed based on Gender for the overall population. A significant difference was found in Perceived Importance of Math and Science (p =0.098) (Figure 4.4.11).

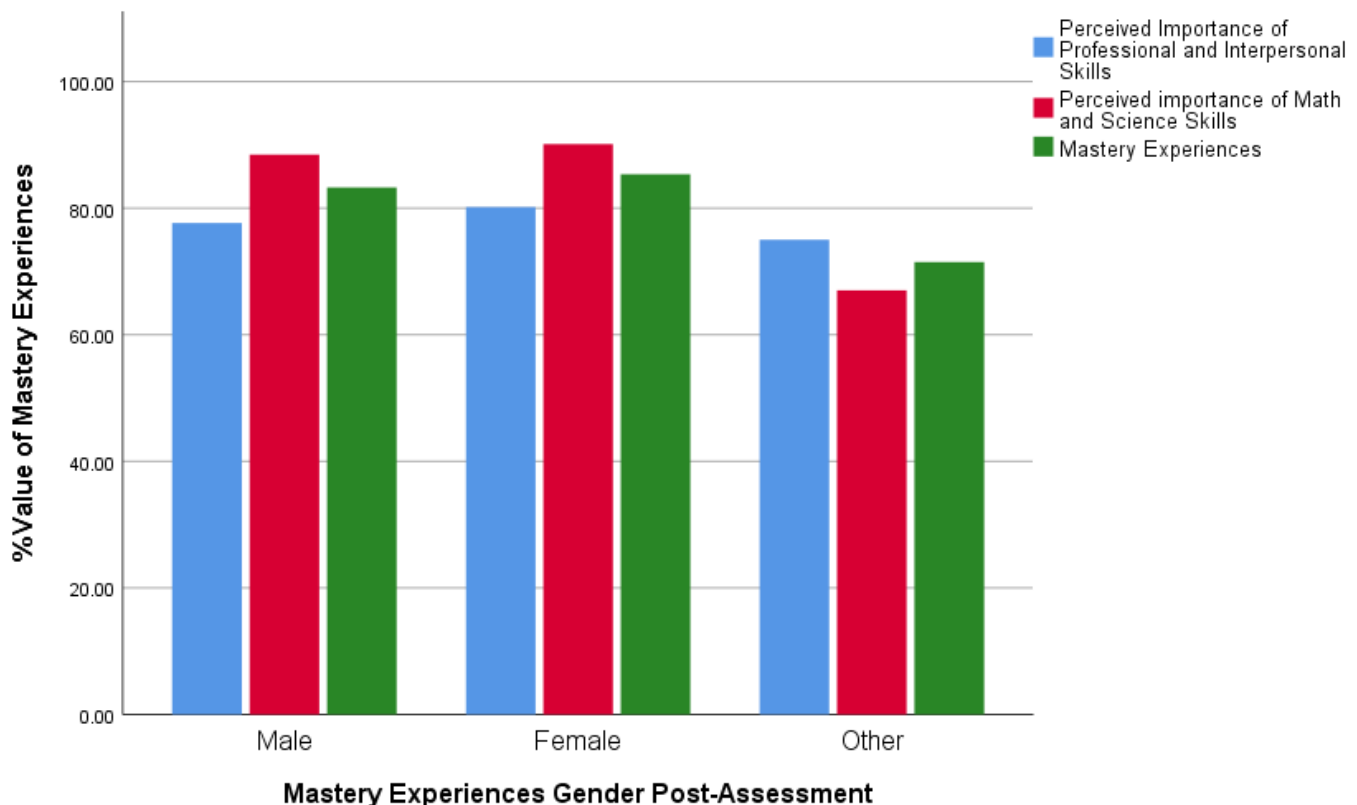


Figure 4.4.11 ENES 101 Gender Mastery Experiences, Error bars are omitted for clarity

A Post hoc analysis of pairwise comparisons showed that there were significant differences between some groups (Table 4.4.8).

Table 4.4.8 Post Hoc Overall Population Perceived Importance of Math and Science Skills

Pairwise Comparisons of Gender: Perceived Importance Math and Science Skills $\eta^2=.021$	
Comparison	p-value
Other < Male	0.06
Other < Female	0.038
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.4.13 ME: Ethnic Between Groups (Table E49)

The ME variables were assessed based on the Ethnic variable between the groups. A Shapiro-Wilk test showed most of the groups with respect to the variable were not normally distributed. All the variables were tested using non-parametric measures. No significance was found between the Ethnic groups in the ME variables (Figure 4.4.12a&b).

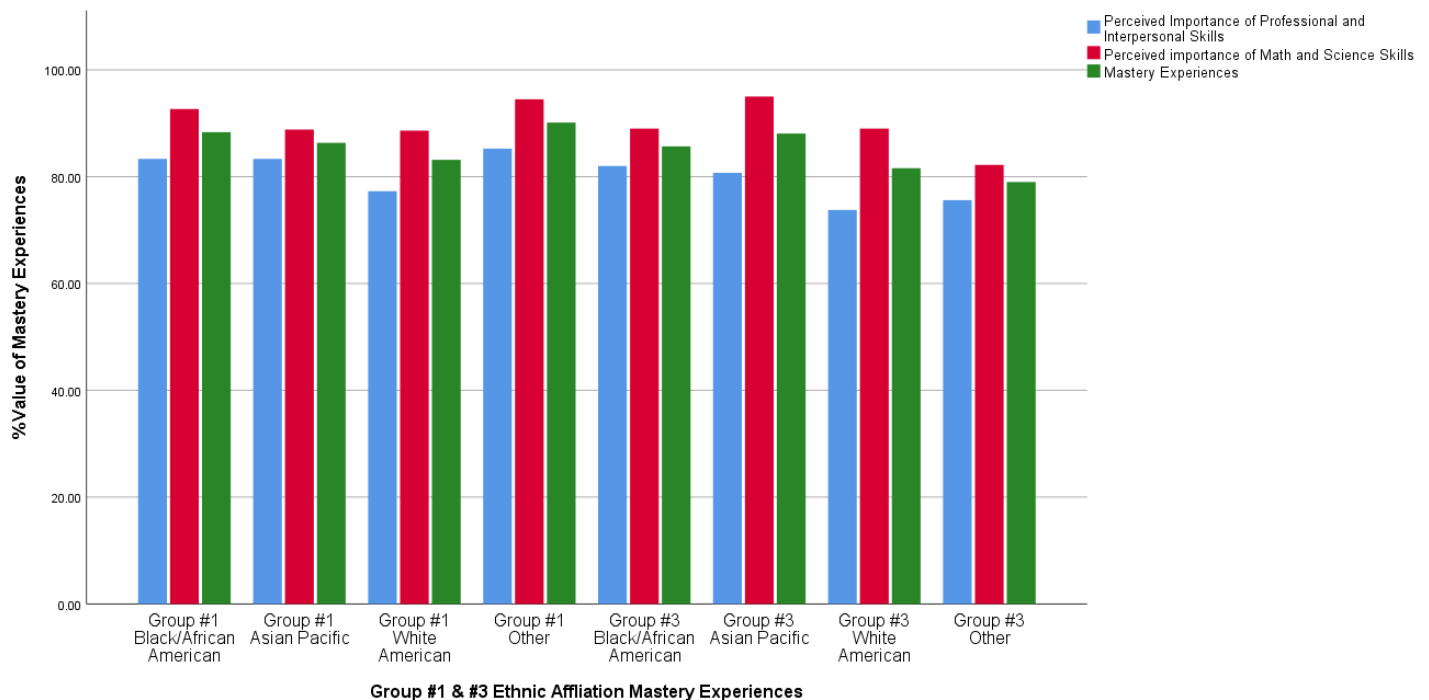


Figure 4.4.12a Group #1 and #3 Mastery Experiences Ethnic Affiliation, Error bars are omitted for clarity

Although there was no significant difference between the Groups, Group #1 showed an overall higher mean value than Group #3 in Mastery Experiences and Perceived importance of Professional and Interpersonal skills.

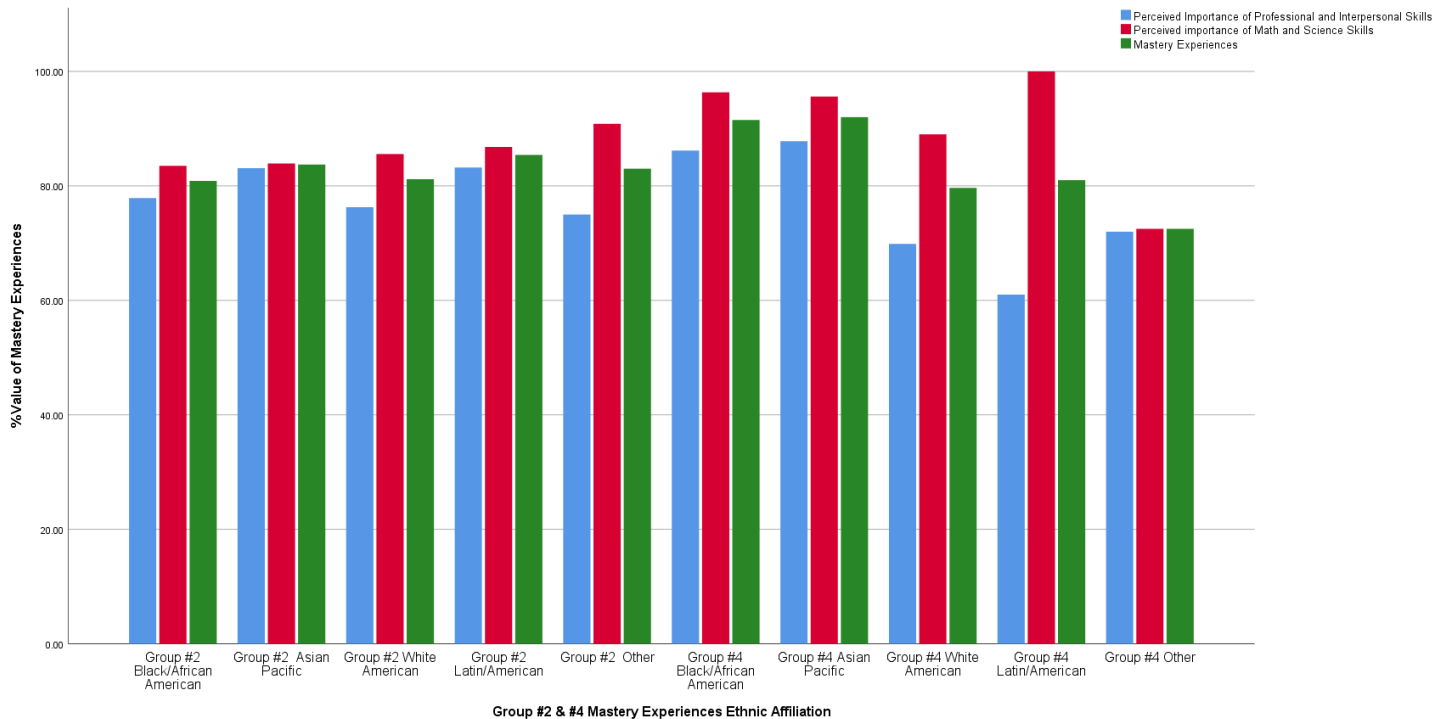


Figure 4.4.12b Group #2 and #4 Mastery Experiences Ethnic Affiliation, Error bars are omitted for clarity

Group #4 showed overall higher mean value in ME compared to the other groups. Group #4 contained both the Y section and Honors section.

4.4.14: ME: Overall Ethnic (Table E50)

The ME variables were assessed between Ethnic groups for the entire population. A significant difference was found between the groups in the Perceived Importance of Math and Science Skills ($p=0.037$), and Mastery Experiences ($p=0.061$) (Table 4.4.9a&b).

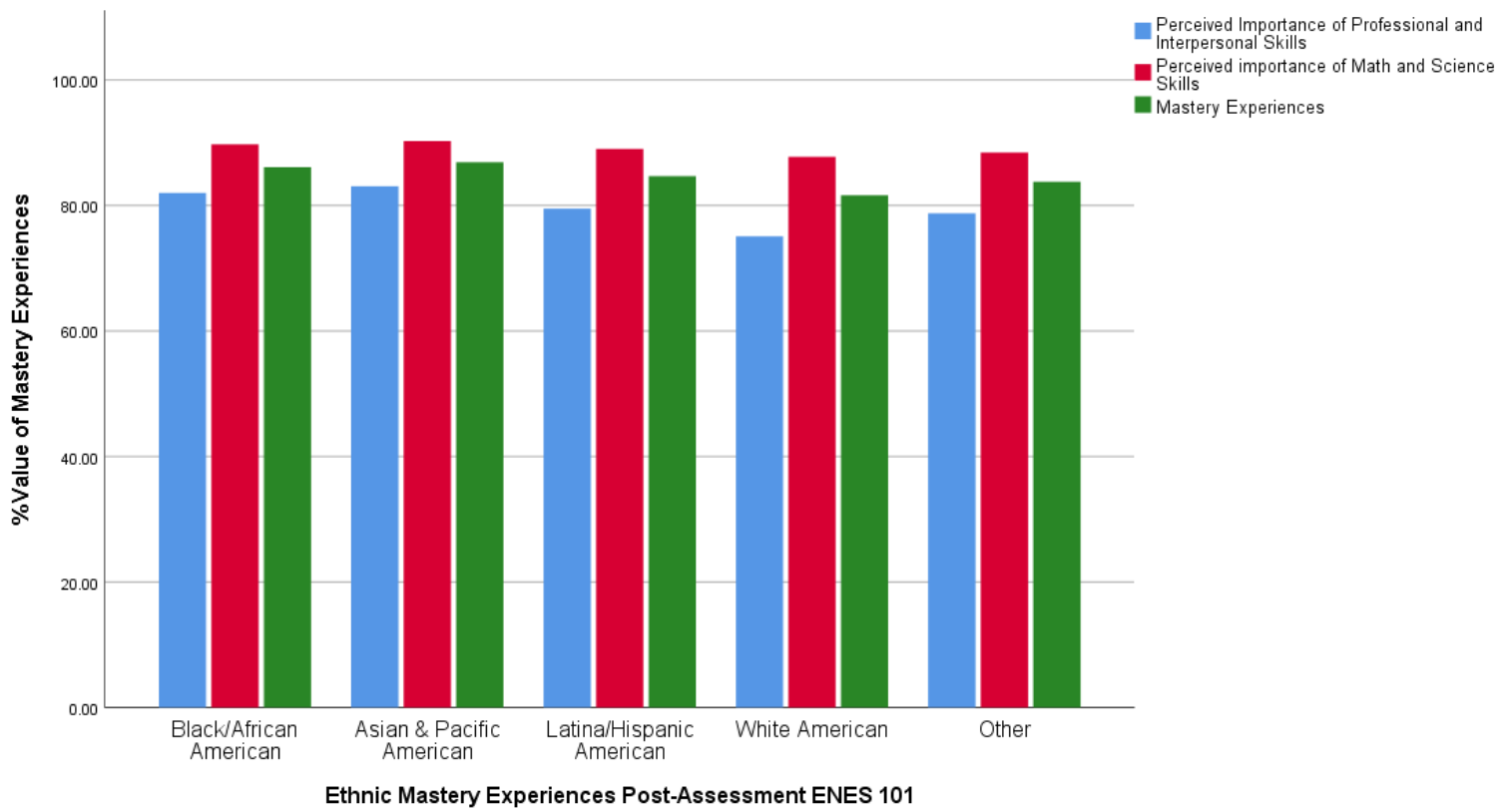


Figure 4.4.13 Mastery Experiences Means Ethnic Affiliation ENES 101, Error bars are omitted for clarity

A Post hoc analysis of pairwise comparisons showed that there were significant differences between some Ethnic Affiliations (Table 4.4.9a&b).

Table 4.4.9a Post Hoc Ethnic Perceived Importance Math and Science Skills

Pairwise Comparisons of Ethnic: Perceived Importance of Math and Science Skills $\eta^2=.042$	
Comparison	p-value
White American < Black/African American	0.029
White American < Asian & Pacific American	0.005
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.4.9b Post Hoc Ethnic Mastery Experiences

Pairwise Comparisons of Ethnic: Mastery Experiences $\eta^2=.035$	
	p-value
White American < Black/African American	0.069
White American < Asian & Pacific American	0.006
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.4.15 ME: Program Affiliation (Table E51)

The ME variables were assessed between the Program Affiliations. A Shapiro-Wilk test showed none of the Mastery Experiences variables were normally distributed in relation to population. An Independent Sample Kruskal-Wallis test revealed no significant difference between the groups (Figure 4.4.14a&b).

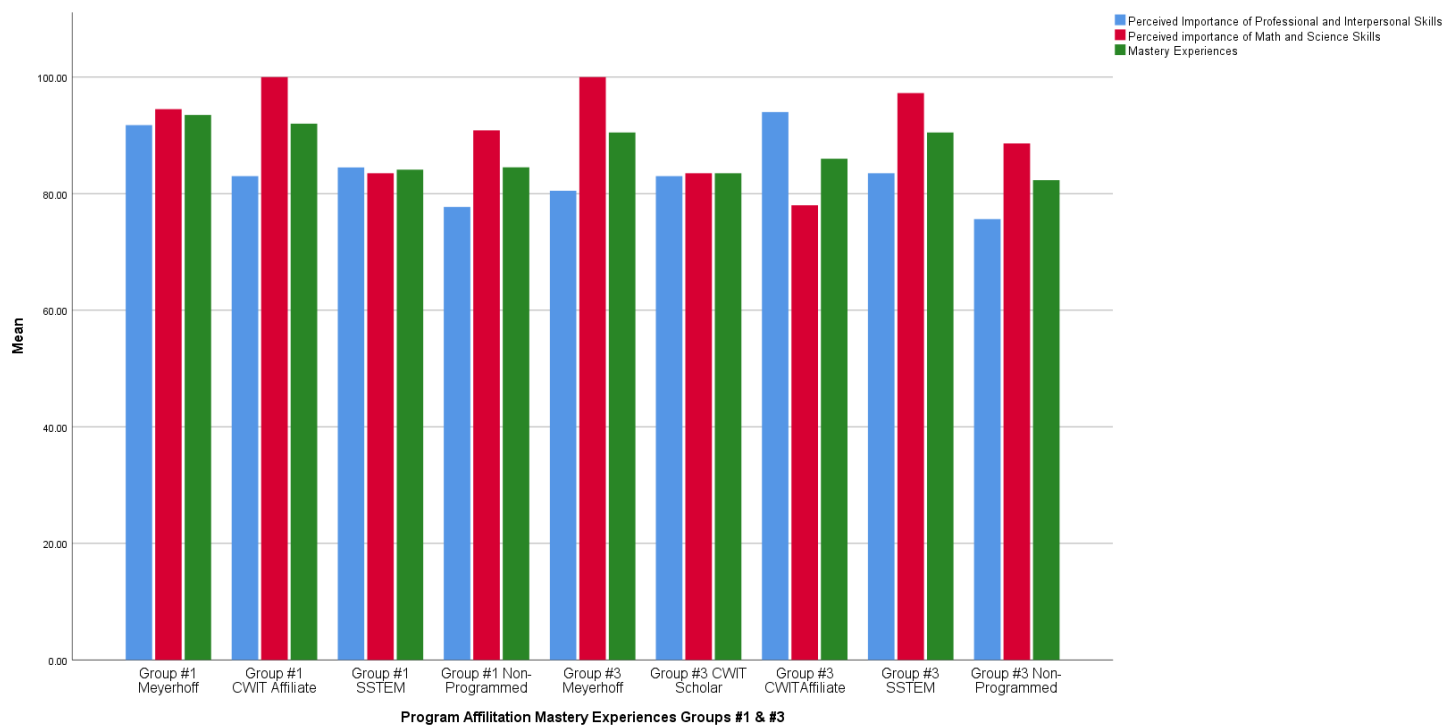


Figure 4.4.14a Group#1 & Group#3 Mastery Experiences Means Program Affiliation ENES 101

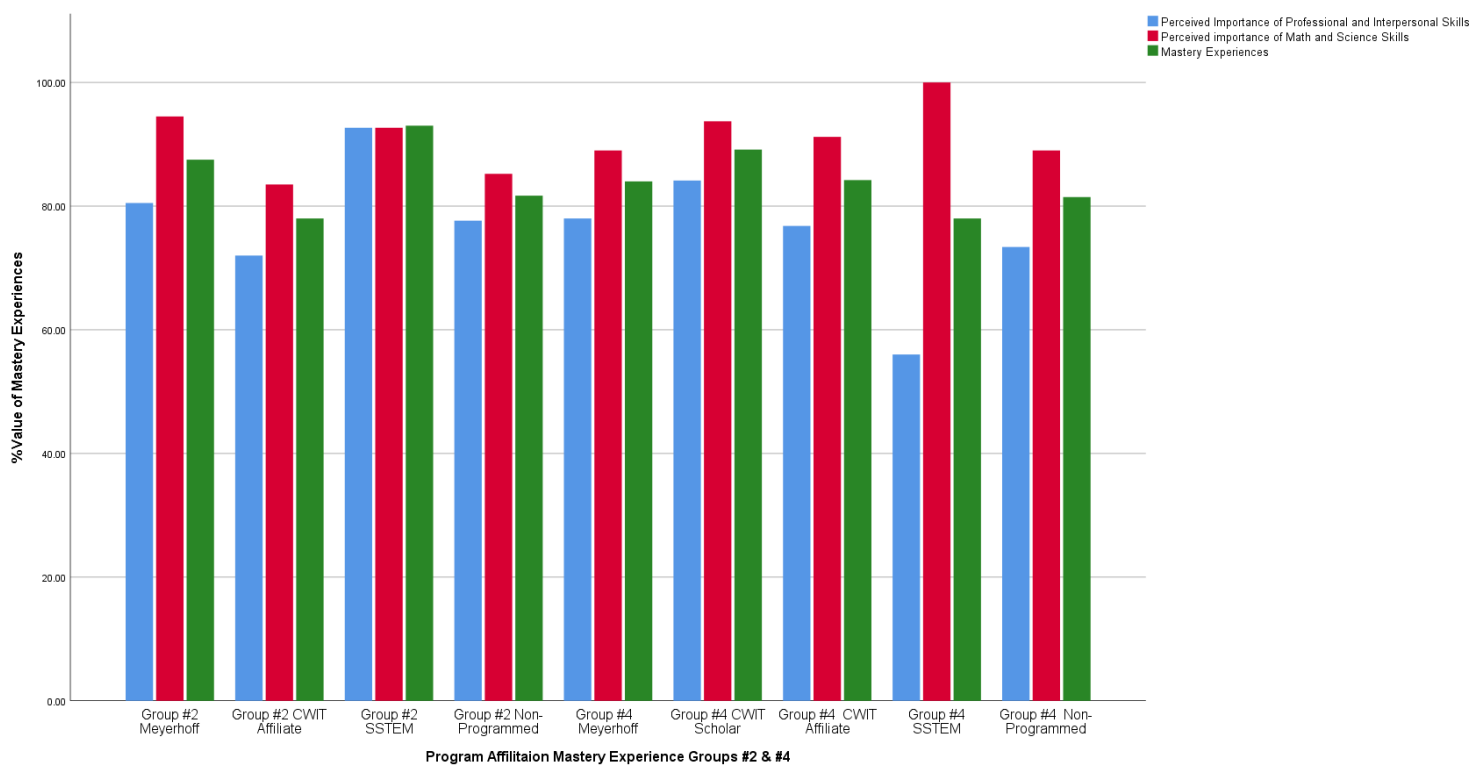


Figure 4.4.14b Group#2 & Group#4 Mastery Experiences Means Program Affiliation ENES 101, Error bars are omitted for clarity

4.4.16 ME: Overall Program Affiliation (Table E52)

The ME variables were assessed between Program Affiliations in the overall population. A Shapiro-Wilk test showed all the mastery experiences variables were not normally distributed in relation to population. An Independent Sample Kruskal-Wallis test revealed no significant difference between the groups (Figure 4.4.15).

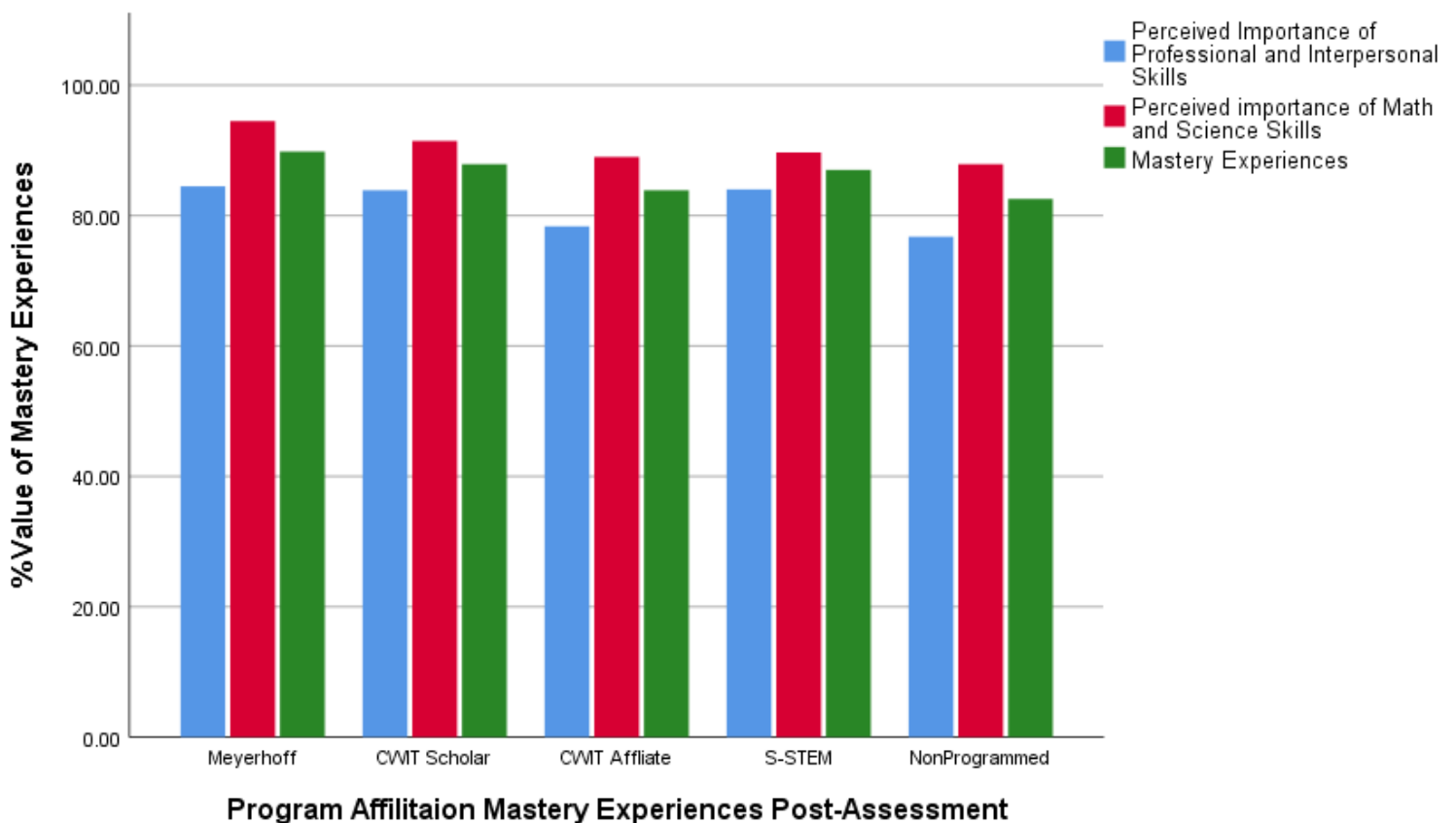


Figure 4.4.15 Mastery Experiences Means Program Affiliation ENES 101, Error bars are omitted for clarity

4.4.17 ME: Mastery Experiences Correlations for the Population (Table E53-E56)

An assessment of the Mastery Experiences variables for each of the 4 Groups was evaluated. For Groups #1, #3, and #4 (Tables E52, E54, E55), Mastery Experience had a strong significant relationship in Perceived Importance of Professional and Interpersonal Skills ($p=0.001$). The coefficient of determination suggests that valuing professional and interpersonal skills accounts for 65%, 70%, and 76%, for Groups #1, #3, and #4 respectively, of the overall perception of the skills engineer's use.

For Group #2, Mastery experience had a strong significant relationship in Perceived Importance of Math and Science Skills ($p=0.001$). The coefficient of determination suggests that valuing math and science skills accounts for 69% of the overall perception of the skills engineer's use. Other strong or moderately strong relationships not explicitly described above are highlighted in the Appendix.

4.4.18: ME: Overall Population Correlations Mastery Experiences (Table E57)

Mastery experience had a strong significant relationship in Perceived Importance of Professional and Interpersonal Skills ($p=0.001$). Therefore, the coefficient of determination suggests that valuing professional and interpersonal skills accounts for 65% of the overall perception of the skills engineers use. Other strong and moderately strong relationships were found and highlighted in the table in the appendix.

4.4.19: Emotional States Post Assessment ENES 101 (Table E58)

All of the Groups were evaluated for their Emotional States mindset. Shapiro-Wilk tests showed that not all variables were normally distributed and therefore non-parametric tests were utilized. An Independent-Samples Kruskal Wallis Test showed no significance between the groups (Figure 4.4.16).

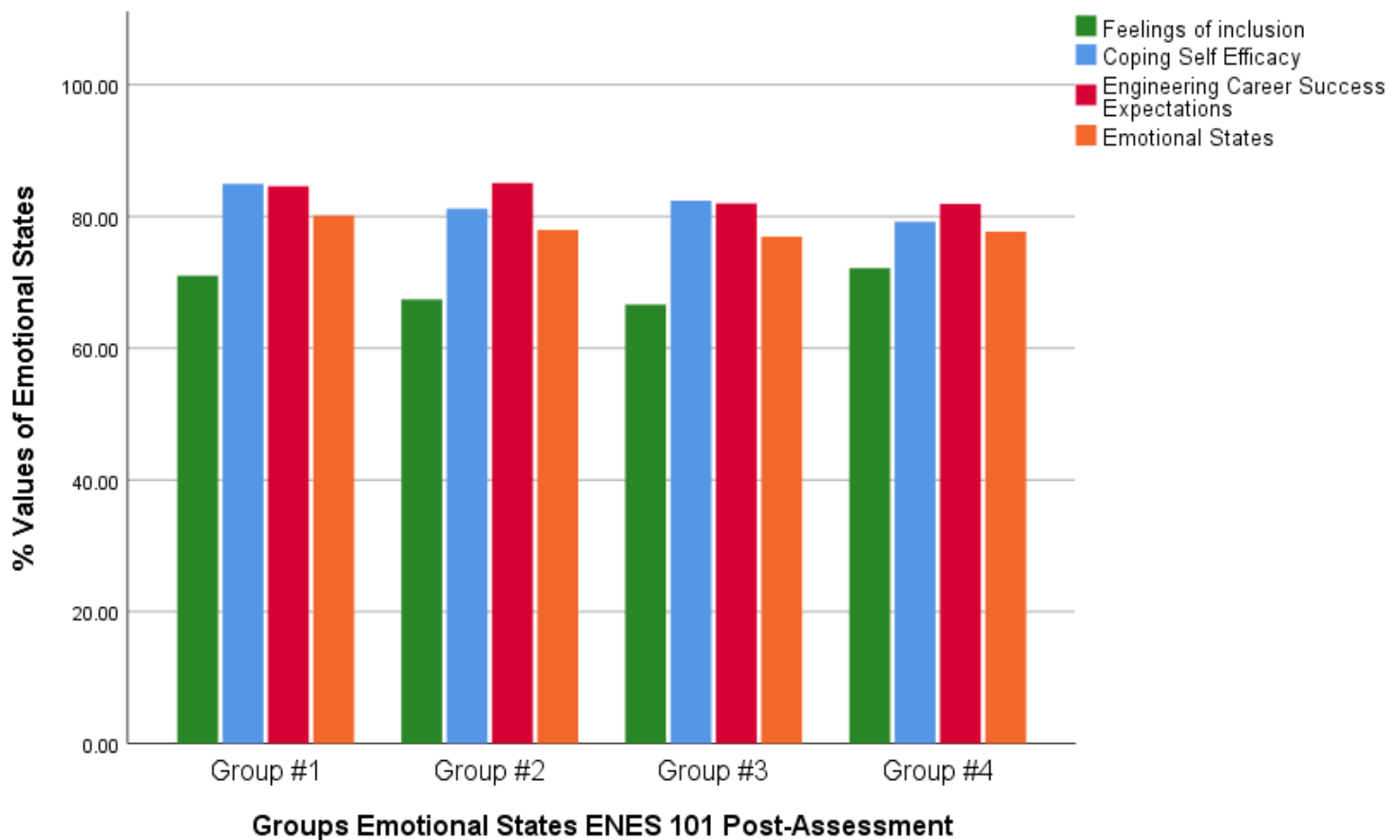


Figure 4.4.16 Emotional States Groups ENES 101 Post-Assessment ENES 101, Error bars are omitted for clarity

4.4.20 Emotional States: Gender (Table E59)

The Emotional State variables were assessed in the groups between Gender. A Shapiro-Wilk test showed that not all the variables in Emotional States were normally distributed. An Independent-Samples Kruskal Wallis Test showed significant differences in coping self-efficacy ($p = 0.02$) (Figure 4.4.17a&b)

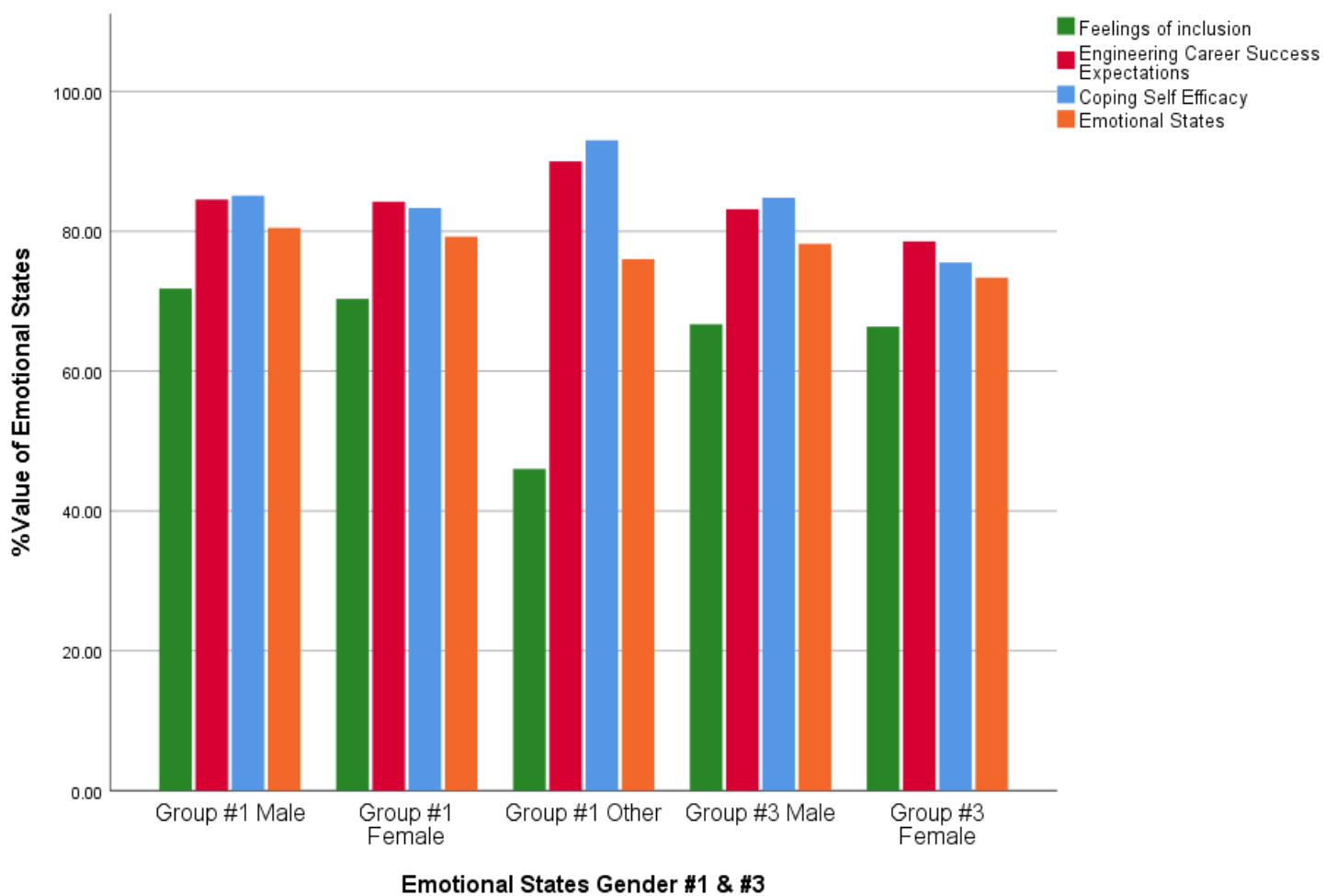


Figure 4.4.17a Emotional States Gender Group#1 & #3 Post-Assessment, Error bars are omitted for clarity

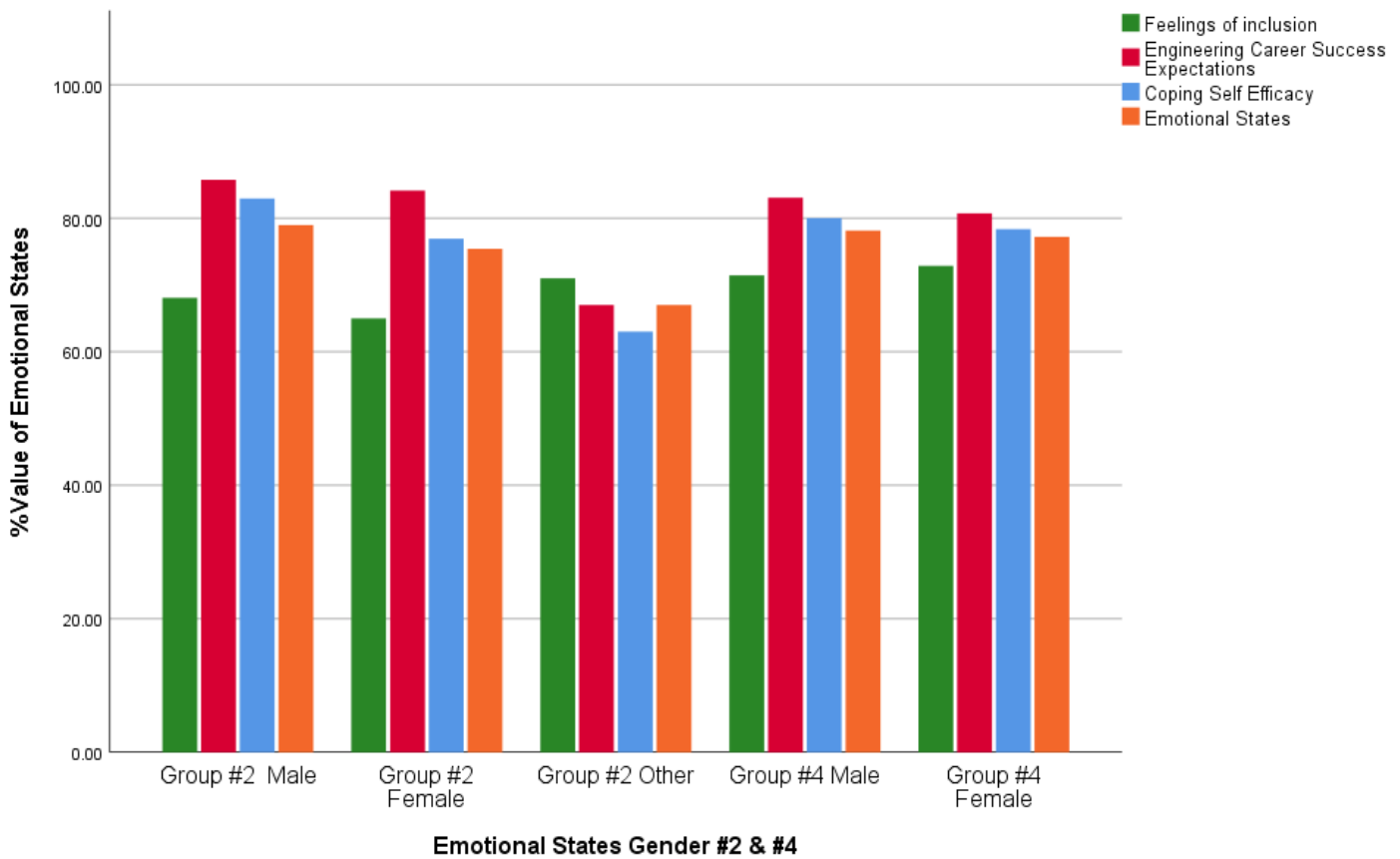


Figure 4.4.17b Emotional States Gender Group#2 & #4 Post-Assessment, Error bars are omitted for clarity

A Post hoc analysis of pairwise comparisons showed that there were significant differences between some groups (Table 4.4.10).

Table 4.4.10 Post Hoc Coping Self-Efficacy Gender Groups

Pairwise Comparisons of Group Gender Coping Self-Efficacy $\eta^2=.069$	
Comparison	p-value
Group #3 Female< Group #1 Male	0.02
Group #3 Female>Group #1 Other	0.10
Group #4 Female < Group #2 Male	0.08
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.4.21 Emotional States: Overall Gender (Table E60)

Gender identifications were assessed with respect to emotional states variables. A Shapiro-Wilk test showed that not all the variables in Emotional States with respect to gender, were normally

distributed. Significant differences were found between the groups in Coping Self-Efficacy ($p = .004$), and Emotional States ($p = 0.086$) (Figure 4.4.18).

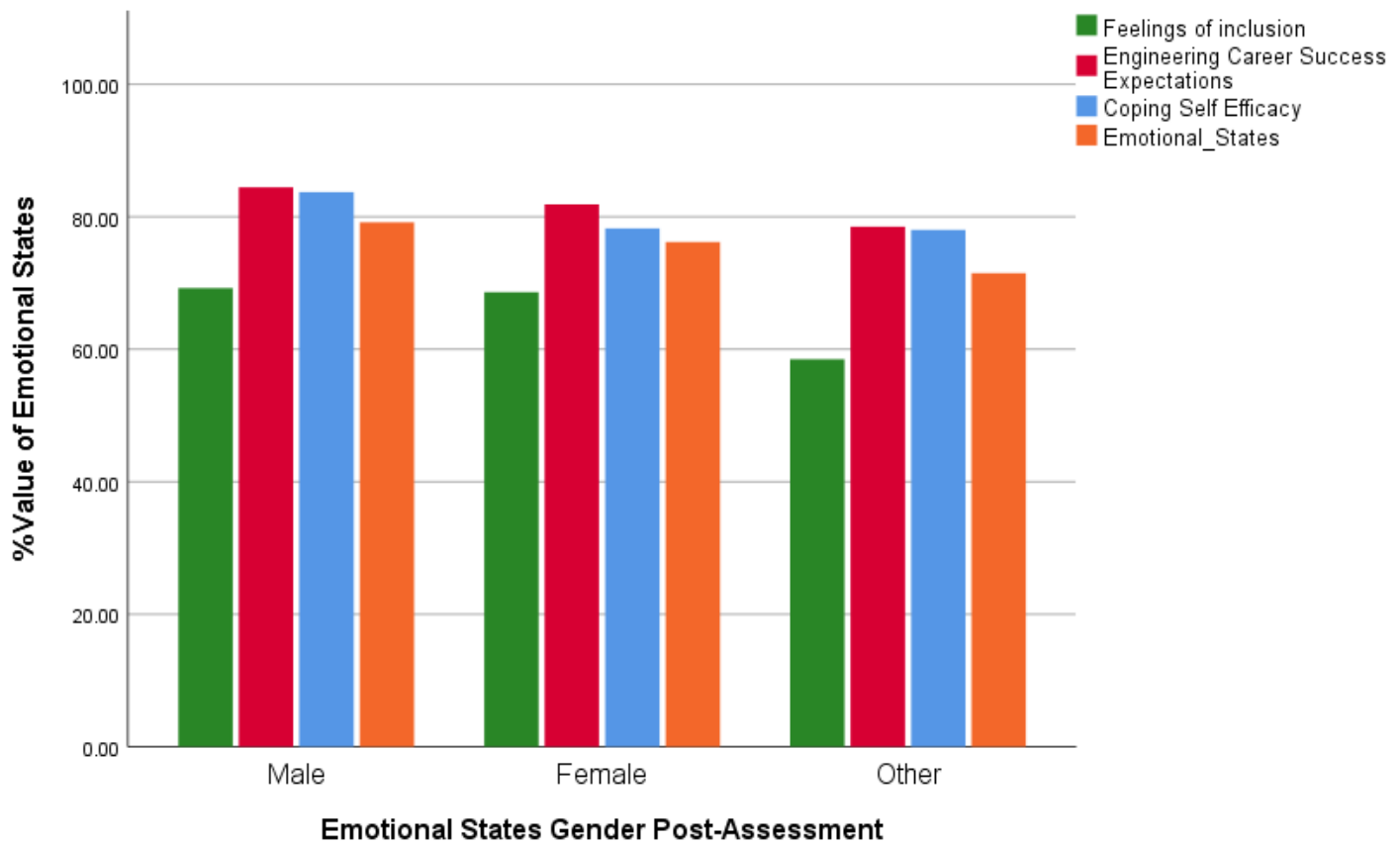


Figure 4.4.18 Emotional States Gender, ENES 101 Post-Assessment, Error bars are omitted for clarity

A post hoc analysis of pairwise comparisons showed that there were significant differences between some groups (Table 4.4.11a&b).

Table 4.4.11a Pairwise Comparisons of Gender: Coping Self-Efficacy

Pairwise Comparisons of Gender: Coping Self-Efficacy $\eta^2 = .06$	
Comparison	p-value
Female < Male	0.001
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.4.11b Pairwise Comparisons of Gender: Emotional States

Pairwise Comparisons of Gender: Emotional States $\eta^2=.023$	
Comparison	p-value
Female < Male	0.056
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.4.22 Emotional States: Ethnic Between Groups (Table E61)

The Emotional State variables were assessed between the Groups for Ethnic Affiliation. Shapiro-Wilk tests showed that the data for most of the Groups were not normally distributed. All the variables were tested using non-parametric measures. Significance was found between Groups for Coping Self-Efficacy ($p = 0.094$), Feelings of Inclusion ($p = 0.06$), and Emotional States ($p = 0.028$) (Figure 4.4.19a&b).

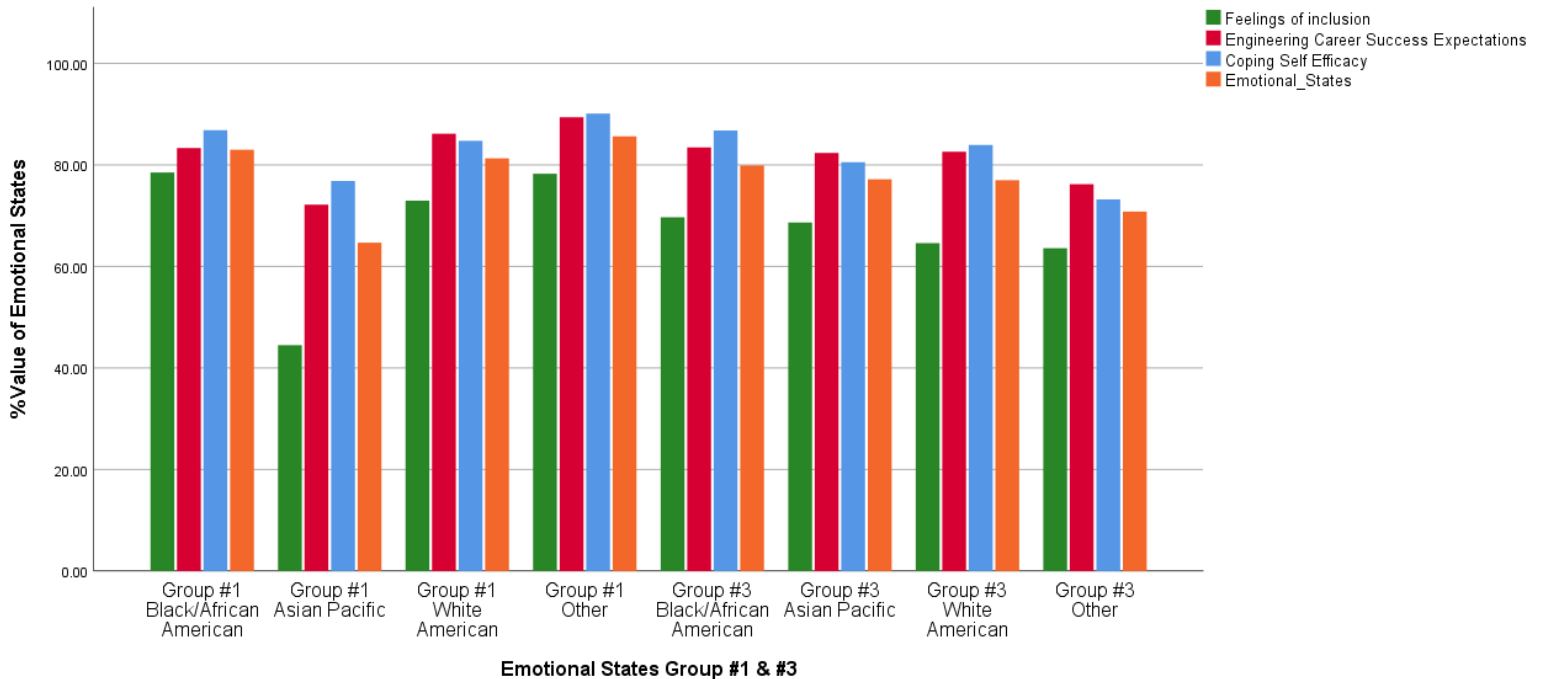


Figure 4.4.19a Emotional States Ethnic Affiliation Group #1 and #3, Error bars are omitted for clarity

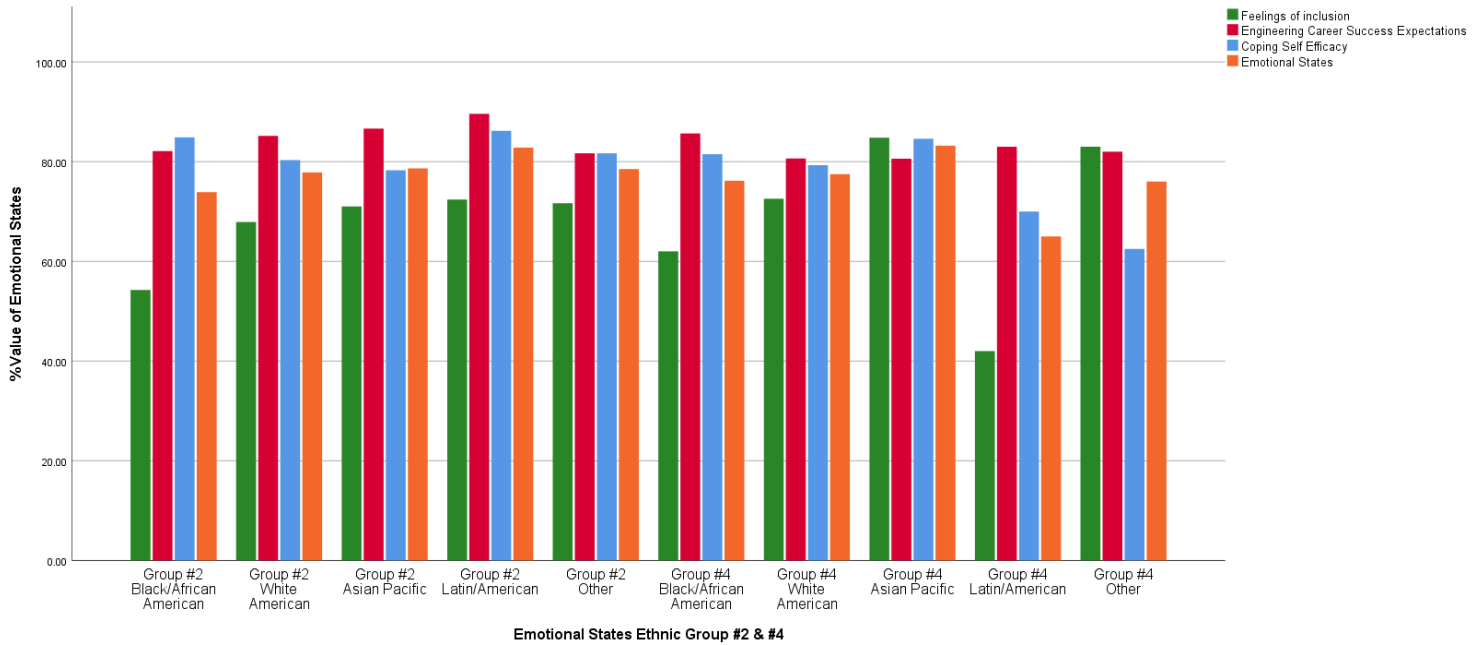


Figure 4.4.19b Emotional States Ethnic Affiliation Group #2 and #4, Error bars are omitted for clarity

A Post hoc analysis of pairwise comparisons showed that there were significant differences between some groups (Table 4.4.12a-c).

Table 4.4.12a Pairwise Comparisons of Ethnic Group Coping Self-Efficacy

Comparison $\eta^2=.057$	p-value
Group #4 other < Group #2 AP	0.085
Group #4 other < Group #2 Other	0.094
Group #4 other < Group #2 WA	0.056
Group #4 other < Group #2 B/AA	0.026
Group #4 other < Group #2 L/A	0.026
Group #1 AP < Group #3 WA	0.055
Group #1 AP < Group #3 B/A	0.021
Group #3 AP < Group #1 other	0.030
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

*B/AA- Black African American; WA-White American; AP-Asian Pacific; L/A-Latin American

Table 4.4.12b Pairwise Comparisons of Ethnic Group Feelings of Inclusion

Pairwise Comparisons of Ethnic Group: Feelings of Inclusion $\eta^2=.068$	
Comparison	p-value
Group #2 B/AA < Group #4 WA	0.033
Group #2 B/AA < Group #4 AP	0.005
Group #2 B/AA < Group #4 other	0.028
Group #3 Other < Group #1 -B/AA	0.095
Group #3 Other < Group #1 other	0.065
Group #3 WA < Group #1 -B/AA	0.088
Group #3 WA < Group #1 other	0.047
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

**B/AA- Black African American; WA-White American; AP-Asian Pacific; L/A-Latin American*

Table 4.4.12c Pairwise Comparisons of Ethnic Group Emotional States

Pairwise Comparisons of Ethnic Group: Emotional States $\eta^2=.086$	
Comparison	p-value
Group #1 AP < Group #3 AP	0.03
Group #1 AP < Group #3 WA	0.01
Group #1 AP < Group #3 B/A	0.005
Group #3 Other < Group #1 WA	0.026
Group #3 Other < Group #1 -B/AA	0.024
Group #3 Other < Group #1 other	0.005
Group #3 WA < Group #1 other	0.05
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

**B/AA- Black African American; WA-White American; AP-Asian Pacific; L/A-Latin America*

4.4.23 Emotional States: Overall (Table E61)

The variables were assessed for the entire post-population between Ethnic Affiliations. Using non-parametric measures, no significance was found between the Ethnic groups in emotional states.

4.4.24 Emotional States: Program Affiliation Between Groups (Table E62)

The Program Affiliation variables were assessed between the Groups. A Shapiro-Wilk test showed that none of the variables, except Emotional States, were normally distributed. An independent

Sample Kruskal-Wallis test and One-Way ANOVA revealed no significant difference between the groups (Figures 4.4.20a&b).

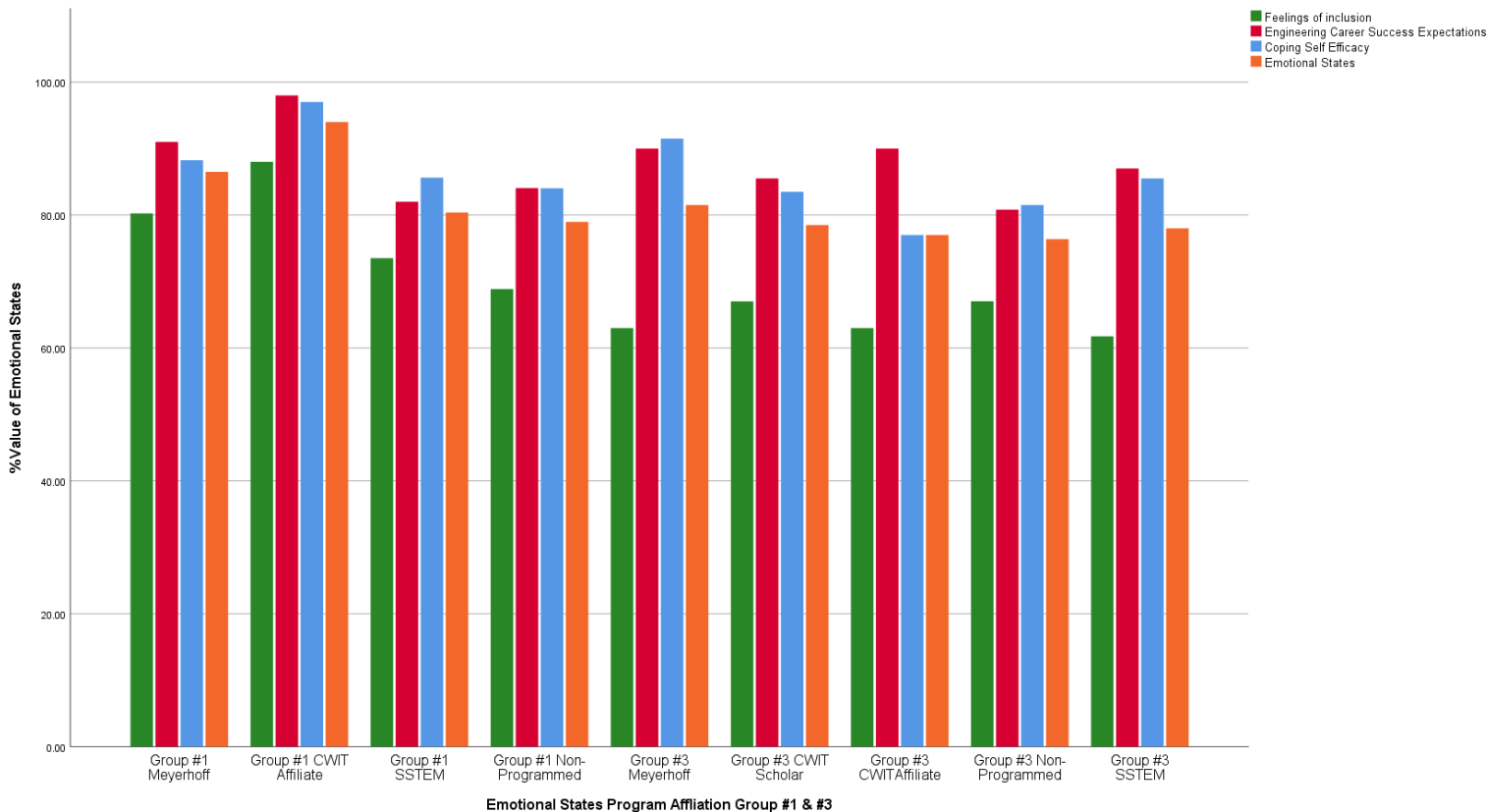


Figure 4.4.20a Emotional States Program Affiliation Group #1 and #3, Error bars are omitted for clarity

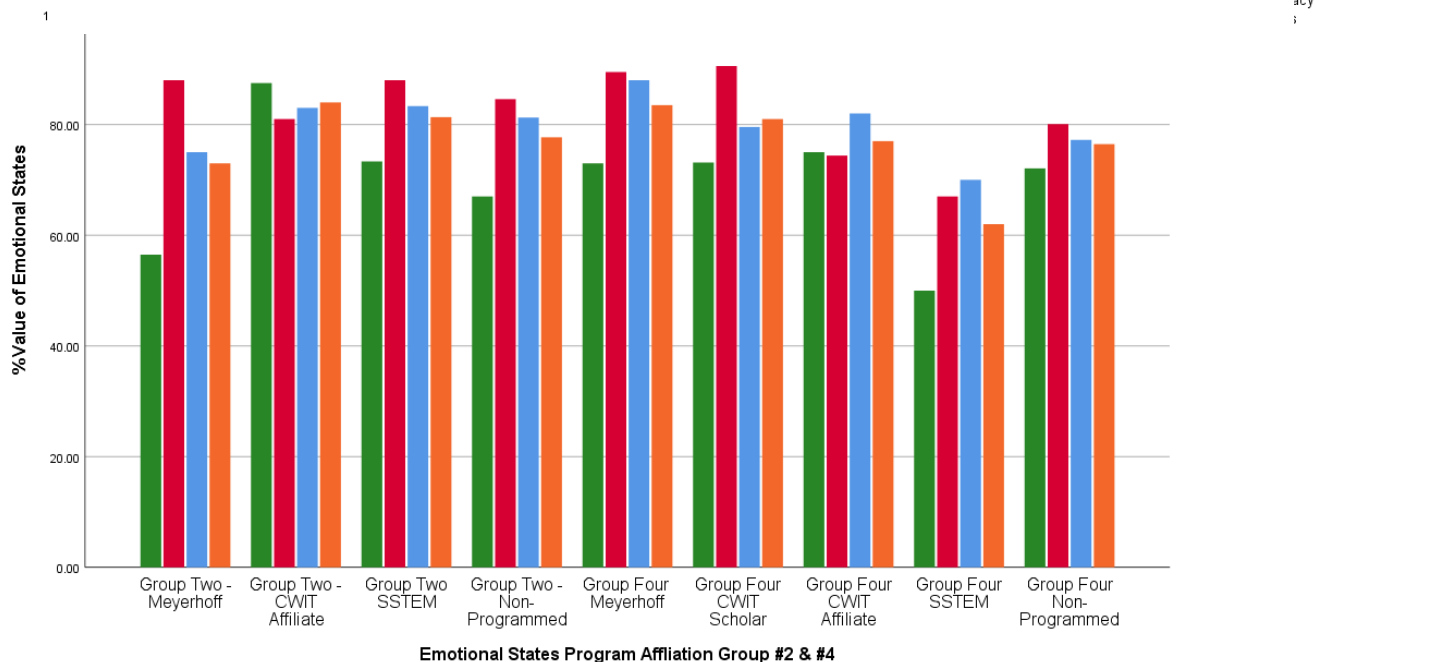


Figure 4.4.20b Emotional States Program Affiliation Group #2 and #4, Error bars are omitted for clarity

4.4.25 Emotional States: Overall Program Affiliation (Table E63)

The Program Affiliation variables were assessed for overall post-population related to the student's program affiliation. Shapiro-Wilk test showed none of the variables were normally distributed, except for Emotional States, therefore non-parametric measures were used to test for significance. No significance was found between the groups in these tests.

4.4.26 Emotional States: Correlations for the Population (Tables E64- E68)

An assessment of the Emotional States variables for each Group was evaluated. In the following sections, strong and intermediate relationships are highlighted. Spearman's Rho Correlations for Emotional States for each group are shown in Appendix E Tables E64-E67. Strong or moderately strong relationships not explicitly described below are highlighted in the appendix.

Group #1 (Table E64)

Feelings of Inclusion had a moderately strong significant correlation with Emotional States ($p=0.0$). Therefore, the analysis suggests that Group #1's perceptions of inclusion positively accounts for 61% of their emotional state as an engineer.

Group #2 (Table E65)

Feelings of Inclusion had a strong significant relationship with Emotional ($p=0.00$). Therefore, the analysis suggests that Group #2's perceptions of inclusion positively accounts for 81% of their emotional state as an engineer.

Group #3 (Table E66)

Engineering Career Success Expectations had a significant correlation with Emotional States ($p=0.00$). Therefore, the analysis suggests that Group #3's perceptions of being able to succeed in engineering positively accounts for 52% of their emotional state as an engineer.

Group #4 (Table E67)

Feelings of Inclusion had a strong significant correlation with Emotional States ($p<0.00$). Therefore, the analysis suggests that Group #4's perceptions inclusion positively accounts for 51% of their emotional state as an engineer.

Overall Population (Table E68)

Feelings of Inclusion had a strong significant relationship with Emotional States ($p=0.00$).

Therefore, the analysis suggests that student's perceptions inclusion positively accounts for 65% of their emotional state as an engineer.

4.5 Comparison of Pre-Semester and Post-Semester Group #1 and #2 (Table E69 and E70)

Group #1 and Group #2 both received the ESMI in the beginning. However, only Group #2 received interventions during the semester. Therefore, differences between Group #1 and Group #2 may be attributed to the presence or absence of interventions. This section presents significant differences in variable between Pre- (beginning of the semester), and Post- (end of the semester) assessment, that is, receiving the ESMI.

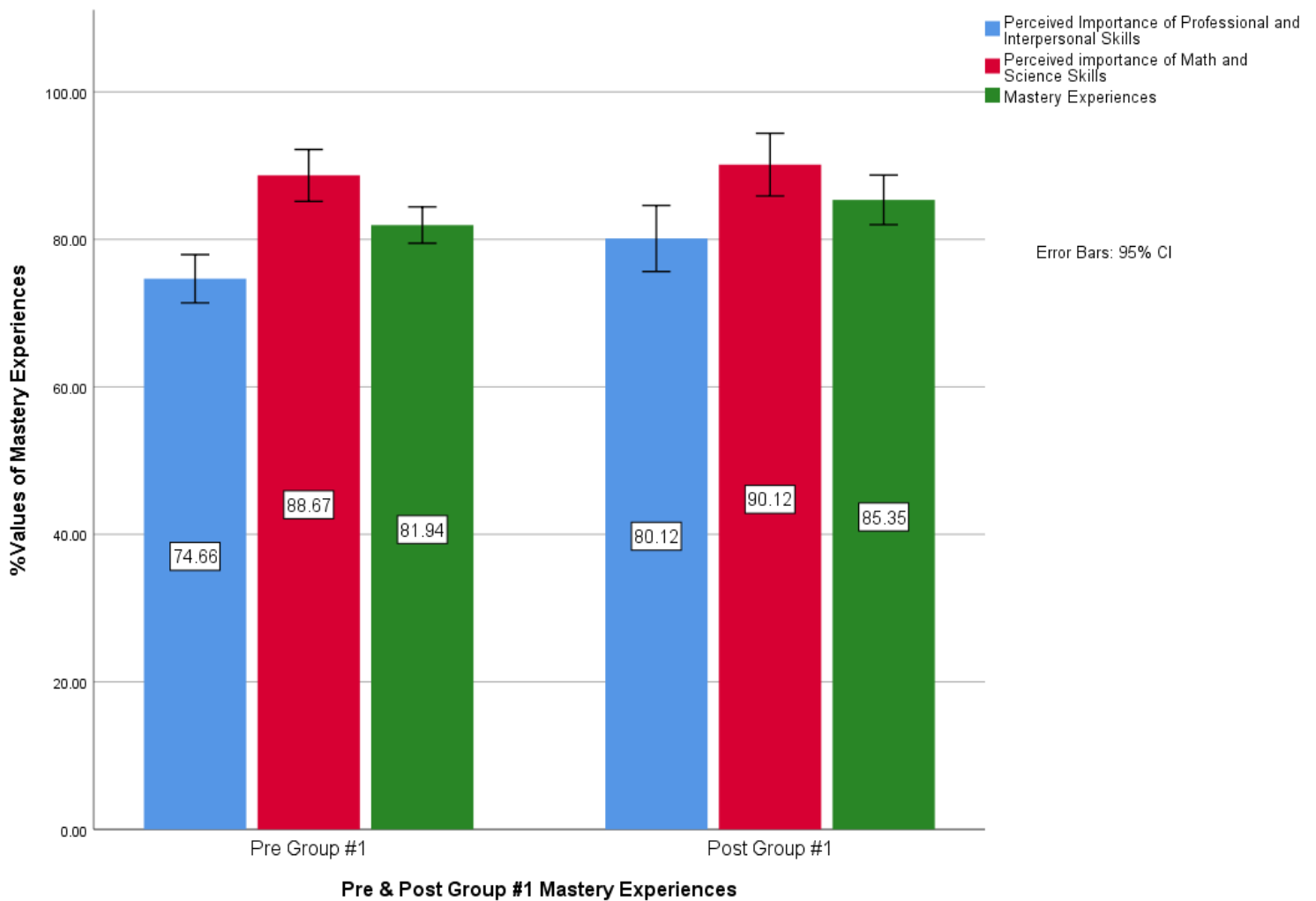


Figure 4.5.1a Pre-Post Comparison Confidence Group #1

For both Group #1 and Group #2, the Pre- and Post- Confidence in Graduating variable was assessed. Shapiro-Wilk tests showed that no variables were normally distributed for either Group #1 or Group #2. All the variables were tested using non-parametric measures showing no significant differences.

The Confidence in Graduating variable was assessed at the beginning and end of the semester in Group #2 (Figure 4.5.1b). The Shapiro-Wilk test showed the variables were not normally distributed. All the variables were tested using non-parametric measures. No significance was found between the pre

and post discussions and their times (Table E70). However, the confidence in Group #2 remained the same from the beginning of the semester compared to the end.

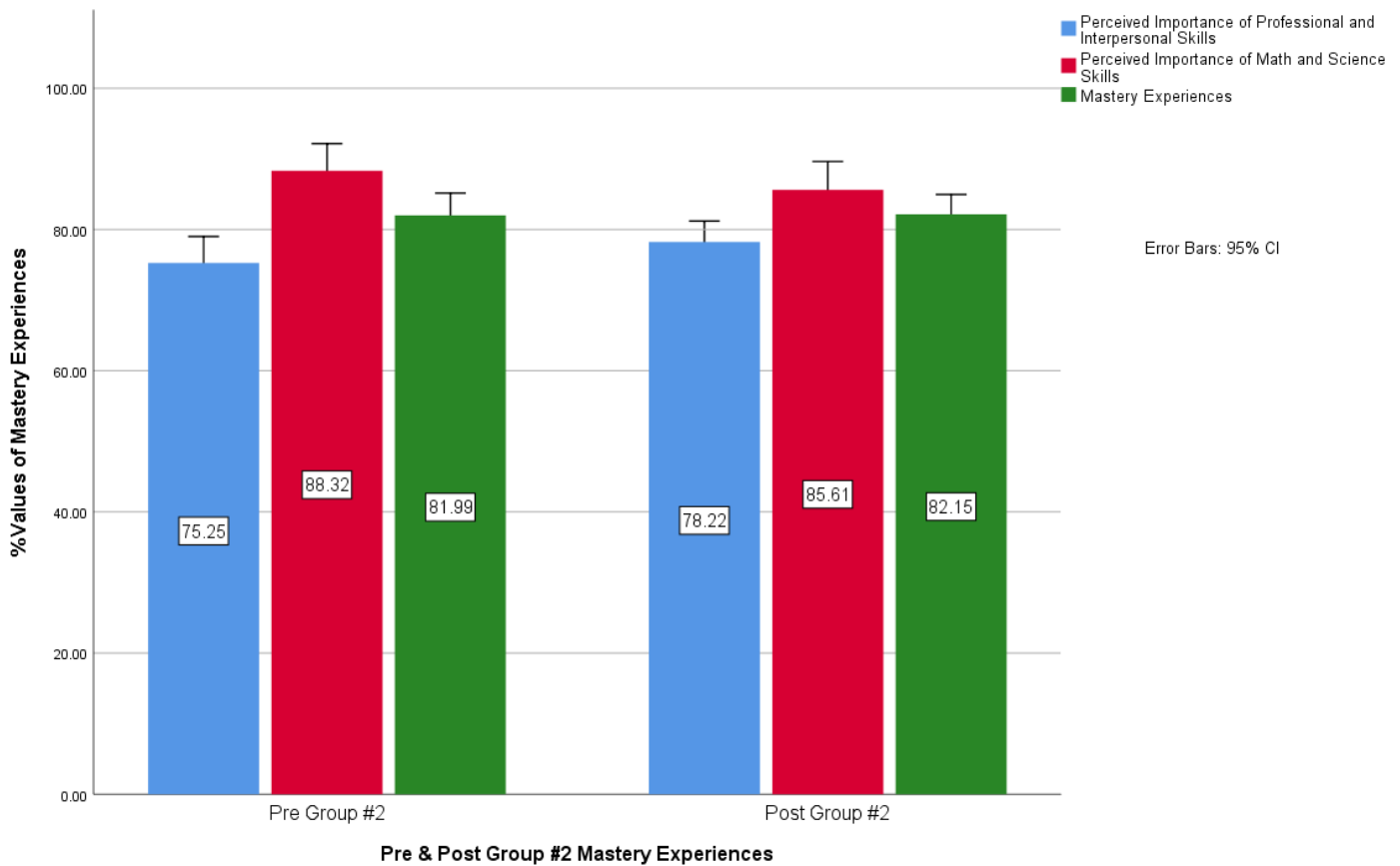


Figure 4.5.1b Pre and Post Confidence in Graduating Group #2

4.5.1 SPVE: Pre and Post Responses (Table E71 and E72)

For Group #1 and Group #2, Social Persuasion and Vicarious Experience variables were assessed for Pre and Post responses. Shapiro-Wilk tests showed that no variables were normally distributed except for General Impressions of Engineering and SPVE in Group #1, and overall motivation to study engineering (SPVE variable) in Group #2. A Kruskal Wallis test showed no significant differences. However, a One-Way ANOVA revealed a significant difference in General

Impressions in Engineering ($p=0.029$, $\eta^2=.039$) between pre & post assessment Group #1. In Group #2, significant differences were found in Social Good ($p=.005$, $\eta^2=0.05$), Intrinsic Psychological ($p=0.096$, $\eta^2=0.018$), and Social Persuasion and Vicarious experiences ($p=0.024$, $\eta^2=0.039$). Figures 4.5.3 a and b show the means of the Pre- and Post-SPVE variables.

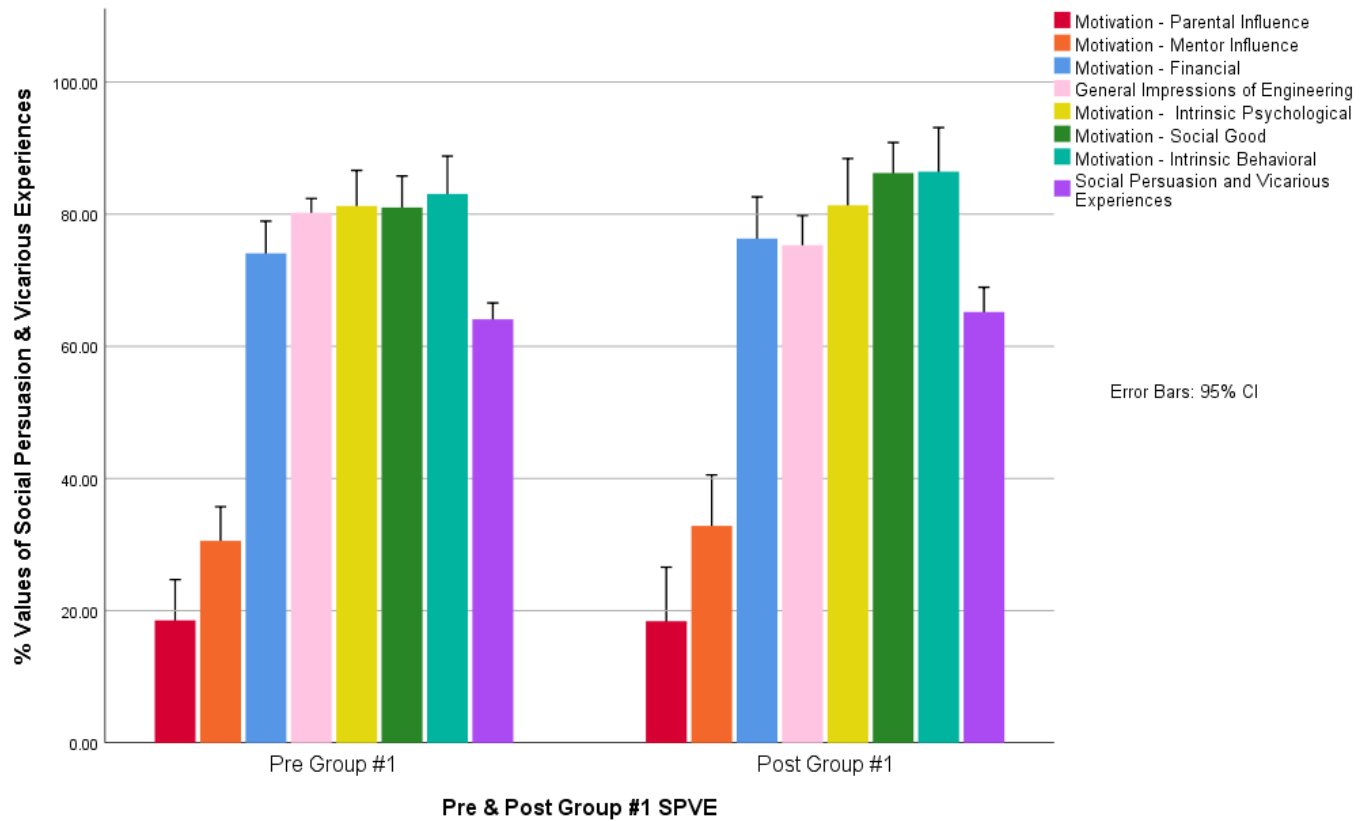


Figure 4.5.2a Pre & Post SPVE Tuesday Group #1

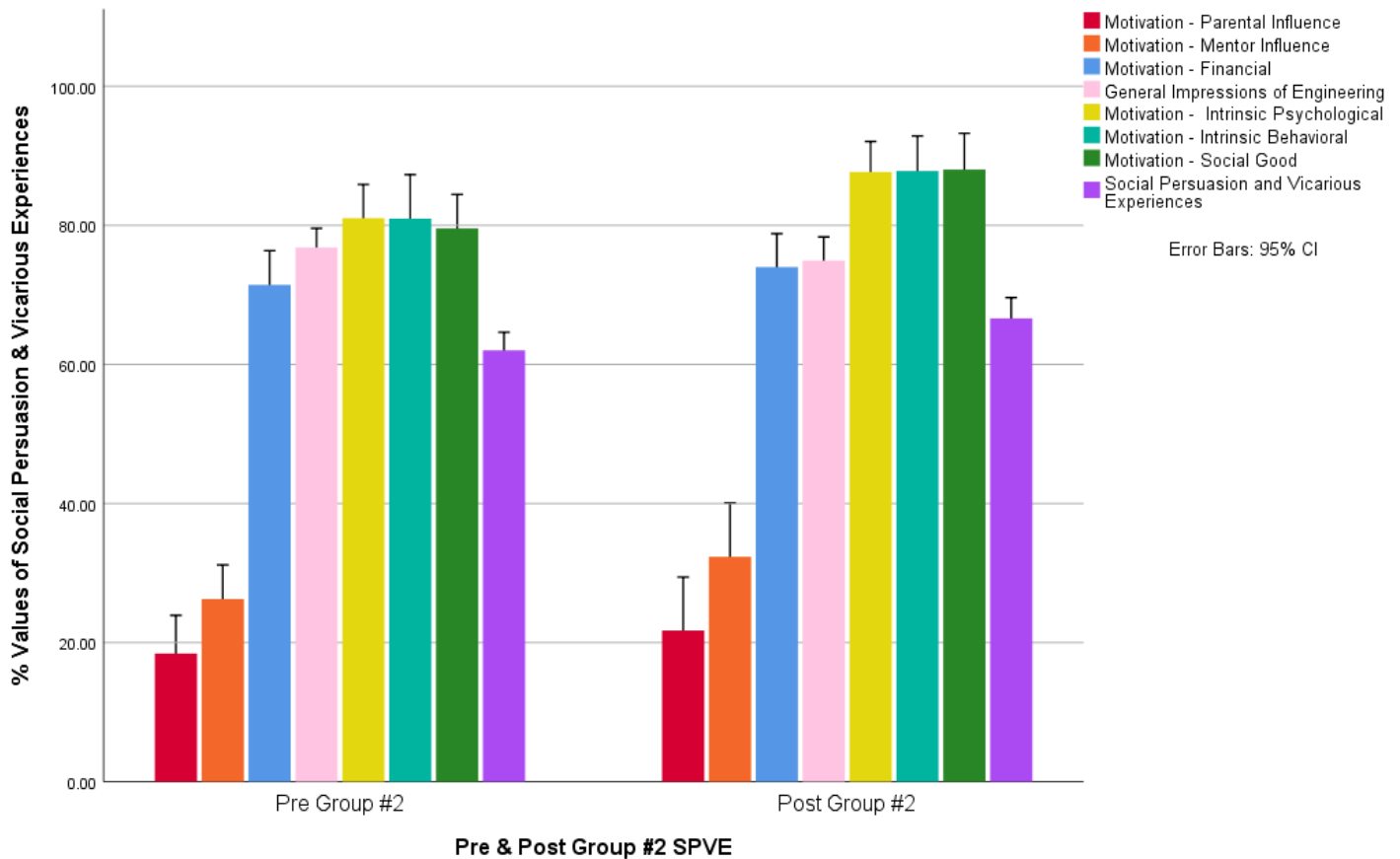


Figure 4.5.2b Pre & Post SPVE Group#2

4.5.2 SPVE: Gender (Table E73 and E74)

Group #1 and Group #2 Pre- and Post- Gender groups were assessed on the SPVE variable. For both Groups, Shapiro-Wilk tests showed that only General Impressions of Engineering and SPVE were normally distributed. A Kruskal Wallis test and One-Way ANOVA revealed no significant differences for Group #1. However, for Group #2, one of the groups had too few cases to do a post hoc analysis, so non-parametric measures were used for SPVE. The Kruskal Wallis Test and One-Way ANOVA revealed significant differences in Social Good ($p = 0.027$), Intrinsic behavioral ($p = 0.059$), and Social Persuasion and Various Experiences ($p = 0.059$). Figures 4.5.3 a and b show the means of the Pre- and Post-Gender groups. Pre-Other population was not reported. for Group #2, and therefore not included in Figure 4.5.3b.

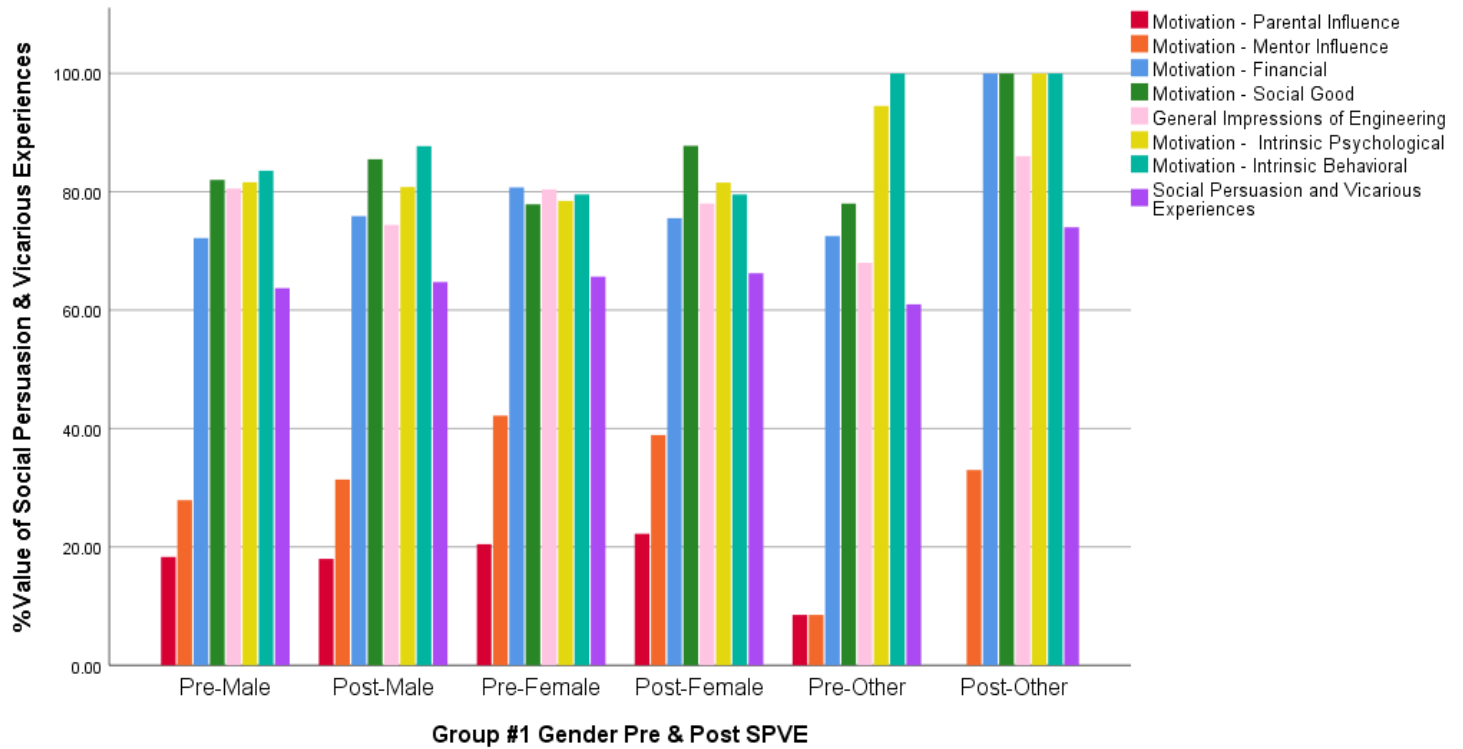


Figure 4.5.3a Pre& Post Gender SPVE Group #1 SVPE, Error bars are omitted for clarity

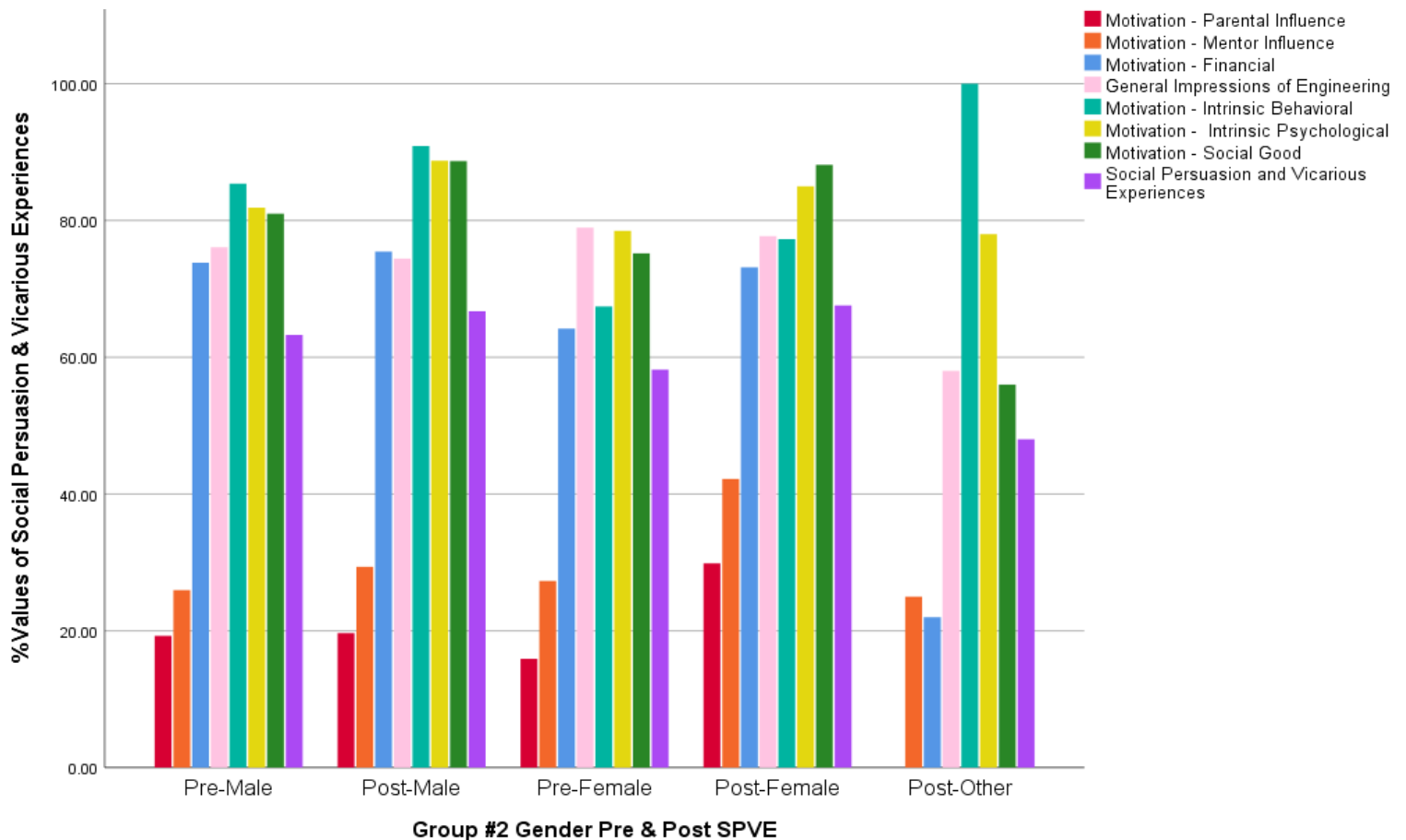


Figure 4.5.3b Pre& Post Gender Group #2 SVPE, Error bars are omitted for clarity

A Post hoc analysis of pairwise comparisons showed that there were significant differences between some groups (Table 4.5.1a-c).

Table 4.5.1a Group #2, Social Good Gender Pre & Post

Group # 2, Motivation - Social Good across Gender Pre & Post $\eta^2=.057$	
Pairwise Comparisons of Gender	
Comparison	p-value
Pre-Female < Post-Male	0.018
Pre-Male < Post-Male	0.013
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.1b Pairwise Comparisons Intrinsic Behavioral Gender Pre & Post Group #2

Group #2, Motivation - Intrinsic Behavioral Pre& Post $\eta^2=.043$	
Pairwise Comparisons of Gender	
Comparison	p-value
Pre-Female < Post-Male	0.007
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.1c Group #2, SPVE Gender Pre & Post

Group #2, Social Persuasion and Vicarious Experiences Pre& Post $\eta^2=.043$	
Pairwise Comparisons of Gender	
Comparison	p-value
Pre-Female < Post-Male	0.021
Pre-Female < Post-Female	0.046
Pre-Male < Post-Male	0.095
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.5.3 SPVE: Ethnic (Table E75 and E76)

Group #1 and Group #2 Pre- and Post- Gender groups were assessed on the Emotional variable. For both Group #1 and Group #2, Shapiro-Wilk tests showed that only the General Impressions of

Engineering variable was normally distributed. For Group # 1, Kruskal Wallis Tests and One-Way ANOVAs revealed significant differences in Motivation variables Social Good ($p=0.045$), Intrinsic Psychological ($p = .056$), and General Impressions of Engineering ($p =0.086$). For Group #2, significant differences were found in Motivation variables Parent Influence ($p =0.071$), Social Good ($p=0.069$), and Intrinsic Behavioral ($p=0.036$). Pre-Other did not have a population in either Group, and was therefore not analyzed.

Figures 4.5.4 a and b show the means of the Ethnic groups. Post Latin American population was not reported for either Group and therefore not included in the figures.

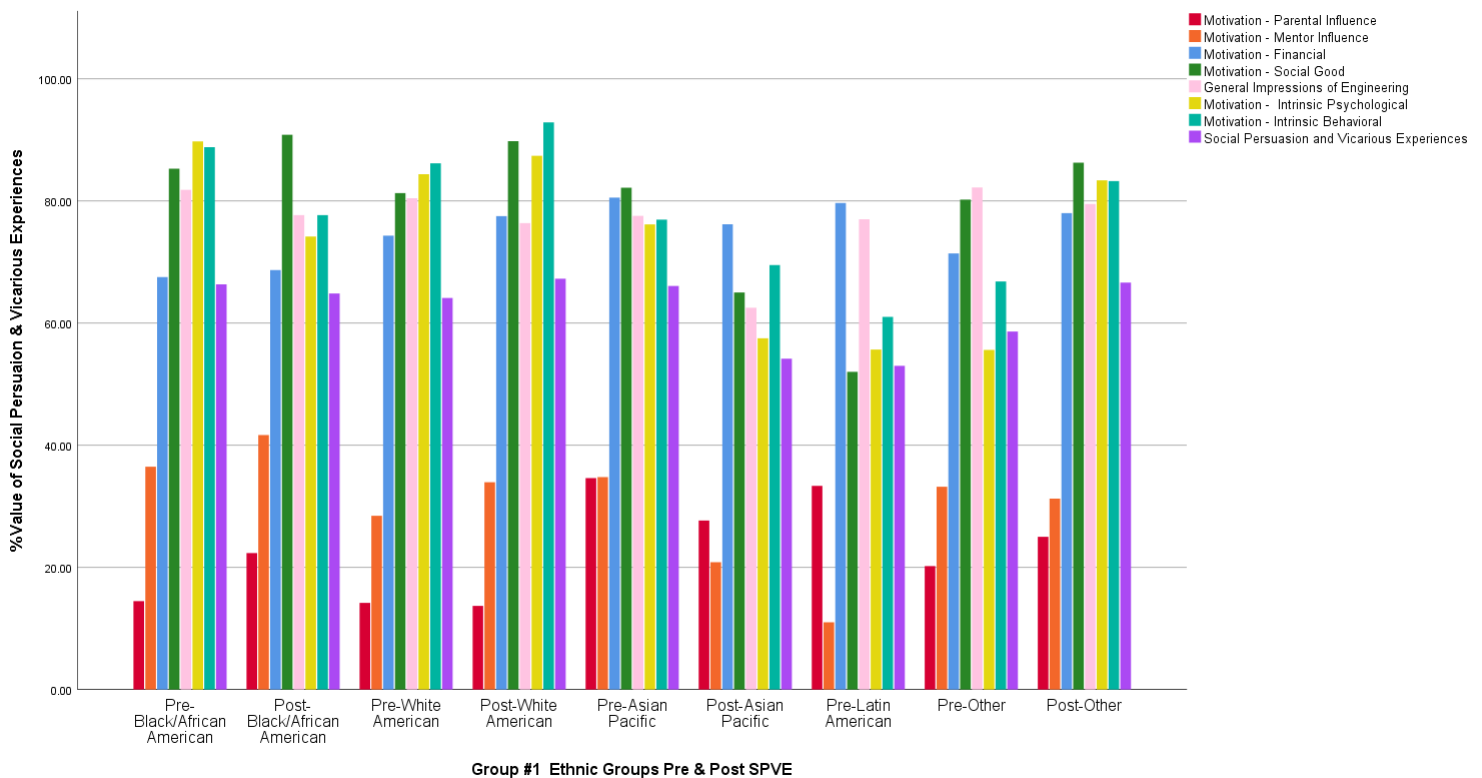


Figure 4.5.4a Group #1 Ethnic Groups SPVE Means, Error bars are omitted for clarity

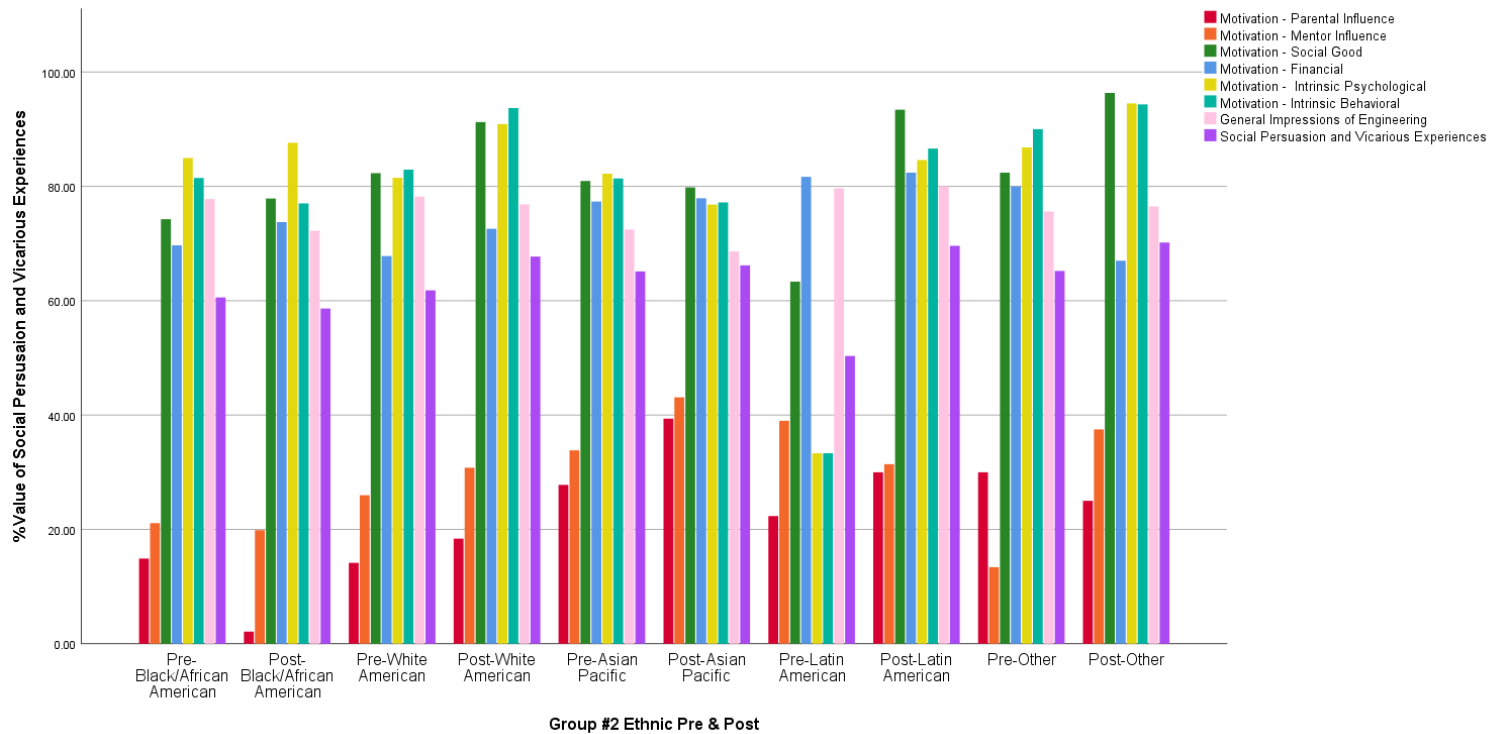


Figure 4.5.4b Group #2 Ethnic Groups SPVE, Error bars are omitted for clarity

A post hoc analysis, including pairwise comparisons and LSD for ANOVA, revealed significant differences in the SPVE variables (Tables 4.5.2a-c)

Table 4.5.2a Group #1 SPVE Ethnic Social Good Pre & Post

Ethnic Social Good Pre & Post $\eta^2=.092$	
Comparison	p-value
Pre-Latin American < Post-Black/African American	0.025
Pre-Latin American < Post-White American	0.007
Post-Asian Pacific < Pre-White American	0.037
Post-Asian Pacific < Pre-Asian Pacific	0.027
Post-Asian Pacific < Pre-Black/African American	0.023
Pre-White American < Post-White American	0.072
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same. Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.2b Group #1 SPVE Ethnic Intrinsic Psychological Pre & Post

Ethnic Intrinsic Psychological Pre & Post $\eta^2=.087$	
Comparison	p-value
Pre-Latin American < Post-Other	0.072
Pre-Latin American < Post-White American	0.017
Pre-Other < Post-White American	0.031
Pre-Other < Pre-Black/African American	0.036
Post-Asian Pacific < Pre-White American	0.041
Post-Asian Pacific < Pre-Black/African American	0.035
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.2c LSD SPVE Ethnic General Impressions of Engineering Pre & Post Group #1

LSD: Dependent Variable: General Impressions of Engineering Tuesday Ethnic $\eta^2=.010$		
(I) Ethnic Pre&Post	(J) Ethnic Pre&Post	p-value
Pre-Black/African American	Post-Asian Pacific	0.001
Pre-White American	Post-Asian Pacific	0.001
Pre-Asian Pacific	Post-Asian Pacific	0.013
	Pre-Black/African American	0.001
	Post-Black/African American	0.032
	Pre-White American	0.001
	Pre-Asian Pacific	0.013
Post-Asian Pacific	Pre-Latin American	0.093
	Pre-Other	0.008
	Post-Asian Pacific	0.008
* The mean difference is significant at the .1 level.		

A post hoc analysis with pairwise comparisons revealed the significant differences in the SPVE variables (Table 4.5.3a-c).

Table 4.5.3a Group #2, Ethnic Parent Influence

Ethnic Parent Influence Pre & Post $\eta^2=.058$	
Comparison	p-value
Post-Black/African American < Pre-Other	0.085
Post-Black/African American < Pre-Asian Pacific	0.009
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.3b Group #2 Ethnic Social Good

Ethnic Social Good Pre & Post $\eta^2=.058$	
Comparison	p-value
Pre-Latin American < Post-Asian Pacific	0.072
Pre-Latin American < Post-Latin American	0.032
Pre-Latin American < Post-White American	0.008
Pre-Latin American < Post-Other	0.008
Pre-Black/African American < Post-White American	0.017
Pre-Black/African American < Post-Other	0.037
Pre-White American < Post-White American	0.052
Pre-White American < Post-Other	0.09
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.3c Group #2 Ethnic Intrinsic Behavioral

Ethnic Intrinsic Behavioral Pre & Post $\eta^2=.073$	
Comparison	p-value
Pre-Latin American < Post-Asian Pacific	0.074
Pre-Latin American < Post-Black/African American	0.085
Pre-Latin American < Post-Latin American	0.026
Pre-Latin American < Post-Other	0.007
Pre-Latin American < to Post-White American	0.001
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.5.4 SPVE: Program Affiliation (Tables E77 and E78)

Group #1 and Group #2 Pre and Post Program Affiliation groups were assessed on the SPVE variable. For both Group #1 and Group #2, the Shapiro-Wilk test showed that only the General Impressions of Engineering and SVPE variables were normally distributed. The Kruskal Wallis test and One-Way ANOVA revealed significant differences for Group #2 in the Motivation variables Mentor Influence ($p = 0.041$) and Intrinsic Behavioral ($p = 0.095$). There were no significant differences for Group #1. Figures 4.5.5 a & b show the means of the Program Affiliation groups. Post CWIT Scholar and Pre CWIT were not reported in pre or post assessment and therefore removed.

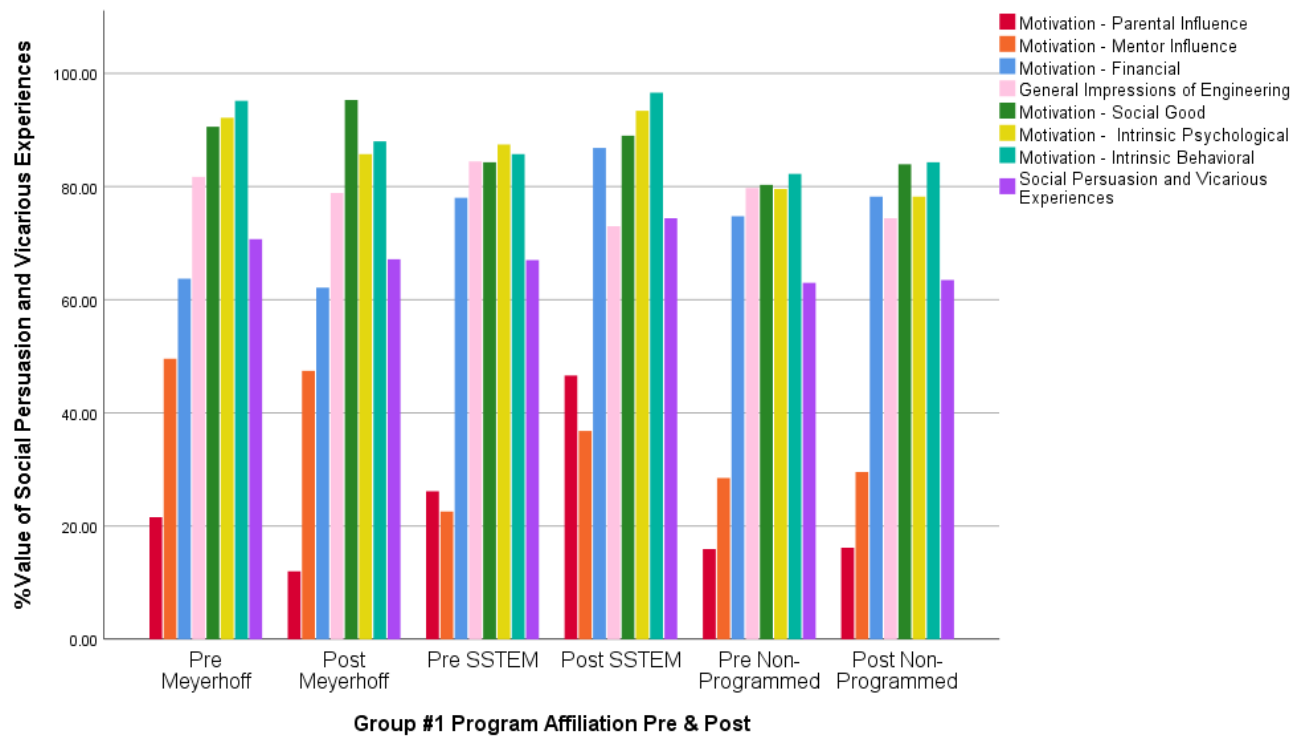


Figure 4.5.5a Group #1 Program Affiliation Groups SPVE Means, Error bars are omitted for clarity

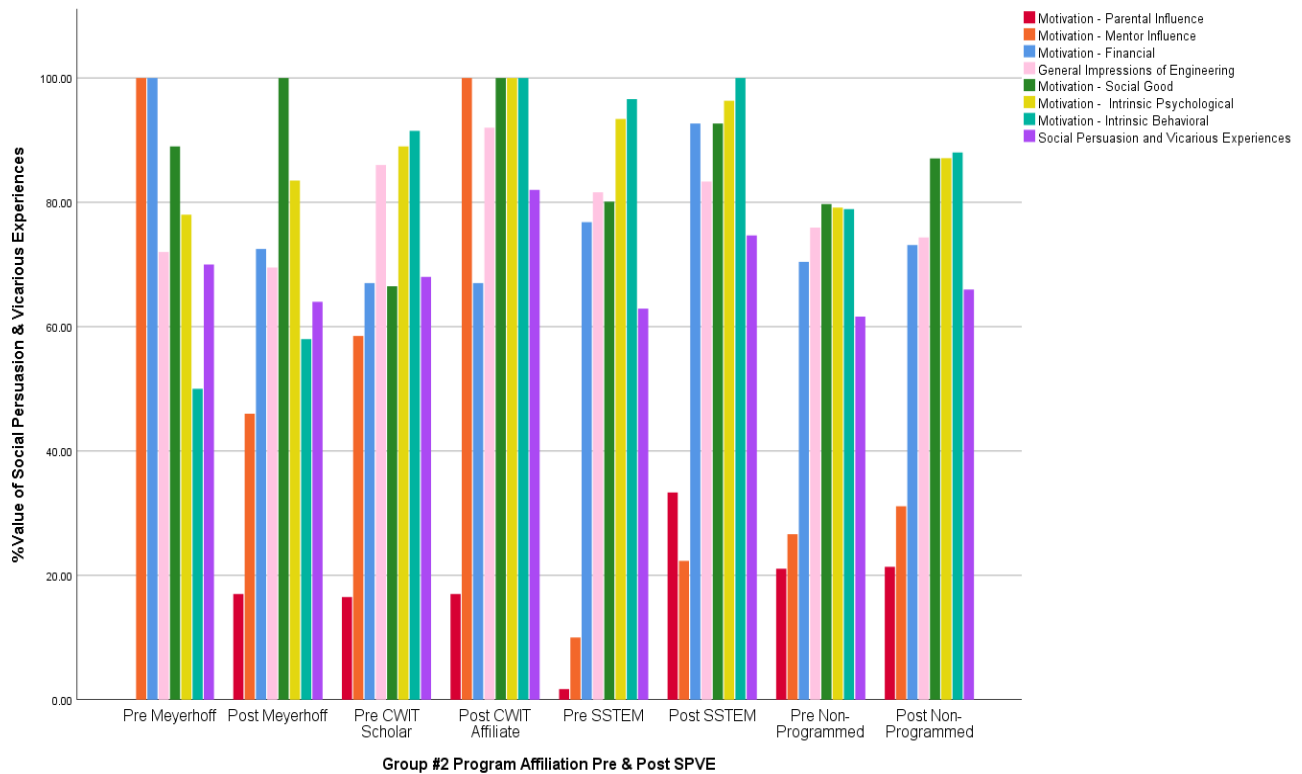


Figure 4.5.5b Group #2 Program Affiliation Groups SPVE Means, Error bars are omitted for clarity

A post hoc analysis revealed the significant differences between some groups for the SPVE variables (Table 4.5.4 a&b).

Table 4.5.4a Mentor Influence Program Affiliation

Group #2, Mentor Influence Program Affiliation $\eta^2=.063$	
Comparison	p-value
Pre SSTEM < to Post SSTEM	0.42
Pre SSTEM < to Post Non-Programmed	0.016
Pre SSTEM < Post CWIT Affiliate	0.019
Pre Non-Programmed > Post CWIT Affiliate	0.086
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.4b Intrinsic Behavioral Program Affiliation

Group #2, Program Intrinsic Behavioral Program Affiliate $\eta^2=.045$	
Comparison	p-value
Pre Meyerhoff < Post SSTEM	0.046
Post Meyerhoff < Pre SSTEM	0.03
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.5.5. Mastery Experiences (ME): Overall (Table E79 and E80)

Group #1 and Group #2 Pre and Post groups were assessed on the Mastery Experiences variable. Shapiro-Wilk tests showed that no variables were normally distributed in either Group #1 or Group #2. Kruskal Wallis tests revealed no significant differences in either Group. Figures 4.5.6 a & b show the means of the Group #1 and Group #2 Mastery Experiences.

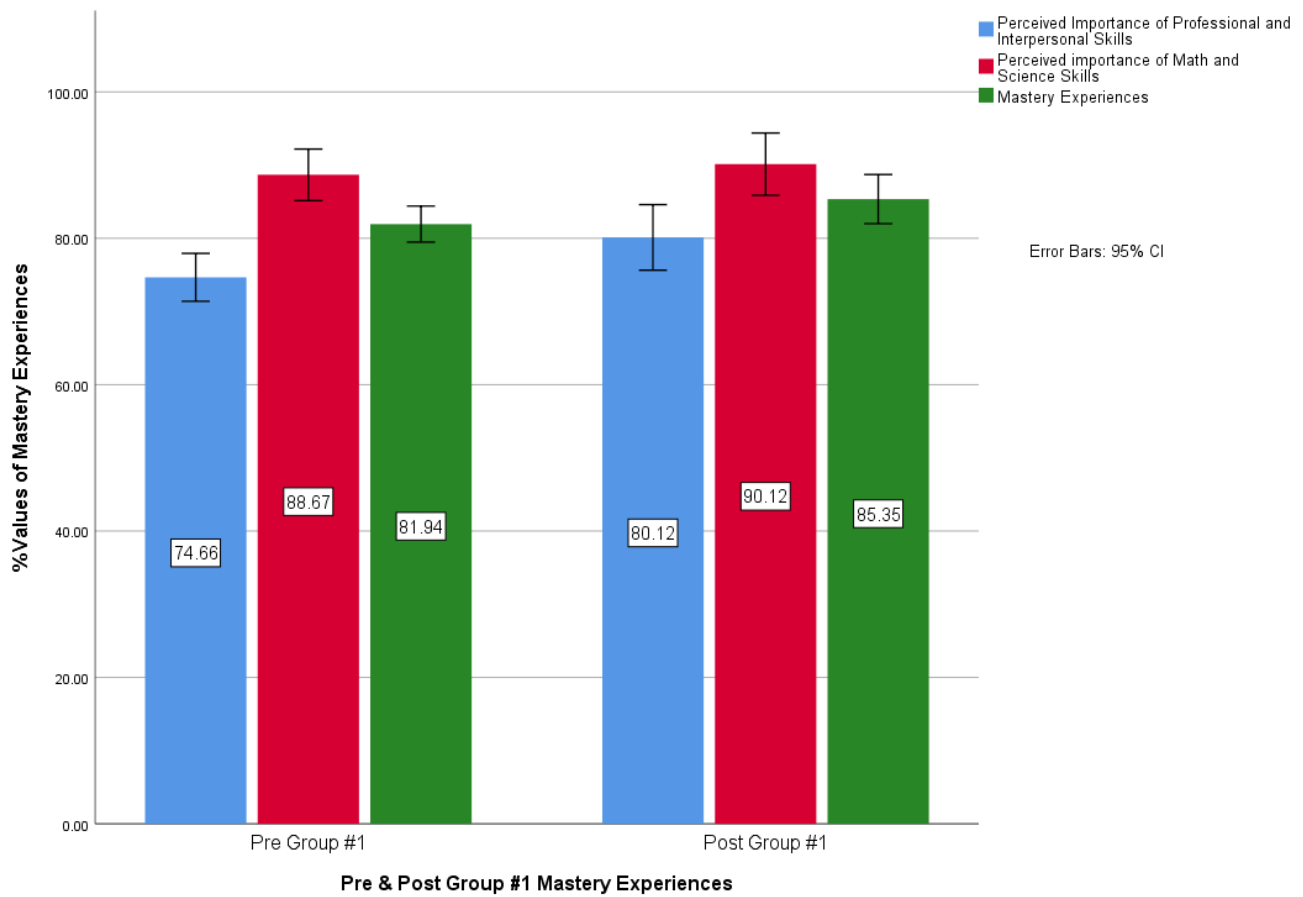


Figure 4.5.6a Mastery Experiences Pre & Post Group #1

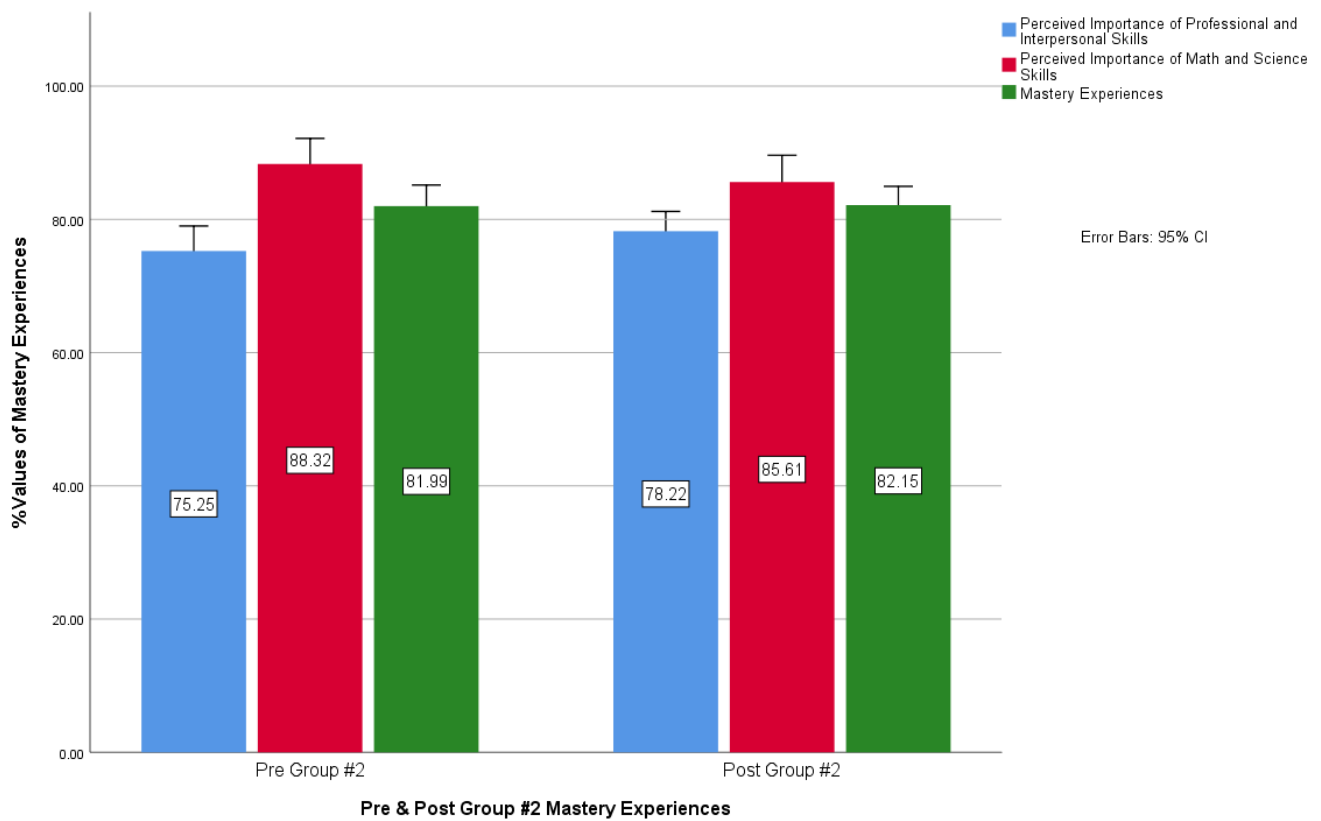


Figure 4.5.6b Mastery Experiences Pre & Post Group #2

4.5.6 ME: Gender (Table E81 and E82)

Group #1 and Group #2 pre and post were assessed on the Mastery Experiences variables between Gender Identifications. For Group #1, a Shapiro-Wilk test showed the variables were normally distributed except for Perceived Importance of Math and Science Skills, but for Group #2, none of the variables were normally distributed. The Kruskal Wallis Test was used for both Groups because some of the categories in Group #1 had only a few cases (Other). Significant differences were found in Perceived Importance Professional and Interpersonal skills ($p = 0.048$), Perceived Importance of Math and Science skills ($p=0.052$), and Mastery Experiences ($p = 0.006$). For Group #2, there were no significant differences.

Figures 4.5.7 a and b show the means of the Gender groups. For 4.5.7b, Pre-Other population was not reported and therefore not included in the figure.

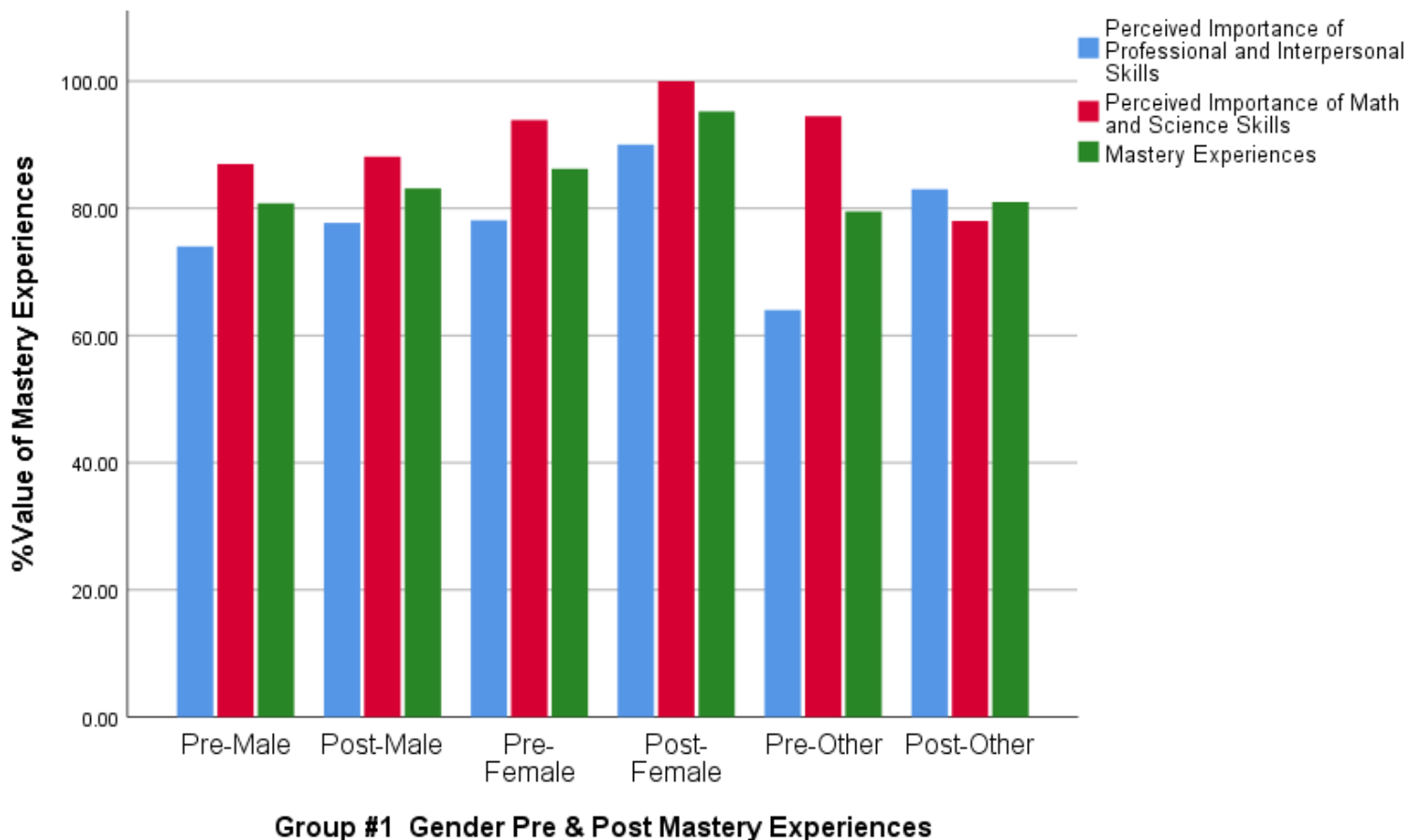


Figure 4.5.7a Pre& Post Mastery Experiences Group #1 Gender, Error bars are omitted for clarity

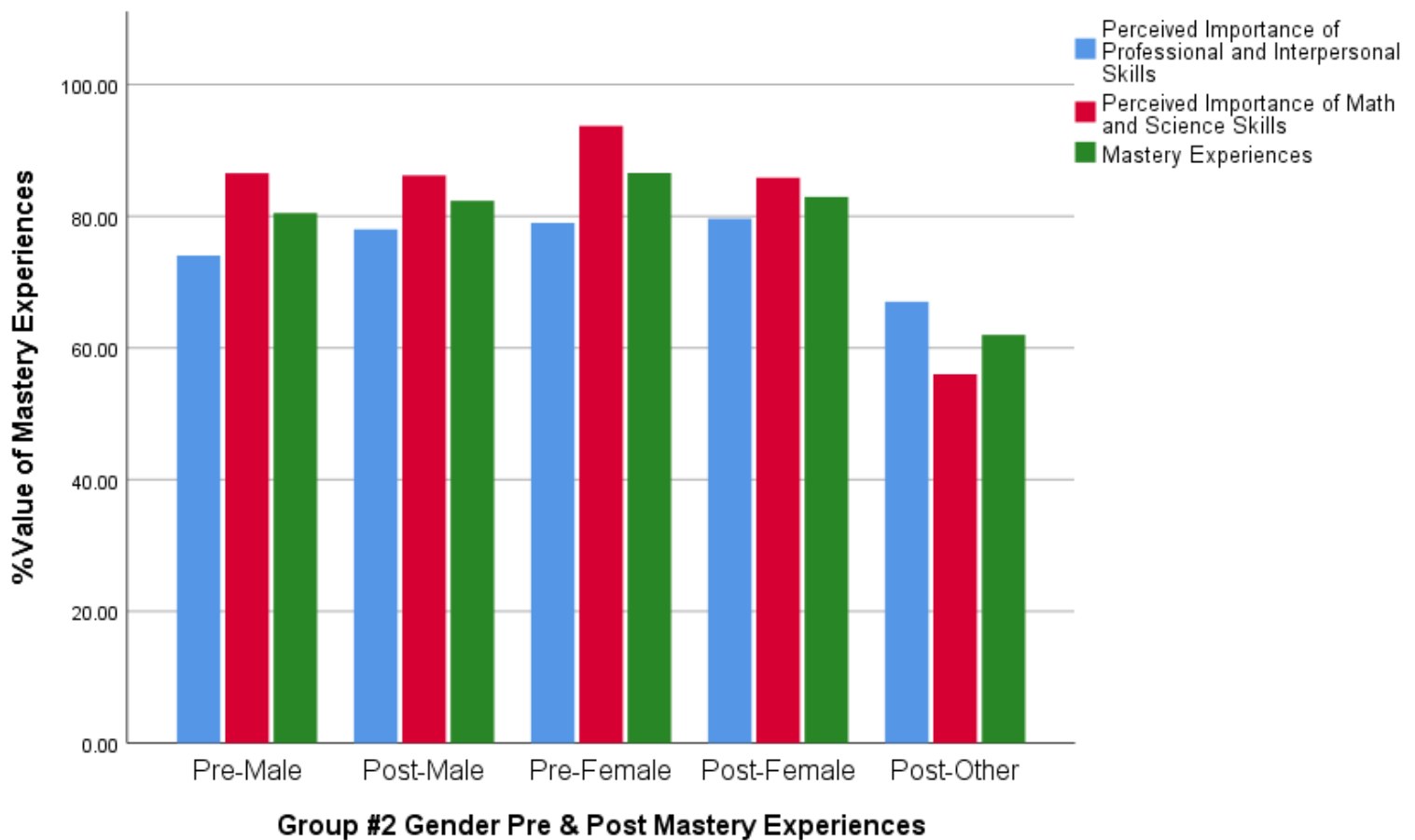


Figure 4.5.7b Pre& Post Mastery Experiences Group #2 Gender, Error bars are omitted for clarity

Interpersonal Skills

Table 4.5.5a Pairwise Comparison Gender Perceived Importance of Professional and Interpersonal Skills

Perceived Importance of Professional and Interpersonal Skills Group #1 Gender Pre & Post $\eta^2=.058$	
Comparison	p-value
Pre-Male < Post-Female	0.002
Pre-Female < Post-Female	0.031
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.5b Pairwise Comparison Gender Perceived Importance of Math and Science Skills

Perceived importance of Math and Science Skills Group #1 Gender Pre & Post $\eta^2=.056$	
Comparison	p-value
Pre-Male < Post-Female	0.006
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

A post hoc analysis with pairwise comparisons revealed the significant groups. Table 4.5.6a-c show the Group #2 comparisons that showed significance in each of the Mastery Experience variables.

Table 4.5.6c Pairwise Comparison Gender Mastery Experiences

Mastery Experiences Group #2, Gender Pre & Post $\eta^2=.066$	
Comparison	p-value
Pre-Male > Post-Female	<0.001
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.5.7 ME: Ethnic (Tables E83 and E84)

Group #1 and Group #2 Pre- and Post-Assessment were assessed on the Mastery Experience variables between Ethnic groups. A Shapiro-Wilk test showed that no variables were normally distributed except for the Group #1 Perceived Importance of Professional and Interpersonal Skills. Using Kruskal Wallis test no significant differences were found for either Group. A One-Way ANOVA revealed a significant difference in Perceived Importance of Professional and Interpersonal Skills ($p = 0.089$). Figures 4.5.8 a & b show the means of the Ethnic groups. Post-Latin American population was not reported and therefore not included the figure.

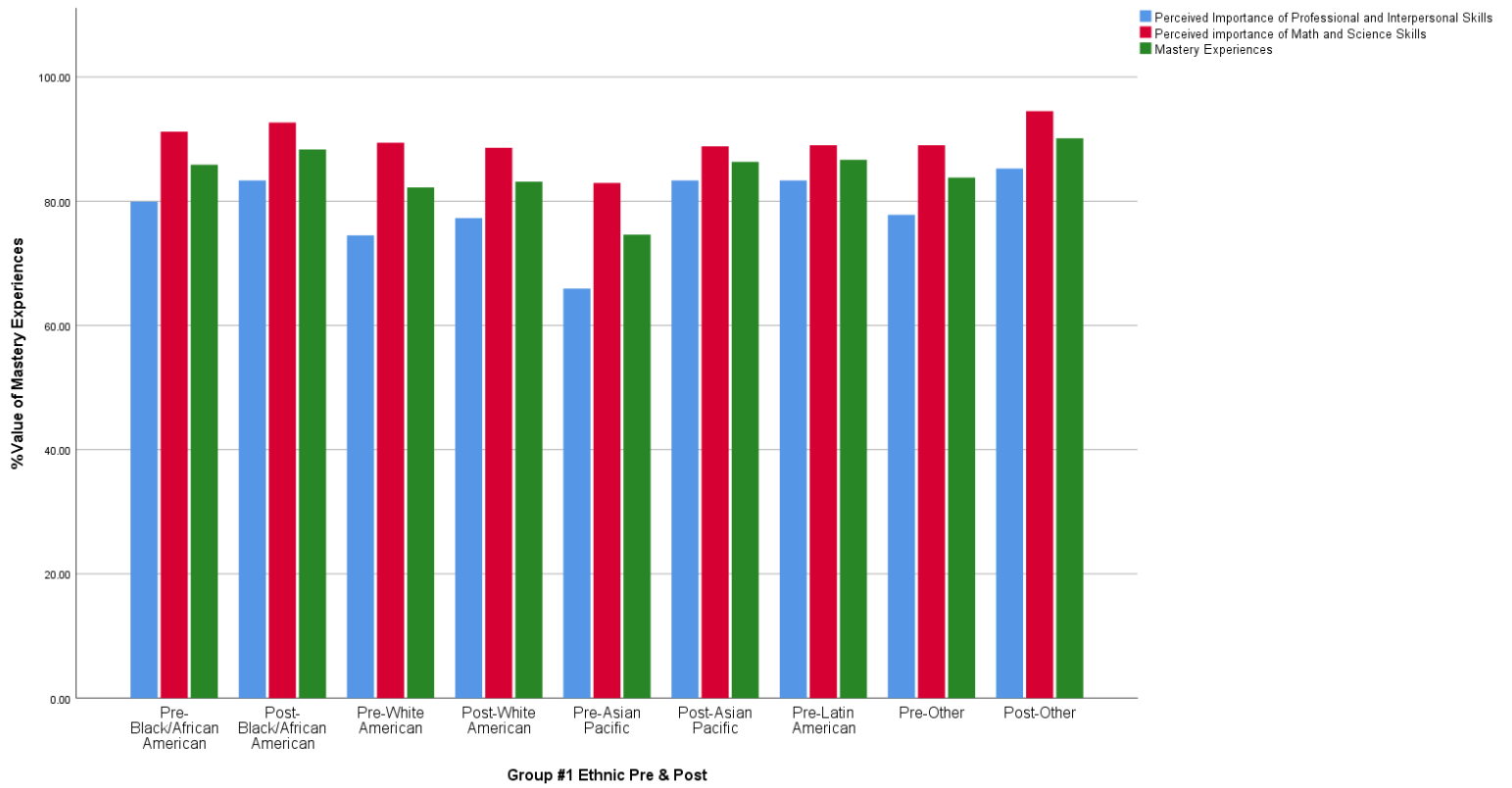


Figure 4.5.8a Pre& Post Mastery Experiences Group #1 Ethnic, Error bars are omitted for clarity

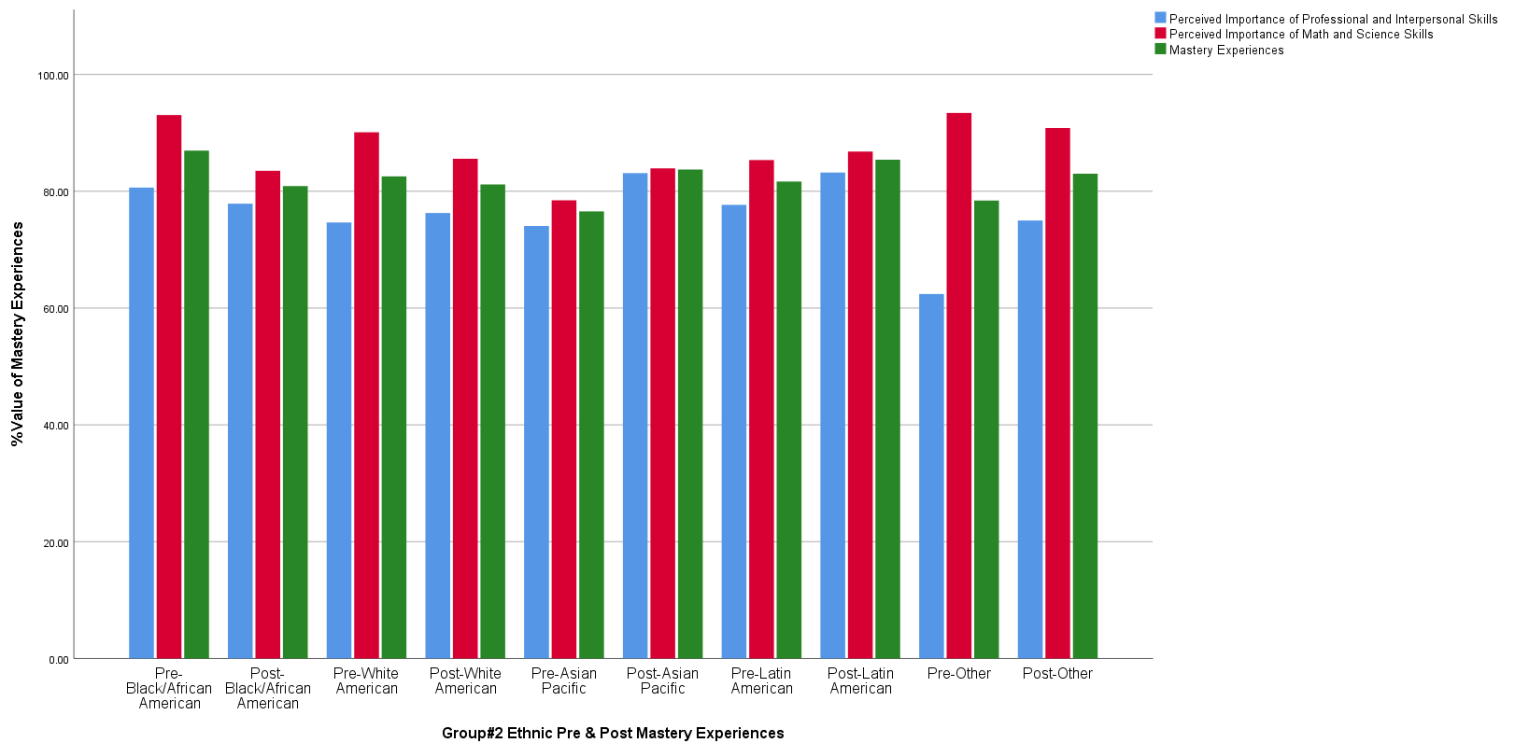


Figure 4.5.8b Pre& Post Mastery Experiences Group #2 Ethnic, Error bars are omitted for clarity

A post hoc analysis of pairwise comparisons showed that there were significant comparisons between some groups (Table 4.5.7)

Table 4.5.7 LSD Perceived Importance of Professional and Interpersonal Skills

Perceived Importance of Professional and Interpersonal Skills $\eta^2=.10$		
(I) Tuesday Ethnic Pre & Post	(J) Tuesday Ethnic Pre & Post	p-value
Pre-White American	Post-Other	0.06
Pre-Asian Pacific	Post-Black/African American	0.02
	Pre-White American	0.07
	Post-White American	0.03
	Post-Other	0.01
Post-Asian Pacific	Pre-Asian Pacific	0.02
* The mean difference is significant at the .1 level.		

4.5.8 ME: Pre and Post Mastery Experiences (ME) Program Affiliation (Tables E85 and E86)

Group #1 and Group #2 pre and post were assessed on the Mastery Experiences variables between Program Affiliation groups. For Group #1, a Shapiro-Wilk test showed the variables were normally distributed except for Perceived Importance of Math and Science Skills. For Group #2, none of the variables were normally distributed. For both Group #1 and Group #2, Kruskal Wallis test was used due to some of the groups having few cases (Other). For both Group #1 and Group #2, there was a significant different in Perceived Importance Professional and Interpersonal skills ($p=0.055$ and $p=0.086$). Figures 4.5.9 a and b, shows the means of the program affiliation groups. For Group #1, Post-Other population was not reported, and for Group #2 in the figure. Post-CWIT Scholar and Pre-CWIT affiliate was population were not reported and therefore not included in the figure.

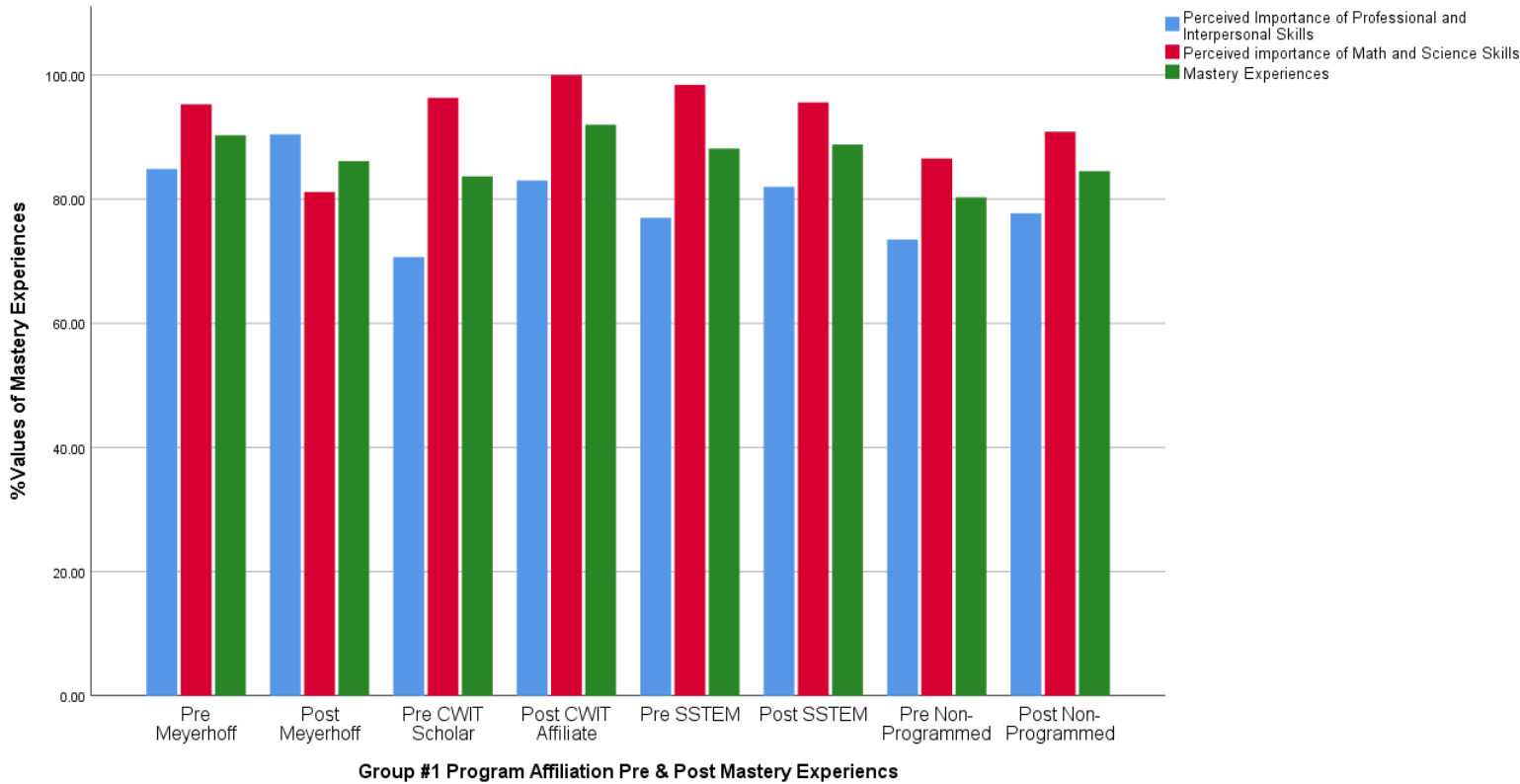


Figure 4.5.9a Mastery Experiences Program Affiliation Pre & Post Group #1, Error bars are omitted for clarity

A post hoc analysis with pairwise comparisons revealed that the only significant comparison for the Mastery Experience variables in Group #1 was between Pre-CWIT and Post-Meyerhoff ($p=0.31$) (Table 4.5.8).

Table 4.5.8 Professional and Interpersonal Skills Group #1, Pre & Post

Perceived Importance of Professional and Interpersonal Skills group #1, Program Affiliation Pre & Post $\eta^2=.063$	
Comparison	p-value
Pre CWIT Scholar < Post Meyerhoff	0.031
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

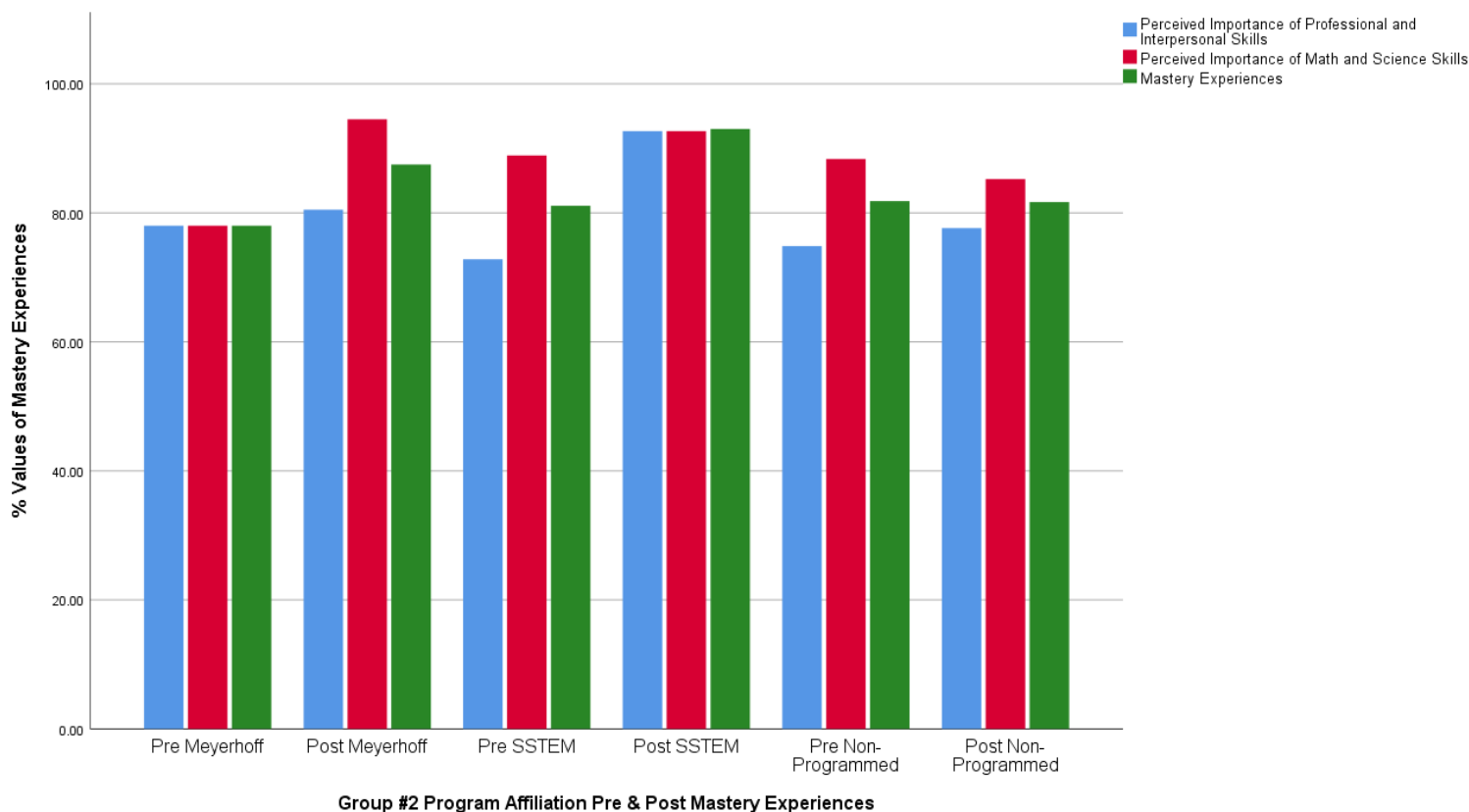


Figure 4.5.9b Mastery Experiences Program Affiliation Pre & Post Group #2, Error bars are omitted for clarity

A post hoc analysis with pairwise comparisons revealed the significant comparisons between pre and post program affiliation groups for Group #2 in each of the Mastery Experience variables (Table 4.5.9).

Table 4.5.9 Pairwise Comparison Professional and Interpersonal Skills Group #2 Pre & Post

Perceived Importance of Professional and Interpersonal Skills Group #2, Program Affiliation Pre & Post $\eta^2=.094$	
Comparison	p-value
Pre SSTEM < Post SSTEM	0.011
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.5.9 Emotional States: Overall (Table E87 and E88)

Group #1 and Group #2 pre and post Program Affiliation groups were assessed on the Emotional States variables. For Group #1, the Shapiro-Wilk test showed that only the Emotional

States variable was normally distributed; however, for Group #2, all variables were normally distributed except for Feelings of Inclusion. For Group # 1, a One Way ANOVA showed a significant difference in Emotional states ($p=0.091$, $\eta^2=0.022$). A Mann-Whitney-U for Group #2 showed significant differences in Feelings of Inclusion ($p =0.004$, $\eta^2= 0.058$) and Engineering Career Success Expectations ($p =0.032$, $\eta^2=0.032$). Further for Group #2, a One-Way ANOVA revealed significant differences in and Emotional State ($p =0.004$, $\eta^2=0.06$). Figures 4.5.10 a and b show the means of the Emotional State.

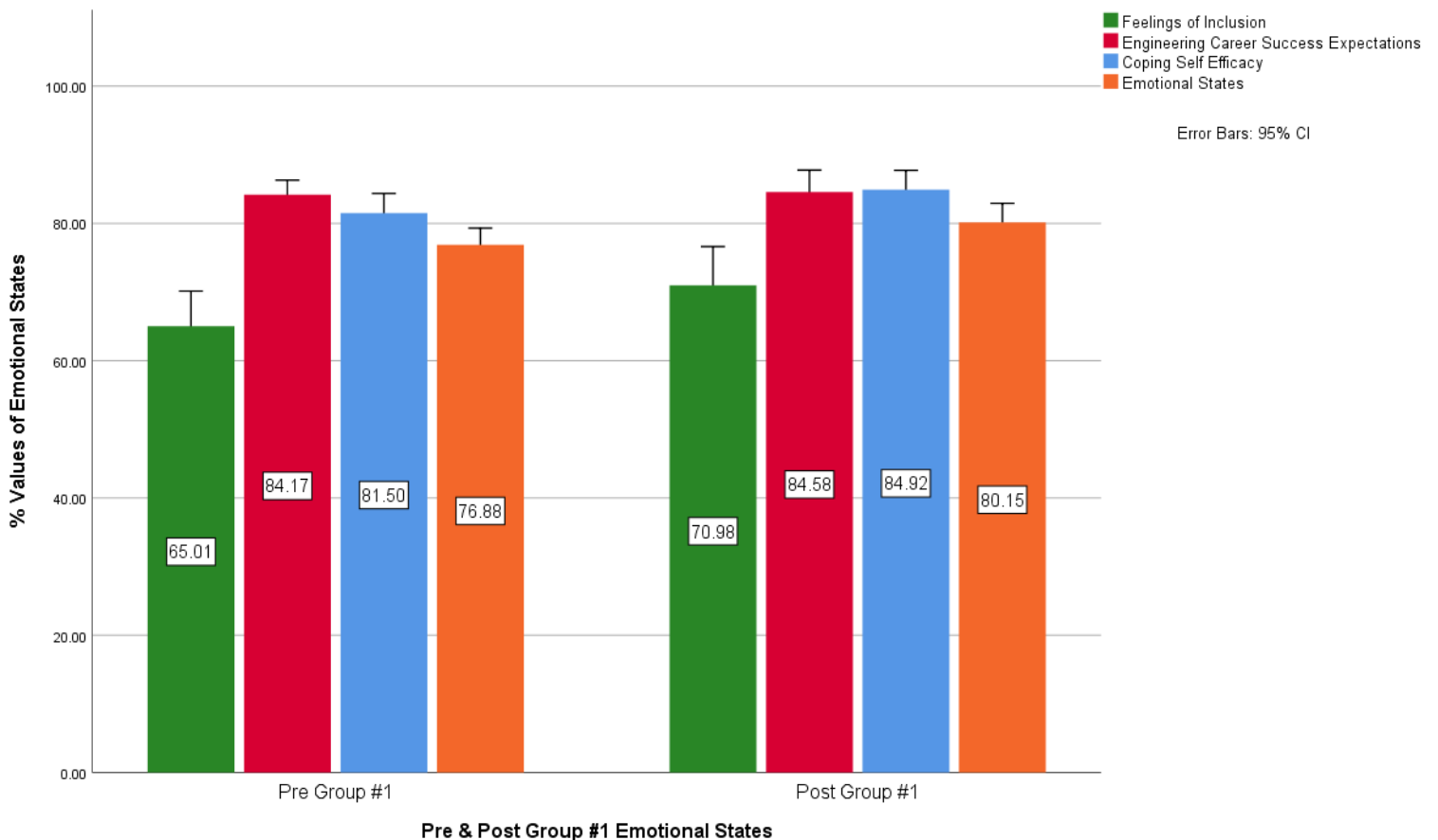


Figure 4.5.10a Emotional States Pre & Post Group #1

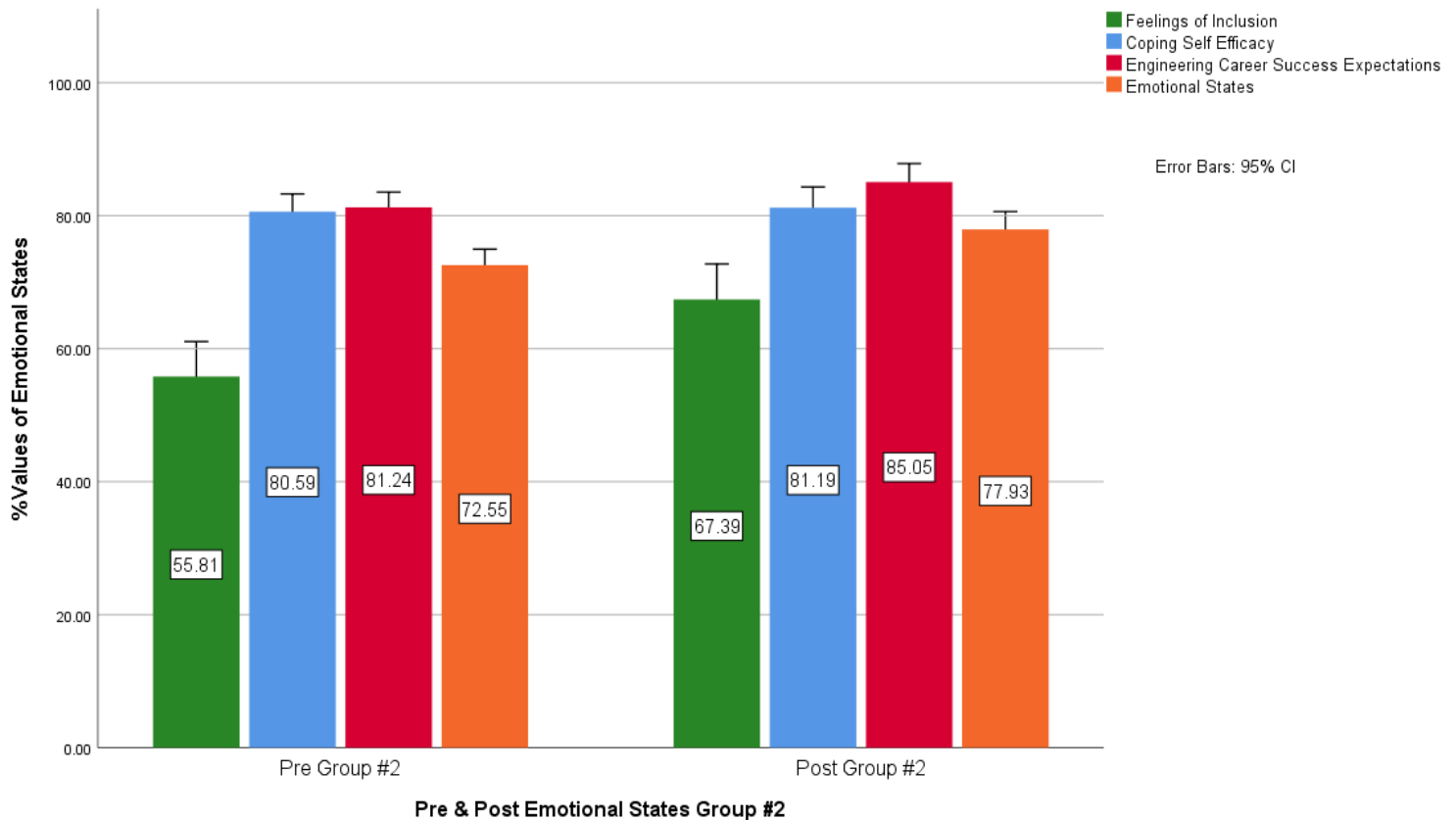


Figure 4.5.10b Emotional States Pre & Post Group #2

4.5.10 Emotional States: Gender (Tables E89 and E90)

Group #1 and Group #2 Gender groups were assessed on the Emotional States variables. For both Groups, the Shapiro-Wilk test showed that no variables were normally distributed across Gender groups, except for Group #2 Emotional States. For a few cases in the Group #2, Other, category, non-parametric measures were used. Kruskal Wallis Test parametric measure revealed no significant differences between variables in Group #1; however, in Group #2, significant differences were found among Engineering Career Success Expectations ($p=0.096$), Feelings of Inclusions ($p=0.045$), and Emotional States ($p=0.041$). Figures 4.5.11a and b show the means of the Gender groups. Pre-Other population was not reported for Group # 2 and therefore not included in Figure 4.5.11b.

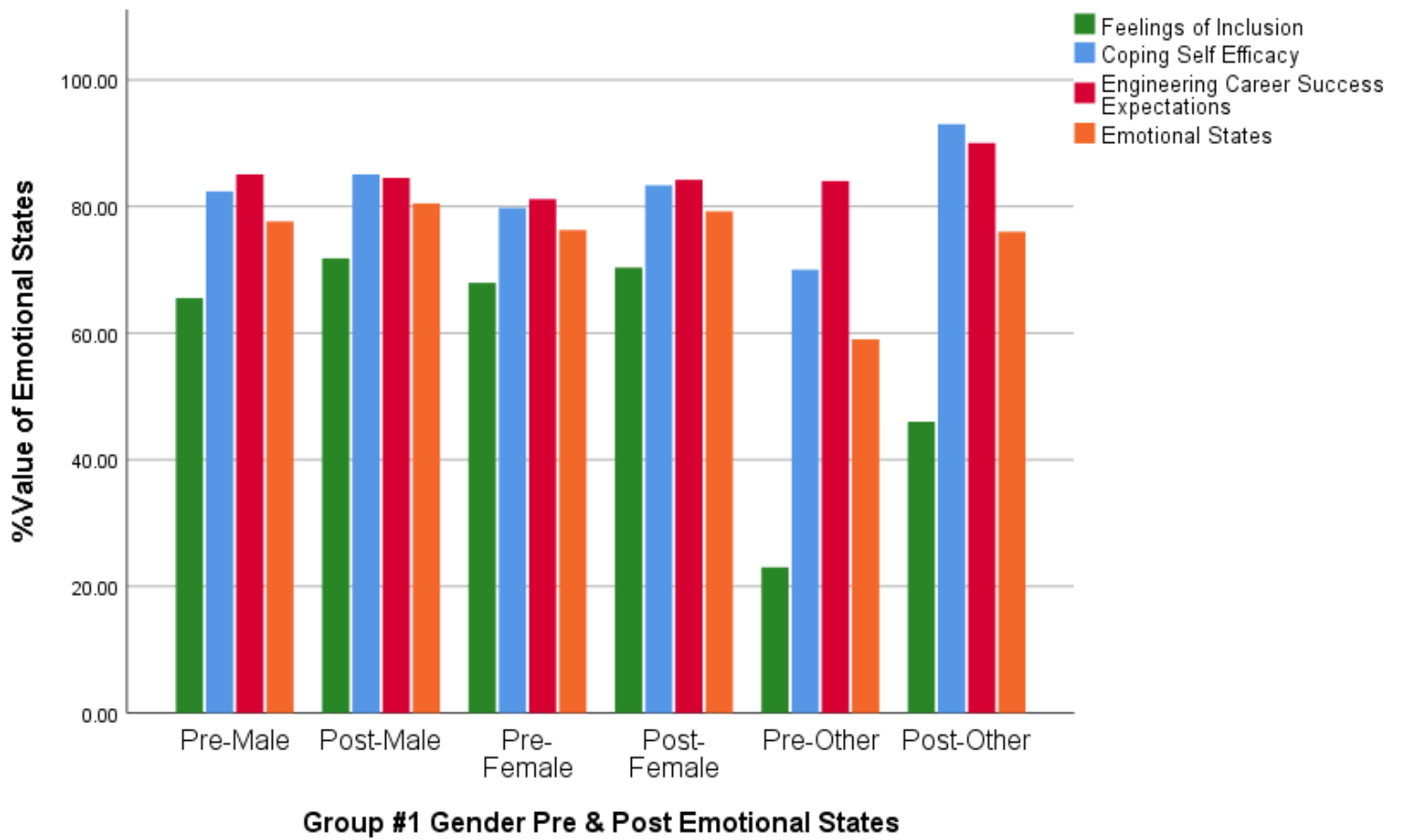


Figure 4.5.11a Emotional States Pre & Post Gender Group #1, Error bars are omitted for clarity

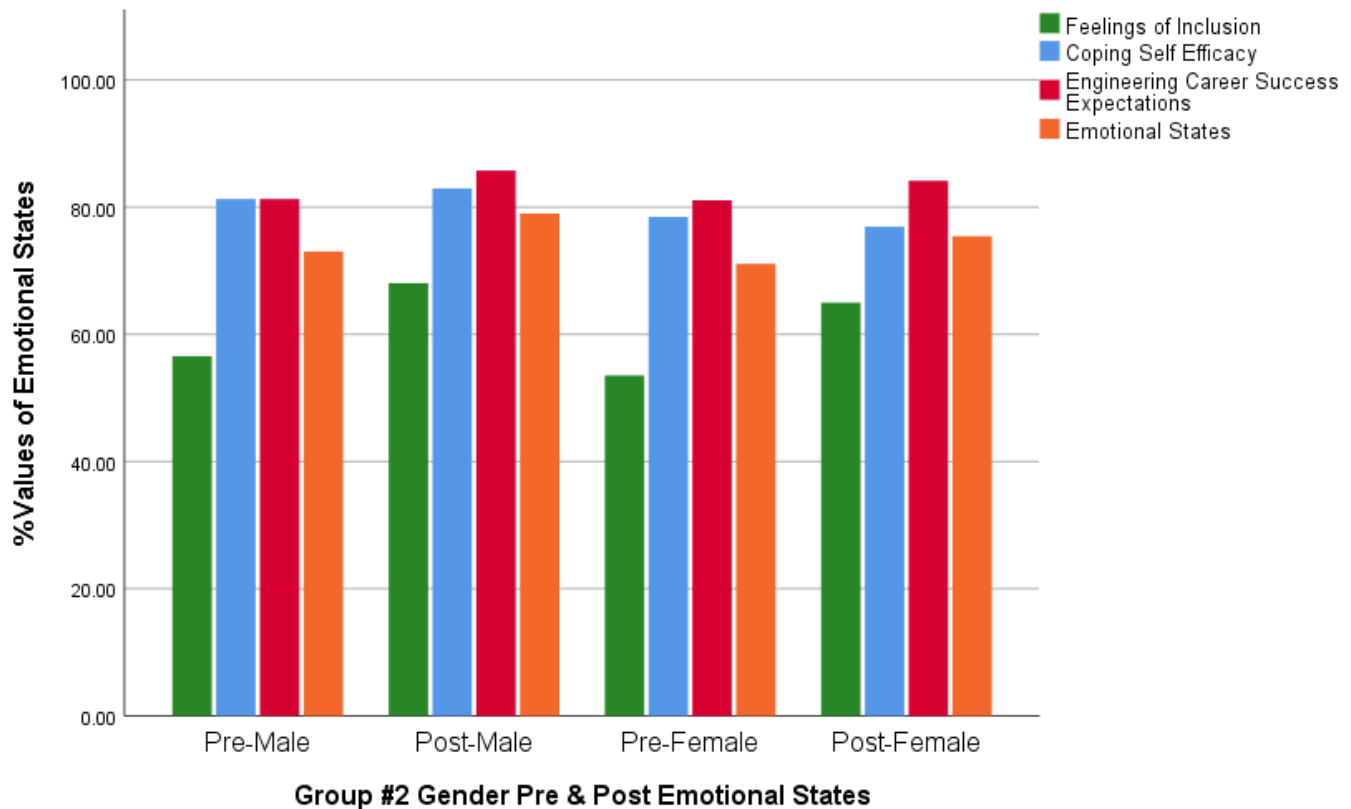


Figure 4.5.11b Emotional States Pre & Post Gender Group #1, Error bars are omitted for clarity

Table 4.5.10a Pairwise Comparisons of Coping Self-Efficacy

Engineering Career Success Expectations: Group #2, Gender, Pre & Post $\eta^2 = .035$	
Comparison	p-value
Pre-Female < Post-Male	0.087
Pre-Male < Post-Male	0.027
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.10b Pairwise Comparisons of Feelings of Inclusion Group #2

Feelings of inclusion: Group #2, Gender, Pre & Post $\eta^2 = .067$	
Comparison	p-value
Pre-Female < Post-Male	0.008
Pre-Male < Post-Male	0.01
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.10c Pairwise Comparisons of Emotional States Group #2

Emotional States: Group #2, Gender, Pre & Post $\eta^2 = .07$	
Comparison	p-value
Pre-Female < Post-Male	0.009
Pre-Male < Post-Male	0.012
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.5.11 Emotional States: Ethnic (Table E91 and E92)

Group #1 and #2 were assessed on the Emotional States variables between Ethnic Groups. A Shapiro-Wilk test showed the variables were not normally distributed for either Group #1 or #2. A Kruskal Wallis test found all variables had significant differences in the Ethnic groups. For Group #1 Coping Self-Efficacy ($p=0.008$), Engineering Career Success Expectations ($p=0.023$), Feelings of Inclusion ($p=0.049$), and Emotional States ($p=0.000$). For Group #2 a Kruskal Wallis test revealed significant difference in Feelings of Inclusion ($p=0.047$).

Figures 4.5.12a and b, show the means of the Ethnic groups. Post-Latin American population was not reported for Group #1 and therefore was not included in the Figure 4.5.12a.

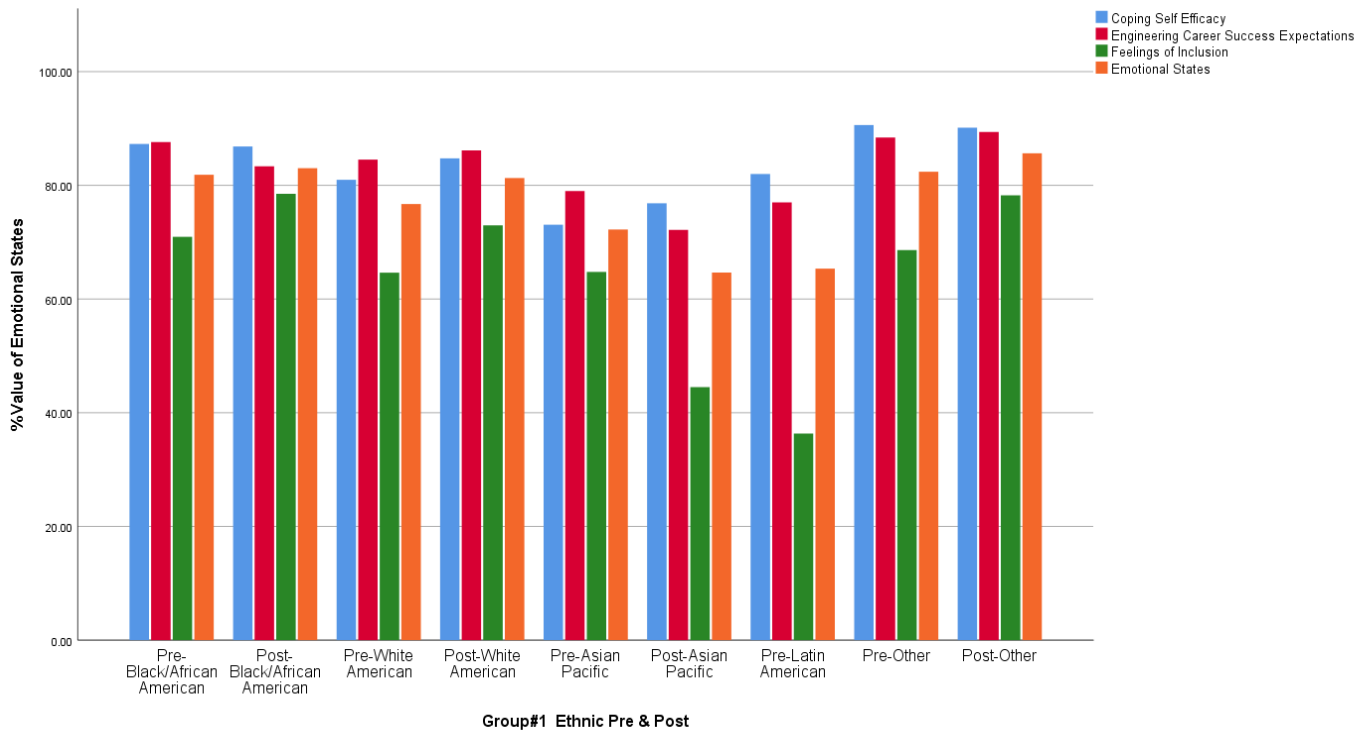


Figure 4.5.12a Emotional States Pre & Post Ethnic Group #1, Error bars are omitted for clarity

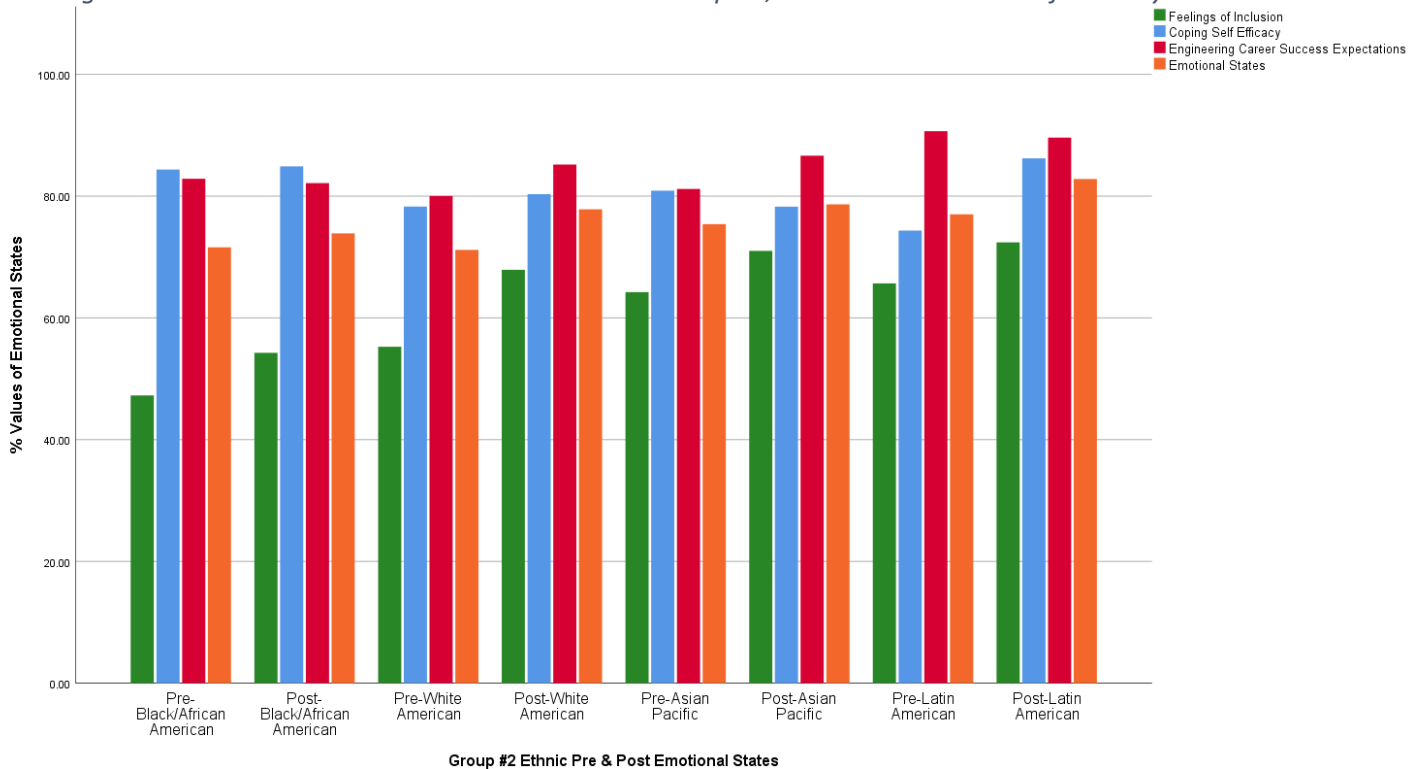


Figure 4.5.12b Emotional States Pre&Post Ethnic Group #2, Error bars are omitted for clarity

A post hoc analysis with pairwise comparisons revealed the significant comparisons between groups for Group #1 (Table 4.5.11a-d) and Group #2 (Table 4.5.12).

Table 4.5.11a Pairwise Comparisons of Coping Self-Efficacy Ethnic Group #1

Coping Self Efficacy: Group #1 Ethnic Pre & Post $\eta^2 = .13$	
Comparison	p-value
Post-Asian Pacific < Pre-Black/African American	0.011
Post-Asian Pacific < Pre-Other	0.01
Pre-Asian Pacific < Post-White American	0.02
Pre-Asian Pacific < Post-Black/African American	0.068
Pre-Asian Pacific < Post-Other	0.004
Pre-White American < Post-Other	0.027
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.11b Pairwise Comparisons of Engineering Career Success Expectations Group #1

Engineering Career Success Expectations: Group #1 Ethnic Pre & Post $\eta^2 = .088$	
Comparison	p-value
Post-Asian Pacific < Pre-White American	0.02
Post-Asian Pacific < Pre-Black/African American	0.004
Post-Asian Pacific < Pre-Other	0.021
Pre-Latin American < Post-White American	0.063
Pre-Latin American < Post-Other	0.031
Pre-Asian Pacific < Post-White American	0.047
Pre-Asian Pacific < Pre-Black/African American	0.027
Pre-Asian Pacific < Post-Other	0.027
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.11c Pairwise Comparisons of Feelings of Inclusion Ethnic Group #1

Feelings of Inclusion: Group #1 Ethnic Pre & Post $\eta^2 = .07$	
Comparison	p-value
Pre-Latin American < Post-White American	0.013
Pre-Latin American < Post-Other	0.007
Pre-Latin American < to Post-Black/African American	0.009
Post-Asian Pacific < Pre-Black/African American	0.045
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.11d Pairwise Comparisons of Emotional States Ethnic Group #1

Emotional States: Group #1 Ethnic Pre & Post $\eta^2 = .182$	
Comparison	p-value
Pre-Latin American < Post-White American	0.01
Pre-Latin American < Post-Black/African American	0.01
Pre-Latin American < Post-Other	0.003
Post-Asian Pacific < Pre-White American	0.015
Post-Asian Pacific < Pre-Black/African American	0.002
Post-Asian Pacific < Pre-Other	0.007
Pre-Asian Pacific < Post-White American	0.014
Pre-Asian Pacific < Post-Black/African American	0.026
Pre-Asian Pacific < Post-Other	0.004
Pre-White American < Post-White American	0.093
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

Table 4.5.12 Pairwise Comparisons of Feelings of Inclusion Ethnic Group #2

Feelings of Inclusion Pairwise Comparisons of Thursday Ethnic Pre & Post $\eta^2 = .074$	
Comparison	p-value
Pre-Black/African American < Post-White American	0.002
Pre-Black/African American < Post-Asian Pacific	0.006
Pre-Black/African American < Post-Latin American	0.036
Pre-Black/African American < Post-Other	0.021
Pre-White American < Post-White American	0.032
Pre-White American < Post-Asian Pacific	0.059
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.5.12 Emotional States: Program Affiliation (Tables E93 and E94)

Groups #1 and #2 were assessed on the Emotional States variables between Program Affiliations. For Group #1, a Shapiro-Wilk test showed all variables were normally distributed except for Coping Self-Efficacy and Feeling of Inclusion. For Group #2, no variables were normally distributed. For Group #1, both a Kruskal Wallis test and One-Way ANOVA revealed no significant differences. For Group #2 a Kruskal Wallis test revealed significant differences in Feelings of Inclusion ($p = .078$, $\eta^2 = .049$).

Figures 4.5.13a&b show the means of the Program Affiliation groups. For both Groups Post-CWIT Scholar and Pre-CWIT-Affiliate were not reported and therefore not included in Figure 4.5.13a&b.

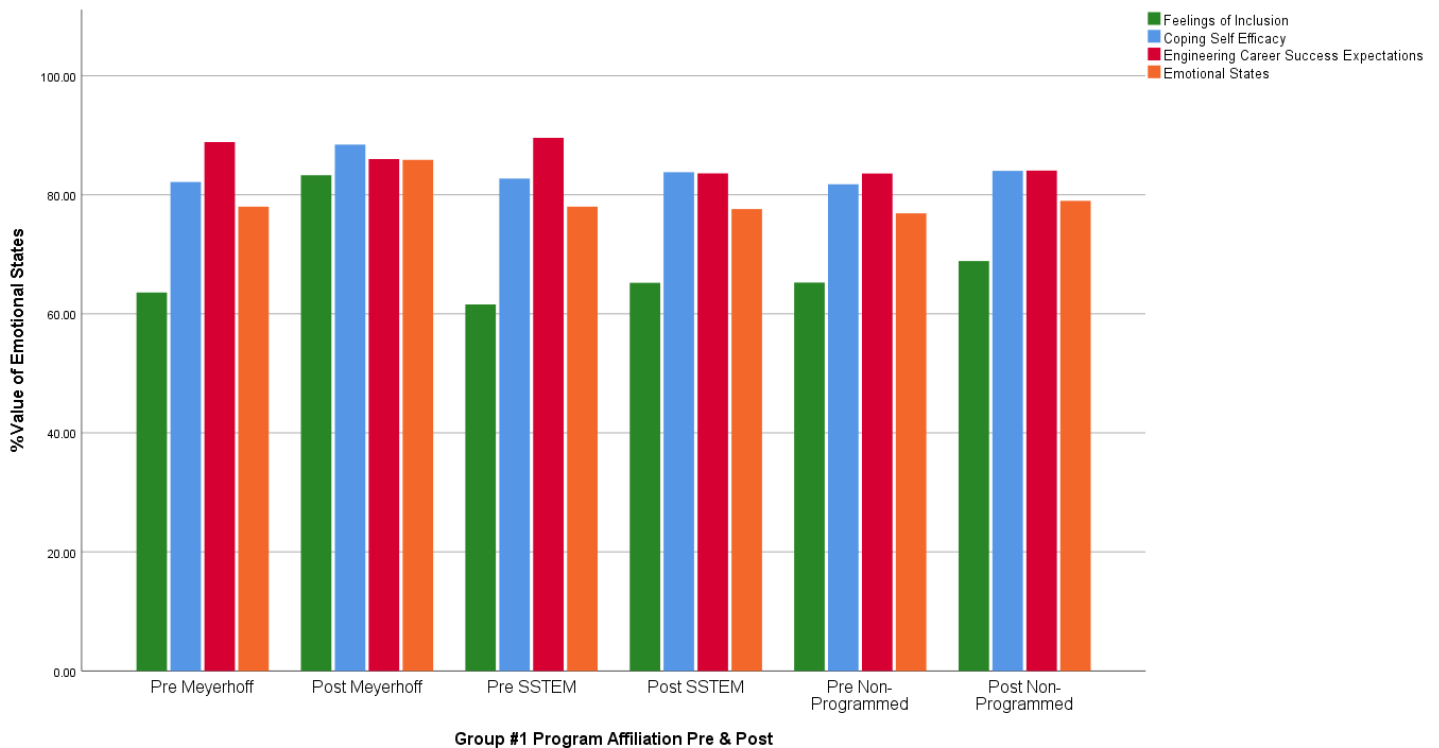
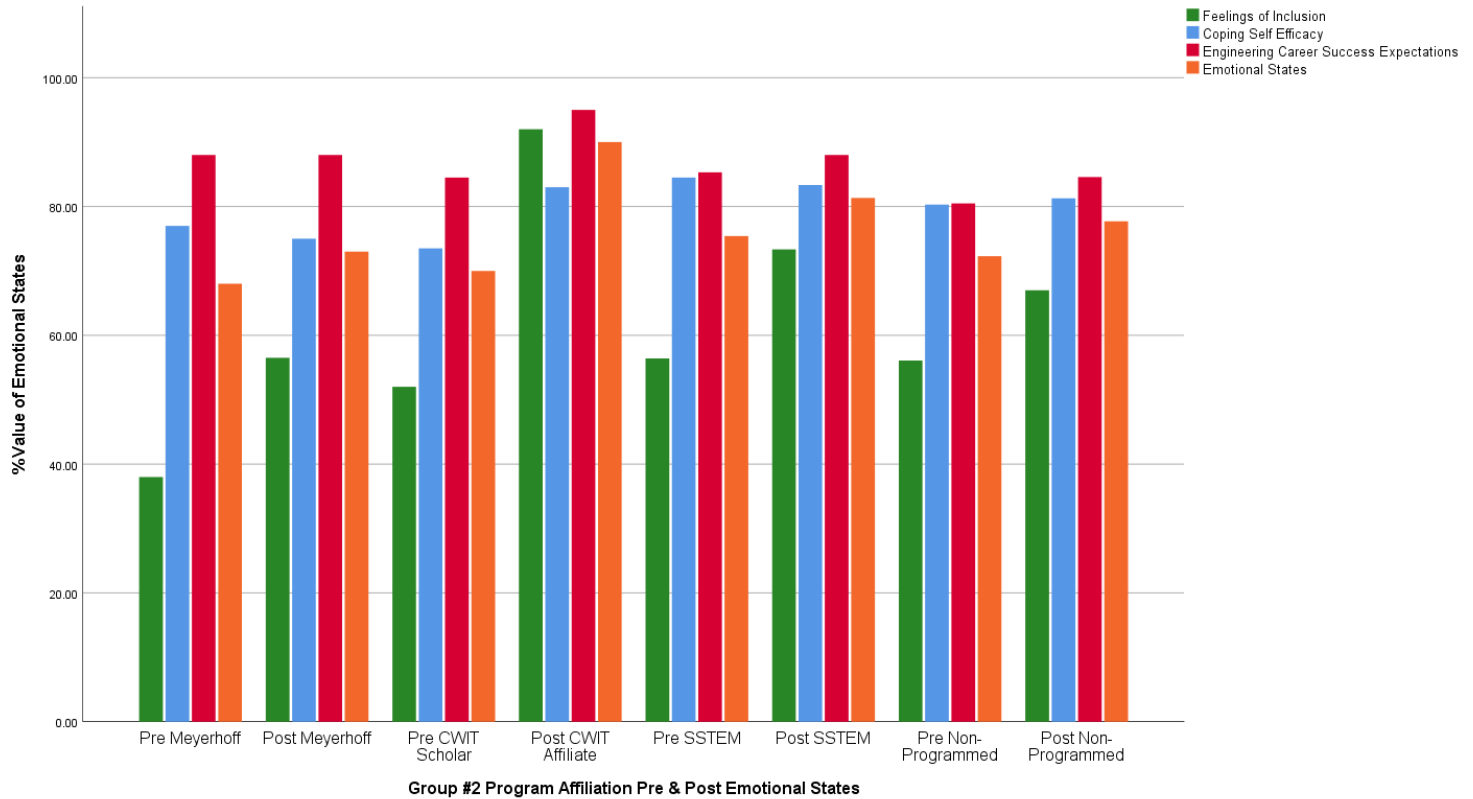


Figure 4.5.13a Emotional States Pre & Post Program Affiliation Group #1, Error bars are omitted for clarity



*Figure 4.5.13b Emotional States Pre & Post Program Affiliation Group#2,
Error bars are omitted for clarity*

For Group #2, a post hoc analysis with pairwise comparisons revealed that there were two significant comparisons between groups: Pre-Meyerhoff and Post-CWIT ($p = 0.048$) and Pre-Non-Programmed and Post-Non-Programmed ($p=0.008$).

Although the effect size is small according to Cohen, Non-programmed showed an increase in Feelings of inclusion from $M=56.08$ to $M=67$.

4.6 Follow-up Impact Survey

As described in Chapter 3, Grounded Theory was used to reveal themes within the data. Forty-six ENES 101 students voluntarily participated in the follow-up impact study. Three of the response's answers that lacked detail and consistency were removed, leaving 43 valid responses.

General questions

The impact survey contained five questions to help the students reflect on their results. Over half of the students who responded to the question felt, with the option to expand on their response, that the website was sufficient for them to understand the results from the Instrument, Figure 4.6.1.

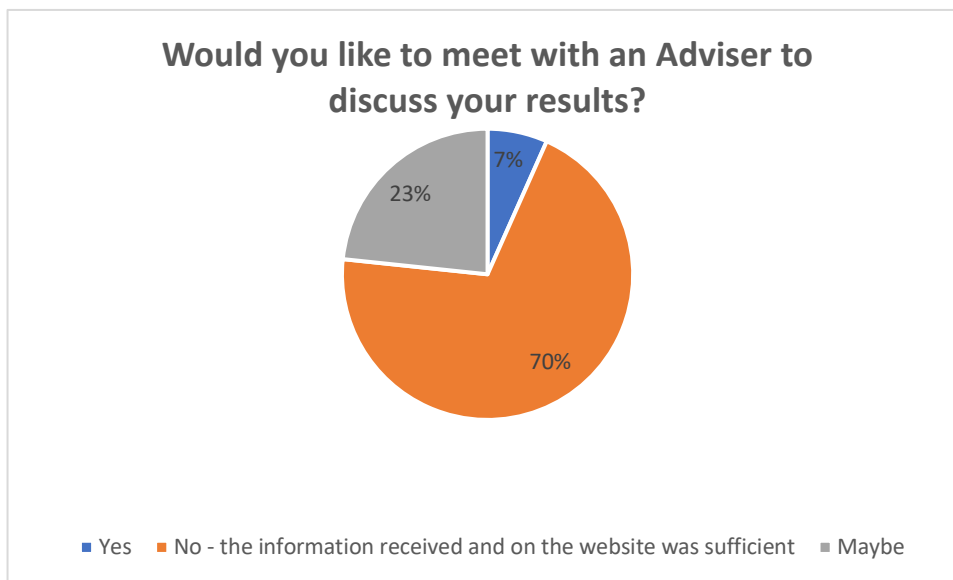


Figure 4.6.1 Meet with Adviser Impact Survey

They were also asked if they felt that ESMI was informative. Out of the 30 participants who responded to the question, 83% felt it was informative or highly informative, Figure 4.6.2.

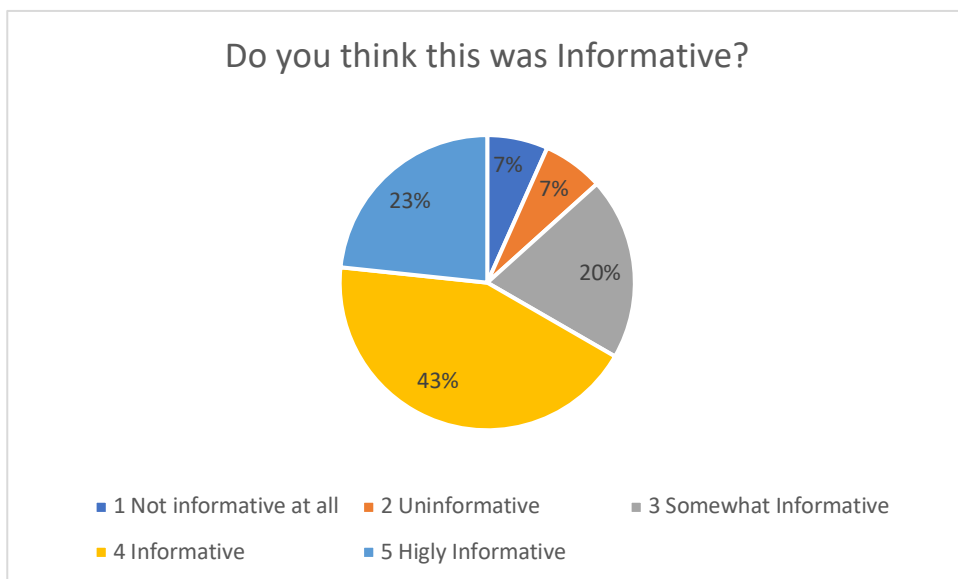


Figure 4.6.2 Informative Impact Survey

Additionally, most of those who responded felt the study was interesting as shown in Figure 4.6.3

Did you find this study interesting?

24 responses

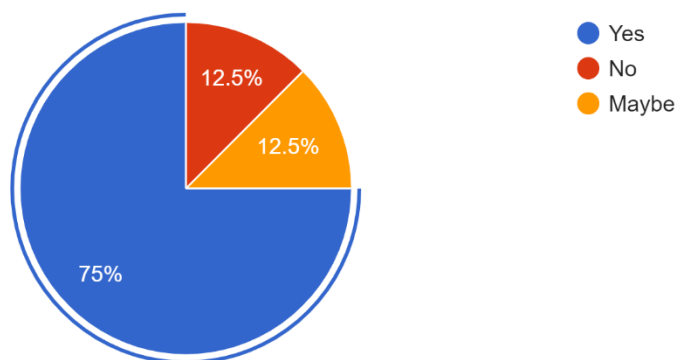


Figure 4.6.3 Interesting Impact Survey

Open-ended questions Impact survey

Using a deductive coding scheme, results from the open-ended questions were examined multiple times to code and categorize the responses into themes to explain the impact of the instrument on the students. Table 4.6.1 shows most common themes that emerged from each group as it related to the survey question. The most common themes were determined by 15 or more common responses. The least common themes had 5 or fewer responses. The explanation of theme and codes can be found in Appendix F.

Table 4.6.1 Open ended Questions and Themes Impact Survey

Open-Ended Question from Impact Survey	Theme commonality	Group#1	Group#2	Group#3	Group#4
Group#1 and Group #2: Take a look at your first ESMI results and compare to your final results. Did your ESMI change since the beginning of the semester? If so, can you explain what?	Most Common theme Moderate Theme Least Common Theme	Increased in SPVE, ME, Emotional Did not change Decreased in specific areas; Did not change	Did not change Increased in SPVE, ME, Emotional Increased and Decreased in SPVE, ME, Emotional		
Group#1 and Group #2: Did you use any of the recommended sections on the website? If so, what did you use? Or will you plan to use them?	Most Common theme Moderate Theme Least Common Theme	Did not use, will use later. Did not use, will not use later yes, used the recommendations	Did not use Did not use, but wasn't aware yes, used the recommendations		
Group #3 and Group#4 Will you plan to use any of the recommended sections on the website? If so, what will you use?	Most Common theme Moderate Theme Least Common Theme			Yes, will be using in the future No, I will not be using the recommendation s	Yes, will be using in the future; No, I will not be using the recommendations

Did you learn something about yourself as an engineer? Name at least one thing and what that means for you.	Most Common theme	The value and connection of engineering skills and practices (professional and technical skills) to themselves beyond the classroom	The value and connection of engineering skills and practices (professional and technical skills) to themselves beyond the classroom	The value and connection of engineering skills and practices (professional and technical skills) to themselves beyond the classroom Motivation to be an engineer	The value and connection of engineering skills and practices (professional and technical skills) to themselves beyond the classroom
	Moderate Theme				
	Least Common Theme	Develop Engineering Skills better	Motivation to be an engineer		Nothing New; Awareness of Inclusion and Confidence
Does looking at the profiles help you? Please explain. (If you didn't look, please do so now and answer)	Most Common theme	Yes, helped to relate to engineers with difficulties	Yes, helped relate to engineers with difficulties	Yes, helped relate to engineers with difficulties Didn't look at the profiles	Yes, helped relate to engineers with difficulties
	Moderate Theme			No, Can't relate to any specific profile	
	Least Common Theme	No, can't relate to any specific profile	No, was interesting to read	No, was interesting to read	No, was interesting to read
What, if anything, for you changed (i.e. your perspective of engineering, your approach to your studies, expectations, etc) since completing the ESMI?	Most Common theme	Expanded understanding of engineering, Reinforcement as engineer - staying	Reinforcement as engineer - staying; Confidence increase, Expanded understanding	Expanded Understanding of engineering	Reinforcement as engineer (staying)
	Moderate Theme	Confidence increase in professional/Math Skills	Least common response: Reinforcement as engineer - leaving	Second common: Reinforcement as Engineer-Staying	Expanded understanding of engineering
	Least Common Theme			Third: Confidence Awareness	Awareness of Motivation
Take a look at your results. Do you agree with your results from the ESMI? Why or why not?	Most Common theme	Agreed, reflected attitude, perception, value	Agreed, reflected attitude, perception, value	Agreed, reflected attitude, perception, value	Agreed, reflected attitude, perception, value
	Moderate Theme	Mostly (Somewhat) Agree reflected attitude, perception, value		Mostly (Somewhat) Agree reflected attitude, perception, value	Mostly (Somewhat) Agree reflected attitude, perception, value
	Least Common Theme		Somewhat Agree (reflected attitude, perception, value.)	Disagree	

4.7 Case Study Mechanical Engineering Sophomores and Post Freshman

4.7.1 ENME 204 and ENES 101 Mechanical Engineering Confidence

Figure 4.7.1 shows the beginning and present confidence of the different ENES 101 Groups and ENME 204 students. A Shapiro-Wilk test of normality revealed that none of the data for any of the Groups were normally distributed. A Kruskal-Wallis test revealed no significant differences. Means, standard deviations and significance are shown in Appendix E Table E95.

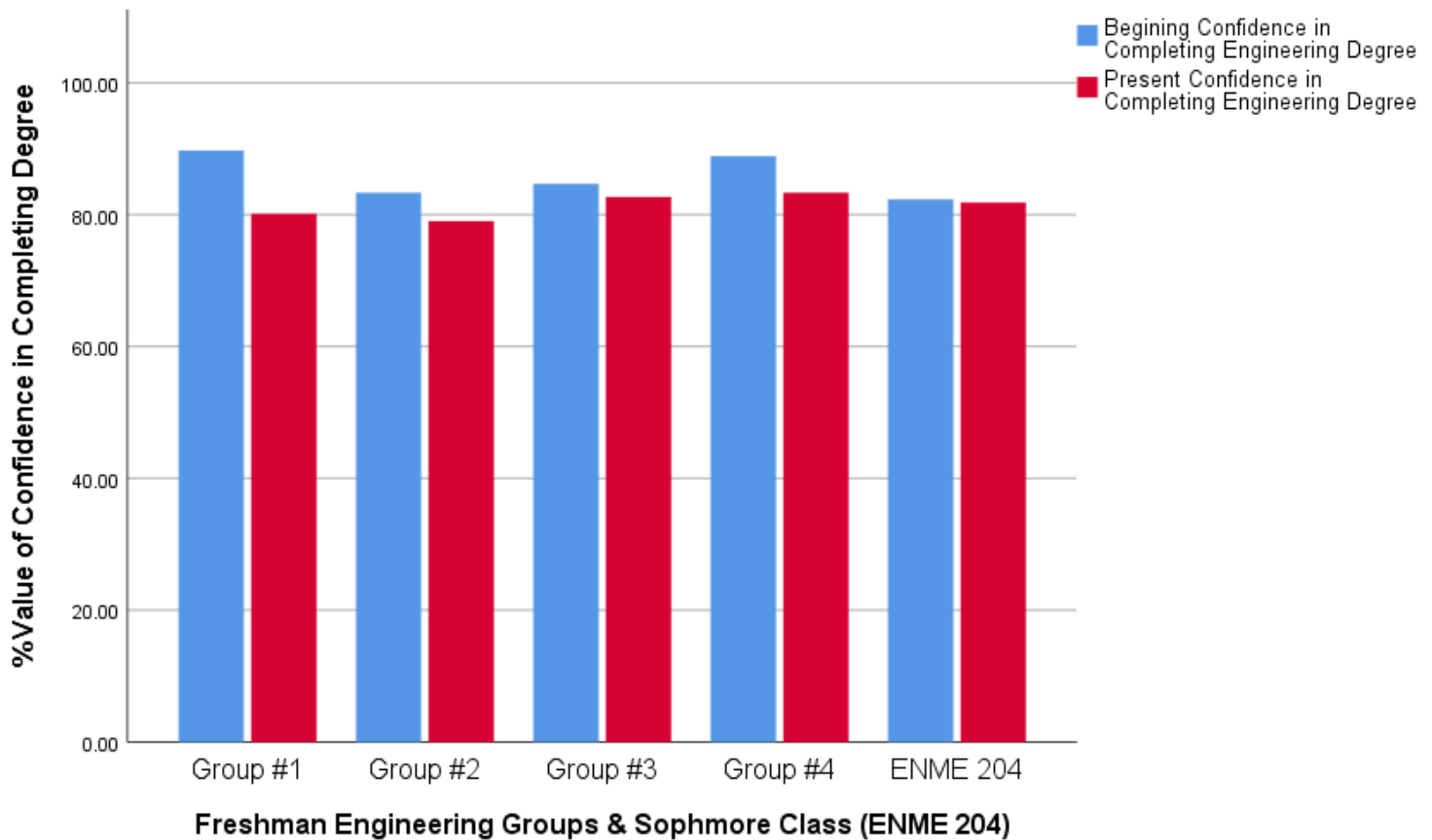


Figure 4.7.1 ENES 101 and ENME 204 Confidence in Completing Engineering Degree

4.7.2 ENME 204 and ENES 101 Mechanical Engineering SPVE

Social Persuasion and Vicarious Experience variables were assessed between ENES 101 and ENME 204 responses (Figure 4.7.2). A Shapiro-Wilk test showed the variables were not normally distributed. A Kruskal Wallis test revealed significant difference only between the ENES 101 Groups, not ENME 204 students. Means, standard deviations and significance be found in Table 96 in Appendix E.

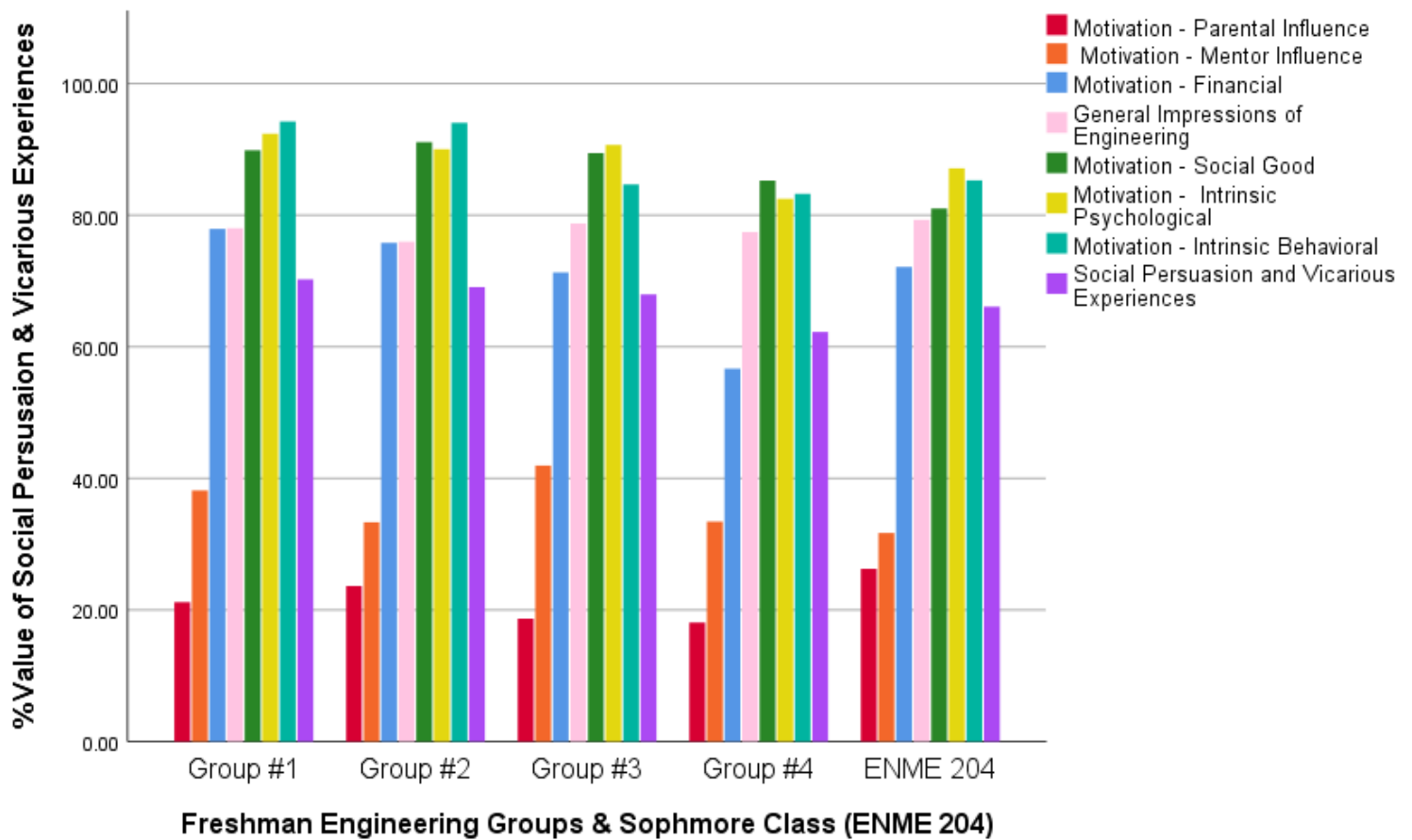


Figure 4.7.2 ENES 101 and ENME 204 SPVE Means

4.7.3 Correlations SPVE ENME 204

Correlations were assessed for the ENME 204 SPVE variables (Table E97 in Appendix E). Using Spearman's Rho, several significant relationships were discovered. Specifically, Social Persuasion and Vicarious Experiences and Motivation Social Good showed a significant strong relationship $r_s(31) = 0.769$ $p < 0.01$. The coefficient of determination suggests that the motivation to practice engineering to help the welfare of society accounts for 59% of the motivation to study engineering for sophomores. Other strong and moderately relationships were found and highlighted in the table in the appendix.

4.7.4 ENME 204 and ENES 101 Mechanical Engineering Mastery Experiences

ENME 204 and ENES 101 were assessed on the Mastery Experience variables (Figure 4.7.3). Shapiro-Wilk test showed the variables were not normally distributed. Using Kruskal Wallis test and One-Way ANOVA revealed no significant differences. Means, standard deviations and significance be found in Table E98 in Appendix E.

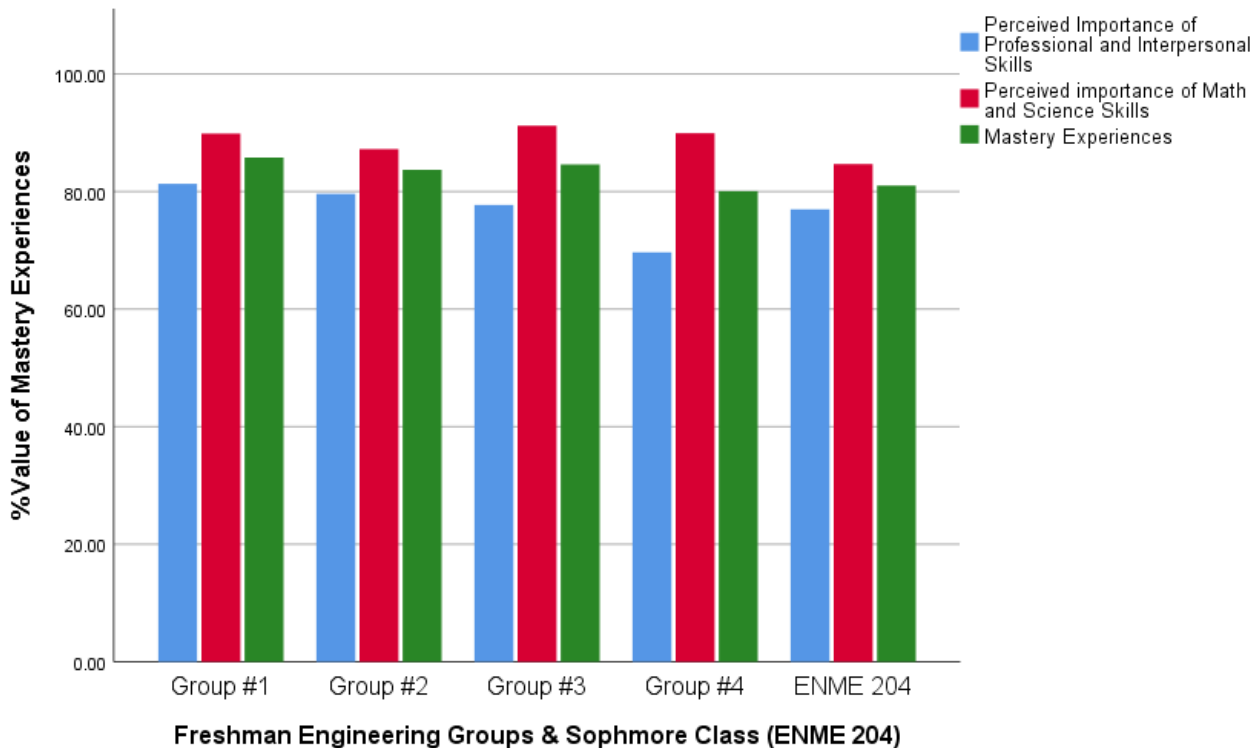


Figure 4.7.3 ENES 101 and ENME 204 Mastery Experiences Means

4.7.5 Correlations Mastery Experiences ENME 204

Correlations were assessed in ENME 204 ME variables in Table E99 in Appendix E. Using Spearman's Rho, several significant relationships were discovered. Specifically, Mastery Experiences and Perceived Importance of Professional and Interpersonal skills has a significant strong relationship $r_s(31) = 0.839$, $p = 0.0$. The coefficient of determination suggests that the sophomore population's value of professional and interpersonal skills accounts for 70% of their overall value of the skills in engineering. Other strong and moderately relationships were found and highlighted in the table in the appendix.

4.7.6 ENME 204 and ENES 101 Mechanical Engineering Emotional States

ENME 204 and ENES 101 were assessed on the Emotional States variable, Figure 4.7.4.

Shapiro-Wilk test showed the variables were not normally distributed. Using Kruskal Wallis test

significant differences on the Feeling of Inclusions variable $\chi^2(4, N=127)=12.087, p=0.017$. Means, standard deviations and significance be found in Table E100 in Appendix E.

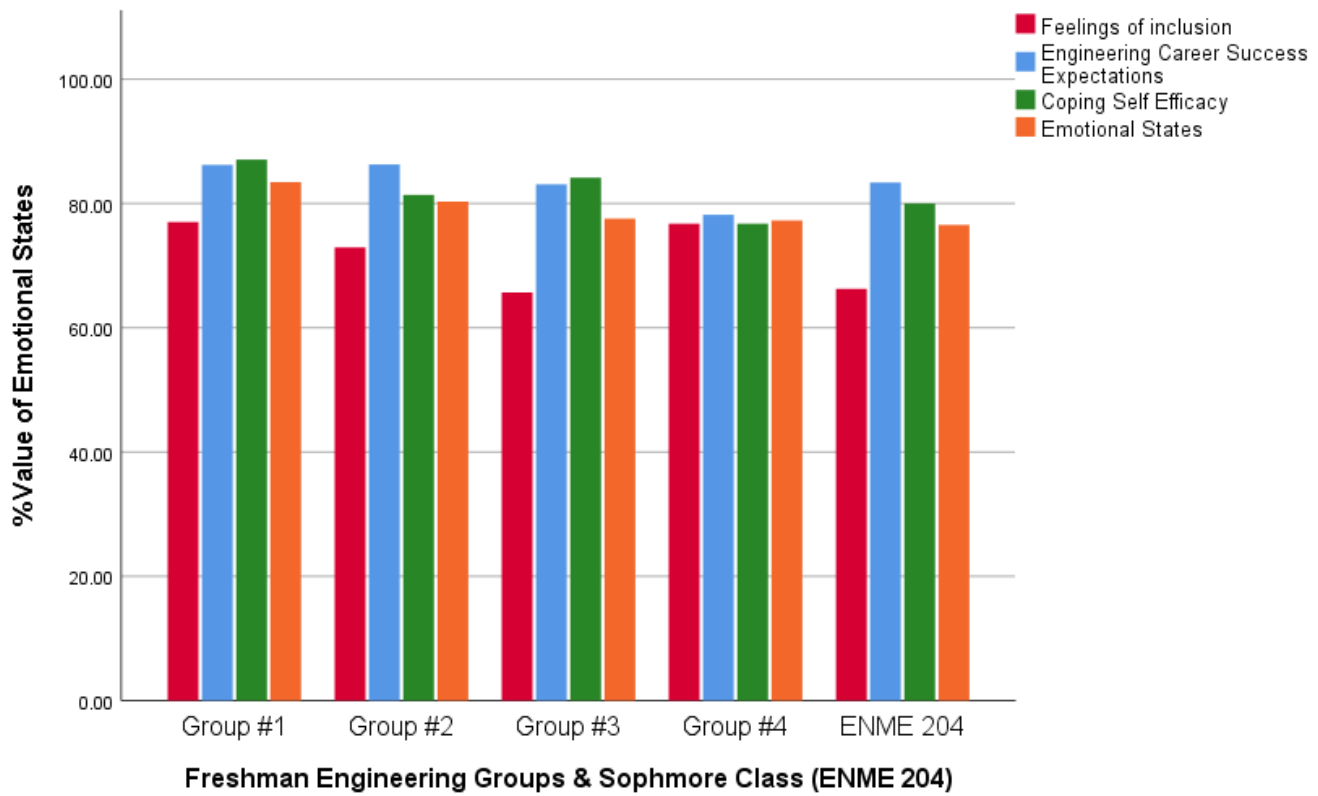


Figure 4.7.4 ENES 101 and ENME 204 Emotional States

A post hoc analysis of pairwise comparisons showed Groups with significant differences for Feelings of Inclusion. Table 4.7.1 shows the significant groups.

Table 4.7.1 Post Hoc Pairwise Comparison Feelings of Inclusion ENME 204 and ENES 101

Pairwise Comparisons of Groups Feelings of Inclusion $\eta^2=.095$	
Sample 1-Sample 2	p-value
ENME 204-Group Four - ENES 101	0.06
ENME 204-Group One -ENES 101	0.015
Each row tests the null hypothesis that the Sample 1 and Sample 2 distributions are the same.	
Asymptotic significances (2-sided tests) are displayed. The significance level is .10.	

4.7.7 Correlations Emotional States ENME 204

Correlations were assessed in ENME 204 ME variables in Table E101 in Appendix E. Using Spearman's Rho, several significant relationships were discovered. Specifically, Emotional States and Engineering Career Expectations has a significant strong relationship $r_s(31) = 0.818$ $p=0.0$. The coefficient of determination suggests that the sophomore population's perceptions of their expectation of succeeding accounts for 67% of their overall emotional state of being an engineer. Other strong and moderately relationships were found and highlighted in the table in the appendix.

Chapter V: Discussion

This chapter discusses the results in this study in relation to research questions proposed. In each aim, relevant and significant results will be highlighted and assessed in the framework of the Social Cognitive Career Theory.

In this study, three research aims concerning engineering students engineering self-assessment will be investigated:

4. To define a UMBC upper class (Third, Fourth and Fifth year) student's successful Engineering State of Mind. This was essential to the creation of the Engineering State of Mind Instrument (ESMI) giving students indirect peer mentoring opportunities through online profiles.
5. Determine the common themes in Freshman Engineering students' Engineering State of Mind and the attitudes and perceptions of the different population groups of the study: specifically, in gender, ethnic affiliation, and mentorship programs in engineering. (Instrument Efficacy)
6. Determine how first year engineering students' perceptions change after they have gained an understanding of their perceptions and attitudes of engineering. (Intervention Efficacy)

This study was designed to determine if the Instrument or the Interventions, or a combination of both, could increase the students' success in the engineering field through attitudes and perceptions. To assess this understanding, qualitative analysis was used to derive themes and define variables that may contribute to the success of the student. Using a 17-item Likert survey, the undergraduate engineering student population was assessed based on their responses. Attitudes and impressions of each of the variables were then analyzed. Using the data acquired from this survey, descriptive and inferential statistics were used to identify significant relationships between the groups and the variables.

In this discussion, percentage values are used to indicate the level of a specific variable.

Appendix F contains the needed scales for reference.

5.1 Junior & Senior Engineering State of Mind – Aim #1

The results of the third-, fourth- and fifth-year engineering students helped develop the engineering student profiles that were identified for the first- and second-year students for indirect peer mentoring. This was an integral part of the development of the ESML.

5.1.1 Confidence in Completing an Engineering Degree

The students were asked to rate their confidence level when they started their engineering degree (reflecting back to the beginning of their first year) and their present confidence level in completing their degree. Most of the upperclassman indicated that their beginning confidence in graduating with an engineering degree was not high, except fourth-year students at 96.3%. However, the fourth-year students' present confidence, although still high, went down slightly to 92.3%.

Fourth-year students' beginning confidence in completing their degree was significantly higher than fifth year students ($p < .005$). For the fifth-year students in different program affiliations, students that were Non-programmed or CWIT affiliates indicated the lowest levels of confidence at the start of their degree. Meyerhoff and S-STEM had higher confidence levels at the beginning of their degrees. Additionally, Males averaged higher in beginning confidence, 91%, compared to Females at 71%, but the differences were not significant at $p < 0.1$. The difference was noticeable, qualitatively, in some of the profiles where the students discussed their difficulties. As an example, one Black/African American/Non-programmed/Female fifth year student commented:

I had trouble voicing my opinions. I would tend to take things at face value and not question why they were that way. In turn, I often found myself not fully understanding a subject.

Another example came from White American Male who commented on his biggest difficulties in his first year:

Difficulty adjusting to heavy workload compared to high school, I needed to reevaluate if I really wanted to do engineering end of sophomore year and if it was worth it for me to change majors, however I'm very happy with my choice now.

A third example came from a White American Female, fifth-year student, who commented that her biggest difficulties came in her first and second year:

The professor I took the course with had never taught the course before and wasn't used to teaching undergraduate level classes. I was reading the textbook, suffering through all of the homework problems, and going to all of the TA office hours, discussions, and review sessions. However, I was not doing well in the class whatsoever and I was heavily contemplating switching out of XXX all together. I asked the TA and professor if I could get a tutor and they said they could set me up with one. However, no tutor came. I honestly thought I wasn't going to be able to pass the class and so did a lot of my classmates. We all were looking at other majors.... I felt like I was failing at life because I wasn't understanding the material and I wasn't receiving the help I'd asked for. Nevertheless, I chose to preserve [sic].

Fifth year students may have struggled in the beginning of their degree. Because of that, they may have needed to take another semester or even pursue a co-op to help them navigate their understanding of the career.

5.1.2 Social Persuasion and Vicarious Experiences (SPVE): Motivations to Pursue Engineering

Variables adopted from the APPLES survey were used to examine the factors that influence students' motivation to study engineering. According to the assessment of SPVE motivational variables, Juniors and Seniors were the least motivated by Mentor and Parent Influence. Similar results were found

in the 2011 study at UMBC (Gurganus 2011). Most of the students, except for Programmed affiliated, tend not to have a mentor. They do not, generally, see their advisers in a mentorship role. Additionally, those who have mentors may have had unfavorable experiences. Significant differences were found between the program affiliations. CWIT affiliates were significantly more motivated by a mentor, at 80.67%, than the other programmed groups. This is especially true compared to Non-programmed students, at 19.88%. Looking at the other program affiliations, Meyerhoff, 50.33%, CWIT scholars 58%, and S-STEM 42% were also impacted by a mentor. Students with two or more programs indicated a higher impact than the other groups, 67%. Females, 51%, indicated a higher motivation from mentors than Males, 32.5%, although the difference was not significant.

In CWIT, a parent support group exists to help connect parents to the students through the program. This helps to provide additional support avenues through fund raising, activities, and additional emotional mechanisms. Due to this initiative, CWIT Affiliates showed a significantly greater impact from Parent Influence (50.33%) compared to Non-programmed (2.13%).

Across the population, consistently high motivation values were shown on Intrinsic Behavioral, Social Good, and Intrinsic Psychological variables, with mean values from 85% to 96%. As Junior and Senior students advanced in their engineering education, they seemed to value things other than the financial benefits of their degree. This value was shown in the data with Financial Rewards values ranging from 56%-68%. Looking at their qualitative responses, many of the students embraced opportunities on campus in research, or in industry, that helped define their engineering motivation.

The overall Social Persuasion and Vicarious Experience variable showed no significant difference among the different population groups. The mean values for every group were around the high 60's to 70%'s. Males (67%) and Females (68.56%) were statistically consistent with each other.

5.1.3: SPVE: Correlations

Strong correlations were found to impact Social Persuasion and Vicarious Experience variables in General Impressions of Engineering, Intrinsic Behavioral, and Intrinsic Psychological. For 4th and 5th year students 37% of their general impressions of engineering contributes to their overall Motivation. Intrinsic Behavioral and Psychological both contributed around 30%. Mentor Influence, although less valued, had significant strong relationship, indicating that a student's motivation, if from a mentor, contributes 35% toward the total variance of SPVE. Upper level engineering students choose to go to into engineering due to internal motivations that tend to be related to personal experiences or the improvement of society. This can be seen especially in Women (Haag and Collofello 2008, Brush 2013).

5.1.4 Mastery Experiences: Overall

The Junior/Senior population had a moderately strong view of skills in engineering (65%-78%). Although not significant, fifth year students showed the highest perceived importance of engineering skills, with mean values of 76.14% for Professional and Interpersonal skills, 81% Math and Science Skills, and 78.71% on their Mastery Experiences.

Female and Males were relatively similar in their perceptions in the engineering skill set. Although not significant, Females valued the skills slightly higher than their Male colleagues with Professional and Interpersonal 72.2% (Females) verses 66.63% (males).

Large significant differences were found between the Black/African American and White American ethnic population of Juniors and Seniors in all three variables. The Black/African American group highly valued the importance of Professional and Interpersonal skills (91.50%) versus the White American group (63.4%). Additionally, the Black/African American students more highly valued the importance of Math and Science Skills (94.50%) compared to the White American group (89%).

Finally, the Black/African American group's overall perception of engineering skills (93%) was significant higher than the White American group (75%). Many of Black/African American students in this population were affiliated with the Meyerhoff program. The Meyerhoff program encourages a strong understanding of essential skills in engineering. Additionally, Meyerhoff students are required to have various research experiences which contribute to these perceptions.

The program affiliation groups demonstrated no significance in the mastery experience variables. The mean values for Non-programmed students were lower compared to their programmed colleagues. This was demonstrated in Math and Science (70.88%) and Professional and Interpersonal skills (59.13%). CWIT affiliate and scholar students had lower values in Math and Science (56% and 66.67% respectively), but still valued Professional and Interpersonal more than the Non-programmed students. Students who were affiliated with a program tend to get support that enables them to take advantage of and participate in opportunities beyond the engineering classroom such as research, internships, co-ops and mentors. Non-programmed students unfortunately do not receive the same experiences which contribute to devaluing the importance of interpersonal and professional skills.

5.1.5 Mastery Experience: Correlations.

In this population, both Perceived Importance of Math and Science and Professional and Interpersonal Skills had a strong significant relationship with Mastery Experiences at around 60%. A student's perception of essential skills in engineering greatly impacted their attitude towards the engineering field. Considering the advanced stage of these students' academic careers, it makes sense that a strong correlation exists between each essential skill set and their overall impressions.

5.1.6 Emotional State: Overall

Junior/Seniors have an overall fairly high sense of Inclusiveness, Coping Self-Efficacy and Engineering Career Success expectations. Fifth-year students had a lower sense of Engineering Career Success Expectations (71.86%) compared to fourth-year (85.89%), and third-year students (88%)

although the differences were not significant. Additionally, fifth-year students' Coping Self-Efficacy (88.57%) and overall engineering Emotional States were lower than their colleagues. Significant differences were found between Males (91.50) and Females (78.56%) in Coping Self-Efficacy. Females tend to struggle more in coping with failure compared to males. (Marra et al. 2004, Marra et al. 2007, Marra et al. 2005).

No significant difference was found between the ethnic groups of this population for any of the emotional state variables. In examining the data, Black/African American students tended showed lower Feelings of Inclusion (68.50%), Engineering Career Success Expectations (77.50%), and Coping Self-Efficacy (77.50%), compared to their colleagues. This impacted their overall all Engineering Emotional State (74.50%).

All program affiliated members showed strong feelings (70%- 85%) in each of the Emotional States variables, except for S-STEM students. This was especially true for S-STEM students in Engineering Career Success Expectations (62%). Non-programmed students' Engineering Emotional State values were similar to their program affiliated colleagues.

5.1.7 Emotional State: Correlations.

Junior and Senior Engineering Career Success Expectations has a strong significant relationship with their overall Emotional States at around 70%, explaining that a Junior's and Senior's expectations to succeed in their engineering career strongly impacts their Emotional State in regard to pursuing a degree in engineering. Additionally, Coping Self-Efficacy at 35%, and Feelings of Inclusion at 31%, also had a strong significant relationship with Engineering Emotional States in this population. Expectations of succeeding, inclusiveness, and self-efficacy are strong indicators of an engineering student's success (Seymour and Hewitt 1997, Marra et al. 2009, Seymour and Hewitt 2000).

5.2 Engineering 101 population Engineering State of Mind - Aim #2

In the following section, a discussion of the results for the freshmen enrolled in ENES 101 will be reviewed in the context of the study's structure, aims, and Social Cognitive Career Theory Framework. A discussion of the pre-assessment data, which serves as a baseline for the study, will be presented, followed by a discussion of the post-assessment data, which illustrates the instrument's efficacy. Finally, the differences between the pre- and post- assessment results and the impact qualitative study will be discussed, highlighting the instrument and intervention efficacy.

5.2.1 Pre-Assessment of Engineering 101(ENES 101): Group #1 and Group #2

5.2.1.1 SPVE: Pre-Assessment

For first year engineering students at the beginning of the semester, the primary motivations for becoming an engineer were Financial Rewards, Intrinsic Behavioral, Intrinsic Psychological and Social Good. They were least motivated by their parents and a mentor influence. When they first took the ESMT, the students were entering their first year of engineering, potentially with various preconceived ideas and misconceptions of the field. Their motivations could be a reflection of the common perception that engineers make a lot of money and build things (Team 2019). Further evidence of these influences were that their General Impressions of Engineering were fairly high (78.58%) and their overall motivation, SPVE variable, was also fairly high (63.28%). Misconceptions could lead to less motivation in some areas, leaving the student to be focused on a single rational motivating factor, as opposed to having several strong motivating factors.

Male participants in the pre-assessment groups exhibited a commonly researched and reported behavior: their motivation to study engineering for the practicality (Intrinsic Behavioral) was significantly greater (84.6%) than that for Females (75.7%) with a small effect size of 2.2% (Halpern et al. 2007).

Ethnic groups varied in their primary motivations for various and different reasons. For example, Asian & Pacific Americans were more influenced by their parents to study engineering (31.1%), compared to Black/African American students, (14.7%). Leong 1985 showed that pressure from Asian American parents plays a large role in their children's choices of careers (Leong and Serafica 1995). He explains that "Asian-American parents are inclined to provide a strong parental guidance, particularly in regard to their careers. They are aware of the discrimination in the world of work... and that their children would have an easier time if they were in a respected and autonomous profession in which many Asian- American's already succeed."

Further evidence that Ethnic groups showed different motivations was in the Latin/American population, where students were significantly less motivated to study engineering based on Intrinsic Psychological or Behavioral compared to Black/African American, White American and Asian & Pacific American colleagues. Research has shown that Latin/Hispanic students tend to struggle in their identity (e.g., self-efficacy and confidence), especially at institutions where they see less of their culture represented (Fiske 1988, Fleming and Smith 2013)

In this study's population, Black/African American students were more motivated to study engineering inherently. White American, Asian & Pacific American, Latina/Hispanic American, and Other affiliations were most motivated by the practicality to study engineering.

Motivations for pursuing engineering were also different between the different Program Affiliations. Meyerhoff (58%) and CWIT (54%) students were more motivated by mentors compared to S-STEM (17.56%) and non-programmed affiliated colleagues (27.28%) with a small effect size of 9%. These results likely reflect the structure in the Meyerhoff and CWIT programs that provides students with mentoring opportunities. Non- programmed students would need to actively find a Mentor if they desired one. Although Meyerhoff and CWIT students value mentors more over other affiliated programs, their value was moderate. This is likely due to a lack of relationship with their peer or

industry mentors because they are unfamiliar with them at the start of the semester. Table E100 shows the different affiliation by each discussion.

Program Affiliated students exhibited motivations that could be connected to their summer bridge experience. For example, Meyerhoff students were significantly more motivated to study engineering, SPVE variable, (71%) than S-STEM (64%) and Non-Programmed (62%) students with a small effect size of 3.5%. The Meyerhoff program is dedicated to their students' success, and provides special attention to their scholars, requiring them to commit their time to developing their skills prior to entering college. Meyerhoff Scholars are provided opportunities beyond the standard college preparation. Meyerhoff students are immediately connected to high impact practices through a summer bridge program, provided mentorship, and inducted into a community, all factors that would contribute to their overall motivation state.

5.2.1.2 SPVE: Pre-Assessment Correlations

Examining the independent motivating variables and their relationship to each other, several significant correlations were found in the Social Persuasion and Vicarious Experience variables in the pre-assessment population. Group #1 and Group #2's motivation to study engineering inherently affects 16% of their motivations to study engineering for Social Good and 38% to study for the Intrinsic Behavioral aspects. Parent Influence motivation accounts for about 11% of the Financial motivation. Although a low percentage, parents may use financial motivation to encourage their children to go into engineering for the sake of earning a good salary (Interactive 2011, Lloyd et al. 2018).

The overall motivation to study engineering, SPVE variable, had a significant strong relationship with all the motivation variables in the assessment. More interesting was Mentor influence, shown to be the least impactful on Group#1 and #2, had a strong correlation on a freshman engineering student's overall motivation to pursue engineering, around 34%. Research has shown that having a strong positive

mentor contributes to their motivations in pursuing an engineering career (Galbraith and Ostrowski 2000, Ragins and Cotton 1999, The National Academy of Sciences and Medicine. 1997). Therefore, if a student has a mentor at the start of their engineering education, their motivation to pursue engineering is likely to increase.

5.2.1.3 Mastery Experiences Pre-Assessment

Engineering students in Group #1 and Group #2 valued the essential engineering skills equally. In comparing the skills sets, more value was placed on Math and Science, ranging from 86% to 91%, than the Professional and Interpersonal skills, which ranged from 73% to 76% in value. There is a common misconception that engineers need only Math and Science in their careers. This leaves students believing professional and interpersonal skills are not a necessity. Overall, they felt both skills sets were valuable at 82%.

In comparing the gender groups in the pre-assessment population, Females value the Math and Science skills (93.95%) significantly more than the Males (86.86%). Additionally, Females overall valued engineering skills more (86.68%) than the Male population (80.63%). Females have been shown to be unconfident in their abilities, not because of their capability, but due to their self-efficacy and differences in their spatial abilities. However, girls get better grades than boys in all grades including elementary, high school, and university, showing their value in potential skill sets higher than their male counterparts (Fox 2018). The designated gender 'Other,' a very small percentage of the population study, had the lowest perceived importance with Professional and Interpersonal Skills (64%). Those who identified as 'Other' gender valued the Math and Science skills the most, with a high importance value of 94.5%.

Exhibiting similar behavior to the entire population, Ethnic and Program Affiliated classifications, attached a higher importance to Perceived Importance of Math and Science skills, ranging from 79%-100%, than the Professional and Interpersonal skills, ranging from 70% to 89%,

Although no significant differences were discovered, students who associate with scholar programs valued Math and Science higher than Non-programmed students. This result can be attributed to the effort by the scholar program's staff promoting the importance of skill development in the students.

5.2.1.4 Mastery Experience: Pre-Assessment Correlations

Showing strong significant correlations, Group #1 and Group #2's positive or negative value of math and science and the interpersonal professional skills highly impacts their overall value of the skills in the engineering field. Through a linear association, looking at just Perceived Importance of the Professional and Interpersonal skills and the overall Mastery Experience, 58% of total variation can be explained. Additionally, the association revealed that 51% of the total variation between the Perceived Importance of Math and Science skills and Mastery Experience variable can also be justified. This relationship promotes the essential need to ensure our students feel both confident and knowledgeable of each skill set.

5.2.1.5 Emotional States: Pre-Assessment

Engineering 101 is typically an engineering student's first college engineering class, and possibly their first exposure to engineering. Almost 90% of these students, were previously in a secondary education environment, making this their first college experience. Because ENES 101 is their first college engineering class, a possible vulnerability could be exposed, causing emotional distress. According to this study, the pre-assessment participants Emotional State variable was moderately high, ranging around 71% to 78%. The students also responded with moderately high to very high feelings about being able to cope with failure (79%-82%) and expecting that they can succeed or fit into an engineering career (78%-85%). In contrast, all the students showed feelings of uncertainty regarding whether they could relate to people in their class, showing a response range between 54% and 69% of feelings of inclusion.

Males and Females were overall similar in their Emotional States variables in Group #1 and Group #2. Both Coping Self-Efficacy (79%-82%) and Engineering Career Success Expectations (81%-83%) were moderate to moderately high in value. No significant differences were found between males and females indicating they have similar emotional states at the start of their engineering education career. Many studies show that females generally have lower emotional states than males as they progress in their engineering career due self-efficacy and confidence in the field, (Zeldin and Pajares 2000, Amelink 2008, Marra et al. 2007, Vogt et al. 2007, Marra et al. 2005). Students who indicated 'Other' had lower emotional state values; however, the population was very small.

Ethnic groups were similar in their Emotional States compared to the overall population. Most groups felt they could fit into an engineering career ranging in high values between 76% and 85%. However, all ethnic groups revealed concerns with relating to people in the class (Feelings of Inclusions) and other activities, with American Indian/Alaskan Native at the lowest score of 51% and Asian & Pacific American at 63%. White American's have significantly lower Coping Self-Efficacy than Black/African Americans (85.65%) and other ethnic groups (87.25%). Additionally, Asian and Pacific American students had lower Coping Self-Efficacy (77%) than their Black/African American and other ethnic group colleagues. As previously discussed in the SPVE variables, Asian students are influenced by their parents to go into STEM professions (Leong and Serafica 1995), which could lend to disappointment if they fail a test or class.

Students affiliated in scholar programs showed similar Emotional States values as their Non-programmed colleagues. A significant difference in values were found across the groups in Engineering Career Success Expectations. Non-programmed students felt less likely that they could fit into an engineering career (81.97%) than the Meyerhoff (90%) and S-STEM scholars (86.61%). CWIT, although not significant, had the lowest Coping Self-Efficacy (73%) and Engineering Career Success Expectations (79.67%). The CWIT scholars did feel the most inclusive with a response of 66%. The

CWIT scholar program focuses on empowering women to feel included in their career. CWIT students, like Meyerhoff's, have a summer bridge experience that focuses on team development and understanding how they belong in the STEM field.

5.2.1.6 Emotional States: Pre-Assessment Correlations

Examination of variable relationship impact revealed several significant and highly correlated interactions. A strong significant relationship was found between Feelings of Inclusion and overall Emotional States. The coefficient of determination described that the students' Feeling of Inclusiveness accounts for 75% of their Emotional States. Students who do not feel accepted, valued, or that they belong are at risk of leaving the field or STEM all together (Seymour and Hewitt 1997, Tinto 2010).

5.2.1.7 Confidence in Completing Engineering Degree Beginning and Present

Group#1 and Group #2 reflected on their confidence beginning their degree and their present feelings toward completing their engineering degree. At the time of the pre-assessment, most students were just starting their college careers with 88.2% of the population matriculating to UMBC directly from the P12 secondary education environment. Only 7% of the population were from a 2-year college and less than 2% were previously at a four-year university. Therefore, reflection on their beginning confidence (80%) would likely be a projection of their high school experiences. This also explains their present confidence in completing their degree reporting at a moderately high 77%.

5.2.2 Engineering 101 Post-Assessment Data

This section will focus on significant differences between the four study Groups of the post-assessment data recorded at the end of the fall 2019 semester.

5.2.2.1 Social Persuasion and Vicarious Experiences (SPVE) Post Assessment (All Groups)

Overall population

The instrument was released to all four Groups of study at the end of the semester in engineering 101. Indicating multiple and various motivating factors to study engineering, the overall motivation to study engineering, SPVE variable, was moderate at 66.3%. More specifically, primary motivations for becoming an engineer were: Social Good, with the highest value at 87%; Intrinsic Behavioral at 85.75%; and Intrinsic Psychological at 85.76%. Financial motivations at 73.21%, Mentor Influence at 35.82%, and Parent Influence at 21.01%, were the least motivating variables among the population.

Looking at the groups of study, in taking the ESMI at the beginning of the semester, students were able to identify their motivations and further grow in their knowledge of the engineering field. Group #2 had a significantly higher motivation in the Intrinsic Psychological (87.66%) compared to Group #4 (79.50%). Group #2 also had interventions which may have fostered an increase in motivation of engineering for its inherent sake. Group #3, the control group, showed a significantly higher value in Intrinsic Psychological (88.95%) compared to Group #1, who received the ESMI at the beginning (81.30%). Having the instrument at the beginning of the semester helped diversify the motivation for Group #1 and therefore reduced the influence of a single dominant motivation.

5.2.2.2.1 SPVE Post Assessment: Gender

Overall population

In examining the post engineering motivations with respect to Gender, overall Males were mostly motivated by the Intrinsic Behavioral aspects of engineering (89.35%), Social Good (87.49%), and Intrinsic Psychological (86.09%). Females were primarily motivated by Social Good (89.08%) and Intrinsic Psychological (81.1%). Moderately high motivations for both groups were Financial rewards (72.61%). Females were only moderately motivated by the Intrinsic Behavioral (75.63%). Mentor and Parent Influence were the least impactful on both gender groups.

A significant difference was found in Mentor influence, with Females being more motivated by a Mentor (47.04%) compared to Males (31.69%), although neither had a large Mentor influence. This is

later discussed in the groups of study section showing this effect was due to the Group #4 population which had the largest population of Honors and CWIT affiliations and where 75% were Female. Males and Other gender affiliated group were more motivated by the Intrinsic Behavioral aspects of engineering (89.35%, 100%, respectively) compared to their Females peers (75.63%).

Groups of Study

Although the ESMI and Interventions demonstrated that they support a positive impact in engineering motivation facets, within and between groups, common behavioral gender tendencies were revealed in the Intrinsic Behavioral and Social Good motivation variables.

In Group #1 and Group #3, both Males and Females showed similar engineering motivations. However, due to the ESMI, gender motivation values in Group #1 were similar and not significant, whereas in Group #3, Males were more motivated (88%) than Females (65%) in Intrinsic Behavioral. This is a stereotypical behavior that reflects what is shown in research (Resiburg et al. 2010, Pajares 2005, Ginorio 1995), that Males are more interested in the building aspect of engineering over their Female colleagues. Further evidence of this in this study showed Females in Group #3, were slightly more motivated by Social Good (91.5%) over their Male peers (89%). The Other gender affiliation, in Group #1, was highly motivated (100%) by the Financial Rewards, Intrinsic Psychological, and Intrinsic Behavioral, although it was a small population.

The Groups of study with interventions, Group #2 and Group #4, showed similar Gender motivations as Groups #1 and Group #3 where Males were more motivated by the practical applications of engineering (Intrinsic Behavioral), compared to their Female colleagues in both groups. However, due the combination of ESMI and interventions, Females and Males valued the Social Good of engineering equally at 88% in Group #2, where in Group #4, Females were slightly more motivated by Social Good (88.5%) than the Males (86.5%). Group #2, that had both the ESMI and interventions,

showed less of a gender difference in motivation variables compared to Group #4, which only had interventions.

Additional assessment was performed within each of the groups of study between the gender classifications. Males in Group #4 were significantly more motivated to study engineering in the Intrinsic Psychological sense (88%) over Females (71%). Females in this group were significantly more influenced by a mentor (56%) versus the Males (34%). Group #4 included the highest number of Honors and CWIT scholar students. Furthermore, 75% of the population identified as Female in this group. The CWIT scholar and Honors College program work to pair students with mentors either from industry or faculty at the university.

The results of the study indicate that Groups that received the ESMI in the beginning and the of the semester, or had interventions, revealed a shift in gender motivation, shrinking the gender difference in motivations to pursue engineering.

5.2.2.2.2 SPVE Post Assessment: Ethnic

Ethnic groups in post-assessment varied on their primary motivations. Black/African American, Asian and Pacific American, Latin/Hispanic and other group affiliations were primarily motivated to study engineering for Social Good at an overall value of 88%. White Americans were very slightly (by only 0.55%) more motivated by the Intrinsic Behavioral compared to Social Good. Common weak motivations included Parent and Mentor Influences. As shown and discussed in the pre-assessment, Asian & Pacific students continued the trend of having significantly higher, Parent Influences (33.82%) compared to their other Ethnic colleagues (around 21.1%).

5.2.2.2.3 SPVE Post Assessment: Program Affiliation

Overall Population

In the post population assessment of the students based on their Program Affiliation, CWIT Scholar, S-STEM, and Non-programmed students were primarily motivated to practice engineering for Social Good. Meyerhoff and CWIT Affiliates were more Intrinsic Psychologically motivated. As with the pre-assessment population, common trends for students affiliated with scholar programs were having higher engineering motivations. Being part of a scholar program, with the included resources and emphasis on community engagement, can positively impact a student's motivation and understanding of the engineering field. In the post assessment, this was evident in the General Impressions of Engineering and Mentor Influence. Non-programmed students' General Impressions of Engineering were significantly less (74.70%) than Meyerhoff students (82.50%) and CWIT Scholars (85.33%). CWIT (22.22%) and Meyerhoff (30.10%) scholars are significantly more motivated by a Mentor than Non-programmed students (19.68%). However, Non-programmed students were more motivated by Mentor Influence than the CWIT Affiliates (5.67%). CWIT Affiliate students benefit from the same opportunities as Scholars, however, they are not assigned a mentor. They often are more aware of the mentorship relationship that other scholars have access to than Non-programmed students who generally do not have an engineering mentor, especially in their first year of college.

S-STEM students (71.63%) were more motivated to study engineering (SPVE variable), overall, than non-programmed students (65.07%) and CWIT Affiliates (64%). This variable indicates they have several motivational factors that help them connect and persist in the engineering field. S-STEM, like Meyerhoff and CWIT scholars, have access to a community that helps facilitate opportunities for the student to engage in the engineering practice.

Groups of Study

Through research and in this study, students who are a part of a program, like Meyerhoff, CWIT, and S-STEM, show a positive increase in their motivation influences, to include the Mentorship factor, and to pursue an engineering degree. This trend was also reinforced because the Non-programmed

student population was the least motivated in Mentor Influence in all groups of study. Group #4 showed the highest Mentor Influence in their Meyerhoff and CWIT students, over all the other groups. Group #2 S-STEM students were significantly less motivated by the influence of Mentors at 22.33% compared to Group #4 Meyerhoff (75%) and CWIT (74.71%) students. This influence could be attributed to Group #4 student's additional relationship with the Honors College, which magnifies their influences, especially with mentorship.

CWIT Affiliate students in Group #4 were the least motivated of all program affiliated populations by the Intrinsic Psychological aspect (67%). This specific group was more interested in studying engineering for Social Good. Group #1's Non-programmed students showed less motivation on the Intrinsic Psychological variable (78.20%) when compared to Group #3 Non-programmed (87.22%) and Meyerhoff students (100%). Although Group #3, did not participate in the ESMI at the beginning of the semester or receive interventions, their peer teaching assistants (known as teaching fellows) who were assigned to the group may have provided a mentor substitute for this group (Scandura and Williams 2001, Philipp, Tretter and Rich 2016).

Although Non-programmed students may have shown to be less motivated than Program Affiliated students, Non-programmed students in Group #2, who received both interventions and the ESMI, exhibited similar, if not higher, motivation scores as their programmed affiliated colleagues in the post-assessment. However, this does not include the Mentor Influence variable that is traditionally higher in programmed affiliated students.

5.2.2.2.4 SPVE Post Assessment: Correlations

An assessment of each of the SPVE variables revealed their relationship with other variables in each group. The ESMI results showed that certain variable outcomes impacted other variables. In this section strong significant relationships are highlighted.

Group #1

Group #1's motivation to pursue engineering for the Intrinsic Psychological (to do engineering for its own sake) can explain 54% of the Intrinsic Behavioral (to practice engineering for its practical aspects) and 53% of the overall motivation to pursue engineering, SPVE variable. Participating in the initial assessment, along with taking Engineering 101, reveals the instrument efficacy in promoting an indirect connection with the behavioral and psychological aspects of engineering. Other strong correlations were shown in this group between the SPVE variable and Mentor influence, Intrinsic Behavioral, and Parent Influence.

Group #2

In Group #2, several strong significant relationships were found between the motivation variables due to both the interventions and the ESMI instrument. The overall motivation to pursue engineering, SPVE variable, had a strong significant relationship with Mentor Influences (49%) and Parent Influences (38%). These variables were the least valued by students over other motivating factors. Additionally, their Intrinsic Psychological value had a strong significant relationship with their General Impressions of Engineering (31%) and Intrinsic Behavioral (38%). The various and multiple strong relationships between the variables indicate that a student's awareness of opportunities in the field of engineering increased his or her motivation to pursue engineering.

Group #3

Group #3's General Impression of engineering had a strong impact on their Intrinsic Psychological motivation value (47%). Additionally, their overall motivation to study engineering had a strong significant relationship with Mentor Influence (26%) and Intrinsic Behavioral, explaining 28% of the variance.

Group #4

Group #4's overall (SPVE) motivation had a strong significant relationship between Intrinsic Psychological (52%) Mentor Influence (49%) Intrinsic Behavioral (32%) and Parent Influence (27%).

Comparing the degrees of correlations between the groups, the most significant and strongest correlations came from Group #1 and Group #2 who participated in the pre-assessment ESMI in the beginning of the year. Group #2 had a higher variety of strong correlations, showing intervention efficacy. Group #3 and Group #4 had fewer strong correlations, without the instrument in the beginning, contributing to their motivation. This finding justifies the value of having an introduction to engineering class at the beginning of their engineering academic career. However, with a self-assessment instrument at the beginning of the semester, its likely Group #3 & Group #4 strong correlations would increase.

Each of the Groups of study revealed strong significant value with the Mentor Influence variable, potentially impacting their overall motivation to study engineering. This finding demonstrates the need for students to engage with strong positive mentor influences at the beginning of their college experience.

5.2.2.3 Mastery Experiences Variables: Post-Assessment

In Engineering 101, intentional time is spent discussing the essential skills of an engineer to include communication, working in teams, and technical writing. The hope is to bring immediate awareness of the need for engineers to have essential skills sets. In the post-assessment, the groups who also participated in the pre-assessment were informed of the value of these skills allowing indirect reflection throughout the semester. Group #1 valued the skills of engineering higher than the rest of the groups of study in all three mastery experience variables, with an overall value of 85%. Also, due the ESMI, Group #1 showed more value specifically in the interpersonal and professional skills than the other three groups (80.12%). Group #2 followed in this behavior with 78.22%.

5.2.2.3.1 Mastery Experiences Variables: Gender

Overall population

In the post-assessment population of Gender, Females in all groups of study were shown to value the engineering skills overall more than Males and Other gender affiliated groups.

Groups of Study

Providing the ESMI at the beginning of the semester to Group #1 and #2 provided a sense of awareness of the engineering skill set earlier in an engineering student's academic career. Evidence of this was shown in Group #1's Female students, who responded significantly higher on the Perceived Importance of Math and Science skills (100%) over Group # 3 Females (82.91%). Additionally, the Group #1 Females valued math and science skills over the Males in the same group (77.71%). Group #1 Females showed significant value of the essential engineering set overall, compared to all the other groups of study and their Genders. Although Group #1 did not have interventions, Engineering 101 provided an enhancement and further opportunities to understand the need for the essential skills.

5.2.2.3.2 Mastery Experiences Variables: Ethnic

Overall Population

Similar to gender and the overall population, assessing the students in terms of their ethnic background showed that all the Groups valued Perceived Importance of Math and Science skills over the Perceived Importance of Professional and Interpersonal skills. Comparing the values between the ethnic groups revealed that Black/African American students (89.76%) and Asian & Pacific American (90.27%) perceived that math and science skills were significantly more important than did the White American students (87.74%). Additionally, the Black/African American (86.10%) and Asian & Pacific population (86.91%) overall valued the engineering skill sets more than did the White American students (81.64%).

Groups of Study

Ethnic groups in the post-assessment study valued the essential engineering skills equitably. Because of the instrument and interventions, the Group #1 and Group #2 ethnic populations demonstrated similar perceived worth of the engineering skill sets. However, looking at the White Americans, particularly in Group #3 and Group #4 (73% and 69%, respectively), it was noted that they valued the interpersonal and professional skills less than the math and science (both at 89%). By having participated in the pre-assessment, Group #1 and Group #2, White Americans valued each skill sets equally.

5.2.2.3.3 Mastery Experiences Variables: Program Affiliation

Students who were affiliated with a scholar program exhibited increased value, overall, in the Mastery Experience (engineering skill set) than Non-programmed students. Both program affiliated and non-programmed students valued the Perceived Importance of Math and Science skills higher than the Perceived Importance of Professional and Interpersonal skills. However, by participating in the pre-assessment, Group #1 and Group #2 Non-programmed and Programmed Affiliated students demonstrated more equivalent values toward each the engineering skills sets. As shown previously, students had the opportunity to reflect on these skills and further understand them when discussed and demonstrated throughout the semester. This reflection helped students regardless of program affiliation.

Group #3 and #4 behaved differently, revealing S-that STEM students, for example, exhibited a larger difference in value between interpersonal skills (83.50% and 56% respectively) and math and science (97.5% and 100%). Non-programmed students in Group #3 and Group #4, also demonstrated this behavior, with interpersonal skills at 75.63% and 73.38% verses math and science at 89% and 87.89%.

5.2.2.3.4 Mastery Experience Post Assessment: Correlations

All four Groups of study had a strong significant relationship between the overall skill set value and the independent variables (math and science, and interpersonal and professional). Group #1 and Group #2 math and science (53% and 69%) and personal and interpersonal skills (65% and 58%) had a similar impact on their overall value of the engineering skills. Group #3 and Group #4 displayed a larger impact of interpersonal and professional skills (71% and 76%), than math and science (55% and 43%). The strong significant relationship demonstrates the need to encourage the positive value of each skill sets earlier in a student's academic career which ensures persistence in the field.

Due to the efficacy of the ESMI, the engineering essential skills were valued more equitably in Group #1 and Group #2. Further discussion in pre to post results will show several increases in value of the engineering skill set.

5.2.2.4 Emotional State Variables: Post-Assessment

The emotional states of the Groups varied depending on participation with the instrument at the beginning of the semester. Group #1 and Group #2 had the highest overall Emotional States compared to Group #3 and Group #4. Group #1 had the highest Coping Self-Efficacy (84.92%) where Group #4 had the lowest (79.18%). Group #2 had the highest Engineering Career Success Expectations (85.05%), but Group #4 had the lowest (81.89%). In contrast, Group #4 had the highest Feelings of Inclusion (72.14%), where Group #3 had the lowest (66.62%).

5.2.2.4.1 Emotional State Variables: Post-Assessment Gender

Overall population

Males, Females and Other gender affiliation had similar feelings of Engineering Career Success Expectations, ranging from 78.50% to 84.46%. However, a significant difference was shown for the

Female population vs. the Male in Coping Self-efficacy, with a moderate effect size of 6%. Females felt significantly less able to cope with failure (78.23%) compared to their Male colleagues (83.72%).

Female students' engineering Emotional States, while fairly high at 76.19%, were significantly less than their male colleagues (79.14%), with a small effect size of 23%.

Groups of Study

Group #1 Males and Females showed higher Emotional states on all variables compared to Group #3, due to the instrument. Additionally, where normally a gender distinction would be seen between the males and females, Group #1 gender emotional states were equitable whereas in Group #3, Males had higher states of emotion compared to their female colleagues. For example, Group #1 Males felt they could cope with failure (coping self-efficacy) at 85% and Females at 83%. Group #3 Males were almost 10% higher in their Coping Self-efficacy at 85% whereas Females felt less of an ability to cope with failure at 76%.

In Group #2 and Group #4 a more equitable behavior was demonstrated in emotional states between the gender populations. Additionally, both groups showed similar values in their emotional states for all variables. Although Group #2 had both the ESMI and Interventions, Group #4 showed how interventions alone can help improve the emotional state of the student. However, Group #1, who participated in the instrument only, without interventions, had the highest overall emotional states in both Males and Females (80% and 79%, respectively) compared to the intervention groups with Group #2 Males and Females at 79% and 75% and Group #4 Males and Females at 78% and 77%. Both instrument and interventions show to be a benefit to both Females and Males. Although Coping Self-

efficacy continues to be a struggle for Female students, Males and Females were shown to have similar feelings of inclusion and engineering career expectations.

Gender populations who identified as non-binary (other gender) populations were only 1.1% of the participant population. Further investigation with a larger population size would be needed to make more definite conclusions.

5.2.2.4.2 Emotional State Variables: Post-Assessment Ethnic

Overall population

Research has shown that certain ethnic populations of students can struggle with their persistence in the engineering field due to their emotional states (Fleming and Smith 2013). This includes feeling they won't fit in with their peers due to a lack of representation of their ethnic population. However, in the post-assessment in this study, several overall positive outcomes revealed that Black/African American Students had the highest Coping Self-Efficacy (85.17%), Latin/Hispanic American population had the highest engineering career success expectations (88.50%), and Other ethnic affiliation had the highest Feelings of Inclusion (73.33%). Latin/Hispanic students had the highest overall engineering Emotional States (79.83%).

Groups of Study

Examining the Ethnic population with respect to their Groups of study, Group #1's ethnic groups commonly showed a higher emotional response rate than Group #3's, due to the instrument efficacy. For example, Black/African American students' Feelings of Inclusion in Group #1 was 10% higher (79%) compared to Group #3 (69.7%). The White American population in Group #1 also felt more included in their environment (73%) than Group #3 (65%). However, the Asian/Pacific population reflected a lower overall Emotional State in Group #1 (65%) than in Group #3 (77%). As seen previously in the pre-

assessment data, the Asian American community has external cultural pressures to succeed which could explain the variation in each of the data sets.

Further assessment of the ethnic groups revealed that Group #4's Latin/Hispanic students felt significantly less included in the field (42.00%) compared to all other ethnic groups. Additionally, their overall engineering Emotional states (65%) were less than the Latin/American population in Group #2 (83%), which received both the instrument and interventions at the beginning and throughout the semester. The Latin/Hispanic participation population was low in Engineering 101, accounting for only 7.1% of the students. Twenty-seven percent¹ of the Latin/Hispanic community at UMBC are first generational students. This population, especially in fields like engineering, struggle to feel they fit and are accepted into their disciplines. By having the opportunity to participate and evaluate their engineering mindsets with ongoing interventions, a positive increase was seen in Latin/American students' Emotional states.

5.2.2.3.3 Emotional State Variables: Post-Assessment Program Affiliation

Overall population

In the post-assessment with respect to the Program Affiliation, common trends were found for students who were associated with a formal program over students who were Non-programmed. In the overall evaluation of this population, Meyerhoff students had the highest feeling of Coping Self-Efficacy (86.20%), the highest Engineering Career Success Expectations (89.90%), and the highest overall Emotional states (82.2%). CWIT affiliates had the highest Feelings of Inclusion (77.89%). Non-programmed students felt the least included in their environment (67.99%). These reflect a program in the Meyerhoff's 2019 Summer Bridge Program. They launched a "persistence series" that included seminars that focused explicitly on their ability to handle failure. Non-programmed students exhibited the lowest emotional states compared to Program Affiliated groups.

Groups of Study

Group #1 and Group #2 showed better Coping Self-Efficacy, Engineering Success Expectations and Feelings of Inclusion compared to Group #3 and Group #4, due to the instrument and interventions. Group #2 Emotional states were higher compared to other Groups. For the Group #2 Non-programmed students, Engineering Career Success Expectations (85%) was higher than the Group #4 Non-programmed population (80%). S-TEM students in Group #2 had higher Feelings of inclusion (73%) compared to Group #4 (50%). Although both groups had interventions, the opportunity for a student to understand their state of mind by taking the ESMI at the beginning of the semester may have helped the students articulate ways to actively improve themselves.

Despite a student's association with a high impact program, the study further revealed that the Program Affiliated students struggled with feelings of inclusion related to their engineering career. Feelings of Inclusion showed to be the lowest value among all Groups, with a total mean value of 68.93%.

5.2.2.3.4 Emotional States Post Assessment: Correlations

It's not uncommon, particularly in the first semester of college, to see students struggle to feel that they can belong in their field. The post-assessment correlation evaluation of the Emotional state variables revealed that a student's perceptions of inclusion, career expectations, and ability to cope with failure all strongly impact their Emotional State as an engineer. For example, in all Groups of study, a significant and strong relationship was found in how a student feels included with their overall emotional states at the following levels: 61%, 81%, 49%, 51%, Groups #1- #4 respectively. These strong relationships between the variables, in combination with an unfavorable Emotional State, could lead to potential failure or dropping out of the major.

5.2.2.4 Confidence in Completing Engineering Degree Post-Assessment

Students in all four Groups were asked to recall their beginning and present confidence at the end of the Fall 2019 semester. Group #1 and Group #3 had similar beginning confidences; however, Group #3 indicated that their present confidence in completing their degree was slightly higher (81%) compared to Group #1 (74%). A similar behavior was found in Group #2 present confidence (76%) compared to Group #4 (82%). Group #2, however, had a smaller drop in confidence from beginning to present (3%) compared to Group #4 at around 5%. Although no significant difference was found between the groups, the higher confidence of control Group #3 maybe attributed to having strong influences, such as their undergraduate teaching assistants. Group #4's, the Honors College and FYE section, interventions provided the support and community needed to give them a sense of belonging and knowing they can succeed.

5.3 How do first year engineering students' perceptions change after a gained understanding of their Engineering State of Mind? – Aim #3

5.3.1 Pre-Post Group #1 and Group #2 Comparison -Aim#3

In this section, a discussion of any significant or important differences from the pre-assessment at the beginning of the semester to the post-assessment at the end of the semester, , will be covered for Group #1 and #2. . Both, Group #1 and Group #2 received the ESMI at the beginning of the semester. However, only Group #2 received interventions.

5.3.2 Pre and Post Social Persuasion and Vicarious Experiences (SPVE)

The ESMI provided a student an awareness in how the engineering field can expand beyond the classroom. Students are exposed to several motivations to pursue engineering, which can help navigate

opportunities outside of academics. In this study Group #1 showed important increases in motivation constructs, although the students did not receive interventions. These increases included motivation to improve the welfare of society (Social Good) (pre=81% to post= 86.57%), Financial motivation (74.04% to 76.81%), and Intrinsic Psychological motivation (83.02% to 87.11%). General Impressions of Engineering decreased from 80.20% at the beginning of the semester to 75.41% at the end of the semester. Although no intentional interventions were used on this group, motivational increases and decreases can be also attributed to the Engineering 101(ENES 101) class. Throughout the term, ENES 101 provided reinforcement of the various engineering careers and practices, which hopefully encouraged a student to continue to pursue a career in engineering.

Group #2 results showed there was a greater impact to their motivations than in for Group #1 due to the added intentional interventions provided throughout the semester. Students in Group #2 received opportunities such as peer mentorship, visiting upper level classes, class reminders about resources on campus, email invitations for seminars from companies and for research, and simple encouragement throughout the semester on understanding that success isn't measured just in grades. Group # 2 showed increases on multiple SPVE variables with significant differences to include Financial rewards (71.68% to 75.22%, with a moderate effect of 7.3%), Social Good (79.51% to 87.38%), Mentor Influence (26.63% to 32.67%), and overall motivation to pursue engineering, SPVE (62.17% to 66.81%). Other increases that were not significant, but important, included Intrinsic Psychological (81.24% to 87.82%), and Intrinsic Behavioral (80.85% to 87.65%).

5.3.2.1 Pre and Post SPVE: Gender

Due to exposure of the ESMI and interventions, a clear impact was made on both Male and Female students within the Groups. Although a small population, those classified in Other (non-binary

gender) also increased in their motivations. While Group #1 had increases, small non-significant decreases were found in each of the gender populations within that group. In Group #1, Female students' motivations increased in Social Good (77.89% to 87.78%) and Intrinsic Psychological (78.44% to 81.56%). Decreased motivations in the Female population included Financial Rewards (80.72% to 75.56%) and Mentor Influence (42.17% to 38.89%). As other motivations increased, the value of engineering weighed less on the Financial aspect of engineering. The Male population in Group #1 had an important motivational increase in, Social Good (82.02% to 85.50%), Mentor Influence (27.90% to 31.37%), and Intrinsic Behavioral (83.55% to 87.71%). Male students' General Impression of Engineering decreased (80.55% to 74.39%).

Group #2 had significant increases both Math and Female motivations. Although clear motivational differences between Male and Females existed, in the post-assessment these differences were either smaller or no longer apparent between the genders. Female students' motivations had an average increase of 11.19% on all motivation variables with Mentor Influence seeing the largest increase from 27.29% to 42.21%; Parent Influence increased from 15.90% to 29.86% and Social Good increased from 75.19% to 88.14%. Their overall motivation to pursue engineering, SPVE, increased by 9.38%, from 58.19% to 67.57%. Male students' motivations had an average increase of 5.02% in most motivation variables, except Parent Influence, which remained the same. The highest increases were for Social Good (80.98% to 88.68%) and Intrinsic Psychological (81.88% to 88.73). Overall motivation to pursue a degree in engineering, SPVE, increased by 3.45%. These significant increases demonstrate the value of the ESMI, and that the effects are amplified with ongoing intentional interventions.

5.3.2.2 Pre and Post SPVE: Ethnic

In each of the Ethnic populations, motivation variables were inconsistent in their increases and decreases. Black/African American students increased in Parent Influence (14.47% to 22.33%) and

decreased in Intrinsic Psychological (89.73% to 74.17). White American students increased in Social Good (81.28% to 89.79%) and decreased in General Impressions of Engineering (80.43%-76.36%). Asian Pacific students had no increases but decreased the most in Intrinsic Psychological (76.15% to 57.50%). Other Ethnic populations increased in Intrinsic Psychological (55.60% to 83.80%) and decreased on General Impressions of Engineering (82.20% to 79.50%). The Latin/Hispanic population was not assessed in Group #1, as no post-group was reported.

Group #1

Many of the Ethnic populations increased in various motivations. More specifically, the White American population increased in Social Good (81.28% to 89.79%). In contrast, Asian Pacific students decreased substantially in Social Good (82.15% to 65%). Further, Asian Pacific students decreased in their General Impressions of Engineering (77.54% to 62.50%). Since the survey was taken at the end of the semester, it is possible the students felt they were no longer interested in the major or not performing well in the class. Specifically, with the Asian American population, if they were pushed into majoring engineering for their parents, its likely they recognize they are not passionate about the field and pursuing an engineering degree for the wrong reasons. The role of the ESMI is to help students self-assess their rational in being an engineer. This does include, helping students recognize they are in the field for the wrong reasons.

Group #2

Group #2 Ethnic Population motivations also had various increases and decreases since the beginning of the semester. As seen with previous populations amplified increases were seen in the motivation to pursue engineering due to interventions. Black/African American students increased in Social Good (74% to 77.88%). White American's Intrinsic Behavioral increased (82.93% to 93.69%) as did their their motivation in Social Good (82.30% to 91.24%). The Latin/Hispanic American Intrinsic

Behavioral significantly increased (33.33% to 86.60%). In the Asian Pacific population, Parent influences increased (27.78% to 39.36%), while several of their motivations decreased, including General Impressions of Engineering (72.44% to 68.64%). This may be caused if their parents potentially push them into an engineering field, their desire to continue to be in the field is low. However, unlike Group #1, other motivations in Group#2 for Asian Pacific students remained around the same, as well as their overall motivation to pursue an engineering degree (65% to 66%). This can be attributed to both the ESMI and intervention efficacy.

5.3.2.3 Pre and Post SPVE: Program Affiliation

Group #1

As shown in previous population data sets, the Program Affiliation's in Group #1 showed similar behaviors with the ESMI, exhibiting various increases and decrease in motivation variables. However, the decreases were not significant. For example, Meyerhoff Scholars increased in their motivation in Social Good (90.57% to 95.29%) but decreased in Mentor Influence (21.57% to 12.0%). Non-programmed students showed mostly increases in their motivation, such as Social Good (80.29% to 83.24%). S-STEM students had only one decrease, in General Impressions of Engineering (84.43% to 73%). Otherwise, all the variables increased for S-STEM students, such as Intrinsic Behavioral (85.71% to 96.60%). CWIT Scholar and CWIT Affiliates were not evaluated, because neither had both a pre and post population.

Group #2

The results in Group #2 reveled Non-programmed and S-STEM students were positively impacted by both ESMI and Interventions. The Meyerhoff scholars had a low response rate and CWIT

Scholar and CWIT Affiliates were not evaluated, because neither had both a pre and post population. Although Programmed affiliated student had a community of support that provided additional resources in self-assessment and interventions to help increase their motivations. S-STEM students increased the most in Parent Influences (1.70% to 33.33%) and Social Good (80% to 93%). No variables decreased for these students. Non-Programmed students increased in Intrinsic Behavioral (78.90% to 88.02%) and Social Good (80% to 87%). Meyerhoff students' mentor influences decreased substantially (100% to 46%). This could be due to an unfavorable experience in their community. In contrast, S-STEM students Mentor Influence increased (10% to 22%). This result is reflective of the program's requirement for S-STEM students to join UMBC's American Society of Mechanical Engineers peer mentoring program.

5.3.3 Pre and Post Mastery Experiences (ME) – Group #1 and Group #2

Each of the Group's skills values increased overall as a result of both the instrument and interventions. An important increase was found in the Professional and Interpersonal Skill set. In the pre-assessment, the Math and Science skill set were seen as the more valuable essential skills. However, after completing the semester of Engineering 101 and using the instrument a second time, both Groups were able to understand how skills such as verbal and written communication and presentations were just as essential as math and science skills.

Group #2 showed a minor decreased (88% to 86%) in their value of Math and Science skills, but an increase in the Professional and Interpersonal skills (75% to 78%). As their value and understanding of the Professional and Interpersonal skill set increased, they may have seen that Math and Science skills are just as important.

5.3.3.1 Pre and Post Mastery Experiences (ME): Gender

Group #1

Group #1 showed large increases in their value of the engineering skill set, especially for the Females, due the efficacy of the instrument. All variables significantly increased for the Females,

especially in the Perceived Importance of Professional and Interpersonal skills (78.11% to 90.00%). The Male population variables all increased, with their highest increase in the Perceived Importance of Professional and Interpersonal skills (74% to 77.71%). The Other gender affiliated group, albeit a small population, increased in the Perceived Importance of Professional and Interpersonal skill value (64% to 83%). This group also decreased in the Perceived Importance of Math and Science skills (94.50% to 78.00%).

Group #2

Group # 2 behaved differently, showing some decreases in the Math and Science skill set for both Males and Females. Both Gender groups felt that Math and Science was slightly more valuable than Professional and Interpersonal at 86%. However, it was only a slight increase of 6% from the skills, which increased for both groups in the post-assessment.

Giving students an opportunity to self-assess helps promote awareness, particularly in their perception of the essential skills of an engineer. Engineering 101 intentionally spends time emphasizing that communication and teamwork are invaluable for an engineer. With both of those factors, a shift bringing both of these skill sets to similar levels is expected as seen for both Group #1 and #2.

5.3.3.2 Pre and Post Mastery Experiences (ME): Ethnic

As with previous population groups, Group #1 and Group #2 showed minor decreases primarily on the Math and Science variable. In contrast, an increase in value was shown on the Professional and Interpersonal skills. The Math and Science skill decreases were not significant, and that skill remained overall strong in value. We want our students to value the professional skill set as equally important as the math and science skill set. The ESMI and interventions both promoted awareness and reinforcement of the essential engineering skill sets, which resulted in the increase in the professional skills that brought them closer to the math and science skills.

Group #1

Group #1, due to the instrument and class alone, Black/African American students only increased, with highest change in the Perceived Importance of Professional and Interpersonal skills (79.9% to 83.33%). White Americans also increased in the Perceived Importance of Professional and Interpersonal skills (74.5% to 77.2%), but had a minor decrease in the Perceived Importance of Math and Science (89.41% to 88.60%). Asian Pacific Americans had only increases a significant increase in the Perceived Importance of Professional and Interpersonal skills (65.9% to 83.33%). The Other Ethnic group also only increased, with the highest change in the Perceived Importance of Professional and Interpersonal skills (77.8% to 85.25%). Latin/Hispanic was not discussed as a post group did not exist.

Group #2

Group #2 demonstrated different behavior than Group #1, showing decreases in some of the Ethnic population. Black/African American students only decreased, with the largest decrease being in the Perceived Importance of Math and Science skills (93.05% to 83.5%). White Americans increased in the Perceived Importance of Professional and Interpersonal skills (74.65% to 76.27%), but had a minor decrease in the Perceived Importance of Math and Science skills (90.1% to 85.50%). Asian Pacific Americans only increased, with the highest change in the Perceived Importance of Professional and Interpersonal skills (74.05% to 83.09%). Latin American students also only increased with the highest change being in the Perceived Importance of Professional and Interpersonal skills (77.67% to 83.20%). The Other Ethnic group also increased in the Perceived Importance of Professional and Interpersonal skills (62.4% to 75%), but had a minor decrease in the Perceived Importance of Math and Science (93.4% to 90.8%). Any decreases could be attributed to an unfavorable experience in the semester

around the math and science classes. If the student does not relate to the professor or is performing low, the student's value of the subject is likely to decrease.

5.3.3.3 Pre and Post Mastery Experiences (ME): Program Affiliation

As shown in other populations, in both the pre- and post-semester groups, the value of perceived Importance of Professional and Interpersonal Skills increased for all of the programmed and non-programmed groups. Additionally, in some cases, the value of Math and Science skills decreased. For example, in Group#1, Meyerhoff students increased in the Perceived Importance of Professional and Interpersonal skills (84.8% to 90.4%), but had a decrease in the Perceived Importance of Math and Science skills (95.28% to 81.14%). S-STEM students also increased in the Perceived Importance of Professional and Interpersonal skills (77% to 82%), but decreased in the Perceived Importance of Math and Science skills (98.4% to 95.6%). Non-programmed students only increased in both skills sets with their with highest in change in Professional and Interpersonal skills (73.4% to 77.7%). CWIT scholars and CWIT Affiliates are not discussed because neither a pre nor post group existed.

Group #2 demonstrated different changes, showing only an increased value for both skills sets due to both the interventions and interventions. Meyerhoff students showed the highest change in the Perceived Importance of Math and Science skills (78% to 94.5%), and S-STEM students also only increased with the highest, significant, change in the Perceived Importance of Professional and Interpersonal skills (72.8% to 92.6%). However, Non-programmed students increased their perceived importance with highest change in Professional and Interpersonal skills (74.86% to 77.64%), but had a small decrease in Math and Science skills (88.36% to 85.22%). CWIT scholars and CWIT Affiliates are not discussed as neither a pre nor post group existed.

Group#2 programmed and non-programmed students revealed very minor increases in math and science, but large professional and interpersonal skill increases, compared to Group #1. It's clear that, with or without programmed connections, allowing the student time to self-assess helps educate the student about the importance of both skill sets. However, students with a connection to their program showed greater change compared to Group #1 programmed affiliated students. Belonging to a program notwithstanding, both ESMI and having additional interventions helped to improve a student's perceptions regarding the essential engineering skills.

5.3.4 Pre and Post Emotional States

In comparing the pre to the post assessment, both groups of study showed increase in their all their Emotional State variables. Significant increases were found in Group #2, with the interventions and the instrument, in contrast to Group #1, where important positive changes were shown, but they were not significant. Group #2 showed significant increases in Feelings of Inclusion (54.59% to 68.06%) , Engineering Career Success Expectations (81.15% to 87.06%), and overall Emotional State (71.63% to 80.95%). Again, this positive effect can be attributed to the interventions that were absent from Group #1.

5.3.4.1 Pre and Post Emotional States: Gender

Further intervention efficacy was found in each Gender population. Group #1 Females increased the most in Coping Self-Efficacy (79.78% to 83.33%), while Males increased the most in their Feelings of Inclusion (65.52% to 71.79%). Group #2 Males significantly increased on all Emotional State variables including their Engineering Career Success Expectations (81.28% to 85.75%), Feelings of Inclusion (56.56% to 68.07%), and overall Emotional states (73.03% to 78.98%). Females in Group #2 had important increases as well, such as their Feelings of inclusion (54% to 65%).

The interventions in Group #2 provided ways, such as peer-mentorship, ongoing encouragement, and positive feedback that explained the ‘normalcy’ of the first semester adjustments, to help the students’ cope with negative feelings.

5.3.4.2 Pre and Post Emotional States: Ethnic

In the Ethnic populations, evidence of increased positive Emotional states was found. By participating in the pre-assessment, Black/African American students only slightly decreased the most on their Engineering Career Success Expectations (87.60% to 83.33%); however, increased in Feelings of Inclusion (70.83% to 78.50%). White Americans increased in all emotional variables with Feelings of Inclusion being the greatest, significant, change (64.63% to 72.96%), and an increase in Emotional States (76.72% to 81.29%). Asian Pacific students decreased in their Emotional States such as Feelings of Inclusion (44.50% to 36.33%). As seen in the Social Persuasion and Vicarious Experiences, the Asian Pacific population showed decreased motivations to pursue an engineering degree in the post-assessment. If a student’s engineering Emotional scores are low, it is reasonable that their motivation would also decrease (Mamaril et al. 2016, Rittmayer and Beier 2008, Seymour and Hewitt 2000). Group #2 showed more of a consistent increase due to added interventions. Black/African American students’ Emotional States all increased with the greatest change in Feelings of Inclusion (47.26% to 54.25%). White Americans also increased in all emotional variables with Feelings of Inclusion being the greatest and significant change (55.25% to 67.90%). Latin/Hispanic American increased on all variables with Coping Self-Efficacy being the highest (74.33% to 86.20%). Unlike Group #1, Asian Pacific students increased overall, except for a minor decrease in Coping Self-Efficacy (80.89% to 78.27%) with the added interventions.

5.3.4.3 Pre and Post Emotional States: Program Affiliation

Having a self-assessment instrument, along with a strong community, supports a student's ability to reflect while providing them another resource to help change their Emotional States. However, despite having a formal program, many of the programmed affiliated students' Emotional States decreased. In Group #1, Meyerhoff students had the highest increase in their Feelings of Inclusion (64% to 83%), but slightly decreased in Engineering Career Success Expectations (89% to 86%). S-STEM students' Feelings of Inclusion increased (62% to 65%), but decreased in their Engineering Career Success Expectations (90% to 84%). In Group #2, Meyerhoff students' Feelings of Inclusion increased (38% to 56%), but slightly decreased on Coping Self-Efficacy (77% to 75%). S-STEM students' Feelings of Inclusion increased (56.40% to 73.33%), but showed a slight decrease in Coping Self-Efficacy (84.50% to 83.33%). Again, although the instrument alone was helpful, having the added interventions minimized the decreases in the engineering Emotional States despite the students programmed associations.

Non-programmed students only increased in their Emotional States in both groups of study. In Group #1, for example, Non-programmed Feelings of Inclusion increased (65% to 67%). Non-programmed students in Group #2 had the same impact except their increases were significant due to the added interventions. For example, Non-programmed students had a significant increase in Feelings of Inclusion (56% to 67%).

5.3.5 Confidence in Completing Engineering Degree

Group #1 and Group #2's confidence, overall, was fairly consistent from the beginning to the end of the semester. Group #1 had a larger variation than Group #2, reflecting their post-assessment beginning confidence increased from their initial assessment (79.77% to 84.23%). Group #2 Students felt they were more confident in the beginning than originally indicated. However, their post-present

(post-assessment) confidence of 74.41% was rated less than their pre-present (pre-assessment) confidence of 79.0%, showing a small 4.6% drop.

In the post-assessment evaluation, Group #2 consistently showed greater improvement in all the Social Cognitive Career Theory (SCCT) variables compared to Group #1. This impact helped contribute to the student confidence remaining strong and consistent from the beginning to the end semester. For example, Group #2's pre-beginning confidence of 80.28% increased to their post-beginning confidence of 79.25%. Their Post-Present confidence of 76.5% was rated slightly higher than their Pre-Present confidence of 75.9%.

The ESMI alone showed invaluable support for the students and their confidence in completing a degree in engineering. Adding interventions with the instrument, magnified this impact, controlling confidences and positively increasing their motivations, emotional states, and perceptions of the field.

5.4 Qualitative Impact Post- Survey

Further evidence of the impact and efficacy of the ESMI and interventions were investigated through a qualitative survey assessment. Those students who participated in the post-assessment were asked to take a follow-up impact qualitative survey. In the following section, the impact of the survey and the responses are discussed. Common themes, derived from each question as shown in Chapter 4, are highlighted as they relate to the groups of study for each aim. Quotes from the students are provided as examples to support the themes. Although many themes were found, more common responses reflected the following:

- Profiles helped students relate to other engineers with difficulties – AIM #1
- Value and connection of engineering skills and practices (professional and technical skills) to themselves outside of the classroom – AIM #2

- ESMI – Reflection of attitude, perception and value - AIM #2
- Reinforcement of their decision to study engineering (Retention) - AIM #2 & #3
- Expanded understanding of Engineering - AIM #2 & #3

No names are provided to ensure anonymity.

5.4.1 Profiles helped relate to engineers with difficulties – AIM #1

As a part of the instrument self-assessment process, it was important to have students in their Third, Fourth, and Fifth years provide their ESMI profiles and explain the challenges they faced when they began their engineering education. This served as an indirect way to provide peer-mentorship. First year students reflected on these profiles and expressed whether they were useful. The most common response from all groups of study was that the profiles were “relatable.” They showed appreciation for peer engineers that experienced difficulties. As an example, some of the students specifically mentioned which upperclassman they related to the most:

Yes, the first one I read about Collin really resonated with me because I have been thinking the same thing he describes in his difficulties section, and know it really could be worth it to just stick to it.

-Female White American, Honors College, Group #1

Students frequently described how it was impactful to see someone who, despite failing or having doubts, could persist in the field and graduate.

Yes, I saw one of the profiles that said someone almost dropped out of their major because of not doing well in one class but ultimately its going to happen. that helped me because I know even if I struggle a lot of other people will be struggling too so I wont be alone

-Female, Latina/Hispanic American, Non-programmed, Group #2

Yes, knowing how people who used to be in the same position I am in now and actually knowing some of them on a personal level helped me to identify similarities between them and myself.

-Male, African American, Meyerhoff, Group #4

I actually feel a lot better after looking at the profiles, because it makes me realize that the difficulties I am having, such as my struggle with math and time management this semester, are normal. Since they have gotten through their difficulties, I know I will be able to as well. Also I didn't have the highest percentages on the ESMI, but some of the profiles show me that I don't necessarily need to.

-Female, White American, Honors College Group #4

5.4.2 Value and connection of engineering skills and practices (professional and technical skills) to themselves beyond the classroom – AIM #2

Group #1 and Group #2 participants were asked to self-assess their initial results at the beginning of the semester and their current results. The most common responses from Group #1 was an increase in their Social Persuasion and Vicarious Experiences, Mastery Experiences and Emotional States variables. For example, a non-binary, White American, Honors College student from this group explained:

I feel much better about being an engineer — mostly because I now know people. My motivation has gone up a little bit (from 66% to 74%) because I have a bit more mentor influence and I feel more motivated by the social good and money that comes from engineering. My value of skills necessary for engineering has gone down slightly, although only by 8%, most likely because I placed slightly less importance on math/ science skills and more importance on interpersonal skills.

Another example was from a White American, Non-programmed male student discussing how his Feelings of Inclusion increased:

Yes. The biggest thing that changed for me is how relatable I found other students. I enjoyed meeting and making friends with people from various backgrounds.

And a White American female discussed how her Mastery Experience skills increased because she was able to connect the engineering skills to Engineering 101.

My first score, how do I feel, decreased a little whereas my middle score did not change significantly. My last score, valuing the skills increased/ I feel this increased because as I progressed in my classes I was able to see a connection between them and I see how important they are to each other.

Common responses from Group #2, mainly from the male population, were their ESMI scores did not change. However, almost half the students expressed change in the various variables in Social Cognitive Career Theory (SCCT), Mastery Experience and Emotional variables. An Asian American male student discussed his increased confidence in his Mastery Experience skills:

Yes it increased, I have a more confidence now in my creativity and problem solving skills.

Another example from this group, a female Latin/Hispanic student, explained she felt more included in her courses through her classmates:

My ESMI percentages went up a little bit, most likely because I realized I wasn't going to be the only person in this class with my background and wasn't going to be the only engineer that was a girl able to stand up for myself.

A female African American/Black student scores increased and decreased on various variables:

My ESMI results change a little. When I first took it I got a score of 77 percent on how I feel about being an engineer, the second time around I got a score of 73 percent which I don't agree with. However, my motivation to study and practice engineering has gone up from 36% to 49%. My value for skills necessary for engineering went down from 95% to 84% which is a huge jump.

Assessing all four Groups revealed the theme of the *value and connection of engineering skills and practices*. Commonly mentioned practices were in the Mastery Experiences construct. However, the students connected to these practices beyond the engineering classroom.

I learned I like being able to think about a problem we have to complete and how to make the best designed machine to complete the problem. I also like working in teams in order to complete it.

-Male, Latina/Hispanic, Non-programmed Group #2

I learned that even if I struggle, I still believe in myself enough to push through and continue with this major

-Male, African American, Non-programmed Group #2

I learned that I am mostly motivated to study engineering because of the positive impact that it has on society as a whole. This means that I'm not studying engineering with the sole purpose of finding a well-paying job.

-Female, African/American Non-programmed, Group #3

I do agree with my results because even though I've known I've wanted to be an engineering major, I am not 100% sure about it.

-Female, Asian & Pacific American, CWIT – Scholar Group #4

Group #3 differed in that they exhibited a moderate response in learning what motivates them to be an engineer.

I learned that I am mostly motivated to study engineering because of the positive impact that it has on society as a whole. This means that I'm not studying engineering with the sole purpose of finding a well-paying job.

-Female, African American/Black, Non-Programmed

I learned that I like engineering because I like actual engineering and not because engineering offers a lot of money. I like to build things the physical building and a bit of the design process. This affirmed my desire to be a civil engineer or just an engineer in general. I also learned I am more motivated than I previously thought which makes me even more motivated to be an engineer

-Female African American/Black CWIT Scholar

Group #3's responses reflected what they experienced through Engineering 101 and the instrument.

5.4.3 ESMI – Reflection of attitude, perception, and value - AIM #2

Students were asked to re-examine their results and decide if they agreed with them or not. The common theme that emerged was the agreement that the instrument reflected an attitude, perception, or value. The least common response was complete disagreement.

For example, this student felt the results were accurate as he has been unsure if he wanted to continue in the field.

I do agree with the results. I am deciding between pursuing mechanical engineering and computer science, but I am leaning towards the latter. As a result, I expected my results to be mid range.

-Male, Asian Pacific American, Non-Programmed Group #4

This student felt the results were true as they doubt their abilities.

I believe it's true as I have a bit of doubt in myself and that seems to be indicated

-Male, White American, Non-Programmed

A number of students also felt the results were true because it reinforced their feelings and dedication to the field of engineering.

I got a really high percentage regarding the value of skills, which makes sense. These skills are why I want to be an engineer. I got a semi-high percentage for how I feel about being an engineer. This also makes sense because I feel like I fit in as an engineer but I still have my doubts. I got a middle-range

percentage for how motivated I am to study engineering which really fits where I am right now with my indecision over what major I really want to pursue.

-Female, White American, Honors College Group #4

I agree with my results because I am still interested and dedicated to getting my degree in mechanical engineering.

-Male, Latin Hispanic American Non-programmed Group #2

I mostly agree with my scores since they're all high and very high. I feel that I'm very confident into going engineering or some technology field and honestly could not imagine myself not graduating in STEM. However, I felt that my score for "Emotional and Physiological States" should be higher.

-Male, Asian Pacific American, Non-programmed Group #3

Looking at it closely, I can agree with where it placed me on everything, but I was still definitely surprised. I hadn't expected to rank very highly on many of them since I didn't experience much in the way of engineering until now, but it just goes to show that there's more to engineering than just being a problem solver or a builder.

-Male, African American/Black, Meyerhoff Scholar Group #3

However, some students were in moderate agreement with their results.

Somewhat, because I feel as though I'm unsure of whether or not I want to remain an engineering major even though my score results were relatively high. On the other hand, I realize that I could take more time researching about the career that I want to pursue and how my interests align with it.

-Female, African/Black American Non-programmed Group #3

I somewhat agree with them. I feel like at least some of the differences in scores could easily be attributed to a difference in willingness to choose the extreme options, although for certain aspects (namely feeling of inclusion and mentor influence) I certainly feel that there was a change there.

-Non-Binary, White American, Honors College Group #1

I disagree and agree with the first and second components. I personally think my feelings about being an engineer increased especially after taking chem 101. I agree with the second aspect about my motivation to study engineering due to me being exposed to a little glimpse of what engineers do.

-Female, African American/Black, Non-programmed Group #2

A third common theme related to their perception of themselves was their *Confidence Increasing or Decreasing*. This ranged from being the most common in Group #2, moderate in Group #1, to the least in Group #3.

My confidence in my abilities to take on college courses increased.

-Male, Asian Pacific American, Non-programmed Group #2

This student explains that by going through Engineering 101, they were able to reflect that they are more confident and able to work with a diverse set of their peers.

When we were taking the ESMI survey at the beginning of the year, I didn't know any of my classmates, which made me less confident. Now, after going through UROS [Engineering 101 project] with a team and after having gotten to know a few of my other classmates, I am more confident in that regard.

-Non-Binary, White American, Honors College Group #1

5.4.4 Reinforcement as Engineer (Retention) - AIM #2 & #3

Another theme that emerged was the *Reinforcement for Being in Engineering*. Students who answered in this classification indicated nothing changed about being an engineer or confirmed their decision to continue in the field. This theme was common in Group #2 and #4.

I think I have become more open-minded with respect to my future in engineering. I honestly have been very unsure and have been thinking about switching majors, but I really want to give engineering a chance and not just give up because of one semester's worth of difficulties.

-Female, White American, Honors College - Group#4

I had a pretty good idea of engineering expectations since one of my parents is an engineer, so nothing really changed for me

-Female, Latina/Hispanic Non-programmed Group#2

ESMI allowed me to reflect but did not change anything.

-Male, White American, Non-programmed Group #3

Not a whole lot changed, completing the course made me realized that engineering isn't as hard as I thought it would be and is actually kind of fun. I was worried I would hate it but I don't hate it

-Non-Binary, White American, Non-programmed Group #2

However, from Group #1, a Non-Binary White American explained the instrument helped them reflect and connect, solidifying their decision to become an engineer and that they wanted to expand their engineering experience into theatre.

Yes. Since taking the survey initially, I have decided to become a computer engineer with a minor in theatre. I realized that solely being an engineer would not be beneficial to be because I miss the emotional and creative outlet that theatre provided for me, and that broadening my outlook would provide more opportunities in the engineering field in general, and the technical theatre world more specifically— therefore making engineering more enjoyable to me.

5.4.5 Expanded understanding of Engineering - AIM #2 & #3

Students in Groups #1, #2, and #3 commonly responded that by taking the time to reflect and understand themselves, they expanded their understanding of the engineering field (*expanded understanding of engineering*). In Group #4, this theme was secondary, as they felt this helped reinforce their understanding that engineering was a good 'fit.'

Since I took the engineering state of mind, I am more aware of what motivates me when in class and how I perceive inclusion in engineering classes.

-Female, African American, Non-Programmed – Group #2

There are many roles that come with engineering and you don't have to be good at all of them to be a successful engineer.

-Male, White American, Non-Programmed – Group#1

I always expected an engineer's main tasks being do math, build, and design. I never really pictured another part of an engineer's job is to work with their peers and present their findings.

-Male, Asian American, Non-Programmed – Group #3

I see engineering now as not just a profession, but an entire state of mind that encapsulates a majority of the values I seek.

-Male, African American, Meyerhoff – Group #3

5.4.6 Feedback on Survey

At the beginning of the survey, several questions were included for feedback purposes. Student responses to these questions was optional. One of the questions asked if the students were interested in meeting with an adviser to discuss their results. 70% responded that they felt the information on website was sufficient and did not want to meet with an adviser. 23% weren't sure, and only 7% indicated "yes." Additionally, out of 30 respondents, most felt this study was informative (43%) to highly informative (23%).

Students were asked if they found the study to be interesting. Of the 24 students who answered this question, 75% agreed that it was interesting. Some of the responses addressed questions the students had about how the instrument was made and its constructs.

I found it interesting only because of the questioned [sic] asked in the survey that determined the percentages were not all that I expected. Like the questions about expecting to "fit in" a engineering job or if you think engineering can let you be creative. It was also refreshing to see the question about being able to be okay if you fail a test. You are supposed to take that failure as a learning opportunity and not something to discourage you from your dreams.

-Female, African American, CWIT- Scholar

Definitely. I'm especially interested in the reasoning behind giving only certain groups a survey at the beginning.

-Male, African American/Black, Meyerhoff Scholar

Yes, I do find it quite interesting. One of my favorite subjects in high school was psychology, so surveys/tools like this really interest me. I always knew that I was pretty certain about going into STEM, but seeing a numerical value is still very interesting.

-Male, Asian Pacific American –Non-programmed

Students in Group #1 and Group #2 were asked if, after receiving their scores at the beginning of the semester, they used any of the listed recommendations (high-impact practices) displayed in each variable.

In Group #1, the most common response theme was that students did not use the recommended sections on the website but will use them in the future. Group #2 expressed they simply did not use the website and were not aware of the recommendations. However, a couple of students did explain that they immediately took advantage of the recommendations at the beginning of the semester:

I used some of them. Lots of support was available

-Male, White American, Non- Programmed, Group#1

Some of the students reflected on the profiles of the upperclassman as recommendations.

I used the student profiles for comparison.

-Female, African American/Black, Non-Programmed Group#2

The same question about using the recommendations was asked of Group #3 and #4. Both groups had the common response theme of using the recommendations in the future. One student reflected that he will not only use the recommendations, but saw how this would help him in the future:

I think I will use the ESMI tool in the future to gauge how I feel about my major as I get closer to graduation and eventually finding a job. Perhaps, I will even use it while I do have a job.

-Male, Asian Pacific American, Non-programmed Group #3

As previously observed, some of the students viewed the profiles of the upperclassmen as recommendations and explained they will continue to reflect on them:

Yes I will review more of the student profiles whenever I am doubting myself because I know those are there to help us realize that we aren't alone in this.

-Female, White American, CWIT Scholar Group#4

Although these groups were not included at the beginning of the study, some of the students reflected on a currently utilized high-impact practice and how they would like to develop themselves more using the recommendations:

I definitely plan to, and actually already began using some of the resources over the course of the semester. Since most of what I already do is look to others for mentor-ship and advice, I would like to start focusing on more individualized and leadership-based recommendations that will help me round myself out as an engineer.

-Male, African American Male, Meyerhoff Group#3

Group #4, the Y and Honor Section, also had a similar response from students who will not be using the recommendations:

Not really sure. Most all the sections had a pretty reasonable score from what I was expecting to get. If something changes in the future, though, I will be sure to look back at these resources.

-Female, White American, CWIT Scholar

I don't think I will use the website, because I think evaluating my major and motivations will be better done through experience and talking to my peers. I did enjoy reading the profiles, however, because I don't feel quite as alone in my struggles.

-Female, White American, Honors College

5.4.7 Additional Feedback

Additional feedback was requested and several of the students provided unexpected answers. A few are shown below:

I love that we did this at the end of the semester but I would have loved if I was informed of it at the beginning of the semester because i think it would be interesting to see how it changes before and after completing enes 101.

-Female, White American, CWIT- Scholar Group #4

I believe the survey does a great job culminating much of what it means to be an engineer, to point of which it almost feels like it should be more integrated into the curriculum it tests off of. Taking an intro class to engineering should inspire students to see what it means to be an engineer just like the results of the survey.

-Male, African American/Black, Meyerhoff Scholar Group #3

I think it might be interesting to apply this study outside of engineering groups. The wording might have to change, but seeing how engineering can be applied to other majors or be multidisciplinary/interdisciplinary would be cool to see

-Non-Binary White American, Non-Programmed Group#2

5.5 Sophomore Mechanical Engineering and Post-Freshman

A small case study of the post-freshman mechanical engineering population comparison was performed with sophomore Mechanical Engineering students. Although no significant difference was found between the groups, sophomore students were shown to have confidences similar to those of freshman, both beginning and present.

No significant differences were found between sophomores or freshmen in their motivation to pursue an engineering degree, the SPVE variables. Examining SPVE correlations, sophomore students demonstrated strong significant relationship between Social Good and their overall motivation pursue engineering (SPVE), $r^2=59\%$. In the Introduction to Engineering Design class they just completed, students are required to design a toy for a child with disabilities, which is reflected in this relationship. The motivation to pursue engineering for practical, hands on application (Intrinsic Behavioral) also had a strong significant relationship with Social Good $r^2=33\%$ and Intrinsic Psychological $r^2=31\%$.

In examining Mastery Experiences variable, sophomores and freshman have the same perceived importance for both engineering skill sets. Both groups valued the Perceived Importance of Math and

Science skills (88.57%) higher than the Perceived Importance of Professional and Interpersonal skills (77%). No significant difference was found between the population groups. Correlations in the sophomore population revealed a significantly strong relationship between both Perceived Importance of Professional and Interpersonal skills at 68%, and Perceived Importance of Math and Science skills at 70% with overall importance of engineering skills (Mastery Experience).

While lower, the value of the professional and interpersonal skills was not significantly different than math and science skills. In Introduction to Engineering Design, students are required to give several presentations and write multiple types of engineering documents for their product. These assignments reinforce understanding of the importance of communication and teamwork which help to bolster the professional and interpersonal skills bringing them closer to the math and science skills.

In the Emotional States variables, post-assessment freshman engineering students in Group #1 (77%) and Group #4 (76.75%) felt more included with their environment and peers than the sophomores (66.27%) a moderate effect of 7.4%. This result reflects the population of sophomores who enrolled in ENME 204 in the Fall. Many of them tend to be first semester transfer students. For this participating population 36.4% of the students had previously attended a 2-year institution and 9.1% attended a four-year college. First semester transfer students tended to exhibit similar behaviors to first semester native freshman in their Emotional States. This was particularly true in their feelings of inclusion and the ability to relate to their peers.

Emotional State correlations revealed strong significant relationships in the sophomores' overall Emotional States with Engineering Career Success Expectations (67%), Feelings of Inclusion (56%), and Coping Self-Efficacy (34%). Sophomores', and especially transfer students', ability to feel they can succeed, deal with failure, and feel included in their environment affect their decision to stay in the engineering discipline (Sullivan et al. 2012).

Chapter 6: Conclusions, Future Work and Limitations

In this study, engineering students were presented with the opportunity to take a newly developed Engineering State of Mind instrument. A mixed method approached (quantitative and qualitative) was used to evaluate how students' perceptions, attitudes and self-efficacy changed as they reflected on their results.

Three research aims concerning engineering students' engineering self-assessment were investigated:

1. To define a UMBC student's (Third, Fourth and Fifth year) successful Engineering State of Mind. This was essential to the creation of the Engineering State of Mind Instrument (ESMI) giving students indirect peer mentoring opportunities through online profiles.
2. Determine the common themes of Freshman Engineering students' Engineering State of Mind and the attitudes and perceptions of the different population groups of the study. Specifically, in gender, ethnic affiliation, and mentorship programs in engineering. (Instrument Efficacy)
3. Determine how first year engineering students' perceptions change after they have gained an understanding of their perceptions and attitudes of engineering. (Intervention Efficacy)

Once these aims were completed, further assessment and conclusions were made determining how a self-assessment instrument, with and without interventions, impacted an engineering student's overall attitude, perception and efficacy of engineering.

6.1 Summary of Findings and Conclusions

This study provided the first evidence of how understanding an engineering student's Engineering State of Mind can change, even after one semester. For each stage of the study, summary charts were developed for the quantitative assessment analysis (charts are in Appendix G). These charts

show significant and notable findings that help to understand the progression of each group and the instrument's impact.

One primary result of this study was that students who had the opportunity to assess their Engineering State of Mind, with concomitant access to interventions or high-impact practices (Kuh 2008), showed increased motivations to pursue engineering, positive increases in their emotional states, and an equal valuing of both the math and science and interpersonal and professional skills. Engineering 101 by itself does not nurture the student's ability to think beyond many of the common misconceptions of engineering and how they play a role in the field. Students are intrinsically motivated (National Academies of Sciences 2018), and offering them a mechanism they can use to evaluate their own perceptions, attitudes, and feelings in a constructive way, as well as providing resources to promote better mindsets, encourages their persistence in the field of engineering (Haag and Collofello 2008).

6.1.1 Confidence in Graduation

After the first semester of Engineering 101, it is common to expect that a student's confidence in their ability to be successful in the program may waiver. When assessing pre- and post-assessment groups of study, Group #1 felt they had higher confidence in the beginning than they initially indicated. By the end of the semester, Groups #1 and Group #3 showed less confidence when compared to their beginning confidence in the post assessment. In Group #4, students felt their confidence persisted from the beginning of the semester to the end, proving the effectiveness of interventions.

Compared to the other groups of study, Group #2, maintained or increased in their confidence levels, due to receiving the ESMI at the beginning and end of the semester combined with interventions.

6.1.2 Social Persuasion and Vicarious Experiences

Freshman engineering students are mostly motivated by Intrinsic Psychological, Intrinsic Behavioral, and Social Good variables. Financial Rewards was an equal motivating factor for Group #1 and Group #2 at the beginning of the semester. In the post assessment, Financial Rewards changed to more a moderate motivation, while helping society, design and building, and doing engineering for its own inherent sake became the priority. Group #3 and Group #4 exhibited similar motivations, concluding that after a semester of exposure to Engineering 101, students had a better understanding of values beyond Financial Rewards that come from being an engineer.

Common to all Groups of study, and the three different populations, Mentor and Parent Influences were the least motivating factors. Populations who showed the most motivation in mentoring were either affiliated with a program, Female, or Black/African American. Program affiliated groups were more motivated by Mentors than Non-programmed students. S-STEM students were not as motivated by Mentors at the beginning of the semester as they were by the end. This is notable because S-STEM students are required to join a peer mentoring program through American Society of Mechanical Engineers and to meet with a faculty mentor at least once each semester. Unless affiliated with a specific type of program, or as part of a requirement, students will not generally interact with a mentor (peer or otherwise). According to the results of this study, Mentor Influence has a strong relationship with a student's overall motivation to study engineering, independent of the group of study. If such a value is shown qualitatively and quantitatively, some form of mentorship from the beginning of their engineering studies could be invaluable to a student for the long term. Unfortunately, Non-programmed students lack the ability to assess the impact from a mentor since they are generally not exposed to that resource. This is especially problematic because Non-programmed students account for 75% of the population of the study.

Among the least motivating factors for all students was Parental Influences. However, Asian American students were more influenced by their parents than other Ethnic groups, and were the least motivated to pursue engineering out of all the Ethnic groups. This indicates that much of their motivation to pursue engineering came from their family and not themselves.

A strong relationship (correlation) between Parental Influences, although the least motivating variable, and overall motivation to pursue engineering was found in all groups of study. Parents or guardians, like a mentor, can serve as a strong source of influence. Parents can be either a strength or a hindrance for the student.

Relationships between the population groups for the different variables revealed that the overall motivation to pursue engineering was highly influenced by the student's Intrinsic Psychological, Intrinsic Behavioral, Mentor Influence and Parent Influence. Stronger relationships between variables were discovered in the groups that had either the ESMI pre & post study and/or interventions (Groups #1, #2, #4). Group #3 was the only group to receive the ESMI at the end the semester without interventions. Students in Group #3 more frequently mentioned recognizing their motivations to study engineering in the qualitative assessment that was given after taking the ESMI. This implies that Group #3 had the least experience identifying why they were studying engineering prior to participating in the ESMI.

The motivation to improve the welfare of society (Social Good), increased in most groups of study across genders, ethnic affiliations and program affiliations. Over time, a student will start to value how engineering ultimately impacts people and the environment, which helps them persist in the field. In Engineering 101, five lectures were dedicated to discussing engineering careers and the ethics of engineering. Additionally, the relevance of engineering's impact is informally integrated in each lecture. Group #2's population significantly increased in Social Good, by the end of the semester, showing that

additional self-assessment and interventions emphasized this motivation in ways that are meaningful and impactful to students.

Students' responses in the qualitative assessment for all four Groups showed that taking the ESMI even once helped expand their understanding of and reduce misconceptions about the practice of engineering. Additionally, motivations to study engineering were connected to factors beyond the classroom, which reinforced their decision to be an engineer.

6.1.3 Master Experiences

Math and Science skills were commonly valued higher than Professional and Interpersonal engineering skills by Freshman in this study. Juniors and Seniors showed they valued Professional and Interpersonal skills as much as Math and Science abilities. Engineering is traditionally classified as being a discipline that requires a student to be 'excellent' or 'superior,' and to 'love' Math and Science. This message is usually provided through different channels including primary and secondary schools, families, and even conventional practicing engineers. These types of influences lead to Professional and Interpersonal skills being undervalued as less important and less necessary for the field, especially when students are first entering into engineering.

After a semester, there were increases in the perceived importance of Professional and Interpersonal skills in all Groups of study, and across all gender, ethnic, and program affiliations. A greater number of significant increases throughout the populations were found in Group #1 compared to Group #2. In both groups of study, the value of Professional and Interpersonal remained moderately high (high 70's to low 80's) while the importance of Math and Science skills decreased (ranging between high 80's to low 90's). This change left noticeably smaller gaps between the proficiencies. Group #1 and Group #2 showed a higher value for Professional and Interpersonal skills compare to

Group #3 and Group #4. A combination of Engineering 101 and exposure to the ESMI may have helped increase the perception of Professional and Interpersonal skills.

6.1.4 Emotional States

Freshman engineering students, in all four Groups, had moderately low to moderately high (high 50's to low 60's) Feelings of Inclusion. Females generally showed the lowest Coping Self-Efficacy and overall Emotional State compared to the Male and Other gender affiliated colleagues. Male and Female Juniors and Seniors were equivalent in their emotional state variables. Despite having high Coping Self-Efficacy, Black/African American students had the worst Feelings of Inclusion compared to other Ethnic groups. Engineering students, regardless of race, gender or religion, were shown to have concerns in their ability to fit into their environment. This concern was more pronounced in Black/African American Students and Females.

All variables for students in Group #1 and Group #2 increased in Emotional States and were higher, overall, than the other two groups. In Group #1 and Group #2, Female students' Coping Self-Efficacy increased, and Black/African American's Feelings of Inclusion increased (~7% in both Group #1 and Group #2). The White American Ethnic group had significant increases in both Groups. Promoting awareness through the ESMI and providing additional interventions helped increase student's Emotional States, which in turn increases their likelihood of remaining in the program.

Group #2's Emotional States variables had more significant increases than Group #1's. Other variable virtually remained unchanged in Group #2. Males from this group showed a significant increase in all variables. Additionally, Non-programmed students significantly increased in their Feelings of Inclusion. Although Group #1 had the ESMI both at the beginning and at the end of the semester, by adding direct interventions the students in Group #2 significantly increased their Emotional States in many of the populations.

In the qualitative study, students from all four Groups showed a reoccurring reflective response of confidence in working in teams and with people, reinforcement of self-efficacy in being in the field, and seeing engineering beyond earning good grades in their classes, all because they had access to the ESMI instrument. There was a clear appreciation for providing the profiles of the upper classman. A common reaction to the upperclassman's honest stories of difficulties and ESMI scores was that it aided the students in understanding that they can persevere in the engineering field despite their doubts or challenges.

This research creates an approach that empowers the student to recognize their own needs, providing them a way to self-assess and change their mind set. In many institutions, finding ways to help students succeed is a constant and major initiative. There is often a disconnect where the student isn't aware of how resources are helpful to them. Encouraging students to better understand their motivations will provide insight into the kind of high impact practices to utilize to be successful. This will be of greater benefit to the student than grasping at random potential solutions without a firm understanding of their engineering current frame of mind. They will no longer feel like they are being forced to fit into a mold, but instead they will be more aware of their state of mind, and therefore better able to articulate their different motivations, feelings, and values. In the qualitative assessment, students indicated that they plan to use the recommendations in the future. Having the knowledge that there is a resource and a readily available tool they can turn to, can provide a sense of comfort and safety, and contribute to a higher persistence rate in the field of engineering.

6.2 Limitations of Study

Several limitations were identified in this study. Many of them provide a motivation for potential future work, which is introduced in 6.3.

Variables in each Social Cognitive Career Theory (SCCT) classification were assumed to contribute equally to each construct (Social Persuasion Vicarious Experiences, Mastery Experiences and Emotional States). All the variables in each construct may not contribute equally and further analysis is needed to identify their relative contribution to each SCCT construct. Evaluating the correlations could lead to better evaluation of each the SCCT constructs.

Several of the questions were worded in such a way that they might have led to some misunderstandings and misconceptions for some variables. One example of this is the question concerning Parent Influence. Students may have interpreted the question as asking whether the parents were forcing them into the major. However, many of our students have parents who are engineers and see them as more of an inspiration. Additional consideration of this variable may help provide a more thorough understanding of its influence.

There was clarification needed about the engineering skills. Students felt they valued the engineering skill set but were doing poorly in their math or science courses. Having related questions about their confidence in succeeding in math and science may help both the researcher and students to further understand the student's mindset relative to their performance in other classes and the value of engineering skills.

The ESMT, although having a question on student GPA, did not use academic performance as a contributor to student motivations. Further assessment also could include using GPA as a potential metric where higher motivations, feelings, and values could potentially contribute to a higher GPA.

Additionally, Physiological State was removed from the study. Future work could include incorporating questions around feelings of anxiety and physical states of the students. Research has shown, even in Engineering 101, that the students' physiological states impact their ability to succeed in engineering (Husman 2015).

Students' mindsets change frequently. Whether a bad day, a personal issue, or stress from too much work, student mindsets will fluctuate. More data to incorporate or account for fluctuations will help ground true outputs from the populations.

Further data on upperclassman will provide a better understanding of how students' mindsets develop as they progress in their engineering education. Additionally, more peer profiles will provide the students with even more specific example to compare to, hopefully resulting in the students feeling more included in the field.

While Engineering 101 is typically a first semester, first time freshman class, it is not homogenous. Around 10% of the Fall 2019 class came from a previous institution (community college or 4-year institution). The population of transfer students isn't large, but it is possible it could impact the results. More work on the transfer population would lead to insights into how to help those students become successful.

6.3 Future Work

This research has provided several opportunities for potential work to improve the Instrument and develop innovative programs to increase student success.

6.3.1 Further Development of the ESMI

There is clear need for further development of the ESMI. Although interesting and important data were generated by this study, there is need for further investigation and development of the instrument. Aspects of this development include:

- Developing more peer profiles, to increase diversity.
- Specify additional impact practices that have benefited these students.
- Examination of variables as they impact the Social Cognitive Career Theory Constructs. Should the weight of a variables change with respect to its impact on the construct?
- Adding or deleting variables as they impact engineering students in regard to Socio-Economic Status and Grades.
- Testing other engineering populations both at UMBC and at other universities.
- Having an output/metric that helps the student compare themselves to a common population of students.
- Providing feedback that immediately provides high impact recommendations based on student responses.

6.3.2 Linear Regression Analysis to Predict Confidence

Several correlations showed strong relationships leading to the question, can we can use the ESMI information to predict a student's confidence? If we can predict the confidence early, we can hopefully intervene and prevent students from feeling like they will fail. Having this predictive ability would provide a valuable instrument to those involved in supporting students, helping them persist in engineering.

6.3.3 Enhancing Engineering Advising to Consider the "Complete Student"

In current medical practice, there has been a strong push for proactive and preventative methods to increase quality of life, longevity, and look beyond the diagnosis to the patient as a whole person. The student advising process is going through a similar transformation, looking to focus beyond the

academic profile of a student. Advisors have begun assessing how to help students structure their engineering education pathway to be successful and finding ways to integrate the student's mindset and information about their motivations into the advising process. This approach could provide the advisor with a more complete picture of the student and help them be a stronger advocate. As a student's mindset changes, whether intrinsically or extrinsically, integrating their mindset into the advising profile would help ensure that students are following a path that better leads to their future success and helps the advising process be more individualized and impactful.

6.3.4 Analyzing and Evaluating the Engineering Mindset of Non-Traditional Students

Nationally, the demographics of the student population are shifting toward more transfer and non-traditional students (Center, McDonell 2017, Center 2019b). According to the National Student Clearinghouse, enrollment for the first-time, full-time freshman is down 2.8% (Center 2019b). Despite this shift, most engineering departments still focus their retention and intervention methodologies on the traditional first year freshman student. Consequently, there is a lack of dedicated research specifically addressing how to successfully retain the growing number of transfer students. This research will continue to more extensively develop the Engineering State of Mind Instrument so that it can be accurately and effectively applied to transfer and non-traditional students to address their specific challenges.

Toward this end, there is currently a proof of concept case study being conducted with the Instrument on a small population of transfer students. The results of this will be used to construct a more robust and specialized instrument designed to bring the benefits of the Instrument bring to a broader audience.

6.3.5 Final Thoughts

As new challenges continue to evolve in our world, engineering educators have a mission to help foster students to see beyond what they immediately perceive. Too often, students enter their degree program with misconceptions from past experiences or prior influences. The field of engineering needs problem solvers, creative thinkers, and empathic human beings that want to impact the world in innovative and novel ways. To do this, we must eliminate what starts internally: misconceptions and negative thoughts. UMBC's President Freeman Hrabowski recites the following quote at countless speaking engagements, "Watch your thoughts, for they become your words. Watch your words, for they become your actions. Watch your actions, for they become your habits. Watch your habits, for they become your character. Watch your character, for they become your destiny." Engineering educators can change the perceptions of emerging engineers to help them fulfill their destiny.

Appendix A

Information IRB Forms/Survey



AN HONORS UNIVERSITY IN MARYLAND

**Office of Research Protections and
Compliance**

University of Maryland, Baltimore County
1000 Hilltop Circle
Baltimore, MD 21250

PHONE: 410-455-2737
EMAIL: compliance@umbc.edu
WEB: research.umbc.edu

Date: 4/18/2019
To: Shannon Clancy, Jamie Gurganus
Department: Mechanical Engineering
Protocol #: Y19JG23156

Notice of Action: Exemption Determination

The Chair of the Institutional Review Board has reviewed your protocol entitled **Evaluating and Self Assessment of Students' Self Efficacy in Engineering Using EngineerID Tool** and has found it met the criteria under category **1 (\$46.104(e)(2)(i0(ii))** for exemption under the requirements of the 2018 Common Rule. The date of exemption determination is **4/17/2019** and applies, if applicable, to the following sponsored project titles and Kuali proposal/approval numbers:

- Click here to enter text.
- Click here to enter text.
- Click here to enter text.

All exempt studies are approved without an expiration date and do not expire. However, any changes to the research design, procedures, or personnel [must be submitted in writing](#) for review by the IRB before the changes are incorporated to insure they do not change the exempt status of the protocol. All correspondence and materials used in this protocol must reference the above IRB protocol number.

Once the study ends or before you leave UMBC and are no longer a student or employee, you must submit a [protocol closure report](#).

Whom to Contact about this study:

Principal Investigator: Shannon Clancy
Department: Mechanical Engineering
Telephone number: 443-989-8682

Informed Consent Form for EngineerID Tool Focus Group/Individual Interview

This is a consent form for participation in a research project. Your participation in this research study is voluntary. It contains important information about this study and what to expect if you decide to participate. Please consider the information carefully. Feel free to ask questions before making your decision whether or not to participate.

I. PURPOSE OF THE RESEARCH:

The purpose of this study is to analyze, understand, and help students assess their self-efficacy and how certain factors, externally and internally, influence their decision to pursue engineering as an area of study and career. The study will allow students to self-assess about how students find their motivation, how success is obtained in their career, and what choices are made in pursuit of their career interests to be successful. Both students programed and non-programmed (not affiliated with any mentoring program) and undergrad years will be evaluated. About 40 persons will be invited to participate for the focus group and 6 people for the individual interview.

II. PROCEDURES:

As a participant in this study, I will be asked to complete a survey, if I haven't already, which will take 15 minutes to complete. The survey includes questions about my Mechanical Engineering Academic career and my current attitudes and perceptions. We also will ask for some demographic information so that we can accurately describe the general traits of the men and women who participate in the study.

I will be asked a series of open ended questions in regards to your scores of the EngineerID tool, my response to the scores and experiences in engineering, and potential steps moving forward after the focus group. This will take no longer than an hour of my time.

After receiving my scores from the tool, I will be guided to read more information and understanding about the variables and information in the tool on the engineeringed.umbc.edu webpage. If at any time I would like to discontinue, I may leave at any time or stop at any point with no consequences. My involvement in this study will begin when I agree to participate and will continue until the end of the focus group or individual interview session (where applicable). I am being asked to volunteer because I am a Mechanical Engineering student.

III. VOLUNTARY PARTICIPATION

I have been informed that my participation in this research study is voluntary and that I am free to withdraw or discontinue participation at any time. If I withdraw from this research study, I will not be penalized in any way for deciding to stop participating. I have been informed that data collected for this study will be retained by the investigator and analyzed even if I choose to withdraw from the research. If I do choose to withdraw, the investigator and I have discussed my withdrawal and the investigator may use my information up to the time I decide to withdraw.

IV. RISKS AND BENEFITS OF BEING IN THE STUDY:

No risks or discomforts are anticipated from taking part in this study. If I feel uncomfortable and/or if I decide to quit at any time before I have finished the questionnaire or before the end of the focus group/individual interview, my answers will NOT be recorded and I will not be penalized.

The benefits to participation are: contributing knowledge about how formal and informal mentorship, advising, prior educational experiences, reasons for studying engineering, and attitudes and perceptions towards engineering retain students and persist through their

Mechanical engineering degree and career. After we have finished data collection and assessed, more detailed information about the purposes of the study and the research findings will be available for your interest. There is no other forms of compensation for participating in this study beyond scholarly knowledge.

V. COMPENSATION/COSTS:

My participation in this study will involve no cost to me. There is no other forms of compensation for participating in this study beyond scholarly knowledge.

VI. CONFIDENTIALITY:

Any information learned and collected from this study in which I might be identified will remain confidential and will be disclosed ONLY if I give permission. The investigator (s) will attempt to keep my personal information confidential. We will NOT know your IP address when you respond to the Internet survey. I may include an e-mail address when I have completed the Internet survey so that I can gain more support and resources in regards to the information and variables discussed in this study. After we have finished data collection we will destroy the list of participants' e-mail addresses.

I will be recorded during the focus group/interview and only the PI and Co-PI will have access to the recording files. No identifying information will be recorded. I will be assigned a participant number, and only the participant number will appear with my survey responses and any notes taken during the focus group/interview. Only the researchers will see my individual survey responses, the notes, and audio recordings taken during the focus group/interview. The list of e-mail of our participants, audio recordings, and notes will be stored electronically in a password protected folder that only the PI and CO-PI have access to.

Please be advised that although the researchers will take every precaution to maintain confidentiality of the data, the nature of focus groups prevents the researchers from guaranteeing confidentiality. The researchers would like to remind participants to respect the privacy of your fellow participants and not repeat what is said in the focus group to others.

Only the investigator and members of the research team will have access to these records. If information learned from this study is published, I will not be identified by name. By signing this form, however, I allow the research study investigator to make my records available to the University of Maryland Baltimore County (UMBC) Institutional Review Board (IRB) and regulatory agencies as required to do so by law.

Consenting to participate in this research also indicates my agreement that all information collected from me individually may be used by current and future researchers in such a fashion that my personal identity will be protected. Such use will include presentations at scientific or professional meetings, publishing in scientific journals, sharing anonymous information with other researchers for checking the accuracy of study findings and for future approved research that has the potential for improving human knowledge.

If applicable (1) my name will not be included on the surveys and other collected data; (2) a code will be placed on the survey and other collected data; (3) through the use of an identification key, the researcher will be able to link my survey to my identity; and (4) only the researcher will have access to the identification key.”

____ I give permission to record my voice or image and use in scientific publications or presentations.

____ I do not give permission to record use my voice or image and use in scientific publications or presentations.

Please be advised that although the researchers will take every precaution to maintain confidentiality of the data, the nature of focus groups prevents the researchers from guaranteeing confidentiality. The researchers would like to remind participants to respect the privacy of your fellow participants and not repeat what is said in the focus group to others.

VII. CONTACTS AND QUESTIONS:

The principal investigator(s), Shannon Clancy and Professor Jamie Gurganus has offered to and has answered any and all questions regarding my participation in this research study. If I have any further questions, I can contact Shannon Clancy at sclanc1@umbc.edu or 443-989-8682 and Professor Jamie Gurganus at jgurganus@umbc.edu or 410-455-8439.

If I have any questions about my rights as a participant in this research study, I can contact the Office of Research Protections and Compliance at (410) 455-2737 or compliance@umbc.edu. All reports or correspondence will be kept confidential.

I will be given a copy of this consent form to keep.

VIII. SIGNATURE FOR CONSENT

I have read (or someone has read to me) this form, and I am aware that I am being asked to participate in a research study. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to participate in this study.

Printed Participant's Name: _____

Participant's Signature: _____ Date: _____

Person Obtaining Consent: _____

Signature: _____ Date: _____

Post - My Engineer State of Mind

Chapter 3 Start of Block: Consent Agreement

Intro

My Engineer State of Mind: A Self-Assessing Tool (End of the Semester).

Before we start, we'd like for you to read the informed consent information below. Informed consent refers to the voluntary choice of an individual to participate in research based on an accurate and complete understanding of its purposes, procedures, risks, benefits, and alternatives. The survey will be completely anonymous and voluntary. We do not ask or identify any individuals who plan to participate in this survey. If you have any questions before completing this survey, please contact the investigator, Professor Jamie Gurganus at jgurganus@umbc.edu or 410-455-8439.

Informed consent:

You must be of 18 years or older to participate.

The purpose of this study is to analyze, understand, and help students assess their self-efficacy and how certain factors, externally and internally, influence their decision to pursue engineering as an area of study and career. The study will allow students to self-assess about how students find their motivation, how success is obtained in their career, and what choices are made in pursuit of their career interests to be successful. Both students programmed and non-programmed (not affiliated with any mentoring program) and undergrad years will be evaluated. You are being asked to volunteer because you are Engineering major.

As a participant in this study, I will be asked to complete a survey tool, which will take 15 minutes to complete. The tool includes questions about your Mechanical Engineering Academic career and your current attitudes and perceptions. We also will ask for some demographic information so that we can accurately describe the general traits of the men and women who participate in the study. If you so desire, you may choose to participate in a focus group to discuss your scores of the My Engineer State of Mind tool, your response to the scores and experiences in engineering, and potential steps moving forward after the focus group. After receiving your scores from the tool, you will be guided to read more information and understanding about the variables and information in the tool on the engineeringed.umbc.edu webpage. If at any time you would like to discontinue, you may leave at any time or stop at any point with no consequences.

I have been informed that my participation in this research study is voluntary and that I am

free to withdraw or discontinue participation at any time. I have been informed that data collected for this study will be retained by the investigator and analyzed even if I choose to withdraw from the research. If I do choose to withdraw, the investigator and I have discussed my withdrawal and the investigator may use my information up to the time I decide to withdraw.

There are no known risks involved in completing the survey. There are no tangible benefits for completing the survey, but you will be contributing to knowledge about how formal and informal mentorship, advising, prior educational experiences, reasons for studying engineering, and attitudes and perceptions towards engineering retain students and persist through their engineering degree and career. After we have finished data collection and assessed, more detailed information about the purposes of the study and the research findings will be available for your interest. There are no other forms of compensation for participating in this study beyond scholarly knowledge.

All data obtained will be anonymous. There is no way for us to find out who you are, and your data will not be shared with any other parties under any circumstance. You may include your e-mail address when you complete the Internet tool so that you can gain more support and resources in regards to the information and variables discussed in this study. However, your address will not be stored with data from your survey. Instead, you will be assigned a participant number, and only the participant number will appear with your survey responses. Only the researchers will see your individual survey responses. The list of e-mail of our participants will be stored electronically in a password protected folder that only the PI and CO-PI have access to. Any information learned and collected from this study in which I might be identified will remain confidential and will be disclosed

Only the investigator and members of the research team will have access to these records. If information learned from this study is published, I will not be identified by name. By consenting, however, I allow the research study investigator to make my records available to the University of Maryland Baltimore County (UMBC) Institutional Review Board (IRB) and regulatory agencies as required to do so by law.

The principal investigator, Professor Jamie Gurganus, has offered to and has answered any and all questions regarding my participation in this research study. If I have any further questions, I can contact Professor Jamie Gurganus at jgurganus@umbc.edu or 410-455-8439.

This study has been reviewed and approved by the UMBC Institutional Review Board (IRB). A representative of that Board, from the Office of Research Protections and Compliance, is available to discuss the review process or my rights as a research participant. Contact information of the Office is (410) 455-2737 or compliance@umbc.edu.

After reading the consent items, please proceed to the questionnaire on the next page. Click "Next" OR "Insert hyperlink here" to get started with the survey. If you'd like to leave the survey at any time, just click "Exit this survey".

I have been informed that I may print out a copy of the consent document (OR I have been informed the investigator will email/mail a copy to me) for me to keep.

Q0

- ☐ I consent (1)
- ☐ I do not consent (2)

End of Block: Consent Agreement

Chapter 3 Start of Block: Demographics and Background

Q1 1. Gender:

- ☐ Male (1)
 - ☐ Female (2)
 - ☐ Other (5)
-

Q2 2. Ethnicity/Citizenship: (Check a maximum of two)

- ☐ African/Black American (1)
 - ☐ American Indian/Alaskan Native (2)
 - ☐ Asian & Pacific American (3)
 - ☐ Latina/Hispanic American (4)
 - ☐ White American (5)
 - ☐ Foreign National on student visa (6)
 - ☐ Foreign National/U.S. Resident (green card) (7)
 - ☐ If other, please specify (8)
-

Q3 3. As of today, I am a: (Choose one)

- ☐ First-year Student (1)
 - ☐ Second-year Student (2)
 - ☐ Third-year Student (3)
 - ☐ Fourth-year Student (4)
 - ☐ Fifth-year Student or above (5)
-

Q4 4. My current GPA is (Choose one):

- ☐ 3.75 - 4.00 (1)
 - ☐ 3.50 - 3.74 (2)
 - ☐ 3.25 - 3.49 (3)
 - ☐ 3.00 - 3.24 (4)
 - ☐ 2.75 - 2.99 (5)
 - ☐ 2.50 - 2.74 (6)
 - ☐ < 2.50 (7)
 - ☐ N/A (8)
-

Q5 5. Program affiliation (select all that apply):

- ☐ Meyerhoff Scholar (1)
 - ☐ Meyerhoff Affiliate (2)
 - ☐ CWIT Scholar (3)
 - ☐ CWIT Affiliate (4)
 - ☐ T-SITE Scholar (CWIT) (5)
 - ☐ S-STEM (6)
 - ☒ Non-programmed (not involved in either CWIT, Meyerhoff, S-Stem) (7)
-

Q6 6. Professional Organization Affiliation (select all that apply):

- ☐ American Society of Mechanical Engineers (ASME) (1)
 - ☐ American Institute of Aeronautics and Astronautics (AIAA) (2)
 - ☐ Society of Women Engineers (SWE) (6)
 - ☐ National Society of Black Engineers (NSBE) (7)
 - ☐ Society of Hispanic Professional Engineers (SHPE) (8)
 - ☐ Society of Automotive Engineers (SAE) (9)
 - ☐ Institute of Electrical and Electronics Engineers (IEEE) (3)
 - ☐ American Institute of Chemical Engineers (AIChE) (4)
 - ☐ Tau Beta Pi (5)
 - ☒ No affiliation (10)
-

Q7 7. Enrollment Status

- ☐ Part time (1)
 - ☐ Full time (2)
-

Q8 8. Where were you immediately before starting at this institution? (check one)

- ☐ High School (1)
 - ☐ 2-year College (2)
 - ☐ 4-year College (3)
 - ☐ Military (4)
 - ☐ Vocation/Technical School (5)
 - ☐ Working a full-time job (6)
 - ☐ Other, please specify (7) _____
-

Q9 9. Have you previously had an internship or co-op in engineering or an engineering-related field?

- ☐ Yes (1)
 - ☐ No (2)
-

Q10 10. Have you done on-campus research?

- ☐ Yes (1)
 - ☐ No (3)
-

Q27 Do you have a parent/guardian who is an Engineer?

- ☐ Yes (1)
 - ☐ No (2)
-

Q28 Do you have a family member who is an engineer?

☐ Yes (1)

☐ No (2)

Q26 Please select the ENES 101 enrolled Discussion time:

☐ Monday 2:30pm (1)

☐ Tuesday 8am (2)

☐ Tuesday 10am (3)

☐ Tuesday 12pm (4)

☐ Tuesday 2pm (10)

☐ Wednesday 3:00pm (5)

☐ Thursday 8am (6)

☐ Thursday 10am (7)

☐ Thursday 12pm (8)

☐ Thursday 2pm (9)

Q29 What is your current Major

☐ Computer Engineer (1)

☐ Mechanical Engineer (2)

☐ Chemical Engineer (3)

☐ Other (4) _____

Q30 How do you think you performed in Math?

- ☐ Withdrew (2)
- ☐ Failing with a D or below (3)
- ☐ Passing with C or above (6)
-

Q33 How do you think you performed in your Physics/Science class?

- ☐ Withdrew (1)
- ☐ Failing with D or below (2)
- ☐ Passing with C or above (3)

End of Block: Demographics and Background

Chapter 3 Start of Block: Impressions of Engineering

Q11 11. Please select your confidence level in the following statements below.

	Very Uncertain (1)	Uncertain (3)	Neutral (4)	Certain (5)	Very Certain (6)
When you began your engineering degree, how certain were you that you would complete it? (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
At the present time, how certain are you that you will complete an engineering degree at this institution? (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q12 12. We are interested in knowing why you are studying engineering. Please indicate below the extent to which the following reasons apply to you:

	Not a Reason (1)	Minimal Reason (2)	Moderate Reason (3)	Major Reason (4)	I prefer not to answer (5)
Technology plays an important role in solving society's problems (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Engineers make more money than most other professionals (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My parent(s) would disapprove if I chose a major other than engineering (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Engineers have contributed greatly to fixing problems in the world (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Engineers are well paid (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My parent(s) want me to be an engineer (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
An engineering degree will guarantee me a job when I graduate (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A faculty member, academic advisor, teaching assistant or other university	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

affiliated
person has
encouraged
and/or inspired
me to study
engineering (8)

A non-
university
affiliated
mentor has
encouraged
and/or inspired
me to study
engineering (9)

A mentor has
introduced me
to people and
opportunities in
engineering
(10)

I feel good
when I am
doing
engineering
(11)

I like to build
stuff (12)

I think
engineering is
fun (13)

Engineering
skills can be
used for the
good of society
(14)

I think
engineering is
interesting (15)

I like to figure
out how things
work (16)

Mentoring
Programs
(Meyerhoff or
CWIT) have
encouraged

☐☐☐

and/or inspired
me to study
(17)

Q13 13. Respond to the following to the best of your ability.

	Strongly Disagree (1)	Disagree (2)	Slightly Disagree (3)	Neither Disagree nor Agree (4)	Slightly Agree (5)	Agree (6)	Strongly Agree (7)	Don't Know (9)
I can relate to the people around me in my classes (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a lot in common with other students in my classes (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The other students in my classes share my personal interests (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can relate to the people around me in my extracurricular activities (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q14 14. Answer the following based on your attitude towards your Engineering Career Expectations.

	Strongly Disagree (4)	Disagree (5)	Slightly Disagree (6)	Neither Disagree nor Agree (7)	Slightly Agree (8)	Agree (9)	Strongly Agree (10)	Don't Know (11)
Someone like me can succeed in an	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

engineering
career (4)

A degree in
engineering
will allow me
to obtain a
well paying
job (5)

I expect to
be treated
fairly on the
job. That is, I
expect to be
given the
same
opportunities
for pay
raises and
promotions
as my fellow
worker if I
enter
engineering
(6)

A degree in
engineering
will give me
the kind of
lifestyle I
want (7)

I expect to
feel "part of
the group"
on my job if I
enter
engineering
(8)

A degree in
engineering
will allow me
to get a job
where I can
use my
talents and
creativity (9)

A degree in
engineering
will allow me

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

to obtain a
job that I like
(10)

Q15 15. I am confident that...

	Strongly Disagree (4)	Disagree (5)	Slightly Disagree (6)	Neither Disagree nor Agree (7)	Slightly Agree (8)	Agree (9)	Strongly Agree (10)	Don't Know (11)
I can cope with not doing well on a test (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can make friends with people from different backgrounds/or values (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can cope with friends' disapproval of my chosen major (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can cope with being the only person of my race/ethnicity in my class (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can approach a faculty or staff member to get assistance (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I can adjust to a new campus environment (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q16 16. How important do you think each of the following skills and abilities is to becoming a successful engineer?

	Not Important (1)	Some What Important (2)	Very Important (3)	Crucial (4)	I prefer not to answer (5)
Self confidence (social) (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leadership ability (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Public speaking ability (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Math ability (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Science ability (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Communication skills (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to apply math and science principles in solving real world problems (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Business ability (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ability to perform in teams (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q17 17. Rate your general impressions of engineering

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
I expect that engineering will be a rewarding career. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

I expect that studying engineering will be rewarding. (2)

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

The advantages of studying engineering outweigh the disadvantages. (3)

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

I don't care for this career. (4)

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

The future benefits of studying engineering are worth the effort. (5)

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

I can think of several other majors that would be more rewarding than engineering. (6)

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

I have no desire to change to another major (ex. Biology, English, Chemistry, Art, History, etc.). (7)

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

The rewards of getting an engineering degree are not worth the effort. (8)

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

From what I know, engineering is boring. (9)

<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
-----------------------	-----------------------	-----------------------	-----------------------	-----------------------

Chapter 3 Start of Block: Faculty/Staff Support

Q18 18. Adviser- Faculty or Staff in the College of Engineering or Major Department

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (10)	Strongly Agree (11)	N/A (12)
My adviser takes a personal interest in my career. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My adviser helps me coordinate professional goals. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My adviser has devoted special time and consideration to my career. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I share personal problems with my adviser. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I exchange confidences with my adviser. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Display This Question:

If 5. Program affiliation (select all that apply): != Non-programmed (not involved in either CWIT, Meyerhoff, S-Stem)

Q19 19. Mentor- Faculty or Staff person in S-STEM, Meyerhoff, CWIT

	Strongly Disagree (4)	Disagree (5)	Neutral (6)	Agree (7)	Strongly Agree (8)	N/A (9)
My mentor takes a personal interest in my career. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My mentor helps me coordinate professional goals. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My mentor has devoted special time and consideration to my career. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I share personal problems with my mentor. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I exchange confidences with my mentor. (that which is confided; a secret; trust or faith; i.e a friend does not betray confidences) (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Display This Question:

If 5. Program affiliation (select all that apply): != Non-programmed (not involved in either CWIT, Meyerhoff, S-Stem)

Q20 20. Peer Mentor- Someone in your program (CWIT, Meyerhoff, S-Stem) that you were assigned. Usually an older more experienced student.

	Strongly Disagree (4)	Disagree (5)	Neutral (6)	Agree (7)	Strongly Agree (8)	N/A (9)
I share personal problems with my Peer Mentor (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I exchange confidences with my Peer Mentor. (that which is confided; a secret; trust or faith; i.e. a friend does not betray confidences) (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
My peer mentor helps me coordinate my academic career goals (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

End of Block: Faculty/Staff Support

Chapter 3 Start of Block: Report Block

Report

You have completed the My Engineering State of Mind tool. Below are your Scores.

The percentages indicates the level of your attitudes, perceptions, confidence and success in the engineering field.

There are no bad scores. This is just to show you how you currently perceive the engineering field.

If you wish to see how you can change these perceptions and understand further what these mean, check out the recommendations.

UMBC Engineering State of Mind webpage here: <http://engineeringed.umbc.edu/>

Additionally, you will find profiles of Juniors/Seniors and Alumni who shared their self-assessment.

You are also welcome to schedule an appointment with Prof. Gurganus to discuss your results at jgurganus@umbc.edu.

The purpose of this tool is to help students who are in their first and second years of engineering school better understand themselves and how certain factors may influence their success. This is only how you perceive engineering today and can be changed!

For a detailed description of the variables and what high and low scores may indicate, please visit the UMBC Engineering ID webpage here: <http://engineeringed.umbc.edu/>

What is My Engineering State of Mind SCORES: This section will provide scores for the main variables and their respective sub-variables. Please note that there is no such thing as a bad score even if your score is low. Your scores within the following variables are as follows:

[How do I feel about being an engineer?](#) $\{e://Field/Emotional_and_Physiological_States\}$ % (Emotional and Physiological States) I feel I can relate to people in my class or activities (Feelings of Inclusion): $\{e://Field/Percent_10\}$ % I feel I can fit into an engineering career and be treated fairly (Engineering Career Success Expectations): $\{e://Field/Percent_9\}$ % I feel I can deal with or overcome problems and difficulties (Coping Self-efficacy): $\{e://Field/Percent_11\}$ %

[How motivated am I to study and practice engineering?](#) $\{e://Field/Social_Persuasion_and_Vicarious_Experiences\}$ % (Social Persuasion and Vicarious Experiences) A. How do I value Engineering (General Impressions of Engineering)?: $\{e://Field/Percent_12\}$ % B. I'm Motivated to Study Engineering Because of... Financial Rewards: $\{e://Field/Percent_1\}$ % Parental Influence: $\{e://Field/Percent_2\}$ % Improving the Welfare of Society: $\{e://Field/Percent_3\}$ % Mentor Influence: $\{e://Field/Percent_4\}$ % It's own Purpose: $\{e://Field/Percent_5\}$ % It's Practical uses (building stuff, how stuff works): $\{e://Field/Percent_6\}$ %

[How do I value skills necessary for engineering?](#) $\{e://Field/Mastery_Experiences\}$ % (Mastery Experiences) I feel Professional and Interpersonal Skills are Essential to Becoming an Engineer: $\{e://Field/Percent_7\}$ % I feel Math and Science Skills are Essential to Becoming an Engineer: $\{e://Field/Percent_8\}$ %

Email If you would like to receive your survey results via email, please enter your email address in the box below.

End of Block: Report Block

Impact Survey

Follow Up on Impact of ESMI (ALL PARTS MUST BE FILLED OUT With Explanation to be eligible! No one word answers will be accepted)

Thank you for participating in our study up to this point. This form is to assess our process, the tool, give feedback about any part of this process, and its impact. This survey is anonymous.

For your participation in this follow up survey, we will be entering you into a drawing of \$100, 3 x \$50, and 2 x \$25 prizes! You will be asked to provide your email if you wish to be included in the random drawing. An email will be sent to your provided address if you are determined to be a winner.

To be eligible, all parts must be filled out with explanation! Thank you!

* Required

I. Which ENES 101 Discussion were you in? *

Mark only one oval.

- ☐ Monday 2:30pm
- ☐ Tuesday 8am
- ☐ Tuesday 10am
- ☐ Tuesday 12pm
- ☐ Tuesday 2pm
- ☐ Thursday 8am
- ☐ Thursday 10am
- ☐ Thursday 12pm
- ☐ Thursday 2pm
- ☐ Wednesday 3pm

2. Gender *

Mark only one oval.

- ☐ Female
- ☐ Male
- ☐ Prefer not to say
- ☐ Other: _____

3. What is your major? *

Mark only one oval.

- ☐ Chemical Engineering Computer
- ☐ Engineering Mechanical
- ☐ Engineering
- ☐ Other: _____

4. Ethnicity *

Check all that apply.

- ☐ African/Black American
- ☐ Native American/Alaskan Native
- ☐ Asian & Pacific American
- ☐ Latina/Hispanic American
- ☐ White American
- ☐ Foreign National on Student Visa
- ☐ Foreign National/U.S. Resident (Green Card)
- Other: ☐ _____

5. Affiliation with Scholar program

Check all that apply.

- ☐ No Affiliation
- ☐ Meyerhoff
- ☐ CWIT - Scholar/Affiliate S-
- ☐ STEM
- ☐ Honors College

6. What group were you in? (Please select one) *

Mark only one oval.

- ☐ Received ESMI At Beginning and End of Semester *Skip to question 7*
- ☐ Received ESMI Only At the End of the Semester *Skip to question 17*

Skip to question 7

Received ESMI at Beginning and End of Semester

7. Did you find this study interesting? *

Mark only one oval.

- ☐ Yes No
- ☐ Maybe
- ☐

8. Would you like to meet with an adviser to discuss your results? *

Mark only one oval.

- ☐ Yes
- ☐ No - the information received and on the website was sufficient Maybe
- ☐ Other: _____
- ☐

9. Do you feel this was informative? *

Mark only one oval.

	1	2	3	4	5	
Not informative	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Very Informative

10. What, if anything, for you changed (i.e. your perspective of engineering, your approach to your studies, expectations, etc) since completing the ESMI? *

11. Take a look at your first ESMI results and compare to your final results. Did your ESMI change since the beginning of the semester? If so, can you explain what? *

12. Take a look at your results. Do you agree with your results from the ESMI? Why or why not? *

13. Did you use any of the recommended sections on the website? If so, what did you use? Or will you plan to use them? (engineeringed.umbc.edu) *

14. Did you learn something about yourself as an engineer? Name at least one thing. *

-
-
15. Did you review, initially, any of the engineering Junior or Senior profiles on the website? *

Mark only one oval.

☐ Yes No

☐ Maybe

☐

Received ESMI Only Towards the End of the Semester

17. Did you find this study interesting?

18. Would you like to meet with an adviser to discuss your results? *

Mark only one oval.

☐ Yes

☐ No - the information received and on the website was sufficient Maybe

☐ Other: _____

19. Do you feel this was informative? *

Mark only one oval.

1 2 3 4 5

☐ ☐ ☐ ☐ ☐

20. What, if anything, for you changed (i.e. your perspective of engineering, your approach to your studies, expectations, etc) since completing the ESMI? *

21. Take a look at your results. Do you agree with your results from the ESMI? Why or why not? *

22. Will you plan to use any of the recommended sections on the website? If so, what will you use? (engineeringed.umbc.edu) *

23. Did you learn something about yourself as an engineer? Name at least one thing and what that means for you. *

24. Did you review any of the engineering Junior or Senior profiles on the website? *

Mark only one oval.

☐ Yes ☐ No

☐

25. Does looking at the profiles help you? Please explain. (If you didn't look, please do so now and answer) *

Skip to question 26

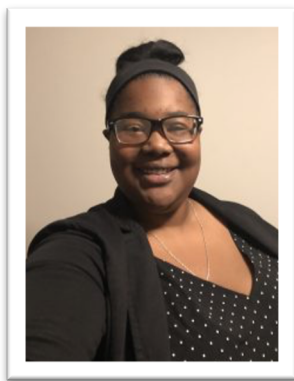
26. Do you have any additional comments or feedback you would like to provide?

27. If you would like to opt-into the drawing (\$100, 3 x \$50, and 2 x \$25) please enter your UMBC email below.

This content is neither created nor endorsed by Google.

Appendix B

Profiles of Juniors & Seniors for Website



Name: DeShaunna Scott – Computer Engineering

Email: deshaunnascott@gmail.com

Other Majors/Minors: N/A

On-Campus Affiliations: NSBE, IEEE, National Society of Collegiate Scholars

Internships: Florida International University

On-Campus Research: N/A

Difficulties: I had trouble voicing my opinions. I would tend to take things at face value and not question why they were that way. In turn, I often found myself not fully understanding a subject.

What helped you with these difficulties: Most times when I got frustrated, I would write down all the questions I had about the topic and find my professor to answer them. I would go to office hours or link up with other students taking the same course to work out problems. Most times it helps to think out loud with other people and bounce ideas off of one another. One thing that helped the most was starting group chats with a small number of students in the courses I was taking so that we had a common place to share ideas and sometimes just vent to one another. The biggest key factor that got me through my freshman and sophomore years were student groups. We'd find a whiteboard and work a problem until we could all do it without a problem. It was easier to bring up my confusions and questions in a group of my peers.

Scores:

How do I feel about being an engineer: 59%

Aspects:

- Relating to people in my class or activities: 75%
- Fitting into an engineering career and being treated fairly: 55%
- Dealing with or overcoming problems and difficulties: 47%

How motivated am I to study engineering: 77%

Aspects:

How I value engineering: 92%

I'm motivated to study engineering because of:

- Financial rewards: 78%
- Parental Influence: 0%
- Improvements to the welfare of society: 100%
- Mentor Influence: 67%
- It's own purpose: 100%
- It's practical uses: 100%

How do I Value Necessary Engineering Skills: 78%

Aspects:

- How essential professional and interpersonal skills are: 78%
- How essential math and science skills are: 78%



Name: Poojan Shah- Mechanical Engineering

Email: spoojan1@umbc.edu

Other Majors/Minors: N/A

On-Campus Affiliations: Meyerhoff Scholar, S-STEM, Tau Beta Pi

Internships: BGE, Boston Scientific

On-Campus Research: Dr. Soobum Lee (ENME)

Difficulties: After receiving a D on my first exam in college, I was not very confident in my abilities to succeed. My peers, mentors and teaching fellows definitely helped me overcome this lack of confidence. I was able to learn a lot from that one small set back and it really helped me realize that college is hard but with hard work it is not impossible.

What helped you with these difficulties: Working with classmates in the common study lounges was a huge help early on in college. This helped me meet new people and understand the material a lot better. Some other helpful resources that have helped me are professor and TA office hours, Castle (for math), Pass SI, and CHEM Discovery center. There are plenty of resources available around campus, we just need to be active in seeking help when needed.

Scores:

How do I feel about being an engineer: 87%

Aspects:

- Relating to people in my class or activities: 71%
- Fitting into an engineering career and being treated fairly: 98%
- Dealing with or overcoming problems and difficulties: 92%

How motivated am I to study engineering: for 77%

Aspects:

How I value engineering: 100%

I'm motivated to study engineering because of:

- Financial rewards: 78%
- Parental Influence: 17%
- Improvements to the welfare of society: 89%
- Mentor Influence: 67%
- It's own purpose: 89%
- It's practical uses: 100%

How do I Value Necessary Engineering Skills: 75%

Aspects:

- How essential professional and interpersonal skills are: 72%
- How essential math and science skills are: 78%



Name: Areej Shahid – Chemical Engineering

Email: areejs1@umbc.edu

Other Majors/Minors: N/A

On-Campus Affiliations: AIChe, Chem-E Car, Muslim Student Association

Internships: I had a summer research experience (REU) the summer before my junior year at the University of Delaware. It was actually due to this experience that I began to consider pursuing a PhD in engineering.

On-Campus Research: I am currently working in Dr. Rosenzweig's lab. Although the lab is not specifically an engineering lab, it has shown me that engineering can be applied in any discipline.

Difficulties: I struggled a lot with time management. I made a lot of new friends my freshman year and I enjoyed socializing with them, but that meant I had less time in the day for schoolwork. This led to me staying up later at night to finish my work and affected the amount of sleep I would get.

Scores:

How do I feel about being an engineer: 86%

Aspects:

- Relating to people in my class or activities: 92%
- Fitting into an engineering career and being treated fairly: 83%
- Dealing with or overcoming problems and difficulties: 83%

How motivated am I to study engineering: 60%

Aspects:

How I value engineering: 78%

I'm motivated to study engineering because of:

- Financial rewards: 56%
- Parental Influence: 0%
- Improvements to the welfare of society: 100%
- Mentor Influence: 33%
- It's own purpose: 89%
- It's practical uses: 67%

How do I Value Necessary Engineering Skills: 81%

Aspects:

- How essential professional and interpersonal skills are: 61%
- How essential math and science skills are: 100%



Name: Daniel DeSmit – Mechanical Engineering

Email: dd7@umbc.edu

Other Majors/Minors: Entrepreneurship

On-Campus Affiliations: ASME, SAE, Teaching Fellow

Internships: Whiting-Turner, Architectural Engineering Firm (unlisted)

On-Campus Research: N/A

Difficulties: Chemistry was a struggle not because of the material learned, but the professors and exams that were made to Trick people. Group dynamics on a project can also be difficult at times and trying to find what path to take in the long term finding a job which can be

stressful because it is unknown into the future.

What helped you with these difficulties: Talk to professors, especially if you need help with how to navigate group dynamics if you are struggling. Talk to UMBC Career Center and professors to help you get internships and figure out what direction to go in after your degree or for internships.

Scores:

How do I feel about being an engineer: 80%

Aspects:

- Relating to people in my class or activities: 83%
- Fitting into an engineering career and being treated fairly: 78%
- Dealing with or overcoming problems and difficulties: 80%

How motivated am I to study engineering: 63%

Aspects:

How I value engineering: 78%

I'm motivated to study engineering because of:

- Financial rewards: 67%
- Parental Influence: 0%
- Improvements to the welfare of society: 89%
- Mentor Influence: 42%
- It's own purpose: 67%
- It's practical uses: 100%

How do I Value Necessary Engineering Skills: 86%

Aspects:

- How essential professional and interpersonal skills are: 72%
- How essential math and science skills are: 100%



Name: Shannon Clancy – Mechanical Engineer

Email: sclancl@umbc.edu

Other Majors/ Minors: N/A

On-Campus Affiliations: CWIT Affiliate, ASME, TBP, Resident Assistant, Teaching Fellow

Internships: Ford Motor Company (2018, 2019)

On-Campus Research: Prof. Gurganus (ENME)

Difficulties: During freshman year, I was very anxious about schoolwork to the point where I was almost constantly doing it and not always taking time for myself. I remember getting a low grade on the first Chem 101 exam and doubting my potential success as a ME and self-worth. I also had difficulty getting an internship after both my freshman and sophomore year in any engineering field, mostly due to my interviewing skills. However, I had the opportunity to work in the CWIT office and in UMBC Residential Life. While it wasn't engineering/technical experience, it taught me skills I used constantly use working with other students and in teams. I realized other skills and positions I had could be used in engineering and are just as valuable as my technical skills.

What helped you with these difficulties: Scheduled time in for myself, talked to friends and peers about my work life balance. I also frequently talked to my professors and upperclassmen students who I trusted about my stresses and ways to be successful in a certain class, project, etc. I also used the Career Center resources to help my resume and frequently went to different industry recruiter events to talk to industry professors from various companies to get practice with my 30 second elevator speech and talked to peers who had previous internships about how they prepared for interviews

Scores:

How do I feel about being an engineer: 75%

Aspects:

- Relating to people in my class or activities: 71%
- Fitting into an engineering career and being treated fairly: 76%
- Dealing with or overcoming problems and difficulties: 77%

How motivated am I to study engineering: 77%

Aspects:

How I value engineering: 81%

I'm motivated to study engineering because of:

- Financial rewards: 44%
- Parental Influence: 67%
- Improvements to the welfare of society: 78%
- Mentor Influence: 67%
- It's own purpose: 100%
- It's practical uses: 100%

How do I Value Necessary Engineering Skills: 67%

Aspects:

- How essential professional and interpersonal skills are: 78%
- How essential math and science skills are: 56%

Appendix C

Algorithm survey, SPSS and Scales

Development of Algorithm for calculation of variables:

The surveying host site, Qualtrics, provides the ability to assign numerical code to variables and create open-ended algorithmic outputs. An example is demonstrated in figure 1, showing the Feelings of Inclusion variable. For each Likert value, a number was assigned dependent on the user's response. Accordingly, if "strongly agree" was selected, a +7 was added into the calculated variable, whereas if the user selects the converse, "strongly disagree", a 1 was applied. After the survey is completed, the user will be supplied a percent value out of 100, based on how they responded to the variables subconstructs. Figure 2 shows what the value represents according to the score received and recommendations to help improve the users score if low.

Additionally, the output provides an overall score based on the SCCT. For example, the sub-variable, feelings of inclusion, lies under the Emotional Physiological States of the SCCT. After the user submits their responses, they will receive both a score for the sub-variable and the overall score in the SCCT. Figure 3 shows the algorithm for each SCCT.

To calculate the SCCT of Emotional and Physiological states = Engineering Career Success Expectations + Coping Self-Efficacy + Feelings of Inclusion. Each contribute an equal amount to the SCCT variable.

Figure 2: Feelings of Inclusion Algorithm

Clear

	Strongly Disagree	Disagree	Slightly Disagree	Neither Disagree nor Agree	Slightly Agree	Agree	Strongly Agree
I can relate to the people around me in my classes	0	1	2	3	4	5	6
I have a lot in common with other students in my classes	0	1	2	3	4	5	6
The other students in my classes share my personal interests	0	1	2	3	4	5	6
I can relate to the people around me in my extracurricular activities	0	1	2	3	4	5	6

Figure 3: Feelings of inclusions scale



Very Low feelings of inclusion: 0-28%

Student responded primary “Strongly disagree” and “Disagree” to the statements. Feels a strong sense of exclusion from the community and rarely feels included within the academic community.

Semi low feelings of inclusion 28%-42%

Student responded with mostly disagree and some agree to the statements. Mostly feels excluded, but at times, may encounter inclusive situations.

Doesn’t feel strongly either way 42% - 56%

Student doesn’t necessarily feel exclusive but doesn’t feel a strong sense of inclusion in their academic environment.

Semi High Feelings of Inclusion 56% - 69%

Student responded with mostly agree and some disagree to the statements. Mostly feels inclusive, but at times, may encounter exclusive situations.

Very High Feelings of Inclusion 69%- 100%

Student responded with mostly Strongly agree and Agree to the statements. Feels a strong sense of inclusion from the community and rarely feels excluded within their academic community.

Recommendations for Improvement of Feelings of Inclusion Score/Influence:

- Join engineering organization, program, or society to connect to other engineers and students of similar majors.
- Find common ground regarding engineering interests with peers and discuss class interests or even struggles with them.
- Research ways of effective methods of collaboration and teamwork. Attend a seminar or workshop with CWIT, Meyerhoff, or the Counseling Center around these topics.

Figure 4:SCCT Algorithm

ED

Set Embedded Data:

Q16 Number = \${gr://SC_8HyMWTIpZNL4kkt/Score}

Add a New Field

Add Below Move Duplicate Add From Contacts Options Delete

ED

Set Embedded Data:

Emotional and Physiological States =

\${e{ gr://SC_enyGYi4324CfVCR/Score + gr://SC_clU7l0OGFcfK9hP/Score + gr://SC_1GDBe16J34Vc4nz/Score }}

Add a New Field

Add Below Move Duplicate Add From Contacts Options Delete

ED

Set Embedded Data:

Social Persuasion and Vicarious Experiences =

\${e{ gr://SC_1lgs9GmR75FGmPz/Score + gr://SC_cHY3cUplocHz9Fb/Score + gr://SC_3dXXJq5itT1Fplj/Score + gr://SC_e8lA9XK4sngjqjH/Score + gr://SC_dcyOuaBZme4VJKB/Score + gr://SC_3C8DWIKKezOypIb/Score + gr://SC_3E2bFb9XWEdnRlx/Score + gr://SC_3q5jiErSra0jiHr/Score + gr://SC_6A2nCuOKlpRDvdr/Score + gr://SC_8HyMWTIpZNL4kkt/Score }}

Add a New Field

Add Below Move Duplicate Add From Contacts Options Delete

ED

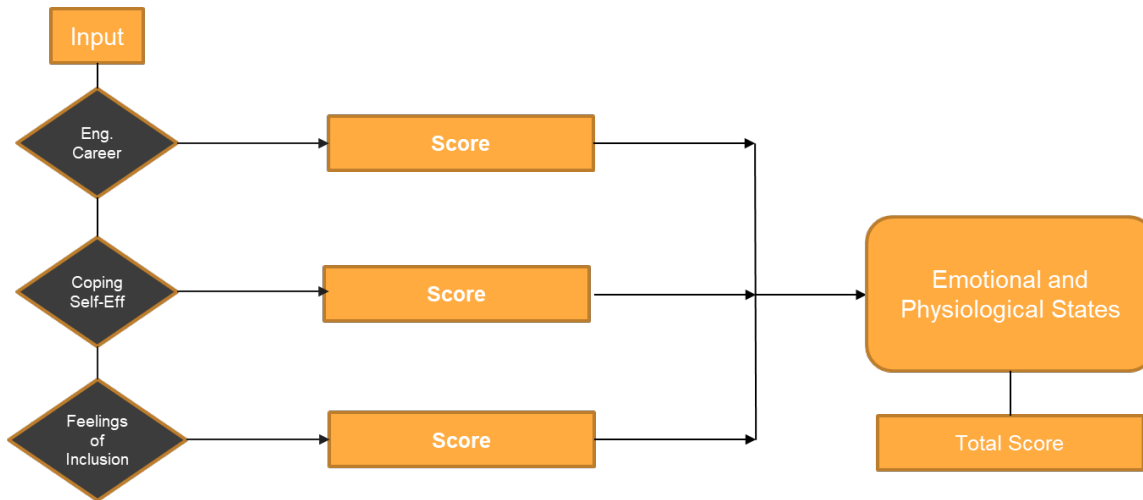
Set Embedded Data:

Mastery Experiences = \${e{ gr://SC_5dyTY2Ye2fhm3f7/Score + gr://SC_9tVMhNQl2RI5dFb/Score }}

Add a New Field

Add Below Move Duplicate Add From Contacts Options Delete

Figure 4: Block Diagram of Emotional and Physiological States



Computing the multi-item variable scores using SPSS (confirmation for Qualtrics output)

To compute each score, item scores were summed; the scale was then normalized and multiplied by 100 for reporting. (Adopted from Academic Pathways of People Learning Engineering Study)

Sample SPSS syntax for computation of multi-item variable scores

The code below represents Intrinsic Psychological -normalized (each item on a scale 0 to , so 3 items x 3 = 9)

```
COMPUTE intrinsicmotv =( GoodFeelings+Engineeringfun+Engineeringinteresting )/9.
```

```
VARIABLE LABELS intrinsicmotv 'Intrinsic Psychological normalized'.
```

```
EXECUTE .
```

```
FREQUENCIES
```

```
VARIABLES=intrinsicmotv
```

```
/STATISTICS=STDDEV VARIANCE SKEWNESS MINIMUM MAXIMUM MEAN
```

```
/ORDER= ANALYSIS .
```

```
compute intrinsicmotvr=intrinsicmotv*100.
```

```
variable labels intrinsicmotvr 'Intrinsic Psychological normalized and converted to 0-100'.
```

```
FREQUENCIES
```

```
VARIABLES=intrinsicmotvr
```

```
/STATISTICS=STDDEV VARIANCE SKEWNESS MINIMUM MAXIMUM MEAN
```

```
/ORDER= ANALYSIS .
```

Appendix D

Sample Intervention Email and Sign-up form

Email to students about Class signup

Email about Class signup

Hello Thursday, 10am Discussion Section:

As discussed, a while ago, we are offering a few times, starting November 11th, for you to visit a class in your major. Please not there is limited seating in some. So, if the seating does fill, I will ask if you could move to another day. I do ask that you signup no later than this Sunday November 10th.

Please take advantage of this rare and awesome opportunity! We are limiting this opportunity to test if we will expand and provide this for the future.

Below are three different forms according to the major:

1. Chemical Engineering <https://forms.gle/sVk5K1C5oaYmDop28>
2. Computer Engineering <https://forms.gle/SwiptuDtApzJYbct5>
3. Mechanical Engineering <https://forms.gle/UFuGsYTEptRMfn9h8>

You will receive a receipt of your choices in your email (it may go to updates tab in Gmail).

~Prof.G

Hello Thursday, 10am Discussion Section:

As discussed, a while ago, we are offering a few times, starting November 11th, for you to visit a class in your major. Please not there is limited seating in some. So, if the seating does fill, I will ask if you could move to another day. I do ask that you signup no later than this Sunday November 10th.

Please take advantage of this rare and awesome opportunity! We are limiting this opportunity to test if we will expand and provide this for the future.

Below are three different forms according to the major:

1. Chemical Engineering <https://forms.gle/sVk5K1C5oaYmDop28>
2. Computer Engineering <https://forms.gle/SwiptuDtApzJYbct5>
3. Mechanical Engineering <https://forms.gle/UFuGsYTEptRMfn9h8>

You will receive a receipt of your choices in your email (it may go to the updates tab in Gmail).

~Prof.G

Mechanical Engineering Classes Signup

Your email address (jmedof1@umbc.edu) will be recorded when you submit this form. Not jmedof1?

[Sign out](#)

1. What is your Current ENES 101 Discussion Section?

2. Last Name

3. First Name

4. Introduction to Engineering Design ENME 204: ILSB 118

Mark only one oval.

- ☐ November 12th 1-1:50pm ILSB 118 (10 seats)
- ☐ November 21st 1-1:50pm ILSB 118 (10 seats)

5. Thermodynamics ENME 217: ILSB 233

Mark only one oval.

- ☐ November 12th 8:30am - 9:45am (5 Seats)

6. Machine Design ENME 304 - Engineering Atrium

Mark only one oval.

- ☐ Demo week Engineering Atrium Building Monday 10am
- ☐ Demo Week Engineering Atrium Wednesday 10am

7. CMPE 306- Circuits: ITE 104

Mark only one oval.

- ☐ Monday November 11th 1-2:15pm
- ☐ Wednesday November 13th 1-2:15pm
- ☐ Monday November 18th 1-2:15pm

8. Senior Capstone Design ENME 444 (Biological Sciences 120)

Mark only one oval.

- ☐ Wednesday November 13th (8 Seats) 11-11:50am

A copy of your responses will be emailed to jmedof1@umbc.edu

Appendix E

Tables, Figures

Table 1E: Junior and Senior Confidence Means, Standard Deviations and Significance

Junior and Senior Confidence Mean Values		Beginning Confidence in Completing Engineering Degree	Present Confidence in Completing Engineering Degree
Third-year Student	Mean	83.33	100.00
	N	1.00	1.00
	Std. Deviation	.	.
Fourth-year Student	Mean	96.30	92.59
	N	9.00	9.00
	Std. Deviation	7.35	16.90
Fifth-year Student or above	Mean	66.67	97.62
	N	7.00	7.00
	Std. Deviation	25.46	6.30
Total	Mean	83.33	95.10
	N	17.00	17.00
	Std. Deviation	22.05	12.86
Significance		S P=.005	NS P=.804

Table E2: Junior and Senior SPVE Means, Standard Deviations and Significance

Junior and Senior Means, Standard Deviations and Significance									
Class Year		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	Social Persuasion and Vicarious Experiences
Third- year Student	Mean	56.00	0.00	89.00	58.00	89.00	100.00	97.00	70.00
	N Std. Deviation	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Fourth- year Student	Mean	68.00	13.00	93.89	34.44	89.00	88.89	84.89	67.33
	N Std. Deviation	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Fifth- year Student or above	Mean	68.43	14.43	84.29	50.14	84.14	95.14	80.57	68.14
	N Std. Deviation	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00
Total	Mean	67.47	12.82	89.65	42.29	87.00	92.12	83.82	67.82
	N Std. Deviation	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00
Significance		NS P=.704	NS P=.747	NS P=.521	NS P=.47	NS P=.793	NS P=.74	NS P=.274	NS P=.763

Table E3: Junior and Senior Gender SPVE Means, Standard Deviations and Significance

Gender		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	Social Persuasion and Vicarious Experiences
Male	Mean	75.13	8.38	93.13	32.50	83.50	93.75	83.63	67.00
	N	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
	Std. Deviation	19.50	12.57	8.18	28.83	17.64	17.68	8.72	5.15
Female	Mean	60.67	16.78	86.56	51.00	90.11	90.67	84.00	68.56
	N	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
	Std. Deviation	12.76	29.01	16.30	31.02	18.09	12.10	10.95	12.34
Total	Mean	67.47	12.82	89.65	42.29	87.00	92.12	83.82	67.82
	N	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00
	Std. Deviation	17.41	22.55	13.17	30.59	17.65	14.58	9.66	9.40
Significance		NS P=.114	NS P=1.0	NS P=.541	NS P=.277	NS P=.423	NS P=.370	NS P=.815	NS P=.745

Table E4 Junior and Senior Ethnic SPVE Means, Standard Deviations and Significance

Ethnic Junior & Seniors		Motivat ion - Financia l	Motivat ion - Parenta l Influenc e	Motivat ion - Social Good	Motivat ion - Mentor Influenc e	Motivatio n - Intrinsic Psycholog ical	Motivat ion - Intrinsic Behavio ral	General Impressi ons of Engineer ing	Social Persuasi on and Vicariou s Experien ces
Black/Afri can American	Mean N Std. Deviati on	72.50 4.00 11.00	25.00 4.00 32.03	91.75 4.00 10.53	62.75 4.00 14.34	80.75 4.00 22.68	87.50 4.00 25.00	85.50 4.00 9.43	72.25 4.00 12.31
Asian & Pacific American	Mean N Std. Deviati on	67.00 2.00 15.56	8.50 2.00 12.02	94.50 2.00 7.78	50.00 2.00 24.04	89.00 2.00 0.00	83.50 2.00 23.33	89.00 2.00 15.56	68.50 2.00 12.02
White American	Mean N Std. Deviati on	67.90 10.00 19.97	10.10 10.00 21.21	86.80 10.00 15.38	32.60 10.00 35.03	87.80 10.00 18.56	94.90 10.00 8.21	81.90 10.00 9.87	66.00 10.00 8.83
Other	Mean N Std. Deviati on	44.00 1.00 .	0.00 1.00 .	100.00 1.00 .	42.00 1.00 .	100.00 1.00 .	100.00 1.00 .	86.00 1.00 .	67.00 1.00 .
Total	Mean N Std. Deviati on	67.47 17.00 17.41	12.82 17.00 22.55	89.65 17.00 13.17	42.29 17.00 30.59	87.00 17.00 17.65	92.12 17.00 14.58	83.82 17.00 9.66	67.82 17.00 9.40
Significance		NS P=.426	NS P=.696	NS P=.705	NS P=.438	NS P=.694	NS P=.792	MS P=.802	NS P=.965

Table E5: Junior and Senior Program Affiliation SPVE Means, Standard Deviations and Significance

Program Affiliation		Motivati on - Financial	Motivati on - Parental Influenc e	Motivati on - Social Good	Motivati on - Mentor Influenc e	Motivatio n - Intrinsic Psychologi cal	Motivati on - Intrinsic Behavio ral	General Impressi ons of Engineeri ng	Social Persuasi on and Vicarious Experien ces
Meyerhoff	Mean	59.33	11.00	89.00	50.33	74.33	83.33	81.33	64.00
	N	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	Std. Deviati on	17.24	19.05	11.00	14.43	22.90	28.87	8.08	4.36
CWIT Scholar	Mean	56.00	0.00	89.00	58.00	89.00	100.00	97.00	70.00
	N	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Std. Deviati on	.	.	.	.	.	.	.	.
CWIT Affiliate	Mean	63.00	50.33	81.67	80.67	96.33	94.33	86.33	79.00
	N	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	Std. Deviati on	17.35	28.87	16.80	17.21	6.35	9.81	5.51	7.21
S-STEM	Mean	44.00	0.00	89.00	42.00	100.00	100.00	69.00	63.00
	N	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Std. Deviati on	.	.	.	.	.	.	.	.
Non- Programmed	Mean	75.25	2.13	93.13	19.88	86.13	91.63	82.00	64.25
	N	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
	Std. Deviati on	17.39	6.01	15.49	25.27	20.45	12.57	9.12	9.56
Two or More	Mean	78.00	17.00	89.00	67.00	89.00	100.00	100.00	77.00
	N	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Std. Deviati on	.	.	.	.	.	.	.	.
Total	Mean	67.47	12.82	89.65	42.29	87.00	92.12	83.82	67.82
	N	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00
	Std. Deviati on	17.41	22.55	13.17	30.59	17.65	14.58	9.66	9.40
Significance *p<.1		NS P=.452	S *P=.067	NS P=.66	S *P=.060	NS P=.705	NS P=.916	NS P=.207	NS P=.197

Table E6: Correlations Juniors and Seniors SPVE

SVPE Correlations Juniors and Seniors		1	2	3	4	5	6	7	8
1.Motivation - Financial	Correlation Coefficient	1							
	Sig. (2-tailed)	.							
	N	17							
2.Motivation - Parental Influence	Correlation Coefficient	-.0021	1						
	Sig. (2-tailed)	0.937	.						
	N	17	17						
3.Motivation - Social Good	Correlation Coefficient	0.373	-.0185	1					
	Sig. (2-tailed)	0.14	0.477	.					
	N	17	17	17					
4.Motivation - Mentor Influence	Correlation Coefficient	-.0097	0.464	-.0356	1				
	Sig. (2-tailed)	0.71	0.06	0.16	.				
	N	17	17	17	17				
5.Motivation - Intrinsic Psychological	Correlation Coefficient	0.101	-.0032	.594*	0.039	1			
	Sig. (2-tailed)	0.7	0.902	0.012	0.882	.			
	N	17	17	17	17	17			
6.Motivation - Intrinsic Behavioral	Correlation Coefficient	0.301	-0.07	0.186	0.163	0.437	1		
	Sig. (2-tailed)	0.24	0.79	0.474	0.531	0.079	.		
	N	17	17	17	17	17	17		
7.General Impressions of Engineering	Correlation Coefficient	0.22	0.307	0.353	0.344	0.255	0.094	1	
	Sig. (2-tailed)	0.397	0.23	0.164	0.176	0.324	0.721	.	
	N	17	17	17	17	17	17	17	
8.Social Persuasion and Vicarious Experiences	Correlation Coefficient	0.37	0.435	0.17	.591*	.549*	.550*	.612**	1
	Sig. (2-tailed)	0.144	0.081	0.514	0.012	0.022	0.022	0.009	.
	N	17	17	17	17	17	17	17	17

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table E7: Junior and Senior Mastery Experiences Means, Standard Deviations and Significance

Class Year		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Third-year Student	Mean	72.00	56.00	64.00
	N	1.00	1.00	1.00
	Std. Deviation	.	.	.
Fourth-year Student	Mean	64.22	74.11	69.33
	N	9.00	9.00	9.00
	Std. Deviation	19.08	34.72	23.85
Fifth-year Student or above	Mean	76.14	81.00	78.71
	N	7.00	7.00	7.00
	Std. Deviation	15.31	20.10	15.98
Total	Mean	69.59	75.88	72.88
	N	17.00	17.00	17.00
	Std. Deviation	17.48	28.15	20.17
Significances		NS P=.394	NS P=.641	NS P=.569

Table E8: Junior and Senior Gender Mastery Experiences Means, Standard Deviations and Significance

Gender ME		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Male	Mean	66.625	73.625	70.25
	N	8	8	8
	Std. Deviation	22.53212	36.14233	27.27505
Female	Mean	72.2222	77.8889	75.2222
	N	9	9	9
	Std. Deviation	12.24518	20.78127	12.24518
Total	Mean	69.5882	75.8824	72.8824
	N	17	17	17
	Std. Deviation	17.47519	28.14667	20.17388
Significance		NS P=.527	NS P=.815	NS P=.628

Table E9: Junior and Senior Ethnic Mastery Experiences Means, Standard Deviations and Significance

Ethnic		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Black/African American	Mean	91.50	94.50	93.00
	N	4.00	4.00	4.00
	Std. Deviation	9.43	11.00	10.10
Asian & Pacific American	Mean	66.50	89.00	78.00
	N	2.00	2.00	2.00
	Std. Deviation	7.78	15.56	4.24
White American	Mean	63.40	63.40	63.60
	N	10.00	10.00	10.00
	Std. Deviation	14.35	30.19	20.14
Other	Mean	50.00	100.00	75.00
	N	1.00	1.00	1.00
	Std. Deviation	.	.	.
Total	Mean	69.59	75.88	72.88
	N	17.00	17.00	17.00
	Std. Deviation	17.48	28.15	20.17
Significance *p<.1 **p<.05		S **P=.03	S *P=.094	S **P=.045

Table E10: Junior and Senior Program Affiliation Means, Deviations and Significance Mastery Experiences

Program Affiliation		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Meyerhoff	Mean	81.33	100.00	90.67
	N	3.00	3.00	3.00
	Std. Deviation	27.30	0.00	13.65
CWIT Scholar	Mean	72.00	56.00	64.00
	N	1.00	1.00	1.00
	Std. Deviation	.	.	.
CWIT Affiliate	Mean	79.67	66.67	73.33
	N	3.00	3.00	3.00
	Std. Deviation	13.58	29.48	21.22
S-STEM	Mean	83.00	89.00	86.00
	N	1.00	1.00	1.00
	Std. Deviation	.	.	.
Non-Programmed	Mean	59.13	70.88	65.25
	N	8.00	8.00	8.00
	Std. Deviation	13.31	34.15	22.58
Two or more	Mean	72.00	78.00	75.00
	N	1.00	1.00	1.00
	Std. Deviation	.	.	.
Total	Mean	69.59	75.88	72.88
	N	17.00	17.00	17.00

	Std. Deviation	17.48	28.15	20.17
Significance		NS P= .343	NS P= .343	NS P= .409

Table E11: Correlations Mastery Experiences Juniors and Seniors

Correlations Mastery Experiences Juniors and Seniors		1	2	3
1. Perceived Importance of Professional and Interpersonal Skills	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
	N	17		
2. Perceived importance of Math and Science Skills	Correlation Coefficient	0.398	1	
	Sig. (2-tailed)	0.113	.	
	N	17	17	
3. Mastery Experiences	Correlation Coefficient	.744**	.887**	1
	Sig. (2-tailed)	0.001	0	.
	N	17	17	17
** Correlation is significant at the 0.01 level (2-tailed).				

Table E12: Junior and Senior Emotional States Means, Standard Deviations and Significance

Emotional States		Engineering Career Success Expectations	Feelings of inclusion	Coping Self Efficacy	Emotional States
Third-year Student	Mean	88.00	79.00	87.00	85.00
	N	1.00	1.00	1.00	1.00
	Std. Deviation	.	.	.	.
Fourth-year Student	Mean	85.89	76.44	89.11	83.78
	N	9.00	9.00	9.00	9.00
	Std. Deviation	16.26	13.49	9.17	8.26
Fifth-year Student or above	Mean	71.86	72.57	78.57	74.29
	N	7.00	7.00	7.00	7.00
	Std. Deviation	10.45	15.02	14.83	9.95
Total	Mean	80.24	75.00	84.65	79.94
	N	17.00	17.00	17.00	17.00
	Std. Deviation	15.02	13.43	12.34	9.75
Significance		NS P= .185	NS P= .179	NS P= .397	NS P= .314

Table E13: Junior and Senior Gender Emotional States Means, Standard Deviations and Significance

Gender Emotional States		Engineering Career Success Expectations	Feelings of inclusion	Coping Self Efficacy	Emotional States
Male	Mean	85.13	75.00	91.50	83.75
	N	8.00	8.00	8.00	8.00
	Std. Deviation	16.98	16.41	7.58	8.68
Female	Mean	75.89	75.00	78.56	76.56
	N	9.00	9.00	9.00	9.00
	Std. Deviation	12.39	11.19	12.87	9.84
Total	Mean	80.24	75.00	84.65	79.94
	N	17.00	17.00	17.00	17.00
	Std. Deviation	15.02	13.43	12.34	9.75
Significance *p<.05		NS P=.139	NS P=.888	S *P=.015	NS P=.139

Table E14: Junior and Senior Ethnic Emotional States Means, Standard Deviations and Significance

Ethnic Emotional States		Engineering Career Success Expectations	Feelings of inclusion	Coping Self Efficacy	Emotional States
Black/African American	Mean	77.50	68.50	77.50	74.50
	N	4.00	4.00	4.00	4.00
	Std. Deviation	17.29	12.56	21.38	10.72
Asian & Pacific American	Mean	90.50	81.50	87.50	86.50
	N	2.00	2.00	2.00	2.00
	Std. Deviation	10.61	14.85	6.36	0.71
White American	Mean	77.50	76.70	86.10	80.10
	N	10.00	10.00	10.00	10.00
	Std. Deviation	14.79	14.51	8.90	10.12
Other	Mean	98.00	71.00	93.00	87.00
	N	1.00	1.00	1.00	1.00
	Std. Deviation	.	.	.	.
Total	Mean	80.24	75.00	84.65	79.94
	N	17.00	17.00	17.00	17.00
	Std. Deviation	15.02	13.43	12.34	9.75
Significance		NS P=.459	NS P=.689	NS P=.605	NS P=.481

Table E15: Junior and Senior Program Affiliation Emotional States Means, Standard Deviations and Significance

Program Affiliation		Engineering Career Success Expectations	Feelings of inclusion	Coping Self Efficacy	Emotional States
Meyerhoff	Mean	93.00	62.33	91.00	82.00
	N	3.00	3.00	3.00	3.00
	Std. Deviation	6.25	7.51	7.21	5.57
CWIT Scholar	Mean	88.00	79.00	87.00	85.00
	N	1.00	1.00	1.00	1.00
	Std. Deviation	.	.	.	.
CWIT Affiliate	Mean	73.67	69.33	80.00	74.33
	N	3.00	3.00	3.00	3.00
	Std. Deviation	2.52	14.57	3.00	6.03
S-STEM	Mean	62.00	63.00	77.00	67.00
	N	1.00	1.00	1.00	1.00
	Std. Deviation	.	.	.	.
Non-Programmed	Mean	77.00	83.38	83.75	81.38
	N	8.00	8.00	8.00	8.00
	Std. Deviation	17.35	12.15	16.92	12.07
Two or more	Mean	98.00	71.00	92.00	87.00
	N	1.00	1.00	1.00	1.00
	Std. Deviation	.	.	.	.
Total	Mean	80.24	75.00	84.65	79.94
	N	17.00	17.00	17.00	17.00
	Std. Deviation	15.02	13.43	12.34	9.75
Significance		NS P=.294	NS P=.179	NS P=.89	NS P=.636

Table E16: Correlations Emotional States Juniors and Seniors

Correlations Emotional States		1	2	3	4
Engineering Career Success Expectations	Correlation Coefficient	1			
	Sig. (2-tailed)	.			
	N	17			
Feelings of inclusion	Correlation Coefficient	0.21	1		
	Sig. (2-tailed)	0.42	.		
	N	17	17		
Coping Self Efficacy	Correlation Coefficient	0.482	0.097	1	
	Sig. (2-tailed)	0.05	0.711	.	
	N	17	17	17	
Emotional States	Correlation Coefficient	.837**	.555*	.598*	1
	Sig. (2-tailed)	0	0.021	0.011	.
	N	17	17	17	17
** Correlation is significant at the 0.01 level (2-tailed).					
* Correlation is significant at the 0.05 level (2-tailed).					

4.3 Engineering 101 Fall 2019 Pre-assessment Data

Table E17: ENES 101Pre-Assessment Confidence Means, Standard Deviations and Significance

Pre-Ass.		Beginning Confidence in Completing Engineering Degree	Present Confidence in Completing Engineering Degree
Group #1	Mean	79.92	79.12
	N	83.00	83.00
	Std. Deviation	22.20	21.12
Group #2	Mean	80.04	76.16
	N	86.00	86.00
	Std. Deviation	20.42	19.22
Total	Mean	79.98	77.61
	N	169.00	169.00
	Std. Deviation	21.25	20.17
	Significance	P=.764	P=.186

Table E18: ENES 101Pre-Assessment SPVE Means, Standard Deviations and Significance

ENES 101 Discussi on		Motivati on - Financia l	Motivati on - Parental Influenc e	Motivati on - Social Good	Motivati on - Mentor Influenc e	Motivatio n - Intrinsic Psycholog ical	Motivati on - Intrinsic Behavio ral	General Impressi ons of Engineer ing	SPVE
Tuesday 10am	Mean	74.44	16.70	79.52	34.81	84.89	86.30	81.29	65.41
	N	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
	Std. Deviati on	21.83	28.48	21.30	24.02	18.20	16.73	10.23	10.30
Tuesday 12pm	Mean	77.17	18.45	86.34	31.31	87.41	87.90	81.03	67.14
	N	29.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00
	Std. Deviati on	18.49	26.45	14.60	20.03	18.25	23.11	8.44	9.09
Thursda y 10am	Mean	67.50	12.47	81.00	20.78	77.56	83.34	75.09	59.63
	N	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00

	Std. Deviation	24.99	20.73	24.15	21.26	25.29	28.97	14.40	12.28
Thursday 12pm	Mean	80.59	19.81	82.41	35.74	80.78	76.48	77.85	64.81
	N	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
	Std. Deviation	19.23	25.76	18.78	24.29	23.56	30.41	13.00	12.31
Thursday 2pm	Mean	67.63	23.41	75.74	25.11	86.11	83.26	78.37	62.74
	N	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
	Std. Deviation	21.21	29.30	24.59	22.26	16.69	29.25	10.90	11.57
Tuesday 2pm	Mean	71.33	21.63	77.48	26.52	71.67	75.30	78.14	60.22
	N	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
	Std. Deviation	26.24	30.24	27.46	26.65	32.27	34.04	10.70	13.73
Total	Mean	72.99	18.56	80.50	28.83	81.36	82.20	78.55	63.26
	N	169.00	169.00	169.00	169.00	169.00	169.00	169.00	169.00
	Std. Deviation	22.42	26.68	22.14	23.40	23.34	27.64	11.50	11.80
Significance *p<.1		NS P=.206	NS P=.556	NS P=.685	S *P=.057	NS P=.239	NS P=.461	NS P=.497	NS P=.123

Table E19: ENES 101Pre-Assessment SPVE Gender Means, Standard Deviations and Significance

Pre-Assessment Gender		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	Social Persuasion and Vicarious Experiences
Male	Mean	73.15	18.64	81.64	27.28	81.90	84.60	78.40	63.63
	N	127.00	127.00	127.00	127.00	127.00	127.00	127.00	127.00
	Std. Deviation	22.77	26.99	21.00	21.22	24.17	25.59	11.70	11.46
Female	Mean	72.53	18.80	77.03	34.75	79.00	73.70	79.57	62.20
	N	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
	Std. Deviation	22.13	26.51	25.86	28.89	21.02	32.63	11.00	13.13
Other	Mean	72.50	8.50	78.00	8.50	94.50	100.00	68.00	61.00
	N	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00

	Std. Deviation	7.78	12.02	0.00	12.02	7.78	0.00	9.80	7.07
Total	Mean	72.99	18.56	80.50	28.83	81.36	82.20	78.55	63.26
	N	169.00	169.00	169.00	169.00	169.00	169.00	169.00	169.00
	Std. Deviation	22.42	26.68	22.14	23.40	23.34	27.64	11.50	11.80
Significance *p<.1		NS P=.932	NS P=.959	NS P=.581	NS P=.194	NS P=.296	S *P<.062	NS P=.296	NS P=.813

Table E20: ENES 101 Pre-Assessment SPVE Ethnic Means, Standard Deviations and Significance

Pre-assessment Ethnc		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	Social Persuasion and Vicarious Experiences
Black/African American	Mean	68.74	14.71	79.12	27.88	87.06	84.71	79.55	63.12
	N	34.00	34.00	34.00	34.00	34.00	34.00	24.00	34.00
	Std. Deviation	26.24	27.71	24.94	27.40	13.12	23.36	9.05	10.84
American Indian/Alaskan Native	Mean	83.00	67.00	67.00	0.00	33.00	33.00	78.00	52.00
	N	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Std. Deviation								
Asian & Pacific American	Mean	79.07	31.10	81.20	34.80	79.37	79.40	73.83	65.50
	N	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
	Std. Deviation	16.27	33.24	22.06	21.94	22.92	29.55	12.00	13.15
Latina/Hispanic American	Mean	80.20	20.00	55.80	30.00	46.80	50.00	78.40	51.60
	N	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	Std. Deviation	19.68	29.91	19.49	22.39	30.02	33.38	7.40	12.82
White American	Mean	71.48	14.00	81.97	27.84	83.23	84.83	79.56	63.23
	N	87.00	87.00	87.00	87.00	87.00	87.00	87.00	87.00

	Std. Deviation	23.13	20.93	21.50	22.37	23.20	26.72	11.70	11.54
Other	Mean	77.00	26.50	83.50	25.67	75.08	80.58	80.33	64.08
	N	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
	Std. Deviation	19.18	31.34	15.91	23.49	30.76	30.81	15.50	11.34
Total	Mean	72.99	18.56	80.50	28.83	81.36	82.20	78.55	63.26
	N	169.00	169.00	169.00	169.00	169.00	169.00	169.00	169.00
	Std. Deviation	22.42	26.68	22.14	23.40	23.34	27.64	11.57	11.80
Significance *P<.1 **P<.05		NS P=.646	S **P= 0.025	NS P=.139	NS P=.338	S **P=.018	S **P=.029	NS P=.207	NS P=.267

Table E21: ENES 101 Pre-Assessment SPVE Program Affiliation Means, Standard Deviations and Significance

Pre- Assessment Program Affiliation		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	Social Persuasion and Vicarious Experiences
Meyerhoff	Mean	70.56	16.78	91.44	58.00	91.44	90.67	82.00	71.67
	N	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
	Std. Deviation	25.50	20.41	14.32	34.85	9.17	16.93	9.94	8.77
CWIT Scholar	Mean	76.17	38.83	72.17	54.00	85.33	80.50	80.16	69.67
	N	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
	Std. Deviation	14.62	37.53	36.47	26.74	16.56	32.20	13.65	10.91
S-STEM	Mean	76.11	11.11	82.22	17.56	90.83	92.56	82.33	64.72
	N	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
	Std. Deviation	17.54	24.89	23.20	21.94	11.48	11.72	10.99	7.69
Non-Programmed	Mean	72.60	18.76	79.92	27.28	79.26	80.35	77.75	62.23
	N	136.00	136.00	136.00	136.00	136.00	136.00	136.00	136.00
	Std. Deviation	23.20	26.55	21.65	20.44	24.95	29.24	11.60	12.20
Total	Mean	72.99	18.56	80.50	28.83	81.36	82.20	78.55	63.26

	N	169.00	169.00	169.00	169.00	169.00	169.00	169.00	169.00
	Std. Deviation	22.42	26.68	22.14	23.40	23.34	27.64	11.50	11.80
Significance *P<.1 **P<.05		NS P=.984	NS P=.176	NS P=.988	S **P=.001	NS P=.251	NS P=.388	NS P=.336	S **P=.05

Table E22: ENES 101 Pre-Assessment SPVE Correlation

		1	2	3	4	5	6	7
1. Motivation - Financial	Correlation Coefficient	1.00						
	Sig. (2-tailed)							
	N	169						
2. Motivation - Parental Influence	Correlation Coefficient	.335**	1.000					
	Sig. (2-tailed)	0.000						
	N	169	169					
3. Motivation - Social Good	Correlation Coefficient	-0.103	-0.077	1.000				
	Sig. (2-tailed)	0.184	0.322					
	N	168	168	168				
4. Motivation - Mentor Influence	Correlation Coefficient	0.119	.165*	.156*	1.000			
	Sig. (2-tailed)	0.122	0.032	0.043				
	N	169	169	168	169			
5. Motivation - Intrinsic Psychological	Correlation Coefficient	-0.069	-.183*	.403**	.233**	1.000		
	Sig. (2-tailed)	0.381	0.018	0.000	0.003			
	N	165	165	165	165	165		
6. Motivation - Intrinsic Behavioral	Correlation Coefficient	-0.056	-0.044	.363**	.165*	.624**	1.000	
	Sig. (2-tailed)	0.482	0.577	0.000	0.037	0.000		
	N	160	160	160	160	160	160	
7. General Impressions of Engineering	Correlation Coefficient	0.009	-.182*	.264**	0.047	.473**	.348**	1.000
	Sig. (2-tailed)	0.909	0.018	0.001	0.547	0.000	0.000	
	N	169	169	168	169	165	160	169
8. Social Persuasion and Vicarious Experiences	Correlation Coefficient	.369**	.326**	.504**	.586**	.577**	.567**	.350**
	Sig. (2-tailed)	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	N	169	169	168	169	165	160	169

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Table E23: ENES 101 Pre-Assessment ENES 101 Mastery Experiences Means, Standard Deviations and Significance

ENES 101 Discussion time		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Tuesday 10am	Mean	74.30	86.52	80.74
	N	27.00	27.00	27.00
	Std. Deviation	14.77	14.53	9.94
Tuesday 12pm	Mean	76.21	91.21	83.97
	N	29.00	29.00	29.00
	Std. Deviation	15.88	16.67	12.66
Thursday 10am	Mean	73.03	90.69	82.09
	N	32.00	32.00	32.00
	Std. Deviation	15.21	14.11	11.15
Thursday 12pm	Mean	75.85	86.56	81.44
	N	27.00	27.00	27.00
	Std. Deviation	15.33	15.66	11.35
Thursday 2pm	Mean	76.74	87.70	82.37
	N	27.00	27.00	27.00
	Std. Deviation	21.67	23.12	20.40
Tuesday 2pm	Mean	74.07	88.52	81.52
	N	27.00	27.00	27.00
	Std. Deviation	14.57	16.77	11.03
Total	Mean	74.99	88.63	82.05
	N	169.00	169.00	169.00
	Std. Deviation	16.19	16.83	13.01
Significance		NS P=0.814	NS P=0.346	NS P=0.498

Table E24: ENES 101 Pre-Assessment Mastery Experiences Gender Means, Standard Deviations and Significance

Gender		Perceived Importance of Professional and Interpersonal Skills Percent	Perceived importance of Math and Science Skills Percent	Mastery Experiences
Male	Mean	73.91	86.86	80.63
	N	127.00	127.00	127.00
	Std. Deviation	16.72	18.01	13.52
Female	Mean	78.98	93.95	86.68
	N	40.00	40.00	40.00
	Std. Deviation	13.77	11.40	10.24
Other	Mean	64.00	94.50	79.50
	N	2.00	2.00	2.00
	Std. Deviation	19.80	7.78	13.44
Total	Mean	74.99	88.63	82.05
	N	169.00	169.00	169.00
	Std. Deviation	16.19	16.83	13.01
Significance		NS P=0.201	S *P=0.054	S *P<.019

Table E25: ENES 101 Pre-Assessment Mastery Experiences Ethnic Means, Standard Deviations and Significance

Ethnic Affiliation Mastery Experiences		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Black/African American	Mean	80.3235	92.2353	86.4706
	N	34	34	34
	Std. Deviation	13.11192	11.65686	9.11953
American Indian/Alaskan Native	Mean	89	100	95
	N	1	1	1
	Std. Deviation	.	.	.
Asian & Pacific American	Mean	70.7667	79.6667	75.4667
	N	30	30	30
	Std. Deviation	20.4192	25.4969	20.13186
Latina/Hispanic American	Mean	78.8	84.6	82
	N	5	5	5

	Std. Deviation	14.02498	21.44295	17.19011
White American	Mean	74.4138	89.8506	82.3563
	N	87	87	87
	Std. Deviation	15.68776	14.26781	10.69229
Other	Mean	71.8333	92.6667	82.6667
	N	12	12	12
	Std. Deviation	14.79455	11.80395	8.3048
Total	Mean	74.9882	88.6272	82.0473
	N	169	169	169
	Std. Deviation	16.19156	16.83313	13.00541
Significance		NS P=0.222	NS P=0.332	NS P=0.12

Table E26: ENES 101 Pre-Assessment Mastery Experiences Program Affiliation Means, Standard Deviations and Significance

Program Affiliation Mastery Experiences		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Meyerhoff	Mean	81.44	93.89	87.89
	N	9.00	9.00	9.00
	Std. Deviation	12.32	7.99	8.36
CWIT Scholar	Mean	84.33	94.50	89.50
	N	6.00	6.00	6.00
	Std. Deviation	17.13	9.20	8.12
S-STEM	Mean	75.00	93.22	84.44
	N	18.00	18.00	18.00
	Std. Deviation	12.06	14.87	10.55
Non-Programmed	Mean	74.15	87.41	81.01
	N	136.00	136.00	136.00
	Std. Deviation	16.75	17.61	13.54
Total	Mean	74.99	88.63	82.05
	N	169.00	169.00	169.00
	Std. Deviation	16.19	16.83	13.01
Significance		NS P= 0.292	NS P=0.339	NS P=0.12

Table E27: ENES 101 Pre-Assessment Mastery Experiences Correlations

		1	2	3
Perceived Importance of Professional and Interpersonal Skills	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
	N	169		
Perceived importance of Math and Science Skills	Correlation Coefficient	0.149	1	
	Sig. (2-tailed)	0.053	.	
	N	169	169	
Mastery Experiences	Correlation Coefficient	.764**	.711**	1
	Sig. (2-tailed)	0	0	.
	N	169	169	169
** Correlation is significant at the 0.01 level (2-tailed).				

Table E28: ENES 101 Pre-Assessment ENES 101 Emotional State Means, Standard Deviations and Significance

Discussion ENES 101		Coping Self Efficacy	Feelings of Inclusion	Engineering Career Success Expectations	Emotional States
Tuesday 10am	Mean	82.19	69.81	83.30	78.44
	N	27.00	27.00	27.00	27.00
	Std. Deviation	10.39	22.65	7.90	9.79
Tuesday 12pm	Mean	81.90	61.62	88.66	77.38
	N	29.00	29.00	29.00	29.00
	Std. Deviation	16.65	25.97	7.96	12.62
Thursday 10am	Mean	81.94	55.59	78.19	71.84
	N	32.00	32.00	32.00	32.00
	Std. Deviation	13.63	23.47	10.77	11.15
Thursday 12pm	Mean	81.30	58.48	85.63	75.19
	N	27.00	27.00	27.00	27.00
	Std. Deviation	10.84	24.27	10.66	10.77
Thursday 2pm	Mean	79.00	54.59	81.15	71.63
	N	27.00	27.00	27.00	27.00

	Std. Deviation	12.91	26.54	9.97	12.29
Tuesday 2pm	Mean	80.22	64.37	80.37	74.93
	N	27.00	27.00	27.00	27.00
	Std. Deviation	10.88	20.61	11.15	10.48
Total	Mean	81.12	60.60	82.81	74.84
	N	169.00	169.00	169.00	169.00
	Std. Deviation	12.68	24.22	10.32	11.37
Sig		NS P=.759	NS P= 0.157	S P=.001	NS P=.126

Table E29: ENES 101 Pre-Assessment ENES 101 Gender Emotional State Means, Standard Deviations and Significance

Gender:		Coping Self Efficacy	Feelings of Inclusion	Engineering Career Success Expectations	Emotional States
Male	Mean	81.9606	61.1811	83.2677	75.4567
	N	127	127	127	127
	Std. Deviation	12.98986	24.44833	10.01859	11.72689
Female	Mean	79.025	60.65	81.3	73.675
	N	40	40	40	40
	Std. Deviation	11.5747	22.26478	11.3119	9.75702
Other	Mean	70	23	84	59
	N	2	2	2	2
	Std. Deviation	4.24264	32.52691	11.31371	8.48528
Total	Mean	81.1243	60.6036	82.8107	74.8402
	N	169	169	169	169
	Std. Deviation	12.68116	24.22298	10.31814	11.36952
SIG		NS P= 0.079	NS P=0.184	NS P=0.717	NS P =.096

Table E30: ENES 101 Pre-Assessment ENES 101 Ethnic Emotional State Means, Standard Deviations and Significance

Ethnic Affiliation Emotional States		Coping Self Efficacy	Feelings of Inclusion	Engineering Career Success Expectations	Emotional States
Black/African American	Mean	85.65	57.71	84.94	76.12
	N	34.00	34.00	34.00	34.00
	Std. Deviation	10.25	25.44	9.88	10.66
American Indian/Alaskan Native	Mean	77.00	50.00	76.00	68.00
	N	1.00	1.00	1.00	1.00
	Std. Deviation	.	.	.	.
Asian & Pacific American	Mean	77.53	64.67	79.77	73.93
	N	30.00	30.00	30.00	30.00
	Std. Deviation	15.03	16.64	11.57	10.20
Latina/Hispanic American	Mean	78.40	51.20	85.40	71.80
	N	5.00	5.00	5.00	5.00
	Std. Deviation	12.01	28.91	10.74	13.33
White American	Mean	79.95	60.59	82.63	74.39
	N	87.00	87.00	87.00	87.00
	Std. Deviation	12.41	25.75	9.96	12.11
Other	Mean	87.25	63.58	85.17	78.58
	N	12.00	12.00	12.00	12.00
	Std. Deviation	11.55	25.92	10.47	10.77
Total	Mean	81.12	60.60	82.81	74.84
	N	169.00	169.00	169.00	169.00
	Std. Deviation	12.68	24.22	10.32	11.37
Significance *P<.1		S *P=0.062	NS P=0.783	NS P=0.364	NS PS=.740

Table E31: ENES 101 Pre-Assessment ENES 101 Program Affiliation Emotional State Means, Standard Deviations and Significance

Program Affiliation Emotional States		Coping Self Efficacy	Feelings of Inclusion	Engineering Career Success Expectations	Emotional States
Meyerhoff	Mean	83.56	63.44	90.00	78.89
	N	9.00	9.00	9.00	9.00
	Std. Deviation	13.60	23.53	6.73	9.73
CWIT Scholar	Mean	73.00	66.00	79.67	72.67

	N	6.00	6.00	6.00	6.00
	Std. Deviation	13.87	18.58	17.37	14.31
S-STEM	Mean	83.39	60.17	86.61	76.72
	N	18.00	18.00	18.00	18.00
	Std. Deviation	14.16	28.50	8.40	12.01
Non-Programmed	Mean	81.02	60.24	81.97	74.42
	N	136.00	136.00	136.00	136.00
	Std. Deviation	12.36	24.09	10.16	11.29
Total	Mean	81.12	60.60	82.81	74.84
	N	169.00	169.00	169.00	169.00
	Std. Deviation	12.68	24.22	10.32	11.37
Significance *P<.1 **P<.05		NS P =0.279	NS P=0.870	S **P=.038	NS P=.568

Table E32: ENES 101 Pre-Assessment ENES 101 Emotional State Correlations

1.Engineering Career Success Expectations		1	2	3	4
	Correlation Coefficient	1			
	Sig. (2-tailed)	.			
2.Feelings of Inclusion	N	169			
	Correlation Coefficient	.218**	1		
	Sig. (2-tailed)	0.004	.		
3.Coping Self Efficacy	N	169	169		
	Correlation Coefficient	.272**	.282**	1	
	Sig. (2-tailed)	0	0	.	
4.Emotional States	N	169	169	169	
	Correlation Coefficient	.524**	.867**	.610**	1
	Sig. (2-tailed)	0	0	0	.
	N	169	169	169	169
** Correlation is significant at the 0.01 level (2-tailed).					

4.3 Post- Assessment ENES 101

Table E32: ENES 101 Post- Assessment Confidence in Completing Degree (Beginning and Present)

Discussion Post		Confidence Begin	Confidence Present	Significance
Monday 2:30pm	Mean N Std. Deviation	83.33 19.00 13.61	81.58 19.00 17.48	NS P= .655
Tuesday 8am	Mean N Std. Deviation	91.67 6.00 13.94	88.89 6.00 13.61	NS P=.564
Tuesday 10am	Mean N Std. Deviation	88.24 17.00 15.33	81.37 17.00 21.96	NS P=.317
Tuesday 12pm	Mean N Std. Deviation	82.05 13.00 24.96	74.36 13.00 30.14	NS P=.206
Wednesday 3:00pm	Mean N Std. Deviation	84.06 23.00 16.27	80.43 23.00 14.78	NS P=.329
Thursday 8am	Mean N Std. Deviation	84.85 22.00 18.48	79.55 22.00 25.16	NS P=.317
Thursday 10am	Mean N Std. Deviation	79.86 24.00 17.01	72.92 24.00 18.92	S P=.013*
Thursday 12pm	Mean N Std. Deviation	75.44 19.00 24.45	75.44 19.00 18.73	NS P=.619
Thursday 2pm	Mean N Std. Deviation	83.33 16.00 19.25	81.25 16.00 23.47	NS P=.932
Tuesday 2pm	Mean N Std. Deviation	82.41 18.00 14.54	67.59 18.00 27.70	NS P=.705
Total	Mean N	82.86 177.00	77.59 177.00	

	Std. Deviation	18.07	21.76	
Sig		NS P=.574	NS P=.254	

*p<.05 (2 sides test)

Table E33: ENES 101 Groups of Study Post- Assessment Confidence in Completing Degree (Beginning and Present)

Groups		Beginning Confidence	Present Confidence
Group One	Mean	84.375	74.3056
Ns Begin P= .448	N	48	48
Ns Present P=.250	Std. Deviation	17.99864	26.62193
Group Two	Mean	79.3785	75.9887
NS Begin P = .556	N	59	59
NS Present P=.181	Std. Deviation	20.13817	20.12204
Group Three	Mean	83.7302	80.9524
NS Begin P = .726	N	42	42
NS Present P=.657	Std. Deviation	14.9471	15.86333
Group Four	Mean	86.3095	81.5476
NS P=.314	N	28	28
NS P=.492	Std. Deviation	17.59955	23.28005
Total	Mean	82.8625	77.5895
	N	177	177
	Std. Deviation	18.0688	21.75889
Significance		NS P=.307	NS P=.326

Social Persuasion and Vicarious Experiences:

Table E34: ENES 101 Groups of Study Post- Assessment SPVE

Groups		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	SPVE
Group One	Mean	76.31	18.40	86.23	32.81	81.33	86.44	75.31	65.21
	N	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00
	Std. Deviation	21.72	28.18	15.87	26.60	24.39	22.98	15.46	12.82
Group Two	Mean	74.00	21.75	88.00	32.34	87.66	87.81	74.93	66.61
	N	59.00	59.00	59.00	59.00	59.00	59.00	59.00	59.00
	Std. Deviation	18.42	29.40	20.04	29.76	16.86	19.31	13.05	11.51
Group Three	Mean	72.10	24.24	89.90	38.29	88.95	82.52	76.83	67.57

	N	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00
	Std. Deviation	20.02	30.57	13.31	33.69	19.15	28.48	16.06	11.01
Group Four	Mean	67.93	19.07	87.00	44.61	79.50	85.04	78.39	65.89
	N	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
	Std. Deviation	25.25	29.94	16.80	32.21	22.53	17.18	12.54	12.26
Total	Mean	73.21	21.01	87.81	35.82	84.96	85.75	76.03	66.34
	N	177.00	177.00	177.00	177.00	177.00	177.00	177.00	177.00
	Std. Deviation	20.89	29.28	16.91	30.41	20.75	22.41	14.34	11.81
Significance *P<.1		NS P=0.393	NS P=0.574	NS P=0.503	NS P=0.375	S *P=0.076	NS P =0.533	NS P=0.468	NS P=0.817

Table E35: ENES 101 Groups of Study Post- Assessment SPVE

Groups	Gender:		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	SPVE
Group One	Male	Mean	75.87	17.97	85.50	31.37	80.79	87.71	74.39	64.74
		N	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00
		Std. Deviation	23.36	27.21	16.08	27.18	25.41	22.82	16.54	13.21
	Female	Mean	75.56	22.22	87.78	38.89	81.56	79.56	78.00	66.22
		N	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
		Std. Deviation	13.22	34.34	15.98	26.27	21.52	24.73	10.62	12.09
	Other	Mean	100.00	0.00	100.00	33.00	100.00	100.00	86.00	74.00
		N	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		Std. Deviation	.	.	.	.	.	.	.	.
	Total	Mean	76.31	18.40	86.23	32.81	81.33	86.44	75.31	65.21
		N	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00
		Std. Deviation	21.72	28.18	15.87	26.60	24.39	22.98	15.46	12.82
Group Two	Male	Mean	75.45	19.66	88.68	29.36	88.73	90.89	74.43	66.73
		N	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00

		Std. Deviation	16.34	27.20	20.27	26.82	16.11	15.00	13.70	9.34
	Female	Mean	73.14	29.86	88.14	42.21	85.00	77.29	77.71	67.57
		N	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
		Std. Deviation	20.37	35.90	18.77	37.84	19.79	27.50	10.37	16.58
	Other	Mean	22.00	0.00	56.00	25.00	78.00	100.00	58.00	48.00
		N	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
		Std. Deviation	.	.	.	.	.	.	.	.
	Total	Mean	74.00	21.75	88.00	32.34	87.66	87.81	74.93	66.61
		N	59.00	59.00	59.00	59.00	59.00	59.00	59.00	59.00
		Std. Deviation	18.42	29.40	20.04	29.76	16.86	19.31	13.05	11.51
Group Three	Male	Mean	72.19	25.84	89.35	34.65	87.87	88.71	77.00	67.94
		N	31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00
		Std. Deviation	19.67	33.78	13.47	32.04	21.52	21.65	17.18	11.96
	Female	Mean	71.82	19.73	91.45	48.55	92.00	65.09	76.36	66.55
		N	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
		Std. Deviation	21.95	19.40	13.36	37.63	9.95	38.31	13.12	8.13
	Total	Mean	72.10	24.24	89.90	38.29	88.95	82.52	76.83	67.57
		N	42.00	42.00	42.00	42.00	42.00	42.00	42.00	42.00
		Std. Deviation	20.02	30.57	13.31	33.69	19.15	28.48	16.06	11.01
Group Four	Male	Mean	70.71	21.50	85.00	33.29	88.21	90.36	76.00	66.36
		N	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
		Std. Deviation	26.78	31.56	20.25	30.35	14.61	10.82	14.61	12.60
	Female	Mean	65.14	16.64	89.00	55.93	70.79	79.71	80.79	65.43
		N	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
		Std. Deviation	24.30	29.21	12.94	30.95	26.03	20.85	10.04	12.36
	Total	Mean	67.93	19.07	87.00	44.61	79.50	85.04	78.39	65.89
		N	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00

		Std. Deviation	25.25	29.94	16.80	32.21	22.53	17.18	12.54	12.26
Total	Male	Mean	74.26	20.87	87.49	31.69	86.09	89.35	75.22	66.39
		N	127.00	127.00	127.00	127.00	127.00	127.00	127.00	127.00
		Std. Deviation	20.53	29.22	17.46	28.39	20.56	18.85	15.43	11.53
	Female	Mean	70.96	22.25	89.08	47.04	81.81	75.63	78.35	66.46
		N	48.00	48.00	48.00	48.00	48.00	48.00	48.00	48.00
		Std. Deviation	20.64	30.02	15.07	33.52	21.43	27.94	10.78	12.57
	Other	Mean	61.00	0.00	78.00	29.00	89.00	100.00	72.00	61.00
		N	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
		Std. Deviation	55.15	0.00	31.11	5.66	15.56	0.00	19.80	18.38
	Total	Mean	73.21	21.01	87.81	35.82	84.96	85.75	76.03	66.34
		N	177.00	177.00	177.00	177.00	177.00	177.00	177.00	177.00
		Std. Deviation	20.89	29.28	16.91	30.41	20.75	22.41	14.34	11.81
Significance			NS P=0.499	NS P=0.858	NS P=0.602	NS P=0.351	NS P=0.116	NS P=0.127	NS P=0.829	NS P=0.891

Table E36: ENES 101 Gender Post- Assessment SPVE

Gender:		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	SPVE
Male	Mean	74.2598	20.8661	87.4882	31.685	86.0866	89.3465	75.2205	66.3858
	N	127	127	127	127	127	127	127	127
	Std. Deviation	20.52533	29.21659	17.46282	28.39453	20.55925	18.84708	15.42515	11.52915
Female	Mean	70.9583	22.25	89.0833	47.0417	81.8125	75.625	78.3542	66.4583
	N	48	48	48	48	48	48	48	48
	Std. Deviation	20.64076	30.02162	15.06981	33.51847	21.42841	27.93733	10.78314	12.56635

Other	Mean	61	0	78	29	89	100	72	61
	N	2	2	2	2	2	2	2	2
	Std. Deviation	55.15433	0	31.1127	5.65685	15.55635	0	19.79899	18.38478
Total	Mean	73.2147	21.0056	87.8136	35.8192	84.9605	85.7458	76.0339	66.3446
	N	177	177	177	177	177	177	177	177
	Std. Deviation	20.89338	29.27873	16.91369	30.40748	20.74613	22.41265	14.34395	11.81437
Significance		NS P=.576	NS P=.424	NS P=.816	NS P=.022	NS P=.277	S P=.002	NS P=.498	NS P=.87

Table E37: ENES 101 Post Groups Ethnic Post- Assessment SPVE

		Group One			Group Two			Group Three			Group Four			Significance
Variable	Ethnic	Mean	N	STD	Mean	N	STD	Mean	N	STD	Mean	N	STD	
Motivation - Financial	Black/African American	68.7	6.0	38.1	73.8	8.0	21.3	71.8	9.0	18.5	72.2	6.0	32.2	NS P=.691
	Asian/Pacific White American	76.2	6.0	16.2	77.9	11.0	15.8	67.7	11.0	21.5	69.0	5.0	33.8	
	American Latin American	77.5	28.0	20.4	72.6	29.0	20.5	70.1	17.0	20.0	66.0	14.0	20.7	
	American Other				82.4	5.0	14.8				44.0	1.0	.	
		78.0	8.0	16.6	67.0	6.0	9.8	89.0	5.0	15.6	78.0	2.0	31.1	
Motivation - Parental Influence	Black/African American	22.3	6.0	38.9	2.1	8.0	6.0	26.0	9.0	42.6	24.8	6.0	32.8	Sig P=.068
	Asian/Pacific White American	27.7	6.0	25.2	39.4	11.0	35.2	40.9	11.0	31.0	13.4	5.0	21.7	
	American Latin American	13.7	28.0	23.1	18.4	29.0	27.2	11.8	17.0	15.3	14.4	14.0	26.8	
	American Other				30.0	5.0	41.5				100.0	1.0	.	
		25.0	8.0	38.9	25.0	6.0	22.9	26.6	5.0	34.4	8.5	2.0	12.0	
Motivation - Social Good	Black/African American	90.8	6.0	8.3	77.9	8.0	33.1	96.3	9.0	7.8	98.2	6.0	4.5	Sig P=.052
	Asian/Pacific White American	65.0	6.0	19.3	79.8	11.0	26.8	90.5	11.0	13.1	82.4	5.0	14.8	
	American Latin American	89.8	28.0	13.7	91.2	29.0	14.3	11.8	17.0	15.3	83.4	14.0	20.3	
	American Other				93.4	5.0	6.0				78.0	1.0	.	
		86.3	8.0	14.1	96.3	6.0	5.7	26.6	5.0	34.4	94.5	2.0	7.8	
	Black/African American	41.7	6.0	28.9	19.9	8.0	37.4	28.7	9.0	29.5	54.2	6.0	40.8	NS

Motivation - Mentor Influence	Asian/Pacific	20.8	6.0	25.3	43.1	11.0	34.0	57.6	11.0	34.9	33.4	5.0	32.8	P=.280
	White													
	American	33.9	28.0	27.5	30.8	29.0	25.8	87.7	17.0	15.5	46.3	14.0	30.0	
	Latin													
	American				31.4	5.0	32.6				0.0	1.0	.	
	Other	31.3	8.0	24.3	37.5	6.0	29.4	48.4	5.0	45.1	54.5	2.0	17.7	
Motivation - Intrinsic Psychological	Black/African													NS P=.132
	American	74.2	6.0	33.5	87.6	8.0	7.0	89.0	9.0	12.3	87.2	6.0	12.9	
	Asian/Pacific	57.5	6.0	38.2	76.8	11.0	29.7	93.0	11.0	13.3	80.2	5.0	19.7	
	White													
	American	87.4	28.0	16.7	90.9	29.0	11.8	88.9	17.0	22.9	74.7	14.0	26.7	
	Latin													
	American				84.6	5.0	18.4				56.0	1.0	.	
	Other	83.4	8.0	19.8	94.5	5.0	18.4	80.0	5.0	27.8	100.0	2.0	0.0	
Motivation - Intrinsic Behavioral	Black/African													NS P=.104
	American	77.7	6.0	29.3	6.0	8.0	25.1	92.6	9.0	16.9	91.5	6.0	9.3	
	Asian/Pacific	69.5	6.0	37.1	6.0	11.0	25.1	77.2	11.0	38.9	86.6	5.0	13.9	
	White													
	American	92.9	28.0	13.9	93.7	29.0	13.6	84.4	17.0	27.3	79.7	14.0	20.8	
	Latin													
	American				86.6	5.0	21.7				83.0	1.0	.	
	Other	83.3	8.0	26.8	94.3	6.0	8.8	70.0	5.0	21.7	100.0	2.0	0.0	
General Impressions of Engineering	Black/African													NS P=.104
	American	77.7	6.0	18.7	72.3	8.0	13.4	77.8	9.0	15.0	84.7	6.0	5.5	
	Asian/Pacific	62.5	6.0	10.5	68.6	11.0	11.4	76.8	11.0	14.0	73.8	5.0	10.0	
	White													
	American	76.4	28.0	16.1	76.9	29.0	13.9	79.7	17.0	18.2	79.4	14.0	11.4	
	Latin													
	American				80.0	5.0	4.4				39.0	1.0		
	Other	79.5	8.0	10.1	76.5	6.0	14.4	65.4	5.0	13.7	83.5	2.0	7.8	
SPVE	Black/African													NS P=.286
	American	64.8	6.0	15.8	58.6	8.0	8.2	68.8	9.0	9.3	73.2	6.0	14.0	
	Asian/Pacific	54.2	6.0	18.1	66.2	11.0	18.5	72.1	11.0	12.7	62.6	5.0	13.6	
	White													
	American	67.3	28.0	10.7	67.7	29.0	9.7	64.4	17.0	10.7	63.4	14.0	11.3	
	Latin													
	American				69.6	5.0	8.1				57.0	1.0		
	Other	66.6	8.0	11.4	70.2	6.0	6.5	66.2	5.0	10.2	74.0	2.0	2.8	

Table E38: ENES 101 Population Means, Standard Deviation and Significance Ethnic SPVE Variables

Ethnic Post Population SPVE		Motivat ion - Financi al	Motivat ion - Parenta l Influen ce	Motivat ion - Social Good	Motivat ion - Mentor Influenc e	Motivati on - Intrinsic Psycholo gical	Motivation - Intrinsic Behavioral	General Impressions of Engineering	SPVE
Black/African American	Mean	71.76	18.41	90.48	34.21	85.17	84.97	77.66	66.07
	N	29.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00
	Std. Deviation	25.67	33.10	19.38	34.78	17.85	21.58	13.99	12.24
Asian & Pacific American	Mean	72.85	33.82	81.06	42.42	79.21	77.21	71.03	65.42
	N	33.00	33.00	33.00	33.00	33.00	33.00	33.00	33.00
	Std. Deviation	20.69	30.74	21.02	33.99	27.61	30.56	12.65	16.50
Latina/Hispanic American	Mean	76.00	41.67	90.83	26.17	79.83	86.00	73.17	67.50
	N	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
	Std. Deviation	20.49	46.82	8.28	31.85	20.18	19.50	17.20	8.92
White American	Mean	72.63	14.98	88.85	33.69	86.83	89.40	77.66	66.25
	N	88.00	88.00	88.00	88.00	88.00	88.00	88.00	88.00
	Std. Deviation	20.44	23.70	15.41	27.49	19.08	18.74	15.01	10.44
Other	Mean	77.48	23.81	89.52	39.33	87.33	84.86	75.67	68.24
	N	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
	Std. Deviation	16.85	30.50	11.78	30.27	18.76	21.70	12.93	9.15
Total	Mean	73.21	21.01	87.81	35.82	84.96	85.75	76.03	66.34
	N	177.00	177.00	177.00	177.00	177.00	177.00	177.00	177.00
	Std. Deviation	20.89	29.28	16.91	30.41	20.75	22.41	14.34	11.81

Significance *P<.1 **P<.05	NS P=.954	S *P=.004	NS P=.18	NS P=.646	NS P=.545	NS P=.207	NS P=.419	S P=.031
-------------------------------	--------------	--------------	-------------	--------------	--------------	-----------	-----------	-------------

Table E39: ENES 101 Groups Means, Standard Deviation and Significance Program Affiliation SPVE Variables

		Group One			Group Two			Group Three			Group Four			Sig
Variable	Program Affiliation	Mea n	N	ST D	Mea n	N	ST D	Mea n	N	ST D	Mea n	N	ST D	
Motivation - Financial	Meyerhoff	55.8	4.0	41.6	72.5	2.0	7.8	61.0	2.0	24.0	72.0	2.0	39.6	NS P= .481
	CWIT												29.1	
	Scholar							72.5	2.0	7.8	68.3	7.0	22.1	
	CWIT									31.1			3	
	Affiliate	56.0	1.0	12.	67.0	1.0	12.	78.0	2.0	14.1	66.8	5.0	25.3	
	S-STEM	80.8	8.0	8	92.7	3.0	7	83.5	4.0	2	44.0	1.0	.	
Motivation - Parental Influence	Non-Programm ed		35.0	19.9		53.0	18.7		32.0	20.7		13.0	25.7	NS P= .613
	Meyerhoff	8.5	4.0	9.8	17.0	2.0	0.0	58.5	2.0	58.7	58.0	2.0	35.4	
	CWIT									12.0			38.3	
	Scholar							8.5	2.0	0	26.1	7.0	7.6	
	CWIT									12.0			3	
	Affiliate	0.0	1.0	41.	17.0	1.0	33.	8.5	2.0	35.0	3.4	5.0	27.7	
Motivation - Social Good	S-STEM	35.4	8.0	2	33.3	3.0	5	33.3	4.0	8	33.0	1.0	.	NS P= .880
	Non-Programm ed		35.0	25.4		53.0	30.2		32.0	29.5		13.0	27.1	
	Meyerhoff	94.5	4.0	6.4	100.0	2.0	0.0	89.0	2.0	15.6	94.5	2.0	7.8	
	CWIT				100.0			100.0					10.5	
	Scholar				0	1.0	.	0	2.0	0.0	92.1	7.0	16.7	
	CWIT									12.0			7	
Motivation - Mentor Influence	Affiliate	89.0	1.0	11.			12.	91.5	2.0	15.0	82.4	5.0	21.7	Sig P= .064
	S-STEM	91.8	8.0	4	92.7	3.0	7	89.0	4.0	6	89.0	1.0	.	
	Non-Programm ed		35.0	17.2		53.0	20.8		32.0	13.8		13.0	21.0	
	Meyerhoff	39.3	4.0	31.5	46.0	2.0	1	46.0	2.0	41.0	75.0	2.0	4	
	CWIT									70.7			18.7	
	Scholar	25.0	1.0	.				50.0	2.0	59.4	74.7	7.0	27.3	
	CWIT				100.0									
	Affiliate				0	1.0	.	50.0	2.0	4	48.6	5.0	3	

	S-STEM Non- Programm ed	44.9	8.0	33. 2	22.3	3.0	25. 4	54.3	4.0	38. 9	17.0	1.0	.	
			35.	24.		53.	27.		32.	30.		13.	24.	
		29.5	0	7	31.1	0	9	34.3	0	9	24.3	0	7	
Motivation - Intrinsic Psychologi cal	Meyerhoff CWIT Scholar CWIT Affiliate	97.3	4.0	5.5	83.5	2.0	7.8	100. 0	2.0	0.0	100. 0	2.0	0.0	Sig
								83.5	2.0	7.8	77.9	7.0	2	
		100. 0	1.0	.	100. 0	1.0	.	100. 0	2.0	0.0	67.0	5.0	7.8	P=.029
				30.						11.				
	S-STEM Non- Programm ed	84.8	8.0	9	96.3	3.0	6.4	94.5	4.0	0	67.0	1.0	.	
			35.	23.		53.	17.		32.	21.		13.	18.	
		78.2	0	9	87.1	0	5	87.2	0	1	83.0	0	5	
	Meyerhoff CWIT Scholar CWIT Affiliate	95.8	4.0	8.5	58.0	2.0	35. 4	50.0	2.0	70. 7	100. 0	2.0	0.0	NS
								100. 0	2.0	0.0	90.4	7.0	13. 1	
		100. 0	1.0	.	100. 0	1.0	.	50.0	2.0	70. 7	70.0	5.0	13. 7	P=.305
				23.	100.					15.	100.			
	S-STEM Non- Programm ed	89.5	8.0	6	0	3.0	0.0	87.5	4.0	8	0	1.0	.	
			35.	24.		53.	18.		32.	23.		13.	18.	
Motivation - Intrinsic Behavioral		84.3	0	2	88.0	0	6	84.9	0	7	84.5	0	6	
	Meyerhoff CWIT Scholar CWIT Affiliate	86.8	4.0	12. 0	69.5	2.0	3.5	82.0	2.0	5.7	87.5	2.0	2.1	NS
								79.5	2.0	2.1 11.	87.0	7.0	5.0	
		94.0	1.0	.	92.0	1.0	.	86.0	2.0	3	77.2	5.0	8.6	P=.513
				17.						17.				
General Impression s of Engineerin g	S-STEM Non- Programm ed	71.3	8.0	8	83.3	3.0	2.5	72.0	4.0	7	78.0	1.0	.	
			35.	14.		53.	13.		32.	17.		13.	15.	
		74.4	0	9	74.3	0	4	76.4	0	2	72.8	0	0	
	Meyerhoff CWIT Scholar CWIT Affiliate	68.5	4.0	6.2	64.0	2.0	1.4	69.5	2.0	19. 1	84.0	2.0	0	NS
										12. 0	73.9	7.0	8.2	
		66.0	1.0	.	82.0	1.0	.	66.0	2.0	11. 3	59.2	5.0	8.9	P=.346
				14.										
SPVE	S-STEM	71.0	8.0	6	74.7	3.0	8.5	73.3	4.0	6.8	61.0	1.0	.	

	Non- Programm ed	35. 13. 63.5 0 0	53. 11. 66.0 0 7	32. 11. 66.7 0 4	13. 11. 61.8 0 1	
--	------------------------	---------------------	---------------------	---------------------	---------------------	--

Table E40: Post ENES 101 Population Means, Standard Deviation and Significance Program Affiliation SPVE Variables

Program Affiliation Post		Motivati on - Financial	Motivati on - Parental Influenc e	Motivati on - Social Good	Motivati on - Mentor Influenc e	Motivatio n - Intrinsic Psychologi cal	Motivati on - Intrinsic Behavior al	General Impressio ns of Engineeri ng	SVP E
	Mean N Std. Deviasi on	63.4 10.0	30.1 10.0	94.5 10.0	49.1 10.0	95.6 10.0	79.9 10.0	82.5 10.0	70.9 10.0
Meyerhoff		29.7	33.9	7.8	36.4	7.7	35.0	10.2	11.7
	Mean N Std. Deviasi on	69.2 9.0	22.2 9.0	93.9 9.0	69.2 9.0	79.1 9.0	92.6 9.0	85.3 9.0	73.1 9.0
CWIT Scholar		25.4	34.3	9.7	31.7	30.7	12.1	5.5	8.4
	Mean N Std. Deviasi on	68.1 9.0	5.7 9.0	87.1 9.0	52.0 9.0	81.7 9.0	72.2 9.0	82.7 9.0	64.0 9.0
CWIT Affiliate		20.3	8.5	14.0	34.6	18.2	32.2	10.1	10.6
	Mean N Std. Deviasi on	81.4 16.0	34.3 16.0	91.1 16.0	41.3 16.0	88.3 16.0	91.6 16.0	74.1 16.0	71.6 16.0
S-STEM		16.1	34.6	11.5	32.7	23.1	18.3	15.3	11.3
	Mean N Std. Deviasi on	73.6 133.0	19.7 133.0	86.6 133.0	30.8 133.0	84.4 133.0	85.9 133.0	74.7 133.0	65.1 133.0
Non- Programm ed		20.2	28.4	18.3	27.4	20.5	21.3	14.8	11.9
	Mean N Std. Deviasi on	73.2 177.0	21.0 177.0	87.8 177.0	35.8 177.0	85.0 177.0	85.7 177.0	76.0 177.0	66.3 177.0
Total		20.9	29.3	16.9	30.4	20.7	22.4	14.3	11.8
Significanc e	*P<.05 **P<.00 5	NS P=0.301	NS P= 0.131	NS P=0.487	S **P=0.0 04	NS P=0.176	NS P=0.294	S *P=0.04	S P= 0.04

Post Groups Correlations SPVE Variables

Table E41: Post ENES 101 Group#1 SPVE correlations

Social Persuasion and Vicarious Experiences Group#1 Tuesday		1	2	3	4	5	6	7	8
1.Motivation - Financial	Correlation Coefficient Sig. (2-tailed) N	1 . 48							
2.Motivation - Parental Influence	Correlation Coefficient Sig. (2-tailed) N	0.16 0.277 48	1 . 48						
3.Motivation - Social Good	Correlation Coefficient Sig. (2-tailed) N	-0.213 0.145 48	0.107 0.469 48	1 . 48					
4. Motivation - Mentor Influence	Correlation Coefficient Sig. (2-tailed) N	-.292* 0.044 48	0.196 0.182 48	.485** 0 48	1 . 48				
5.Motivation - Intrinsic Psychological	Correlation Coefficient Sig. (2-tailed) N	0.128 0.386 48	0.087 0.555 48	.391** 0.006 48	.288* 0.047 48	1 . 48			
6.Motivation - Intrinsic Behavioral	Correlation Coefficient Sig. (2-tailed) N	.286* 0.049 48	0.136 0.356 48	0.279 0.055 48	0.206 0.161 48	.734** 0 48	1 . 48		
7.General Impressions of Engineering	Correlation Coefficient Sig. (2-tailed) N	0.189 0.199 48	-0.04 0.785 48	.299* 0.039 48	-0.12 0.417 48	.537** 0 48	.288* 0.048 48	1 . 48	
8.Social Persuasion and Vicarious Experiences	Correlation Coefficient Sig. (2-tailed) N	.324* 0.025 48	.512** 0 48	.498** 0 48	.521** 0 48	.725** 0 48	.687** 0 48	.419** 0.003 48	1 . 48
* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).									

Table E42: Post ENES 101 Group#2 SPVE correlations

SPVE Correlations Thursday Group#2		1	2	3	4	5	6	7	8
1.Motivation - Financial	Correlation Coefficient Sig. (2-tailed) N	1 . 59							
2.Motivation - Parental Influence	Correlation Coefficient Sig. (2-tailed) N	.298* 0.022 59	1 . 59						
3.Motivation - Social Good	Correlation Coefficient Sig. (2-tailed) N	-0.105 0.429 59	.304* 0.019 59	1 . 59					
4.Motivation - Mentor Influence	Correlation Coefficient Sig. (2-tailed) N	0.048 0.72 59	.360** 0.005 59	0.249 0.057 59	1 . 59				
5.Motivation - Intrinsic Psychological	Correlation Coefficient Sig. (2-tailed) N	-0.056 0.675 59	-0.128 0.335 59	0.241 0.066 59	0.191 0.147 59	1 . 59			
6.Motivation - Intrinsic Behavioral	Correlation Coefficient Sig. (2-tailed) N	0.051 0.7 59	0.098 0.458 59	.346** 0.007 59	0.155 0.24 59	.623** 0 59	1 . 59		
7.General Impressions of Engineering	Correlation Coefficient Sig. (2-tailed) N	0.075 0.575 59	-0.246 0.06 59	0.079 0.55 59	0.021 0.877 59	.555** 0 59	.271* 0.038 59	1 . 59	
8.Social Persuasion and Vicarious Experiences	Correlation Coefficient Sig. (2-tailed) N	.345** 0.007 59	.614** 0 59	.476** 0 59	.698** 0 59	.418** 0.001 59	.531** 0 59	.271* 0.038 59	1 . 59
* Correlation is significant at the 0.05 level (2-tailed).									
** Correlation is significant at the 0.01 level (2-tailed).									

Table E43: Post ENES 101 Group#3 SPVE correlations

SPVE Correlations Thursday Group#3		1	2	3	4	5	6	7	8
1.Motivation - Financial	Correlation Coefficient Sig. (2-tailed) N	1 . 42							

2.Motivation - Parental Influence	Correlation Coefficient Sig. (2-tailed) N	0.295 0.058 42	1 42					
3.Motivation - Social Good	Correlation Coefficient Sig. (2-tailed) N	0.171 0.28 42	-0.225 0.152 42	1 42				
4. Motivation - Mentor Influence	Correlation Coefficient Sig. (2-tailed) N	-0.113 0.475 42	0.182 0.25 42	-0.089 0.575 42	1 42			
5.Motivation - Intrinsic Psychological	Correlation Coefficient Sig. (2-tailed) N	-0.102 0.521 42	-0.1 0.529 42	0.195 0.215 42	0.265 0.09 42	1 42		
6.Motivation - Intrinsic Behavioral	Correlation Coefficient Sig. (2-tailed) N	-0.188 0.232 42	-0.116 0.463 42	.438** 0.004 42	0.021 0.894 42	.338* 0.028 42	1 42	
7.General Impressions of Engineering	Correlation Coefficient Sig. (2-tailed) N	-0.118 0.458 42	-0.115 0.47 42	0.198 0.208 42	-0.041 0.797 42	.688** 0 42	.373* 0.015 42	1 42
8.Social Persuasion and Vicarious Experiences	Correlation Coefficient Sig. (2-tailed) N	.319* 0.039 42	.466** 0.002 42	.330* 0.033 42	.515** 0 42	.407** 0.008 42	.534** 0 42	.310* 0.046 42
* Correlation is significant at the 0.05 level (2-tailed).								
** Correlation is significant at the 0.01 level (2-tailed).								

Table E44: Post ENES 101 Group#4 SPVE correlations

SPVE Correlations Thursday Group #4		1	2	3	4	5	6	7	8
1. Motivation - Financial	Correlation Coefficient Sig. (2-tailed) N	1 28							
2. Motivation - Parental Influence	Correlation Coefficient Sig. (2-tailed) N	0.019 0.924 28	1 28						
3. Motivation - Social Good	Correlation Coefficient Sig. (2-tailed) N	0.211 0.282 28	-0.027 0.893 28	1 28					

4. Motivation - Mentor Influence	Correlation Coefficient Sig. (2-tailed) N	0.29 0.135 28	0.155 0.432 28	0.283 0.145 28	1 . 28				
5. Motivation - Intrinsic Psychological	Correlation Coefficient Sig. (2-tailed) N	0.192 0.328 28	0.331 0.085 28	0.2 0.308 28	0.275 0.157 28	1 . 28			
6. Motivation - Intrinsic Behavioral	Correlation Coefficient Sig. (2-tailed) N	0.029 0.882 28	.420* 0.026 28	0.161 0.414 28	0.316 0.101 28	.569** 0.002 28	1 . 28		
7. General Impressions of Engineering	Correlation Coefficient Sig. (2-tailed) N	0.322 0.095 28	-0.147 0.454 28	0.251 0.198 28	.438* 0.02 28	0.349 0.069 28	0.105 0.594 28	1 . 28	
8. Social Persuasion and Vicarious Experiences	Correlation Coefficient Sig. (2-tailed) N	.448* 0.017 28	.520** 0.005 28	.433* 0.021 28	.700** 0 28	.723** 0 28	.565** 0.002 28	.515** 0.005 28	1 . 28
* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).									

Table E45: Post ENES 101 SPVE correlations

SPVE Correlations		1	2	3	4	5	6	7	8
1.Motivation - Financial	Correlation Coefficient Sig. (2-tailed) N	1 .177							
2.Motivation - Parental Influence	Correlation Coefficient Sig. (2-tailed) N	.202** 0.007 177	1 .177						
3.Motivation - Social Good	Correlation Coefficient Sig. (2-tailed) N	-0.005 0.943 177	0.083 0.275 177	1 .177					
4. Motivation - Mentor Influence	Correlation Coefficient Sig. (2-tailed) N	-0.037 0.624 177	.233** 0.002 177	.216** 0.004 177	1 .177				
5.Motivation - Intrinsic Psychological	Correlation Coefficient Sig. (2-tailed)	0.035 0.64	0.039 0.604	.294** 0	.241** 0.001	1 .177			

	N	177	177	177	177	177			
6.Motivation - Intrinsic Behavioral	Correlation								
	Coefficient	0.062	0.094	.314**	0.146	.584**	1		
	Sig. (2-tailed)	0.412	0.214	0	0.053	0	.		
	N	177	177	177	177	177	177		
7.General Impressions of Engineering	Correlation								
	Coefficient	0.083	-0.129	.209**	0.056	.529**	.277**	1	
	Sig. (2-tailed)	0.272	0.087	0.005	0.456	0	0	.	
	N	177	177	177	177	177	177	177	
8. Social Persuasion and Vicarious Experiences	Correlation								
	Coefficient	.353**	.533**	.461**	.596**	.577**	.572**	.364**	1
	Sig. (2-tailed)	0	0	0	0	0	0	0	.
	N	177	177	177	177	177	177	177	177

** Correlation is significant at the 0.01 level (2-tailed).

Post Groups Mastery Experiences Variables

Table E46: Post ENES 101 Population Means, Standard Deviation and Significance

Groups		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Group One	Mean	80.13	90.13	85.35
	N	48.00	48.00	48.00
	Std. Deviation	15.43	14.64	11.56
Group Two	Mean	78.22	85.61	82.15
	N	59.00	59.00	59.00
	Std. Deviation	11.41	15.41	10.77
Group Three	Mean	77.57	89.76	83.86
	N	42.00	42.00	42.00
	Std. Deviation	16.10	14.75	12.31
Group Four	Mean	76.39	90.96	83.93
	N	28.00	28.00	28.00
	Std. Deviation	16.27	12.00	11.22
Total	Mean	78.29	88.67	83.71
	N	177.00	177.00	177.00
	Std. Deviation	14.46	14.60	11.41
Significance between groups		NS P=.653	NS P=.209	NS P=.502

Table E47: Post ENES 101 Mastery Experiences Gender Means, Standard Deviation and Significances

Groups	Gender		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Group One	Male	Mean	77.71	88.11	83.13
		N	38.00	38.00	38.00
		Std. Deviation	15.89	15.50	11.64
	Female	Mean	90.00	100.00	95.22
		N	9.00	9.00	9.00
		Std. Deviation	9.62	0.00	4.71
	Other	Mean	83.00	78.00	81.00
		N	1.00	1.00	1.00
		Std. Deviation	.	.	.
Group Two	Male	Mean	78.02	86.20	82.36
		N	44.00	44.00	44.00
		Std. Deviation	11.55	15.52	10.60
	Female	Mean	79.64	85.86	82.93
		N	14.00	14.00	14.00
		Std. Deviation	11.28	13.93	10.66
	Other	Mean	67.00	56.00	62.00
		N	1.00	1.00	1.00
		Std. Deviation	.	.	.
Group Three	Male	Mean	78.42	92.19	85.48
		N	31.00	31.00	31.00
		Std. Deviation	16.04	11.43	10.17
	Female	Mean	75.18	82.91	79.27
		N	11.00	11.00	11.00
		Std. Deviation	16.78	20.74	16.72
Group Four	Male	Mean	74.50	88.21	81.64
		N	14.00	14.00	14.00
		Std. Deviation	15.08	13.27	10.61
	Female	Mean	78.29	93.71	86.21
		N	14.00	14.00	14.00
		Std. Deviation	17.73	10.31	11.74
Total	Male	Mean	77.64	88.46	83.28
		N	127.00	127.00	127.00
		Std. Deviation	14.34	14.40	10.78
	Female	Mean	80.17	90.13	85.35
		N	48.00	48.00	48.00
		Std. Deviation	14.94	14.65	12.73
	Other	Mean	75.00	67.00	71.50
		N	2.00	2.00	2.00

	Std. Deviation	11.31	15.56	13.44
	Significance *p<.05	NS P=.427	S *P=.036	S *P=.038

Table E48: Post ENES 101 Overall Means Gender Mastery Experiences population

Gender		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Male	Mean	77.6378	88.4567	83.2756
	N	127	127	127
	Std.			
	Deviation	14.34367	14.39894	10.7804
Female	Mean	80.1667	90.125	85.3542
	N	48	48	48
	Std.			
	Deviation	14.94292	14.65435	12.73208
Other	Mean	75	67	71.5
	N	2	2	2
	Std.			
	Deviation	11.31371	15.55635	13.43503
Total	Mean	78.2938	88.6667	83.7062
	N	177	177	177
	Std.			
	Deviation	14.45815	14.59789	11.40542
Significance *p<.1		NS P=.552	*S P=.098	NS P=.109

Table E49: Post ENES 101 Groups Means Ethnic Mastery Experiences population

Groups	Ethnic		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Group One	Black/African American	Mean N Std. Deviation	83.3333 6 7.11805	92.6667 6 11.36075	88.3333 6 5.78504
	Asian & Pacific American	Mean N Std. Deviation	83.3333 6 21.03014	88.8333 6 22.40015	86.3333 6 18.86443
	White American	Mean N Std. Deviation	77.2857 28 15.68877	88.6071 28 13.5492	83.1429 28 9.90591
	Other	Mean N Std. Deviation	85.25 8 14.73334	94.5 8 15.55635	90.125 8 13.64276
	Black/African American	Mean N Std. Deviation	77.875 8 11.31923	83.5 8 13.14751	80.875 8 9.24952
	Asian & Pacific American	Mean N Std. Deviation	83.0909 11 10.53997	83.9091 11 18.85447	83.7273 11 12.21549
	Latina/Hispanic American	Mean N Std. Deviation	83.2 5 8.70057	86.8 5 14.34225	85.4 5 9.68504
	White American	Mean N Std. Deviation	76.2759 29 12.00267	85.5517 29 16.22077	81.1724 29 11.93754
Group Two	Other	Mean N Std. Deviation	75 6 11.3842	90.8333 6 10.81511	83 6 5.36656

Group Three	Black/African American	Mean N Std. Deviation	82 9 13.33229	89 9 12.29837	85.6667 9 9.17878
	Asian & Pacific American	Mean N Std. Deviation	80.7273 11 18.76748	95 11 10.27619	88.0909 11 11.96206
	White American	Mean N Std. Deviation	73.7647 17 15.29105	89 17 12.89864	81.5882 17 11.55995
	Other	Mean N Std. Deviation	75.6 5 18.60914	82.2 5 29.1067	79 5 19.62142
Group Four	Black/African American	Mean N Std. Deviation	86.1667 6 16.24089	96.3333 6 8.98146	91.5 6 8.89382
	Asian & Pacific American	Mean N Std. Deviation	87.8 5 8.228	95.6 5 9.8387	92 5 6.04152
	Latina/Hispanic American	Mean N Std. Deviation	61 1 .	100 1 .	81 1 .
	White American	Mean N Std. Deviation	69.8571 14 15.72777	89 14 12.2034	79.6429 14 10.8103
	Other	Mean N Std. Deviation	72 2 15.55635	72.5 2 7.77817	72.5 2 12.02082
Total	Black/African American	Mean N Std. Deviation	82 29 12.16259	89.7586 29 12.0968	86.1034 29 8.98548
	Asian & Pacific American	Mean N Std. Deviation	83.0606 33 15.09126	90.2727 33 16.15602	86.9091 33 12.6327
	Latina/Hispanic American	Mean N	79.5 6	89 6	84.6667 6

		Std. Deviation	11.94571	13.91402	8.84685
	White American	Mean	75.0909	87.7386	81.6364
		N	88	88	88
		Std. Deviation	14.47363	14.03239	10.94519
	Other	Mean	78.7619	88.4286	83.7619
		N	21	21	21
		Std. Deviation	14.76111	18.38361	13.83078
Significance			NS P=.223	NS P=.428	NS P=.167

Table E50: Overall Means, Standard Deviations and Significance ENES 101 Ethnic Population

Ethnic Affiliation		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
	Mean	82.00	89.76	86.10
	N	29.00	29.00	29.00
Black/African American	Std. Deviation	12.16	12.10	8.99
	Mean	83.06	90.27	86.91
	N	33.00	33.00	33.00
Asian & Pacific American	Std. Deviation	15.09	16.16	12.63
	Mean	79.50	89.00	84.67
	N	6.00	6.00	6.00
Latina/Hispanic American	Std. Deviation	11.95	13.91	8.85
	Mean	75.09	87.74	81.64
	N	88.00	88.00	88.00
White American	Std. Deviation	14.47	14.03	10.95
	Mean	78.76	88.43	83.76
	N	21.00	21.00	21.00
Other	Std. Deviation	14.76	18.38	13.83
	Mean	78.29	88.67	83.71
	N	177.00	177.00	177.00
Total	Std. Deviation	14.46	14.60	11.41
Significance		S P=.037	NS P=.670	S P=.061

Table E51: Post Groups Program Affiliation Means, Standard Deviations and Significance Mastery Experiences

Groups	Program Affiliation		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Group One	Meyerhoff	Mean	91.75	94.50	93.50
		N	4.00	4.00	4.00
		Std. Deviation	5.50	11.00	6.76
	CWIT Affiliate	Mean	83.00	100.00	92.00
		N	1.00	1.00	1.00
		Std. Deviation	.	.	.
	S-STEM	Mean	84.50	83.50	84.13
		N	8.00	8.00	8.00
		Std. Deviation	12.21	19.50	10.38
	NonProgrammed	Mean	77.71	90.86	84.51
		N	35.00	35.00	35.00
		Std. Deviation	16.40	13.83	12.17
Total		Mean	80.13	90.13	85.35
		N	48.00	48.00	48.00
		Std. Deviation	15.43	14.64	11.56
Group Two	Meyerhoff	Mean	80.50	94.50	87.50
		N	2.00	2.00	2.00
		Std. Deviation	3.54	7.78	2.12
	CWIT Affiliate	Mean	61.00	67.00	64.00
		N	1.00	1.00	1.00
		Std. Deviation	.	.	.
	S-STEM	Mean	92.67	92.67	93.00
		N	3.00	3.00	3.00
		Std. Deviation	6.35	12.70	8.19
	NonProgrammed	Mean	77.64	85.23	81.68
		N	53.00	53.00	53.00
		Std. Deviation	11.19	15.65	10.59
Group Three	Meyerhoff	Mean	80.50	100.00	90.50
		N	2.00	2.00	2.00
		Std. Deviation	3.54	0.00	2.12
	CWIT Scholar	Mean	83.00	83.50	83.50
		N	2.00	2.00	2.00
		Std. Deviation	15.56	23.33	19.09
	CWIT Affiliate	Mean	88.50	89.00	89.00
		N	2.00	2.00	2.00
		Std. Deviation	7.78	15.56	4.24

	S-STEM	Mean	83.50	97.25	90.50	
		N	4.00	4.00	4.00	
		Std. Deviation	21.06	5.50	11.24	
		NonProgrammed	Mean	75.63	88.63	82.31
			N	32.00	32.00	32.00
			Std. Deviation	16.46	15.54	12.77
Group Four	Meyerhoff	Mean	78.00	89.00	84.00	
		N	2.00	2.00	2.00	
		Std. Deviation	15.56	15.56	0.00	
	CWIT Scholar	Mean	84.14	93.71	89.14	
		N	7.00	7.00	7.00	
		Std. Deviation	16.89	10.73	10.93	
	CWIT Affiliate	Mean	76.80	91.20	84.20	
		N	5.00	5.00	5.00	
		Std. Deviation	19.38	12.05	15.19	
	S-STEM	Mean	56.00	100.00	78.00	
		N	1.00	1.00	1.00	
		Std. Deviation				
	NonProgrammed	Mean	73.38	89.00	81.46	
		N	13.00	13.00	13.00	
		Std. Deviation	15.08	13.47	11.02	
Total	Meyerhoff	Mean	84.50	94.50	89.80	
		N	10.00	10.00	10.00	
		Std. Deviation	8.92	9.35	5.57	
	CWIT Scholar	Mean	83.89	91.44	87.89	
		N	9.00	9.00	9.00	
		Std. Deviation	15.63	13.22	11.89	
	CWIT Affiliate	Mean	78.33	89.00	83.89	
		N	9.00	9.00	9.00	
		Std. Deviation	16.22	13.47	13.49	
	S-STEM	Mean	84.00	89.69	87.00	
		N	16.00	16.00	16.00	
		Std. Deviation	15.21	15.80	10.24	
	NonProgrammed	Mean	76.76	87.89	82.56	
		N	133.00	133.00	133.00	
		Std. Deviation	14.31	14.98	11.54	
Significance			NS P=.385	NS P=.765	NS P=.682	

Table E52: Program Affiliation Means, Standard Deviations and Significance Mastery Experiences

Overall Means Population ME		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Group One	Mean	80.13	90.13	85.35
	N	48.00	48.00	48.00
	Std. Deviation	15.43	14.64	11.56
Group Two	Mean	78.22	85.61	82.15
	N	59.00	59.00	59.00
	Std. Deviation	11.41	15.41	10.77
Group Three	Mean	77.57	89.76	83.86
	N	42.00	42.00	42.00
	Std. Deviation	16.10	14.75	12.31
Group Four	Mean	76.39	90.96	83.93
	N	28.00	28.00	28.00
	Std. Deviation	16.27	12.00	11.22
Total	Mean	78.29	88.67	83.71
	N	177.00	177.00	177.00
	Std. Deviation	14.46	14.60	11.41
Significance		NS P=.104	NS P=.602	NS P=.204

Post Groups Correlations Mastery Experience Variables

Table E53: Group #1 Correlations Mastery Experiences

Mastery Experiences Variables Group#1 Tuesday		1	2	3
1.Perceived Importance of Professional and Interpersonal Skills	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
	N	48		
2.Perceived importance of Math and Science Skills	Correlation Coefficient	0.25	1	
	Sig. (2-tailed)	0.087		
	N	48	48	48
3.Mastery Experiences	Correlation Coefficient	.808**	.731**	1
	Sig. (2-tailed)	0	0	.
	N	48	48	48
** Correlation is significant at the 0.01 level (2-tailed).				

Table E54: Group #2 Correlations Mastery Experiences

Mastery Experiences Correlations Thursday Group#2		1	2	3
1.Perceived Importance of Professional and Interpersonal Skills	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
2.Perceived importance of Math and Science Skills	N	59		
	Correlation Coefficient	.329*	1	
	Sig. (2-tailed)	0.011	.	
	N	59	59	
3.Mastery Experiences	Correlation Coefficient	.759**	.831**	1
	Sig. (2-tailed)	0	0	.
	N	59	59	59
* Correlation is significant at the 0.05 level (2-tailed).				
** Correlation is significant at the 0.01 level (2-tailed).				

Table E55: Group #3 Correlations Mastery Experiences

Mastery Experiences Correlations Thursday Group #3		1	2	3
1.Perceived Importance of Professional and Interpersonal Skills	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
2.Perceived importance of Math and Science Skills	N	42		
	Correlation Coefficient	0.302	1	
	Sig. (2-tailed)	0.052	.	
	N	42	42	
3.Mastery Experiences	Correlation Coefficient	.841**	.743**	1
	Sig. (2-tailed)	0	0	.
	N	42	42	42
** Correlation is significant at the 0.01 level (2-tailed).				

Table E56: Group #4 Correlations Mastery Experiences

Mastery Experiences Correlations Thursday Group #4		1	2	3
1. Perceived Importance of Professional and Interpersonal Skills	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
2.Perceived importance of Math and Science Skills	N	28		
	Correlation Coefficient	0.237	1	
	Sig. (2-tailed)	0.225	.	
	N	28	28	
	Correlation Coefficient	.874**	.659**	1
	Sig. (2-tailed)			.

3.Mastery Experiences	Sig. (2-tailed) N	0 28	0 28	.	28
** Correlation is significant at the 0.01 level (2-tailed).					

Table E57: Overall ENES 101 Correlations Mastery Experiences

Mastery Experiences		1	2	3
Perceived Importance of Professional and Interpersonal Skills	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
	N	177		
Perceived importance of Math and Science Skills	Correlation Coefficient	.261**	1	
	Sig. (2-tailed)	0	.	
	N	177	177	
Mastery_Experiences	Correlation Coefficient	.804**	.755**	1
	Sig. (2-tailed)	0	0	.
	N	177	177	177
** Correlation is significant at the 0.01 level (2-tailed).				

Post-Assessment Emotional State Variables

Table E58: Post Groups Program Affiliation Means, Standard Deviations and Significance Emotional States

Groups		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional States
Group One	Mean	84.92	84.58	70.98	80.15
	N	48.00	48.00	48.00	48.00
	Std. Deviation	9.70	10.96	19.41	9.58
Group Two	Mean	81.19	85.05	67.39	77.93
	N	59.00	59.00	59.00	59.00
	Std. Deviation	11.98	10.65	20.52	10.31
Group Three	Mean	82.38	81.95	66.62	76.93
	N	42.00	42.00	42.00	42.00
	Std. Deviation	10.87	15.67	14.91	10.29
Group Four	Mean	79.18	81.89	72.14	77.68
	N	28.00	28.00	28.00	28.00
	Std. Deviation	10.15	10.17	17.23	8.45
Total	Mean	82.16	83.69	68.93	78.25
	N	177.00	177.00	177.00	177.00

	Std. Deviation	10.94	12.02	18.48	9.83
Significance		NS P=.153	NS P=.607	NS P=.238	NS P=.465

Table E59: Post Groups Gender Means, Standard Deviations and Significance Emotional States

Groups	Gender		Coping Self Efficac y	Engineering Career Success Expectation s	Feelings of inclusio n	Emotiona l States
Group One	Male	Mean	85.08	84.53	71.79	80.47
		N	38.00	38.00	38.00	38.00
		Std. Deviation	10.27	11.70	17.57	9.74
	Female	Mean	83.33	84.22	70.33	79.22
		N	9.00	9.00	9.00	9.00
		Std. Deviation	7.35	8.24	26.55	9.85
Group Two	Other	Mean	93.00	90.00	46.00	76.00
		N	1.00	1.00	1.00	1.00
		Std. Deviation	.	.	.	.
	Male	Mean	82.95	85.75	68.07	78.98
		N	44.00	44.00	44.00	44.00
		Std. Deviation	12.74	10.95	21.81	10.76
Group Three	Female	Mean	76.93	84.14	65.00	75.43
		N	14.00	14.00	14.00	14.00
		Std. Deviation	6.93	9.06	17.24	8.44
	Other	Mean	63.00	67.00	71.00	67.00
		N	1.00	1.00	1.00	1.00
		Std. Deviation	.	.	.	.
Group Four	Male	Mean	84.81	83.16	66.71	78.19
		N	31.00	31.00	31.00	31.00
		Std. Deviation	9.10	16.36	16.05	10.91
	Female	Mean	75.55	78.55	66.36	73.36
		N	11.00	11.00	11.00	11.00
		Std. Deviation	12.89	13.64	11.76	7.63
Group Four	Male	Mean	80.00	83.07	71.43	78.14
		N	14.00	14.00	14.00	14.00

		Std. Deviation	11.01	7.17	19.76	8.73
	Female	Mean	78.36	80.71	72.86	77.21
		N	14.00	14.00	14.00	14.00
		Std. Deviation	9.55	12.67	15.00	8.47
	Male	Mean	83.72	84.46	69.22	79.14
		N	127.00	127.00	127.00	127.00
		Std. Deviation	11.01	12.30	18.95	10.22
	Female	Mean	78.23	81.88	68.60	76.19
		N	48.00	48.00	48.00	48.00
		Std. Deviation	9.50	11.13	17.46	8.52
	Other	Mean	78.00	78.50	58.50	71.50
		N	2.00	2.00	2.00	2.00
		Std. Deviation	21.21	16.26	17.68	6.36
	Total	Mean	82.16	83.69	68.93	78.25
		N	177.00	177.00	177.00	177.00
		Std. Deviation	10.94	12.02	18.48	9.83
Total						
Significance			*S P=.02	NS p=.540	NS P=.553	NS P =.403

*p<.05

Table E60: Post- assessment Population Gender Means, Standard Deviations and Significance Emotional States

Gender:		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional States
	Mean	83.72	84.46	69.22	79.14
	N	127.00	127.00	127.00	127.00
Male	Std. Deviation	11.01	12.30	18.95	10.22
	Mean	78.23	81.88	68.60	76.19
	N	48.00	48.00	48.00	48.00
Female	Std. Deviation	9.50	11.13	17.46	8.52
	Mean	78.00	78.50	58.50	71.50
	N	2.00	2.00	2.00	2.00
other	Std. Deviation	21.21	16.26	17.68	6.36
	Mean	82.16	83.69	68.93	78.25
	N	177.00	177.00	177.00	177.00
Total	Std. Deviation	10.94	12.02	18.48	9.83
Significance		**S P=.004	NS P=.215	NS P= .62	*S P =.0863

*p<.1 **p<.005

Table E61: Post- assessment Ethnic Group Means, Standard Deviations and Significance Emotional States

Groups	Ethnic		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional States
Group One	Black/African American	Mean N Std. Deviation	86.83 6.00 13.70	83.33 6.00 11.81	78.50 6.00 8.94	83.00 6.00 4.20
	Asian & Pacific American	Mean N Std. Deviation	76.83 6.00 2.23	72.17 6.00 10.21	44.50 6.00 32.51	64.67 6.00 8.09
	White American	Mean N Std. Deviation	84.75 28.00 9.47	86.14 28.00 8.58	72.96 28.00 15.35	81.29 28.00 8.23
	Other	Mean N Std. Deviation	90.13 8.00 7.64	89.38 8.00 13.35	78.25 8.00 9.11	85.63 8.00 6.67
Group Two	Black/African American	Mean N Std. Deviation	84.88 8.00 9.52	82.13 8.00 9.63	54.25 8.00 24.02	73.88 8.00 8.36
	Asian & Pacific American	Mean N Std. Deviation	78.27 11.00 15.45	86.64 11.00 10.54	71.00 11.00 18.45	78.64 11.00 10.18
	Latina/Hispanic American	Mean N Std. Deviation	86.20 5.00 8.87	89.60 5.00 7.23	72.40 5.00 18.39	82.80 5.00 10.57
	White American	Mean N	80.31 29.00	85.17 29.00	67.90 29.00	77.83 29.00

		Std. Deviation	12.37	11.67	20.88	11.14
	Other	Mean	81.67	81.67	71.67	78.50
		N	6.00	6.00	6.00	6.00
		Std. Deviation	8.45	10.33	18.15	9.57
Group Three	Black/African American	Mean	86.78	83.44	69.67	79.89
		N	9.00	9.00	9.00	9.00
		Std. Deviation	9.81	12.66	15.89	11.06
	Asian & Pacific American	Mean	80.55	82.36	68.64	77.18
		N	11.00	11.00	11.00	11.00
		Std. Deviation	4.57	13.46	14.64	7.05
	White American	Mean	83.94	82.59	64.59	77.00
		N	17.00	17.00	17.00	17.00
		Std. Deviation	10.35	19.19	16.55	12.09
	Other	Mean	73.20	76.20	63.60	70.80
		N	5.00	5.00	5.00	5.00
		Std. Deviation	19.21	14.86	9.04	8.04
Group Four	Black/African American	Mean	81.50	85.67	62.00	76.17
		N	6.00	6.00	6.00	6.00
		Std. Deviation	9.73	11.45	14.39	10.13
	Asian & Pacific American	Mean	84.60	80.60	84.80	83.20
		N	5.00	5.00	5.00	5.00
		Std. Deviation	9.24	8.62	17.22	8.67
	Latina/Hispanic American	Mean	70.00	83.00	42.00	65.00
		N	1.00	1.00	1.00	1.00
		Std. Deviation	.	.	.	.
	White American	Mean	79.29	80.64	72.57	77.50
		N	14.00	14.00	14.00	14.00
		Std. Deviation	9.22	11.51	15.75	7.71
Group Four	Other	Mean	62.50	82.00	83.00	76.00
		N	2.00	2.00	2.00	2.00

		Std. Deviation	6.36	1.41	0.00	2.83
Total	Black/African American	Mean	85.17	83.52	65.66	78.10
		N	29.00	29.00	29.00	29.00
		Std. Deviation	10.24	10.90	18.66	9.27
	Asian & Pacific American	Mean	79.73	81.67	67.48	76.30
		N	33.00	33.00	33.00	33.00
		Std. Deviation	9.94	11.94	22.94	10.13
	Latina/Hispanic American	Mean	83.50	88.50	67.33	79.83
		N	6.00	6.00	6.00	6.00
		Std. Deviation	10.33	7.01	20.61	11.92
	White American	Mean	82.26	84.26	69.61	78.72
		N	88.00	88.00	88.00	88.00
		Std. Deviation	10.71	12.58	17.66	10.00
	Other	Mean	81.05	83.33	73.33	79.14
		N	21.00	21.00	21.00	21.00
		Std. Deviation	14.04	12.71	13.09	9.33
	Total	Mean	82.16	83.69	68.93	78.25
		N	177.00	177.00	177.00	177.00
		Std. Deviation	10.94	12.02	18.48	9.83
Significance			S P=.094	NS P=.482	S P=.06	S P= 0.028

Table E61: Post- assessment Overall Population Ethnic Group Means, Standard Deviations and Significance Emotional States

Ethnic		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional States
Black/African American	Mean	85.17	83.52	65.66	78.10
	N	29.00	29.00	29.00	29.00
	Std. Deviation	10.24	10.90	18.66	9.27

Asian & Pacific American	Mean	79.73	81.67	67.48	76.30
	N	33.00	33.00	33.00	33.00
	Std. Deviation	9.94	11.94	22.94	10.13
Latina/Hispanic American	Mean	83.50	88.50	67.33	79.83
	N	6.00	6.00	6.00	6.00
	Std. Deviation	10.33	7.01	20.61	11.92
White American	Mean	82.26	84.26	69.61	78.72
	N	88.00	88.00	88.00	88.00
	Std. Deviation	10.71	12.58	17.66	10.00
Other	Mean	81.05	83.33	73.33	79.14
	N	21.00	21.00	21.00	21.00
	Std. Deviation	14.04	12.71	13.09	9.33
Total	Mean	82.16	83.69	68.93	78.25
	N	177.00	177.00	177.00	177.00
	Std. Deviation	10.94	12.02	18.48	9.83
Significance		NS P=.375	NS P=.655	NS P.585	NS P=.821

Emotional States Program Affiliation

Table E62: Emotional States Program Affiliation Group Means, Standard Deviations and Significance
Emotional States

Groups	Program Affiliation		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional States
Group One	Meyerhoff	Mean	88.25	91.00	80.25	86.50
		N	4.00	4.00	4.00	4.00
		Std. Deviation	12.58	7.87	11.00	2.65
	CWIT Affiliate	Mean	97.00	98.00	88.00	94.00
		N	1.00	1.00	1.00	1.00
		Std. Deviation	.	.	.	.
	S-STEM	Mean	85.63	82.00	73.50	80.38
		N	8.00	8.00	8.00	8.00
		Std. Deviation	10.36	11.02	17.04	7.71
	NonProgrammed	Mean	84.03	84.06	68.86	78.97
		N	35.00	35.00	35.00	35.00
		Std. Deviation	9.36	11.11	20.63	10.12
Group Two	Meyerhoff	Mean	75.00	88.00	56.50	73.00
		N	2.00	2.00	2.00	2.00

	CWIT Affiliate	Std. Deviation	2.83	7.07	9.19	1.41
		Mean	83.00	95.00	92.00	90.00
		N	1.00	1.00	1.00	1.00
	S-STEM	Std. Deviation				
		Mean	83.33	88.00	73.33	81.33
		N	3.00	3.00	3.00	3.00
	NonProgrammed	Std. Deviation	9.07	10.44	16.74	10.97
		Mean	81.26	84.58	67.00	77.70
		N	53.00	53.00	53.00	53.00
		Std. Deviation	12.45	10.88	20.95	10.46
Group Three	Meyerhoff	Mean	91.50	90.00	63.00	81.50
		N	2.00	2.00	2.00	2.00
	CWIT Scholar	Std. Deviation	2.12	0.00	0.00	0.71
		Mean	83.50	85.50	67.00	78.50
		N	2.00	2.00	2.00	2.00
	CWIT Affiliate	Std. Deviation	9.19	6.36	0.00	4.95
		Mean	80.00	78.50	73.00	77.50
		N	2.00	2.00	2.00	2.00
	S-STEM	Std. Deviation	4.24	16.26	14.14	0.71
		Mean	85.50	87.00	61.75	78.00
		N	4.00	4.00	4.00	4.00
	NonProgrammed	Std. Deviation	3.00	7.62	8.69	5.48
		Mean	81.50	80.81	67.03	76.38
		N	32.00	32.00	32.00	32.00
		Std. Deviation	12.00	17.29	16.54	11.59
Group Four	Meyerhoff	Mean	88.00	89.50	73.00	83.50
		N	2.00	2.00	2.00	2.00
		Std. Deviation	7.07	4.95	8.49	0.71
	CWIT Scholar	Mean	79.57	90.57	73.14	81.00
		N	7.00	7.00	7.00	7.00
		Std. Deviation	7.14	4.79	15.28	6.32
	CWIT Affiliate	Mean	82.00	74.40	75.00	77.00
		N	5.00	5.00	5.00	5.00

		Std. Deviation	9.95	8.93	14.78	8.00
	S-STEM	Mean	70.00	67.00	50.00	62.00
		N	1.00	1.00	1.00	1.00
		Std. Deviation	.	.	.	.
	NonProgramme d	Mean	77.23	80.08	72.08	76.46
		N	13.00	13.00	13.00	13.00
		Std. Deviation	11.90	9.68	20.67	9.22
Total	Meyerhoff	Mean	86.20	89.90	70.60	82.20
		N	10.00	10.00	10.00	10.00
		Std. Deviation	9.82	5.51	12.55	5.49
	CWIT Scholar	Mean	80.44	89.44	71.78	80.44
		N	9.00	9.00	9.00	9.00
		Std. Deviation	7.20	5.22	13.51	5.85
	CWIT Affiliate	Mean	83.33	80.22	77.89	80.44
		N	9.00	9.00	9.00	9.00
		Std. Deviation	8.89	12.72	13.53	8.72
	S-STEM	Mean	84.19	83.44	69.06	78.81
		N	16.00	16.00	16.00	16.00
		Std. Deviation	8.83	10.46	15.51	8.45
	NonProgramme d	Mean	81.65	83.10	67.99	77.59
		N	133.00	133.00	133.00	133.00
		Std. Deviation	11.57	12.67	19.70	10.47
	Total	Mean	82.16	83.69	68.93	78.25
		N	177.00	177.00	177.00	177.00
		Std. Deviation	10.94	12.02	18.48	9.83
Significance			NS P=.578	NS P=.377	NS P=.522	NS P=.723

Table E63: Emotional States Overall Population Program Affiliation Group Means, Standard Deviations and Significance Emotional States

Program Affiliation		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional States
---------------------	--	----------------------------	--	-----------------------------	---------------------

Meyerhoff	Mean N Std. Deviation	86.20 10.00 9.82	89.90 10.00 5.51	70.60 10.00 12.55	82.20 10.00 5.49
CWIT Scholar	Mean N Std. Deviation	80.44 9.00 7.20	89.44 9.00 5.22	71.78 9.00 13.51	80.44 9.00 5.85
CWIT Affiliate	Mean N Std. Deviation	83.33 9.00 8.89	80.22 9.00 12.72	77.89 9.00 13.53	80.44 9.00 8.72
S-STEM	Mean N Std. Deviation	84.19 16.00 8.83	83.44 16.00 10.46	69.06 16.00 15.51	78.81 16.00 8.45
Nonprogrammed	Mean N Std. Deviation	81.65 133.00 11.57	83.10 133.00 12.67	67.99 133.00 19.70	77.59 133.00 10.47
Total	Mean N Std. Deviation	82.16 177.00 10.94	83.69 177.00 12.02	68.93 177.00 18.48	78.25 177.00 9.83
Significance		NS P=.665	NS P=.139	NS P=.616	NS=.536

Post Groups Correlations Emotional States Variables

Table E64: Emotional States Group One Correlations

Emotional States Variables Group#1 Tuesday		1	2	3	4
1.Coping Self Efficacy	Correlation Coefficient	1			
	Sig. (2-tailed) N	. 48			
2.Engineering Career Success Expectations	Correlation Coefficient	.379**			
	Sig. (2-tailed) N	0.008 48	48		
3. Feelings of inclusion	Correlation Coefficient	.295*	.301*	1	
	Sig. (2-tailed) N	0.042 48	0.038 48	. 48	48
4.Emotional States	Correlation Coefficient	.641**	.715**	.784**	1
	Sig. (2-tailed) N	0 48	0 48	0 48	. 48
** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).					

Table E65: Emotional States Group Two Correlations

Emotional States Correlations Thursday Group#2		1	3	3	4
1.Coping Self Efficacy	Correlation Coefficient	1			
	Sig. (2-tailed)	.			
	N	59			
2.Engineering Career Success Expectations	Correlation Coefficient	0.158	1		
	Sig. (2-tailed)	0.232	.		
	N	59	59		
3.Feelings of inclusion	Correlation Coefficient	.309*	.452**	1	
	Sig. (2-tailed)	0.017	0	.	
	N	59	59	59	
4.Emotional States	Correlation Coefficient	.544**	.627**	.901**	1
	Sig. (2-tailed)	0	0	0	.
	N	59	59	59	59
* Correlation is significant at the 0.05 level (2-tailed).					
** Correlation is significant at the 0.01 level (2-tailed).					

Table E66: Emotional States Group Three Correlations

Emotional States Correlations Thursday Group #3		1	2	3	4
1.Coping Self Efficacy	Correlation Coefficient	1			
	Sig. (2-tailed)	.			
	N	42			
2.Engineering Career Success Expectations	Correlation Coefficient	.541**	1		
	Sig. (2-tailed)	0	.		
	N	42	42		
3.Feelings of inclusion	Correlation Coefficient	0.189	0.166	1	
	Sig. (2-tailed)	0.23	0.292	.	
	N	42	42	42	
4.Emotional States	Correlation Coefficient	.702**	.726**	.679**	1
	Sig. (2-tailed)	0	0	0	.
	N	42	42	42	42
** Correlation is significant at the 0.01 level (2-tailed).					

Table E67: Emotional States Group Four Correlations

Emotional States Correlations Thursday Group #4		1	2	3	4
1. Coping Self Efficacy	Correlation Coefficient	1			
	Sig. (2-tailed)	.			
	N	28			
	Correlation Coefficient	0.369	1		

2. Engineering Career Success Expectations	Sig. (2-tailed) N	0.053 28	.		
3. Feelings of inclusion	Correlation Coefficient Sig. (2-tailed) N	-0.028 0.889 28	0.132 0.504 28	1 . 28	
4. Emotional and Physiological States	Correlation Coefficient Sig. (2-tailed) N	.581** 0.001 28	.604** 0.001 28	.717** 0 28	1 . 28
** Correlation is significant at the 0.01 level (2-tailed).					

Table E68: Emotional States Overall Population Correlations

Overall Correlations Emotional States		1	2	3	4
1.Coping Self Efficacy	Correlation Coefficient	1			
	Sig. (2-tailed)	.			
	N	177			
2. Engineering Career Success Expectations	Correlation Coefficient	.344**	1		
	Sig. (2-tailed)	0	.		
	N	177	177		
3. Feelings of inclusion	Correlation Coefficient	.228**	.291**	1	
	Sig. (2-tailed)	0.002	0	.	
	N	177	177	177	
4. Emotional States	Correlation Coefficient	.612**	.662**	.805**	1
	Sig. (2-tailed)	0	0	0	.
	N	177	177	177	177
** Correlation is significant at the 0.01 level (2-tailed).					

Comparison of Pre and Post Group 1 and 2 (Tuesday and Thursday 10am, 12pm, 2pm)

Table E69: Pre and Post Means, Standard Deviation, and Significance of Confidence Tuesday

Pre and Post		Confidence Beginning	Confidence Present
Pre- Tuesday 10am	Mean	82.10	82.10
	N	27.00	27.00
	Std. Deviation	23.08	16.62
Post-Tuesday 10am	Mean	88.24	81.37
	N	17.00	17.00
	Std. Deviation	15.33	21.96
Pre-Tuesday12pm	Mean	88.69	83.93
	N	28.00	28.00
	Std. Deviation	12.87	21.02
Post-Tuesday 12pm	Mean	82.05	74.36
	N	13.00	13.00
	Std. Deviation	24.96	30.14
Pre- Tuesday 2pm	Mean	68.52	70.99

	N	27.00	27.00
	Std. Deviation	25.04	23.84
	Mean	82.41	67.59
Post-Tuesday 2pm	N	18.00	18.00
	Std. Deviation	14.54	27.70
	Mean	81.54	77.31
Total	N	130.00	130.00
	Std. Deviation	20.88	23.39
Significance		S P=.022	NS P=.1

Comparison of Pre and Post Group 1 and 2 (Tuesday and Thursday 10am, 12pm, 2pm)

Table E70: Pre and Post Means, Standard Deviation, and Significance of Confidence Thursday

Pre & Post		Confidence Beginning	Confidence Present
Pre-Thursday 10am	Mean	78.49	73.66
	N	31.00	31.00
	Std. Deviation	19.81	19.61
Post-Thursday 10am	Mean	79.86	72.92
	N	24.00	24.00
	Std. Deviation	17.01	18.92
Pre-Thursday 12pm	Mean	84.57	76.54
	N	27.00	27.00
	Std. Deviation	20.11	19.75
Post-Thursday 12pm	Mean	75.44	75.44
	N	19.00	19.00
	Std. Deviation	24.45	18.73
Pre-Thursday 2pm	Mean	77.78	77.78
	N	27.00	27.00
	Std. Deviation	21.68	18.49
Post-Thursday 2pm	Mean	83.33	81.25
	N	16.00	16.00
	Std. Deviation	19.25	23.47
Total	Mean	79.86	75.93
	N	144.00	144.00
	Std. Deviation	20.28	19.49
Significance		NS P =.538	NS P=.512

Table E71: Pre & Post Social Persuasion and Vicarious Experiences (SPVE) Tuesday

Pre& Post		Motivat ion - Financi al	Motivat ion - Parenta l Influen ce	Motivat ion - Social Good	Motivat ion - Mentor Influen ce	Motivati on - Intrinsic Psycholo gical	Motivat ion - Intrinsic Behavio ral	General Impressi ons of Enginee ring	SPVE
Pre- Tuesday 10am	Mean	74.44	16.70	79.52	34.81	84.89	86.30	81.30	65.41
	N	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
	Std. Deviati on	21.83	28.48	21.30	24.02	18.20	16.73	10.23	10.30
Post- Tuesday 10am	Mean	77.94	16.71	82.53	30.41	85.06	87.24	78.47	65.47
	N	17.00	17.00	17.00	17.00	17.00	17.00	17.00	17.00
	Std. Deviati on	19.20	33.85	15.58	28.04	17.08	19.13	16.93	11.67
Pre- Tuesday1 2pm	Mean	76.36	17.32	85.86	30.36	86.96	87.46	81.14	66.54
	N	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
	Std. Deviati on	18.29	26.22	14.62	19.72	18.42	23.41	8.58	8.65
Post- Tuesday 12pm	Mean	81.38	11.46	90.69	35.15	84.62	93.54	75.77	67.38
	N	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
	Std. Deviati on	15.15	18.39	14.09	24.36	27.49	18.79	13.21	10.83
Pre- Tuesday 2pm	Mean	71.33	21.63	77.48	26.52	71.67	75.30	78.15	60.22
	N	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
	Std. Deviati on	26.24	30.24	27.46	26.65	32.27	34.04	10.74	13.73
Post- Tuesday 2pm	Mean	71.11	25.00	86.50	33.39	75.44	80.56	72.00	63.39
	N	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00

	Std. Deviation	27.27	28.14	17.29	28.06	27.88	28.13	15.69	15.37
Total	Mean	74.90	18.48	82.94	31.39	81.28	84.32	78.40	64.50
	N	130.00	130.00	130.00	130.00	130.00	130.00	130.00	130.00
	Std. Deviation	21.92	28.00	19.86	24.64	24.36	24.88	12.40	11.83
Significance		NS P=.908	NS P=.561	NS P=.476	NS P=.709	NS=.252	NS=.283	NS =.142	NS =.355

Table E72: Pre & Post Social Persuasion and Vicarious Experiences (SPVE) Thursday

Pre& Post SPVE		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	SPVE
Pre-Thursday 10am	Mean	66.81	12.87	80.39	19.03	76.84	82.81	74.48	58.97
	N	31.00	31.00	31.00	31.00	31.00	31.00	31.00	31.00
	Std. Deviation	25.09	20.95	24.29	19.13	25.37	29.29	14.25	11.90
Post-Thursday 10am	Mean	64.50	17.38	89.88	23.92	85.75	88.17	72.42	63.17
	N	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
	Std. Deviation	18.40	30.49	16.02	24.31	16.83	18.71	14.21	10.97
Pre-Thursday 12pm	Mean	80.59	19.81	82.41	35.74	80.78	76.48	77.85	64.81
	N	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
	Std. Deviation	19.23	25.76	18.78	24.29	23.56	30.41	13.06	12.31
Post-Thursday 12pm	Mean	79.74	30.68	93.00	49.58	90.16	89.42	76.21	72.58
	N	19.00	19.00	19.00	19.00	19.00	19.00	19.00	19.00
	Std. Deviation	14.79	33.01	13.02	29.79	12.65	19.46	9.73	9.20
Pre-Thursday 2pm	Mean	67.63	23.41	75.74	25.11	86.11	83.26	78.37	62.74
	N	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
	Std. Deviation	21.21	29.30	24.59	22.26	16.69	29.25	10.92	11.57
Mean		81.44	17.69	79.25	24.50	87.56	85.38	77.19	64.69

Post-Thursda y 2pm	N Std. Deviati on	16.00	16.00	16.00	16.00	16.00	16.00	16.00	16.00
		16.91	21.47	28.94	29.94	21.44	20.99	14.75	12.57
	Mean	72.49	19.78	83.01	28.76	83.75	83.76	76.03	63.90
	N	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00
	Std. Deviati on								
Total		21.06	27.09	21.97	25.90	20.53	25.92	12.92	12.00
Significance S	S	NS	S	S		NS			S
*P<.05 **P<.005	*P=.015	P=.342	*P=.035	*P=.002	NS P=.34	P=.608	P=.574		*P=.004

Table E73: Pre & Post Social Persuasion and Vicarious Experiences (SPVE) Gender Tuesday

Tuesday Gender Pre & Post		Motivat ion - Financi al	Motivat ion - Parenta l Influenc e	Motivat ion - Social Good	Motivat ion - Mentor Influenc e	Motivat ion - Intrinsic Psycholo gical	Motivat ion - Intrinsic Behavio ral	General Impressi ons of Engineer ing	SPVE
Pre- Male	Mean	72.19	18.31	82.02	27.90	81.63	83.55	80.55	63.73
	N	62.00	62.00	62.00	62.00	62.00	62.00	62.00	62.00
	Std. Deviatio n	24.06	28.40	21.28	20.52	25.03	26.20	9.65	11.82
Post- Male	Mean	75.87	17.97	85.50	31.37	80.79	87.71	74.39	64.74
	N	38.00	38.00	38.00	38.00	38.00	38.00	38.00	38.00
	Std. Deviatio n	23.36	27.21	16.08	27.18	25.41	22.82	16.54	13.21
Pre- Female	Mean	80.72	20.44	77.89	42.17	78.44	79.56	80.39	65.67
	N	18.00	18.00	18.00	18.00	18.00	18.00	18.00	18.00
	Std. Deviatio n	13.89	28.91	24.69	29.93	24.01	26.53	10.27	9.89
Post- Female	Mean	75.56	22.22	87.78	38.89	81.56	79.56	78.00	66.22
	N	9.00	9.00	9.00	9.00	9.00	9.00	9.00	9.00
	Std. Deviatio n	13.22	34.34	15.98	26.27	21.52	24.73	10.62	12.09

Pre-Other	Mean	72.50	8.50	78.00	8.50	94.50	100.00	68.00	61.00
	N Std. Deviation	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
		7.78	12.02	0.00	12.02	7.78	0.00	9.90	7.07
Post-Other	Mean	100.00	0.00	100.00	33.00	100.00	100.00	86.00	74.00
	N Std. Deviation	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	
Total	Mean	74.90	18.48	82.94	31.39	81.28	84.32	78.40	64.50
	N Std. Deviation	130.00	130.00	130.00	130.00	130.00	130.00	130.00	130.00
		21.92	28.00	19.86	24.64	24.36	24.88	12.40	11.83
Significance		Ns P=.599	NS P=.959	NS P=.655	NS P=.284	NS= P.831	NS P=.329	NS P= 0.15	NS P= 0.92

Table E74: Pre & Post Social Persuasion and Vicarious Experiences (SPVE) Gender Thursday

Thursday Gender Pre & Post		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	SPVE
Pre-Male	Mean	73.83	19.25	80.98	25.94	81.88	85.38	76.08	63.28
	N Std. Deviation	64.00	64.00	64.00	64.00	64.00	64.00	64.00	64.00
		21.70	25.89	20.93	21.32	23.59	25.29	13.08	11.09
Post-Male	Mean	75.45	19.66	88.68	29.36	88.73	90.89	74.43	66.73
	N Std. Deviation	44.00	44.00	44.00	44.00	44.00	44.00	44.00	44.00
		16.34	27.20	20.27	26.82	16.11	15.00	13.70	9.34
Pre-Female	Mean	64.19	15.90	75.19	27.29	78.48	67.43	78.95	58.19
	N Std. Deviation	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00
		24.89	24.49	27.47	27.04	18.68	37.04	12.20	14.20
Post-Female	Mean	73.14	29.86	88.14	42.21	85.00	77.29	77.71	67.57
	N	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00

	Std. Deviation	20.37	35.90	18.77	37.84	19.79	27.50	10.37	16.58
Post-Other	Mean	22.00	0.00	56.00	25.00	78.00	100.00	58.00	48.00
	N	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
	Std. Deviation	.	.	.	.	.	.	.	.
Total	Mean	72.49	19.78	83.01	28.76	83.75	83.76	76.03	63.90
	N	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144.00
	Std. Deviation	21.06	27.09	21.97	25.90	20.53	25.92	12.92	12.00
Significance *P<.1 **P<.05		NS P=.164	NS P=.677	S *P=.02 7	NS P=.77	NS P=.212	S *P=.05 9	NS P=.419	S *P=.0 59

Table E75: Pre & Post Social Persuasion and Vicarious Experiences (SPVE) Ethnic Tuesday

Tuesday Ethnic Pre & post		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	SPVE
Pre-Black/African American	Mean	67.53	14.47	85.27	36.47	89.73	88.80	81.80	66.33
	N	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
	Std. Deviation	28.10	31.99	18.60	27.78	12.79	15.01	9.29	11.26
Post-Black/African American	Mean	68.67	22.33	90.83	41.67	74.17	77.67	77.67	64.83
	N	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
	Std. Deviation	38.09	38.95	8.28	28.87	33.50	29.28	18.74	15.75
Pre-White American	Mean	74.30	14.17	81.28	28.43	84.37	86.15	80.43	64.11
	N	46.00	46.00	46.00	46.00	46.00	46.00	46.00	46.00
	Std. Deviation	22.37	20.75	20.90	22.58	22.30	24.18	9.27	10.59

Post-White American	Mean	77.50	13.68	89.79	33.93	87.39	92.86	76.36	67.25
	N	28.00	28.00	28.00	28.00	28.00	28.00	28.00	28.00
	Std. Deviation	20.41	23.10	13.70	27.47	16.69	13.89	16.13	10.67
Pre-Asian Pacific	Mean	80.54	34.62	82.15	34.77	76.15	76.92	77.54	66.08
	N	13.00	13.00	13.00	13.00	13.00	13.00	13.00	13.00
	Std. Deviation	14.31	40.50	26.23	21.60	29.36	32.93	11.89	14.16
Post-Asian Pacific	Mean	76.17	27.67	65.00	20.83	57.50	69.50	62.50	54.17
	N	6.00	6.00	6.00	6.00	6.00	6.00	6.00	6.00
	Std. Deviation	16.19	25.15	19.28	25.29	38.22	37.11	10.46	18.06
Pre-Latin American	Mean	79.67	33.33	52.00	11.00	55.67	61.00	77.00	53.00
	N	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
	Std. Deviation	22.19	33.50	25.98	19.05	19.63	25.53	1.73	5.57
Pre-Other	Mean	71.40	20.20	80.20	33.20	55.60	66.80	82.20	58.60
	N	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
	Std. Deviation	18.41	27.51	18.07	25.96	37.75	40.83	15.19	9.53
Post-Other	Mean	78.00	25.00	86.25	31.25	83.38	83.25	79.50	66.63
	N	8.00	8.00	8.00	8.00	8.00	8.00	8.00	8.00
	Std. Deviation	16.63	38.87	14.10	24.33	19.78	26.82	10.13	11.44
Total	Mean	74.90	18.48	82.94	31.39	81.28	84.32	78.40	64.50
	N	130.00	130.00	130.00	130.00	130.00	130.00	130.00	130.00
	Std. Deviation	21.92	28.00	19.86	24.64	24.36	24.88	12.40	11.83
Significance *P<0.1 **P<.05		NS P=.976	NS P=.421	S **P=.045	NS P=.547	S *P=.056	NS P=.174	S* P=.06	NS P=.195

Table E76: Pre & Post Social Persuasion and Vicarious Experiences (SPVE) Ethnic Thursday

Ethnic Pre&Post		Motivati on - Financial	Motivati on - Parental Influenc e	Motivati on - Social Good	Motivati on - Mentor Influenc e	Motivatio n - Intrinsic Psychologi cal	Motivati on - Intrinsic Behavior al	General Impressio ns of Engineeri ng	SPVE
Pre- Black/Afric an American	Mean N Std. Deviati on	69.68 19.00 25.41	14.89 19.00 24.73	74.26 19.00 28.56	21.11 19.00 25.81	84.95 19.00 13.33	81.47 19.00 28.30	77.79 19.00 8.71	60.58 19.00 10.07
Post- Black/Afric an American	Mean N Std. Deviati on	73.75 8.00 21.35	2.13 8.00 6.01	77.88 8.00 33.07	19.88 8.00 37.40	87.63 8.00 7.05	77.00 8.00 25.14	72.25 8.00 13.40	58.63 8.00 8.18
Pre-White American	Mean N Std. Deviati on	67.80 40.00 23.90	14.15 40.00 21.53	82.30 40.00 22.50	25.98 40.00 21.31	81.50 40.00 24.53	82.93 40.00 29.79	78.20 40.00 14.07	61.80 40.00 12.41
Post- White American	Mean N Std. Deviati on	72.59 29.00 20.51	18.38 29.00 27.24	91.24 29.00 14.33	30.79 29.00 25.84	90.90 29.00 11.78	93.69 29.00 13.61	76.86 29.00 13.94	67.72 29.00 9.71
Pre-Asian Pacific	Mean N Std. Deviati on	77.33 18.00 17.63	27.78 18.00 26.79	80.94 18.00 18.64	33.83 18.00 22.57	82.22 18.00 16.64	81.39 18.00 26.75	72.44 18.00 12.84	65.11 18.00 12.37
Post-Asian Pacific	Mean N	77.91 11.00	39.36 11.00	79.82 11.00	43.09 11.00	76.82 11.00	77.18 11.00	68.64 11.00	66.18 11.00

	Std. Deviati on	15.77	35.18	26.76	33.98	29.66	25.09	11.43	18.53
Pre-Latin American	Mean N Std. Deviati on	81.67 3.00 16.80	22.33 3.00 38.68	63.33 3.00 6.35	39.00 3.00 20.66	33.33 3.00 33.50	33.33 3.00 33.50	79.67 3.00 10.07	50.33 3.00 17.10
Post-Latin American	Mean N Std. Deviati on	82.40 5.00 14.76	30.00 5.00 41.47	93.40 5.00 6.02	31.40 5.00 32.60	84.60 5.00 18.41	86.60 5.00 21.74	80.00 5.00 4.42	69.60 5.00 8.14
Pre-Other	Mean N Std. Deviati on	80.00 5.00 21.58	30.00 5.00 41.47	82.40 5.00 16.68	13.40 5.00 17.46	86.80 5.00 18.07	90.00 5.00 22.36	75.60 5.00 18.17	65.20 5.00 11.12
Post- Other	Mean N Std. Deviati on	67.00 6.00 9.84	25.00 6.00 22.93	96.33 6.00 5.68	37.50 6.00 29.40	94.50 6.00 6.02	94.33 6.00 8.78	76.50 6.00 14.45	70.17 6.00 6.46
Total	Mean N Std. Deviati on	72.49 144.00 21.06	19.78 144.00 27.09	83.01 144.00 21.97	28.76 144.00 25.90	83.75 144.00 20.53	83.76 144.00 25.92	76.03 144.00 12.92	63.90 144.0 0 12.00
Significance *P<.1 **P<.05		NS P=.65	S *P=.071	S *P=.069	NS P=.159	NS P.151	S **P=.03 6	NS P=.103	NS P=.25 4

Table E77: Pre & Post Social Persuasion and Vicarious Experiences (SPVE) Program Affiliation Tuesday

Tuesday Program Affiliate Pre& Post		Motivat ion - Financi al	Motivat ion - Parenta l Influenc e	Motivat ion - Social Good	Motivat ion - Mentor Influenc e	Motivat ion - Intrinsic Psycholo gical	Motivat ion - Intrinsic Behavio ral	General Impressi ons of Enginee ring	SPVE
Pre Meyerhof f	Mean N Std. Deviati on	63.71 7.00 24.72	21.57 7.00 20.86	90.57 7.00 16.10	49.57 7.00 34.56	92.14 7.00 8.32	95.14 7.00 8.30	81.71 7.00 9.55	70.7 1 7.00 9.46
Post Meyerhof f	Mean N Std. Deviati on	62.14 7.00 30.70	12.00 7.00 18.57	95.29 7.00 5.88	47.43 7.00 27.50	85.71 7.00 33.20	88.00 7.00 25.07	78.86 7.00 17.31	67.1 4 7.00 13.4 3
Pre CWIT Scholar	Mean N Std. Deviati on	74.33 3.00 12.70	50.00 3.00 50.00	66.67 3.00 48.52	49.67 3.00 38.19	78.00 3.00 19.05	66.67 3.00 43.84	77.00 3.00 18.73	66.0 0 3.00 12.1 2
Post CWIT Affiliate	Mean N Std. Deviati on	56.00 1.00 .	0.00 1.00 .	89.00 1.00 .	25.00 1.00 .	100.00 1.00 .	100.00 1.00 .	94.00 1.00 .	66.0 0 1.00 .
Pre SSTEM	Mean N Std. Deviati on	78.00 7.00 12.70	26.14 7.00 35.78	84.29 7.00 14.00	22.57 7.00 27.62	87.43 7.00 14.80	85.71 7.00 14.87	84.43 7.00 9.54	67.0 0 7.00 9.66
Post SSTEM	Mean N	86.80 5.00	46.60 5.00	89.00 5.00	36.80 5.00	93.40 5.00	96.60 5.00	73.00 5.00	74.4 0 5.00

	Std. Deviati on	12.05	46.18	13.47	38.43	9.84	7.60	18.67	9.74
Pre Non- Program med	Mean	74.75	15.94	80.29	28.49	79.55	82.25	79.74	62.9 7
	N	65.00	65.00	65.00	65.00	65.00	65.00	65.00	65.0 0
	Std. Deviati on	22.99	26.41	21.44	20.11	26.46	27.14	9.60	11.4 9
Post Non- Program med	Mean	78.23	16.17	83.94	29.54	78.20	84.29	74.40	63.4 9
	N	35.00	35.00	35.00	35.00	35.00	35.00	35.00	35.0 0
	Std. Deviati on	19.88	25.40	17.24	24.74	23.88	24.22	14.90	12.9 6
Total	Mean	74.90	18.48	82.94	31.39	81.28	84.32	78.40	64.5 0
	N	130.00	130.00	130.00	130.00	130.00	130.00	130.00	130. 00
	Std. Deviati on	21.92	28.00	19.86	24.64	24.36	24.88	12.40	11.8 3
Significance		NS P=.378	NS P=.421	NS P=.579	NS P=.367	NS P=.437	NS P=.627	NS P=.243	NS P=.383

Table E78: Pre & Post Social Persuasion and Vicarious Experiences (SPVE) Program Affiliation Thursday

Thursday Program Pre & Post		Motivation - Financial	Motivation - Parental Influence	Motivation - Social Good	Motivation - Mentor Influence	Motivation - Intrinsic Psychological	Motivation - Intrinsic Behavioral	General Impressions of Engineering	SPVE
Pre Meyerhoff	Mean N Std. Deviation	100.00 1.00 .	0.00 1.00 .	89.00 1.00 .	100.00 1.00 .	78.00 1.00 .	50.00 1.00 .	72.00 1.00 .	70.0 0 1.00
Post Meyerhoff	Mean N Std. Deviation	72.50 2.00 7.78	17.00 2.00 0.00	100.00 2.00 0.00	46.00 2.00 65.05	83.50 2.00 7.78	58.00 2.00 35.36	69.50 2.00 3.54	64.0 0 2.00 1.41
Pre CWIT Scholar	Mean N Std. Deviation	67.00 2.00 0.00	16.50 2.00 23.33	66.50 2.00 31.82	58.50 2.00 23.33	89.00 2.00 15.56	91.50 2.00 12.02	86.00 2.00 11.31	68.0 0 2.00 7.07
Post CWIT Affiliate	Mean N Std. Deviation	67.00 1.00 .	17.00 1.00 .	100.00 1.00 .	100.00 1.00 .	100.00 1.00 .	100.00 1.00 .	92.00 1.00 .	82.0 0 1.00 .
Pre SSTEM	Mean N Std. Deviation	76.80 10.00 20.62	1.70 10.00 5.38	80.10 10.00 29.54	10.00 10.00 11.68	93.40 10.00 9.28	96.60 10.00 7.17	81.60 10.00 12.55	62.9 0 10.0 0 6.42
Post SSTEM	Mean N	92.67 3.00	33.33 3.00	92.67 3.00	22.33 3.00	96.33 3.00	100.00 3.00	83.33 3.00	74.6 7 3.00

	Std. Deviati on	12.70	33.50	12.70	25.42	6.35	0.00	2.52	8.50
Pre Non- Program med	Mean	70.43	21.06	79.71	26.61	79.14	78.90	75.93	61.6 3
	N	72.00	72.00	72.00	72.00	72.00	72.00	72.00	72.0 0
	Std. Deviati on	23.28	26.53	21.86	21.01	23.52	31.01	12.93	12.7 9
Post Non- Program med	Mean	73.13	21.36	87.06	31.11	87.09	88.02	74.34	65.9 6
	N	53.00	53.00	53.00	53.00	53.00	53.00	53.00	53.0 0
	Std. Deviati on	18.69	30.20	20.77	27.91	17.50	18.61	13.35	11.6 6
Total	Mean	72.49	19.78	83.01	28.76	83.75	83.76	76.03	63.9 0
	N	144.00	144.00	144.00	144.00	144.00	144.00	144.00	144. 00
	Std. Deviati on	21.06	27.09	21.97	25.90	20.53	25.92	12.92	12.0 0
Significance *P<.1 **P<.05		NS P=.443	NS P=.338	NS P.143	S **P=.04 1	NS P=.200	S *P=.095	NS P=.429	NS P=.2 24

Table E79: Pre & Post Mastery Experiences Tuesday

Tuesday ME		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Pre- Tuesday 10am	Mean	74.30	86.52	80.74
	N	27.00	27.00	27.00
	Std.			
	Deviation	14.77	14.53	9.94
Post-Tuesday 10am	Mean	76.41	90.94	83.94
	N	17.00	17.00	17.00
	Std.			
	Deviation	14.45	13.60	11.36
Pre- Tuesday12pm	Mean	75.57	90.89	83.50
	N	28.00	28.00	28.00
	Std.			
	Deviation	15.79	16.89	12.64
Post-Tuesday 12pm	Mean	81.54	86.46	84.15
	N	13.00	13.00	13.00
	Std.			
	Deviation	18.63	16.29	11.94
Pre- Tuesday 2pm	Mean	74.07	88.52	81.52
	N	27.00	27.00	27.00
	Std.			
	Deviation	14.57	16.77	11.03
Post-Tuesday 2pm	Mean	82.61	92.00	87.56
	N	18.00	18.00	18.00
	Std.			
	Deviation	13.95	14.71	11.78
Total	Mean	76.68	89.21	83.20
	N	130.00	130.00	130.00
	Std.			
	Deviation	15.26	15.48	11.41
Significance		NS P=.291	NS P=.372	NS P=.266

Table E80: Pre & Post Mastery Experiences Thursday

Thursday Pre and Post		Perceived Importance of Professional and Interpersonal Skills	Perceived Importance of Math and Science Skills	Mastery Experiences
Pre-Thursday 10am	Mean N Std. Deviation	73.4194 31 15.29875	90.3871 31 14.23535	82.129 31 11.33355
Post-Thursday 10am	Mean N Std. Deviation	75.1667 24 9.86723	84.375 24 16.29834	80 24 10.21082
Pre-Thursday 12pm	Mean N Std. Deviation	75.8519 27 15.32897	86.5556 27 15.65575	81.4444 27 11.34878
Post-Thursday 12pm	Mean N Std. Deviation	79.0526 19 12.51876	85.4737 19 15.7246	82.4737 19 10.6842
Pre-Thursday 2pm	Mean N Std. Deviation	76.7407 27 21.66811	87.7037 27 23.11645	82.3704 27 20.39824
Post-Thursday 2pm	Mean N Std. Deviation	81.8125 16 11.68029	87.625 16 14.41238	85 16 11.63329
Total	Mean N Std. Deviation	76.4653 144 15.27598	87.2083 144 16.851	82.0556 144 13.15841
Significance		NS P=.46	NS P=.531	NS P=.527

Table E81: Pre & Post Mastery Experiences Gender Tuesday

Tuesday Gender Pre & Post		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Pre-Male	Mean N Std. Deviation	74 62 15.65824	86.9677 62 17.05052	80.7742 62 11.63716
Post-Male	Mean N Std. Deviation	77.7105 38 15.88967	88.1053 38 15.50203	83.1316 38 11.64375
Pre-Female	Mean N Std. Deviation	78.1111 18 11.22963	93.8889 18 11.45779	86.2222 18 8.70805
Post-Female	Mean N Std. Deviation	90 9 9.61769	100 9 0	95.2222 9 4.7111
Pre-Other	Mean N Std. Deviation	64 2 19.79899	94.5 2 7.77817	79.5 2 13.43503
Post-Other	Mean N Std. Deviation	83 1 .	78 1 .	81 1 .
Total	Mean N Std. Deviation	76.6769 130 15.26369	89.2077 130 15.47676	83.2 130 11.40746
Significance *P<.1 **P<.05		S **P=.048	S *P=.052	S **P= .006

Table E82: Pre & Post Mastery Experiences Gender Thursday

Thursday Gender Pre & Post		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Pre-Male	Mean	74.0156	86.5469	80.4844
	N	64	64	64
	Std. Deviation	17.86501	19.09037	15.30639
Post-Male	Mean	78.0227	86.2045	82.3636
	N	44	44	44
	Std. Deviation	11.5547	15.5228	10.60077
Pre-Female	Mean	79	93.7143	86.5714
	N	21	21	21
	Std. Deviation	15.83035	11.83276	11.59125
Post-Female	Mean	79.6429	85.8571	82.9286
	N	14	14	14
	Std. Deviation	11.27698	13.93312	10.65879
Post-Other	Mean	67	56	62
	N	1	1	1
	Std. Deviation	.	.	.
Total	Mean	76.4653	87.2083	82.0556
	N	144	144	144
	Std. Deviation	15.27598	16.851	13.15841
Significance		NS P=.569	NS P=.109	NS P=.189

Table E83: Pre & Post Mastery Experiences Ethnic Tuesday

Tuesday Ethnic Pre & Post		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Pre-Black/African American	Mean	79.9333	91.2	85.8667
	N	15	15	15
	Std.			
	Deviation	10.78668	10.35236	8.24506
Post-Black/African American	Mean	83.3333	92.6667	88.3333
	N	6	6	6
	Std.			
	Deviation	7.11805	11.36075	5.78504
Pre-White American	Mean	74.5	89.413	82.2174
	N	46	46	46
	Std.			
	Deviation	15.47866	16.07839	10.8175
Post-White American	Mean	77.2857	88.6071	83.1429
	N	28	28	28
	Std.			
	Deviation	15.68877	13.5492	9.90591
Pre-Asian Pacific	Mean	65.9231	82.9231	74.6154
	N	13	13	13
	Std.			
	Deviation	16.7554	22.11508	14.0032
Post-Asian Pacific	Mean	83.3333	88.8333	86.3333
	N	6	6	6
	Std.			
	Deviation	21.03014	22.40015	18.86443
Pre-Latin American	Mean	83.3333	89	86.6667
	N	3	3	3
	Std.			
	Deviation	5.50757	19.05256	11.93035
Pre-Other	Mean	77.8	89	83.8
	N	5	5	5
	Std.			
	Deviation	10.42593	11	8.43801
Post-Other	Mean	85.25	94.5	90.125
	N	8	8	8
	Std.			
	Deviation	14.73334	15.55635	13.64276

Total	Mean	76.6769	89.2077	83.2
	N	130	130	130
	Std. Deviation	15.26369	15.47676	11.40746
Significance *P<.1		S *P=.089	NS P=.856	NS P=.103

Table E84: Pre & Post Mastery Experiences Ethnic Thursday

Thursday Ethnic Pre & Post		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Pre-Black/African American	Mean N Std. Deviation	80.6316 19 14.98225	93.0526 19 12.81264	86.9474 19 9.95252
Post-Black/African American	Mean N Std. Deviation	77.875 8 11.31923	83.5 8 13.14751	80.875 8 9.24952
Pre-White American	Mean N Std. Deviation	74.65 40 16.17302	90.1 40 12.15245	82.55 40 10.81535
Post-White American	Mean N Std. Deviation	76.2759 29 12.00267	85.5517 29 16.22077	81.1724 29 11.93754
Pre-Asian Pacific	Mean N Std. Deviation	74.0556 18 22.01195	78.4444 18 27.89945	76.5556 18 23.56773
Post-Asian Pacific	Mean N Std. Deviation	83.0909 11 10.53997	83.9091 11 18.85447	83.7273 11 12.21549
Pre-Latin American	Mean N Std. Deviation	77.6667 3 19.55335	85.3333 3 25.40341	81.6667 3 22.36813

Post-Latin American	Mean	83.2	86.8	85.4
	N	5	5	5
	Std.			
	Deviation	8.70057	14.34225	9.68504
Pre-Other	Mean	62.4	93.4	78.4
	N	5	5	5
	Std.			
	Deviation	14.44991	14.75805	6.50385
Post-Other	Mean	75	90.8333	83
	N	6	6	6
	Std.			
	Deviation	11.3842	10.81511	5.36656
Total	Mean	76.4653	87.2083	82.0556
	N	144	144	144
	Std.			
	Deviation	15.27598	16.851	13.15841
Significance		NS P=.291	NS P=.527	NS P=.727

Table E85: Pre & Post Mastery Experiences Program Affiliation Tuesday

Tuesday Program Affiliation Pre & Post		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Pre Meyerhoff	Mean	84.8571	95.2857	90.2857
	N	7	7	7
	Std. Deviation	10.82326	5.87975	7.88911
Post Meyerhoff	Mean	90.4286	81.1429	86.1429
	N	7	7	7
	Std. Deviation	7.0677	19.79418	10.85401
Pre CWIT Scholar	Mean	70.6667	96.3333	83.6667
	N	3	3	3
	Std. Deviation	12.70171	6.35085	5.50757
Post CWIT Affiliate	Mean	83	100	92
	N	1	1	1
	Std. Deviation	.	.	.
Pre SSTEM	Mean	77	98.4286	88.1429
	N	7	7	7
	Std. Deviation	14.08309	4.15761	7.42582
Post SSTEM	Mean	82	95.6	88.8
	N	5	5	5
	Std. Deviation	13.85641	9.8387	9.98499

Pre Non-Programmed	Mean	73.4923	86.5538	80.2923
	N	65	65	65
	Std. Deviation	15.22859	17.19923	11.49011
Post Non-Programmed	Mean	77.7143	90.8571	84.5143
	N	35	35	35
	Std. Deviation	16.40404	13.82909	12.17367
Total	Mean	76.6769	89.2077	83.2
	N	130	130	130
	Std. Deviation	15.26369	15.47676	11.40746
Significance *P<.1		S *P=.055	NS P=.288	NS P=.113

Table E86: Pre & Post Mastery Experiences Program Affiliation Thursday

Thursday Program Affiliation Pre & Post		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery Experiences
Pre Meyerhoff	Mean	78	78	78
	N	1	1	1
	Std. Deviation	.	.	.
Post Meyerhoff	Mean	80.5	94.5	87.5
	N	2	2	2
	Std. Deviation	3.53553	7.77817	2.12132
Pre CWIT Scholar	Mean	100	89	94.5
	N	2	2	2
	Std. Deviation	0	15.55635	7.77817
Post CWIT Affiliate	Mean	61	67	64
	N	1	1	1
	Std. Deviation	.	.	.
Pre SSTEM	Mean	72.8	88.9	81.1
	N	10	10	10
	Std. Deviation	11.26252	18.95873	11.99491
Post SSTEM	Mean	92.6667	92.6667	93
	N	3	3	3
	Std. Deviation	6.35085	12.70171	8.18535
Pre Non-Programmed	Mean	74.8611	88.3611	81.8194
	N	72	72	72
	Std. Deviation	18.02448	17.99241	15.16977
Post Non-Programmed	Mean	77.6415	85.2264	81.6792
	N	53	53	53

	Std. Deviation	11.18566	15.64835	10.59349
Total	Mean	76.4653	87.2083	82.0556
	N	144	144	144
	Std. Deviation	15.27598	16.851	13.15841
Significance *P<.1		S P=.06	NS P=.544	NS P=.282

Table E87: Pre & Post Emotional States Tuesday

Tuesday Pre & Post		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional and Physiological States
Pre- Tuesday 10am	Mean	82.1852	83.2963	69.8148	78.4444
	N	27	27	27	27
	Std. Deviation	10.39244	7.89749	22.64787	9.79141
Post-Tuesday 10am	Mean	85.8824	85.5294	74.1765	81.9412
	N	17	17	17	17
	Std. Deviation	8.66662	9.8876	16.02044	7.68497
Pre- Tuesday12pm	Mean	82.0714	88.6786	61	77.25
	N	28	28	28	28
	Std. Deviation	16.93326	8.10146	26.22693	12.83694
Post-Tuesday 12pm	Mean	86.3077	86.0769	69.1538	80.3846
	N	13	13	13	13
	Std. Deviation	11.947	10.7739	25.20862	11.75825
Pre- Tuesday 2pm	Mean	80.2222	80.3704	64.3704	74.9259
	N	27	27	27	27
	Std. Deviation	10.87811	11.1464	20.60834	10.48415
Post-Tuesday 2pm	Mean	83	82.6111	69.2778	78.2778
	N	18	18	18	18
	Std. Deviation	9.08781	12.29605	18.32647	9.68811
Total	Mean	82.7615	84.3231	67.2154	78.0846
	N	130	130	130	130
	Std. Deviation	11.96623	10.13492	22.06825	10.64365

Significance *p<.1	NS P=.363	S *P=.081	NS P=.468	NS P=.336
--------------------	--------------	-----------	-----------	-----------

Table E88: Pre & Post Emotional States Thursday

Thursday Pre and Post		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional States
Pre-Thursday 10am	Mean	81.3548	77.4839	54.5484	71.0645
	N	31	31	31	31
	Std. Deviation	13.44507	10.16816	23.09089	10.41133
Post-Thursday 10am	Mean	80.9583	81.375	64.2917	75.5417
	N	24	24	24	24
	Std. Deviation	11.09437	12.18985	20.36083	10.36289
Pre-Thursday 12pm	Mean	81.2963	85.6296	58.4815	75.1852
	N	27	27	27	27
	Std. Deviation	10.84441	10.65959	24.26515	10.77046
Post-Thursday 12pm	Mean	83.7368	88	70.7368	80.9474
	N	19	19	19	19
	Std. Deviation	10.51899	8.34666	19.12776	10.64307
Pre-Thursday 2pm	Mean	79	81.1481	54.5926	71.6296
	N	27	27	27	27
	Std. Deviation	12.91094	9.96804	26.54352	12.28867
Post-Thursday 2pm	Mean	78.5	87.0625	68.0625	77.9375
	N	16	16	16	16
	Std. Deviation	14.75579	9.50417	22.88076	9.46199
Total	Mean	80.8333	82.7986	60.5556	74.7569
	N	144	144	144	144
	Std. Deviation	12.19194	10.80183	23.50384	11.10739
Significance *P<.1 **P<.05		NS P=.801	S **P=.003	S *P =.085	S **P=.021

Table E89: Pre & Post Emotional States Gender Tuesday

Tuesday Gender Pre & Post		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional aStates
Pre-Male	Mean	82.371	85.0484	65.5161	77.629
	N	62	62	62	62
	Std. Deviation	13.75575	8.72988	22.99803	11.28648
Post-Male	Mean	85.0789	84.5263	71.7895	80.4737
	N	38	38	38	38
	Std. Deviation	10.27298	11.70294	17.56864	9.74468
Pre-Female	Mean	79.7778	81.1667	67.9444	76.2778
	N	18	18	18	18
	Std. Deviation	10.19548	12.40612	20.31074	9.23424
Post-Female	Mean	83.3333	84.2222	70.3333	79.2222
	N	9	9	9	9
	Std. Deviation	7.34847	8.24284	26.54713	9.84604
Pre-Other	Mean	70	84	23	59
	N	2	2	2	2
	Std. Deviation	4.24264	11.31371	32.52691	8.48528
Post-Other	Mean	93	90	46	76
	N	1	1	1	1
	Std. Deviation	.	.	.	.
Total	Mean	82.7615	84.3231	67.2154	78.0846
	N	130	130	130	130
	Std. Deviation	11.96623	10.13492	22.06825	10.64365
Significance		Ns P=.22	NS P=.862	NS P=.17	NS P=.158

Table E90: Pre & Post Emotional States Gender Thursday

Thursday Gender Pre & Post		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional States
Pre-Male	Mean	81.2813	81.2812	56.5625	73.0313
	N	64	64	64	64
	Std. Deviation	12.18439	10.74151	25.13448	11.59224
Post-Male	Mean	82.9545	85.75	68.0682	78.9773
	N	44	44	44	44
	Std. Deviation	12.74245	10.94835	21.80612	10.76275
Pre-Female	Mean	78.4762	81.0952	53.5238	71.0952
	N	21	21	21	21
	Std. Deviation	13.10961	10.78844	22.31506	9.86866
Post-Female	Mean	76.9286	84.1429	65	75.4286
	N	14	14	14	14
	Std. Deviation	6.93336	9.06266	17.24038	8.43723
Post-Other	Mean	63	67	71	67
	N	1	1	1	1
	Std. Deviation	.	.	.	.
Total	Mean	80.8333	82.7986	60.5556	74.7569
	N	144	144	144	144
	Std. Deviation	12.19194	10.80183	23.50384	11.10739
Significance *P<.1 **P<.05		Ns P=.108	S *P=.096	S **P=.045	S **P=.041

Table E91: Pre & Post Emotional States Ethnic Tuesday

Tuesday Ethnic Pre & Post		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional and Physiological States
Pre-Black/African American	Mean	87.2667	87.6	70.9333	81.8667
	N	15	15	15	15
	Std. Deviation	10.09573	10.45945	21.08644	8.15796
Post-Black/African American	Mean	86.8333	83.3333	78.5	83
	N	6	6	6	6
	Std. Deviation	13.7028	11.8096	8.93868	4.19524
Pre-White American	Mean	80.9783	84.5217	64.6304	76.7174
	N	46	46	46	46
	Std. Deviation	12.10232	8.94859	24.99899	11.53095
Post-White American	Mean	84.75	86.1429	72.9643	81.2857
	N	28	28	28	28
	Std. Deviation	9.46974	8.58385	15.35381	8.22758
Pre-Asian Pacific	Mean	73.0769	79	64.7692	72.2308
	N	13	13	13	13
	Std. Deviation	15.82962	10.59874	15.80166	10.99359
Post-Asian Pacific	Mean	76.8333	72.1667	44.5	64.6667
	N	6	6	6	6
	Std. Deviation	2.2286	10.20621	32.51307	8.09115
Pre-Latin American	Mean	82	77	36.3333	65.3333
	N	3	3	3	3
	Std. Deviation	7	3.60555	17.21434	5.50757
Pre-Other	Mean	90.6	88.4	68.6	82.4
	N	5	5	5	5
	Std. Deviation	13.42758	8.96103	27.53725	9.20869
Post-Other	Mean	90.125	89.375	78.25	85.625
	N	8	8	8	8
	Std. Deviation	7.64269	13.3517	9.11435	6.67485
Total	Mean	82.7615	84.3231	67.2154	78.0846
	N	130	130	130	130

	Std. Deviation	11.96623	10.13492	22.06825	10.64365
Significance *P<.05		S *P=.008	S *P=.023	S *P=.049	S *P=.000

Table E92: Pre & Post Emotional States Ethnic Thursday

Thursday Ethnic Pre & Post		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional and Physiological States
Pre-Black/African American	Mean	84.3684	82.8421	47.2632	71.5789
	N	19	19	19	19
	Std. Deviation	10.45206	9.13639	24.07129	10.35114
Post-Black/African American	Mean	84.875	82.125	54.25	73.875
	N	8	8	8	8
	Std. Deviation	9.52347	9.6279	24.02231	8.35699
Pre-White American	Mean	78.275	80.025	55.25	71.175
	N	40	40	40	40
	Std. Deviation	12.50638	10.36881	25.94743	11.86654
Post-White American	Mean	80.3103	85.1724	67.8966	77.8276
	N	29	29	29	29
	Std. Deviation	12.36673	11.66518	20.88462	11.13896
Pre-Asian Pacific	Mean	80.8889	81.1667	64.2222	75.3889
	N	18	18	18	18
	Std. Deviation	13.47717	12.65027	17.27138	9.41925
Post-Asian Pacific	Mean	78.2727	86.6364	71	78.6364
	N	11	11	11	11
	Std. Deviation	15.45374	10.53824	18.44993	10.18109
Pre-Latin American	Mean	74.3333	90.6667	65.6667	77
	N	3	3	3	3
	Std. Deviation	14.0119	10.69268	27.02468	15.13275
Post-Latin American	Mean	86.2	89.6	72.4	82.8
	N	5	5	5	5
	Std. Deviation	8.8713	7.23187	18.39293	10.56882

Pre-Other	Mean	87.4	79.4	56.6	74.4
	N	5	5	5	5
	Std. Deviation	11.52389	11.84483	30.48442	13.88524
Post-Other	Mean	81.6667	81.6667	71.6667	78.5
	N	6	6	6	6
	Std. Deviation	8.4538	10.32796	18.15122	9.56556
Total	Mean	80.8333	82.7986	60.5556	74.7569
	N	144	144	144	144
	Std. Deviation	12.19194	10.80183	23.50384	11.10739
Significance *P<.05		NS P=.644	NS P=.35	S* P=.047	NS P=.269

Table E93: Pre & Post Emotional States Program Affiliation Tuesday

Tuesday Program Affiliation Pre & Post		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional States
Pre Meyerhoff	Mean	82.1429	88.8571	63.5714	78
	N	7	7	7	7
	Std. Deviation	13.86156	6.4402	23.02069	7.52773
Post Meyerhoff	Mean	88.4286	86	83.2857	85.8571
	N	7	7	7	7
	Std. Deviation	12.02577	12.38278	10.78138	5.39841
Pre CWIT Scholar	Mean	71.3333	73.6667	71	71.6667
	N	3	3	3	3
	Std. Deviation	16.92139	23.07235	4	14.57166
Post CWIT Affiliate	Mean	97	98	88	94
	N	1	1	1	1
	Std. Deviation	.	.	.	.
Pre SSTEM	Mean	82.7143	89.5714	61.5714	78
	N	7	7	7	7
	Std. Deviation	21.02153	8.48247	26.03112	14.84363
Post SSTEM	Mean	83.8	83.6	65.2	77.6
	N	5	5	5	5
	Std. Deviation	8.8713	8.87694	14.70374	6.38749
Pre Non-Programmed	Mean	81.7692	83.5692	65.2615	76.8769
	N	65	65	65	65

	Std. Deviation	11.85033	8.9669	23.8971	11.03051
Post Non-Programmed	Mean	84.0286	84.0571	68.8571	78.9714
	N	35	35	35	35
	Std. Deviation	9.35724	11.11158	20.63284	10.11547
Total	Mean	82.7615	84.3231	67.2154	78.0846
	N	130	130	130	130
	Std. Deviation	11.96623	10.13492	22.06825	10.64365
Significance		NS P=.429	NS P=.251	NS P=.388	NS P=.322

Table E94: Pre & Post Emotional States Program Affiliation Thursday

Thursday Program Affiliation Pre & Post		Coping Self Efficacy	Engineering Career Success Expectations	Feelings of inclusion	Emotional States
Pre Meyerhoff	Mean	77	88	38	68
	N	1	1	1	1
	Std. Deviation	.	.	.	.
Post Meyerhoff	Mean	75	88	56.5	73
	N	2	2	2	2
	Std. Deviation	2.82843	7.07107	9.19239	1.41421
Pre CWIT Scholar	Mean	73.5	84.5	52	70
	N	2	2	2	2
	Std. Deviation	19.09188	14.84924	32.52691	22.62742
Post CWIT Affiliate	Mean	83	95	92	90
	N	1	1	1	1
	Std. Deviation	.	.	.	.
Pre SSTEM	Mean	84.5	85.3	56.4	75.4
	N	10	10	10	10
	Std. Deviation	8.82232	8.38053	31.28436	10.96662
Post SSTEM	Mean	83.3333	88	73.3333	81.3333
	N	3	3	3	3
	Std. Deviation	9.07377	10.44031	16.74316	10.96966
Pre Non-Programmed	Mean	80.2917	80.4861	56.0833	72.2917
	N	72	72	72	72
	Std. Deviation	12.76928	10.92354	23.64154	11.10695

Post Non-Programmed	Mean	81.2642	84.5849	67	77.6981
	N	53	53	53	53
	Std. Deviation	12.45168	10.883	20.94957	10.45795
Total	Mean	80.8333	82.7986	60.5556	74.7569
	N	144	144	144	144
	Std. Deviation	12.19194	10.80183	23.50384	11.10739
Significance *P<.1		NS P=.877	NS P=.262	S *P=.078	NS P=.174

Table E95: ENES 101 and ENME 204 Confidence in Completing an Engineering Degree

Groups		Begining Confidence in Completing Engineering Degree	Present Confidence in Completing Engineering Degree
Group One - ENES 101	Mean	89.7436	80.1282
	N	26	26
	Std. Deviation	11.62079	24.0459
Group Two - ENES 101	Mean	83.3333	79.0323
	N	31	31
	Std. Deviation	17.21326	19.70511
Group Three - ENES 101	Mean	84.6667	82.6667
	N	25	25
	Std. Deviation	15.15354	14.01058
Group Four - ENES 101	Mean	88.8889	83.3333
	N	12	12
	Std. Deviation	10.85565	18.80254
ENME 204	Mean	82.3232	81.8182
	N	33	33
	Std. Deviation	20.80807	24.06719
Total	Mean	85.1706	81.1024
	N	127	127

	Std. Deviation	16.43065	20.61256
Significance		NS P=.661	NS P=.788

Table E96: ENES 101 and ENME 204 SPVE

Groups		Motivati on - Financial	Motivati on - Parental Influenc e	Motivati on - Social Good	Motivati on - Mentor Influenc e	Motivatio n - Intrinsic Psychologi cal	Motivati on - Intrinsic Behavior al	General Impressio ns of Engineeri ng	SPVE
Group One - ENES 101	Mean	77.9231	21.1923	89.8462	38.1538	92.3846	94.2308	78	70.230 8
	N	26	26	26	26	26	26	26	26
	Std. Deviation	24.1013 2	30.7545 4	11.6092 8	29.2502 2	11.11783	13.2523 4	15.33101	10.782 61
Group Two - ENES 101	Mean	75.8065	23.6452	91.0968	33.3226	90.0323	94.0323	75.9677	69.064 5
	N	31	31	31	31	31	31	31	31
	Std. Deviation	17.9692 7	30.9435 5	15.0007 9	30.856	18.18696	15.3198 9	13.62469	10.392 1
Group Three - ENES 101	Mean	71.28	18.68	89.44	41.96	90.68	84.68	78.72	67.96
	N	25	25	25	25	25	25	25	25
	Std. Deviation	19.7916 6	22.6692 2	14.717	34.6223 4	21.72502	29.9996 1	17.65059	11.278 59
Group Four - ENES 101	Mean	56.6667	18.0833	85.25	33.4167	82.5	83.25	77.4167	62.25
	N	12	12	12	12	12	12	12	12
	Std. Deviation	18.7826 5	28.7953 9	18.0208 2	34.1426 4	17.4069	20.1274 3	11.18	11.840 8
ENME 204	Mean	72.1515	26.2424	81.0303	31.697	87.1212	85.303	79.2727	66.090 9

	N	33	33	33	33	33	33	33	33
	Std. Deviation	24.47718	35.55017	26.70146	29.02853	20.00118	29.0866	11.42988	13.86399
Total	Mean	72.5906	22.315	87.3465	35.5984	89.1732	88.9449	77.9213	67.6693
	N	127	127	127	127	127	127	127	127
	Std. Deviation	21.96944	30.26463	18.64087	30.91341	18.14758	23.12331	13.99411	11.80534
Significance P<.05		S *P=.027	NS P=.982	NS P=.344	NS P=.74	NS P=.159	NS P=.109	NS P=.724	NS P=.422

Table E97: ENME 204 SPVE Correlations

		1	2	3	4	5	6	7	8
1.Motivation - Financial	Correlation Coefficient	1							
	Sig. (2-tailed)	.							
	N	33							
2.Motivation - Parental Influence	Correlation Coefficient	0.19	1						
	Sig. (2-tailed)	0.288	.						
	N	33	33						
3.Motivation - Social Good	Correlation Coefficient	0.191	0.25	1					
	Sig. (2-tailed)	0.288	0.16	.					
	N	33	33	33					
4. Motivation - Mentor Influence	Correlation Coefficient	0.125	0.149	0.25	1				
	Sig. (2-tailed)	0.487	0.406	0.161	.				
	N	33	33	33	33				
5.Motivation - Intrinsic Psychological	Correlation Coefficient	-0.184	-0.103	.434*	0.226	1			
	Sig. (2-tailed)	0.306	0.57	0.012	0.206	.			
	N	33	33	33	33	33			
6.Motivation - Intrinsic Behavioral	Correlation Coefficient	0.198	0.1	.576*	0.028	.561*	1		
	Sig. (2-tailed)	0.269	0.579	0	0.876	0.001	.		
	N	33	33	33	33	33	33		
Correlation Coefficient		-0.013	-0.149	0.197	0.231	0.257	0.045	1	

7.General Impressions of Engineering	Sig. (2-tailed) N	0.944 33	0.407 33	0.271 33	0.195 33	0.149 33	0.802 33	.	
8.Social Persuasion and Vicarious Experiences	Correlation Coefficient Sig. (2-tailed) N	.422* 33	.615* 33	.769* 33	.452* 33	.379* 33	.590* 33	0.228 33	1 33
		0.014 33	0 33	0 33	0.008 33	0.03 33	0 33	0.201 33	.

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table E98: ENME 204 and ENES 101 Mastery Experiences Means

Groups		Perceived Importance of Professional and Interpersonal Skills	Perceived importance of Math and Science Skills	Mastery_ Experiences
Group One - ENES 101	Mean	81.3077	89.8462	85.7692
	N	26	26	26
	Std. Deviation	14.21484	15.5324	11.34304
Group Two - ENES 101	Mean	79.6129	87.2258	83.6774
	N	31	31	31
	Std. Deviation	11.96015	12.7324	10.31306
Group Three - ENES 101	Mean	77.72	91.2	84.6
	N	25	25	25
	Std. Deviation	15.66184	11.88136	11.1018
Group Four - ENES 101	Mean	69.6667	89.9167	80.0833
	N	12	12	12
	Std. Deviation	11.43625	12.8095	9.02983
ENME 204	Mean	76.9697	84.6667	81.0303
	N	33	33	33
	Std. Deviation	15.5774	14.00595	12.47368
Total	Mean	77.9606	88.1339	83.2598

	N	127	127	127
	Std. Deviation	14.27307	13.55082	11.17694
Significance		NS P=.155	NS P=.267	NS P=.307

Table E99: ENME 204 Mastery Experience Correlations

		1	2	3
1.Perceived Importance of Professional and Interpersonal Skills	Correlation Coefficient	1		
	Sig. (2-tailed)	.		
	N	33		
2.Perceived importance of Math and Science Skills	Correlation Coefficient	.414*	1	
	Sig. (2-tailed)	0.017	.	
	N	33	33	
3.Mastery Experiences	Correlation Coefficient	.829**	.839**	1
	Sig. (2-tailed)	0	0	.
	N	33	33	33

* Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

Table E100: ENME 204 and ENES 101 Emotional States

Groups		Engineering Career Success Expectations	Feelings of inclusion	Coping Self Efficacy	Emotional States
Group One -ENES 101	Mean	86.1923	77	87.0385	83.4231
	N	26	26	26	26
	Std. Deviation	10.98005	13.54105	9.54769	8.3913
Group Two - ENES 101	Mean	86.2581	72.9355	81.3871	80.2903
	N	31	31	31	31
	Std. Deviation	12.0332	15.81758	12.78978	10.26383
Group Three - ENES 101	Mean	83.08	65.68	84.16	77.56
	N	25	25	25	25
	Std. Deviation	18.06913	14.19718	9.39716	10.95856
Group Four - ENES 101	Mean	78.1667	76.75	76.75	77.25

	N	12	12	12	12
	Std. Deviation	10.88647	18.46926	10.61838	9.4014
ENME 204	Mean	83.3636	66.2727	80	76.5455
	N	33	33	33	33
	Std. Deviation	15.61613	15.26899	15.76785	10.94615
Total	Mean	84.1024	70.9685	82.2913	79.1339
	N	127	127	127	127
	Std. Deviation	14.09313	15.69397	12.51736	10.33361
Significance *P<.017		NS P=.239	S *P=.017	NS P=.129	NS =.155

Table E101: ENME 204 Emotional States Correlations

		Engineering Career Success Expectations	Feelings of inclusion	Coping Self Efficacy	Emotional States
Engineering Career Success Expectations	Correlation Coefficient	1			
	Sig. (2-tailed)	.			
	N	33			
Feelings of inclusion	Correlation Coefficient	.490**	1		
	Sig. (2-tailed)	0.004	.		
	N	33	33		
Coping Self Efficacy	Correlation Coefficient	0.273	0.234	1	
	Sig. (2-tailed)	0.124	0.19	.	
	N	33	33	33	
Emotional States	Correlation Coefficient	.818**	.748**	.582**	1
	Sig. (2-tailed)	0	0	0	.
	N	33	33	33	33
** Correlation is significant at the 0.01 level (2-tailed).					

Table E102: Junior and Senior Program affiliation Beginning engineering confidence levels
Junior and Senior Confidence

Beginning Confidence in Completing Engineering Degree

Class Year	Program Affiliation	Mean	N	Std. Deviation
Third-year Student	CWIT Scholar	83.3333	1	.

	Total	83.3333	1	.
Fourth-year Student	Meyerhoff	100.0000	2	.00000
	CWIT Affiliate	100.0000	1	.
	Nonprogrammed	93.3333	5	9.12871
	Two or more	100.0000	1	.
	Total	96.2963	9	7.34931
Fifth-year Student or above	Meyerhoff	83.3333	1	.
	CWIT Affiliate	50.0000	2	47.14045
	S-STEM	83.3333	1	.
	NonProgrammed	66.6667	3	16.66667
	Total	66.6667	7	25.45875
Total	Meyerhoff	94.4444	3	9.62250
	CWIT Scholar	83.3333	1	.
	CWIT Affiliate	66.6667	3	44.09586
	S-STEM	83.3333	1	.
	NonProgrammed	83.3333	8	17.81742
	Two or more	100.0000	1	.
	Total	83.3333	17	22.04793

Table E103: Junior and Senior Gender Program Affiliation Beginning engineering confidence levels
Report

Beginning Confidence in Completing Engineering

Degree

Gender	Mean	N	Std. Deviation
Male	91.6667	8	12.59882
Female	75.9259	9	26.49831
Total	83.3333	17	22.04793

Table E104: Program affiliation in each of the discussion times Pre-assessment

Report

Motivation - Mentor Influence Pre-Assessment

Please select the ENES 101

enrolled Discussion time:	Program Affiliation	Mean	N	Std. Deviation
Tuesday 10am	Meyerhoff	71.3333	3	24.84619
	S-STEM	33.0000	1	.
	Non-Programmed	30.1304	23	20.51896
	Total	34.8148	27	24.02409
Tuesday 12pm	Meyerhoff	25.0000	1	.
	CWIT Scholar	58.0000	1	.
	S-STEM	20.8333	6	29.82896
	Non-Programmed	33.3333	21	16.26448
	Total	31.3103	29	20.03230
Thursday 10am	Meyerhoff	75.0000	1	.
	S-STEM	11.6000	5	12.66096
	Non-Programmed	20.4615	26	20.01046
	Total	20.7812	32	21.26292
Thursday 12pm	Meyerhoff	100.0000	1	.
	S-STEM	12.5000	2	17.67767
	Non-Programmed	35.0000	24	20.65030
	Total	35.7407	27	24.29244
Thursday 2pm	CWIT Scholar	58.5000	2	23.33452
	S-STEM	5.6667	3	9.81495
	Non-Programmed	24.7273	22	20.44780
	Total	25.1111	27	22.26127
Tuesday 2pm	Meyerhoff	36.0000	3	40.95119
	CWIT Scholar	49.6667	3	38.18813
	S-STEM	58.0000	1	.
	Non-Programmed	20.0500	20	21.13733
	Total	26.5185	27	26.64925
Total	Meyerhoff	58.0000	9	34.84968
	CWIT Scholar	54.0000	6	26.73574
	S-STEM	17.5556	18	21.94437
	Non-Programmed	27.2794	136	20.44421
	Total	28.8284	169	23.39821

Appendix F

Spearman's Rho Correlation Scale:

Spearman's r

Correlation coefficients between .00 and .30 are considered weak

Between .30 and .70 are moderate

Between .70 and 1.00 are considered high.

Interpreting Correlation Cohen (1988)

Strength	r	r^2	η^2
Weak	.1 to .3	1 to 10%	.0099
Moderate	.3 to .5	10 to 25%	.0588
Strong	>.5	>25%	.1379

Codes for Qualitative Analysis

- I. *Take a look at your first ESMI results and compare to your final results. Did your ESMI change since the beginning of the semester? If so, can you explain what? (Only a question for Group#1 and Group#2)*

Increased in SPVE, ME, Emotional – Students who explained their score increased on Social Vicarious Variable, Mastery Experiences or Emotional Variables

Increased and Decreased in SPVE, ME, Emotional – Students who explained their score increased and decreased on Social Vicarious Variable, Mastery Experiences or Emotional Variables

Increased Mildly- Students explained it increased, but not significantly

Decreased – Decreased on any variable

Did not change – No change indicated

- II. *Did you use any of the recommended sections on the website? If so, what did you use? Or will you plan to use them? (engineeringed.umbc.edu)(only Group#1 and Group#2)*

Did not use, will use later – Participant indicated a plan to use recommendations in the future

Did not use, will not use later – Participant indicated no interest in using the recommendations.

Did not use, but wasn't aware- Participant did not use but wasn't aware of recommendations (common in group#2)

Did not use (no explanation)- Participant did not use and did not provide an explanation

Yes, used the recommendations – Participant used and felt it was helpful.

II-a. Will you plan to use any of the recommended sections on the website? If so, what will you use?(engineeringed.umbc.edu) (only Group#3 and Group#4)

Yes, will be using in the future – Participant indicated they will be using one or more of the recommendations in the future.

No, will be using in the future - Participant indicated they will be using one or more of the recommendations in the future.

No, I will not be using the recommendations – Participant indicated they will not be using the recommendations in the future.

- III. *Did you learn something about yourself as an engineer? Name at least one thing and what that means for you.*

They value and connection of engineering skills and practices (professional and technical skills) to themselves beyond the classroom – Participants indicated they learned to value engineering beyond the misunderstandings, grades and see the importance of the technical, society impact, and professional importance. This ultimately connected to their motivation.

Motivation to be an engineer- Participant focused specifically on learning what motivates them to be an engineer

Develop Engineering Skills - Participant recognized the need to develop specific skill set in engineering.

Nothing New – Participant learned nothing new about themselves as an engineer

Awareness of Inclusion and Confidence- Participants recognized, better, how they perceive inclusion and/or their confidence in engineering.

IV. Does looking at the profiles help you? Please explain. (If you didn't look, please do so now and answer)

Yes, helped to relate to engineers with difficulties – Participants responded how seeing others from different backgrounds and with similar doubts, challenges and failures helped them to realize they were capable of this field.

No, can't relate to any specific profile- Participants indicated that they felt they could not relate one specific person.

No, but was interesting to read the profiles: Participants explained the profiles did not help but felt it was interesting to read.

Didn't look at the profiles – Participants choose not to look at the profiles on the website.

V. What, if anything, for you changed (i.e. your perspective of engineering, your approach to your studies, expectations, etc) since completing the ESMI?

Reinforcement as engineer (leaving or staying)- Participants indicated nothing changed but it did reinforce, motivation, attitude or value of being an engineering. Most had a felt the results accurately showed their motivation on a specific variable. (if leaving, it reinforced why they don't want to stay in engineering)

Expanded Understanding -Participants indicated misconceptions when entering the engineering field. Phrases like “I thought engineering was hard”, “Many roles in engineering” and “engineering is fun.”

Confidence increase math/science or personal/professional skills- Participants discussed their confidence increasing in an engineering practice such as working in team, math skills, engineering design, coding etc.

VI. Take a look at your results. Do you agree with your results from the ESMI? Why or why not?

Agree reflected attitude, perception, value - Participant agreed with their results as it reflected or reinforced what they felt about their current state of mind in engineering whether it be high or low results.

Mostly (Somewhat) Agree reflected attitude, perception, value – Participant felt most of the results reflected or reinforced what they felt about their current state of mind in engineering except for one or two variables.

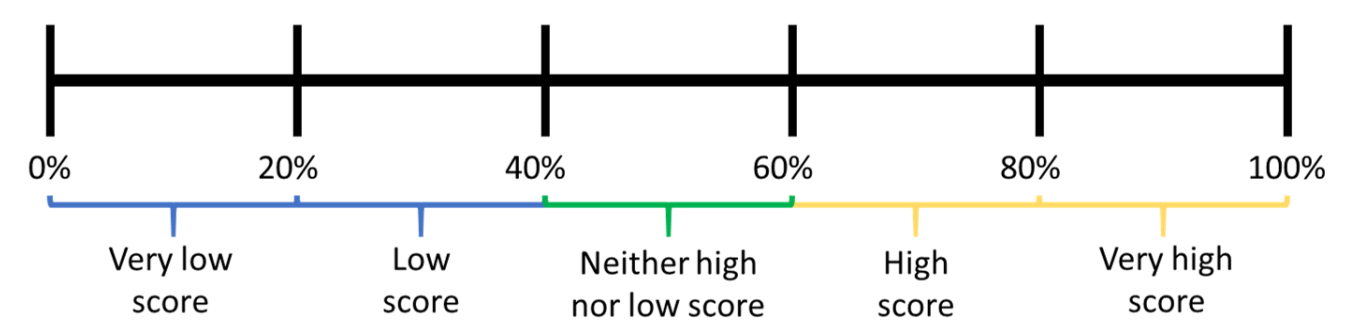
Sample of Coding scheme for Qualitative Impact survey

Does looking at the profiles help you? Please explain. (If you didn't look, please do so now and answer)

¹Yes because it allowed me to see that I don't have to get a high ESMI score to know that I have the potential to successfully pursue a career in engineering. Looking at the profiles also let me realize that it's not uncommon to ²run into problems or have difficulties as a student and that it's beneficial to learn how to approach problems and deal with them.

1. Yes, compared ESMI.
2. Helped related with engineer with difficulties

How Motivated am I to Study Engineering?
Social Persuasion and Vicarious Experiences



Very low motivation to study engineering: 0-19%

The student has no external or internal reasons to study the field of engineering. Additionally, this student may find no value in the field.

Low value of engineering: 20-39%

The student may have some external or internal reasons to study the field of engineering. Additionally, this student may find no value in the field.

Does not feel strongly either way: 40-59%

The student has no strong feelings either way external or internal reasons to study the field of engineering. Additionally, this student may find some value in the field.

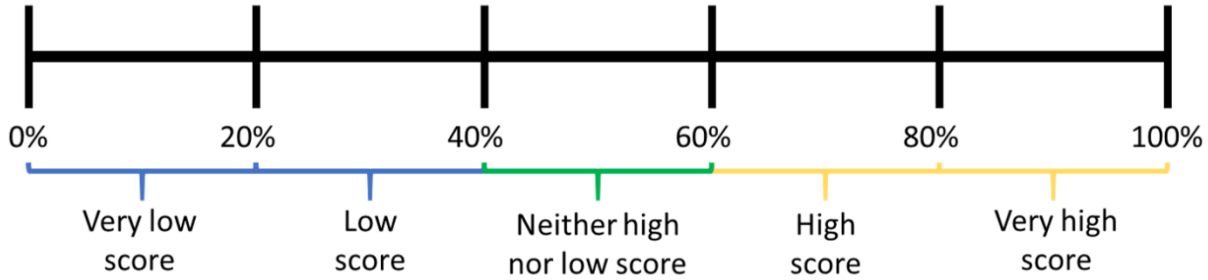
High value of engineering: 60-79%

The student has strong feelings external or internal reasons to study the field of engineering. Additionally, this student may find high value in the field.

Very high value of engineering: 80-100%

The student has very strong feelings external or internal reasons to study the field of engineering. Additionally, this student may find high value in the field.

How do I value Engineering
(General Impressions of Engineering)



Very low value of engineering: 0-19%

The student may find engineering to be of little or no value.

Low value of engineering: 20-39%

The student may find some value in engineering as a career.

Does not feel strongly either way: 40-59%

The student may think of engineering as equal to other careers.

High value of engineering: 60-79%

The student likely finds value in engineering.

Very high value of engineering: 80-100%

The student likely finds engineering to be of extraordinary value.

Recommendations for Improvement of How You Value Engineering:

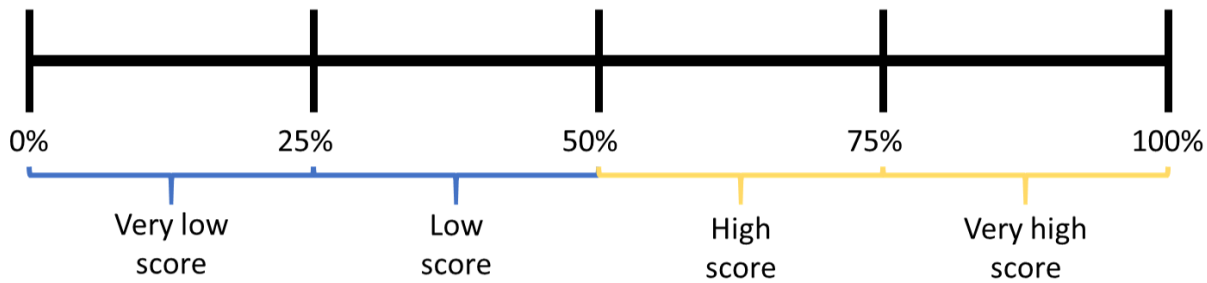
Talk to Professors/Industry Professionals about why they chose/ are passionate about engineering.

Research more pathways in engineering and see what interests you the most.

Read articles on how engineering has positively impacted the community, fascinating topics of interest, and/or why engineering is a rewarding career.

I'm Motivated to Study Engineering because of the Financial Rewards

(Motivation: Financial)



Very low motivation because of financial rewards: 0-24%

The student is motivated to study engineering is unlikely *or not* due to the belief that engineering will provide a financially rewarding career.

Low motivation because of financial rewards: 25-49%

The student is motivated to study engineering may have somewhat due to financial benefits, however, not a significant reason.

High motivation because of financial rewards: 50-74%

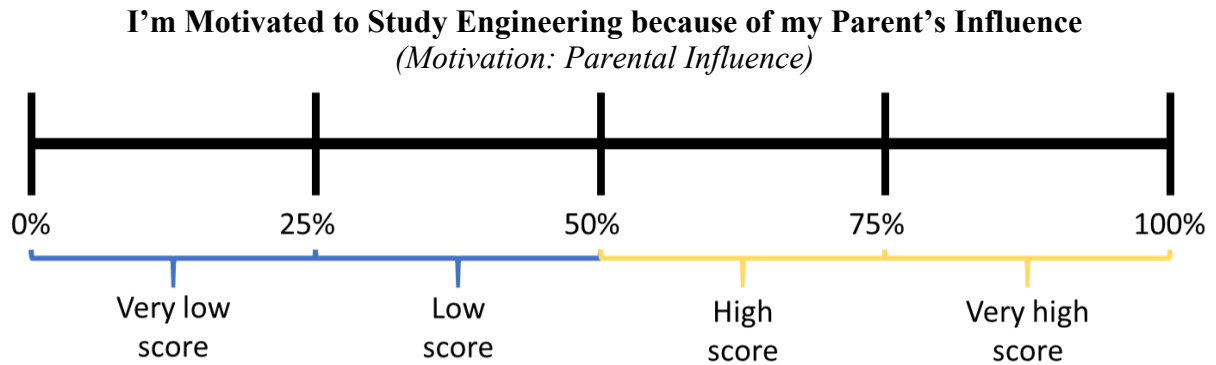
The student is likely studying engineering due to the belief that engineering will provide a financially rewarding career.

Very high motivation because of financial rewards: 75-100%

The student is highly likely studying engineering due to the belief that engineering will provide a financially rewarding career.

Recommendations for Improvement of Motivation: Financial Score/Influence:

- Attend Career Center workshop on salary negotiation.
- Research financial benefits for engineering pathway you may be interested in.



Very low motivation because of parents: 0-24%

The student is unlikely to be motivated to study engineering due to their parents influences.

Low motivation because of parents: 25-49%

The student may be slightly motivated to study engineering due to their parent influences, but it's not a significant reason.

High motivation because of parents: 50-74%

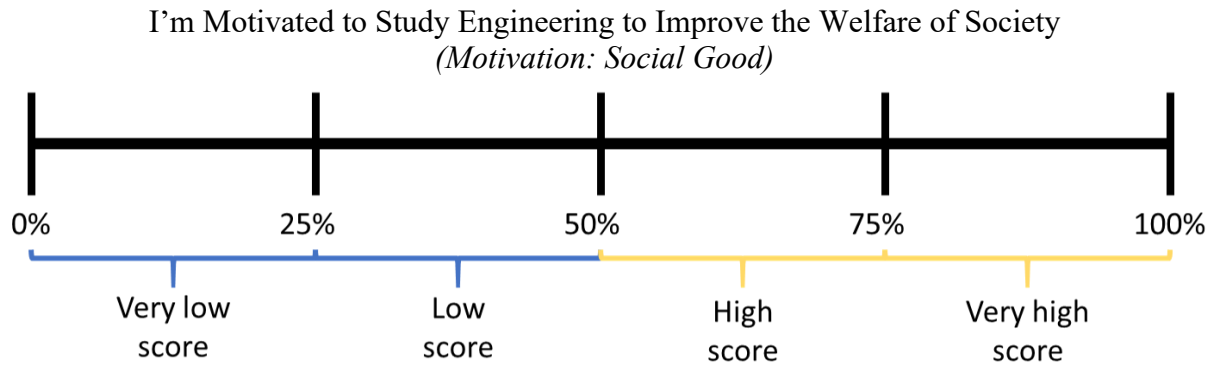
The student is likely studying engineering due to parents influence. This can include a parent being an engineer.

Very high motivation because of parents: 75-100%

The student is highly likely studying engineering due to parents influence. This can include a parent being an engineer.

Recommendations for Improvement of Motivation: Parental Influence Score:

- If you feel this area is important and you are lacking in support in this area, you should seek out mentorship opportunities with a faculty member or peer group



Very low motivation due to improving the welfare of society: 0-24%

The student is not likely motivated to study engineering because of the belief that engineers improve the welfare of society. The student may not think that engineers can make a difference in the world.

Low motivation due to improving the welfare of society: 25-49%

The student might find some motivation to study engineering in the belief that engineers improve the welfare of society.

High motivation due to improving the welfare of society: 50-74%

The student is likely studying engineering because of the benefits it has to the welfare of society.

Very high motivation due to improving the welfare of society: 75-100%

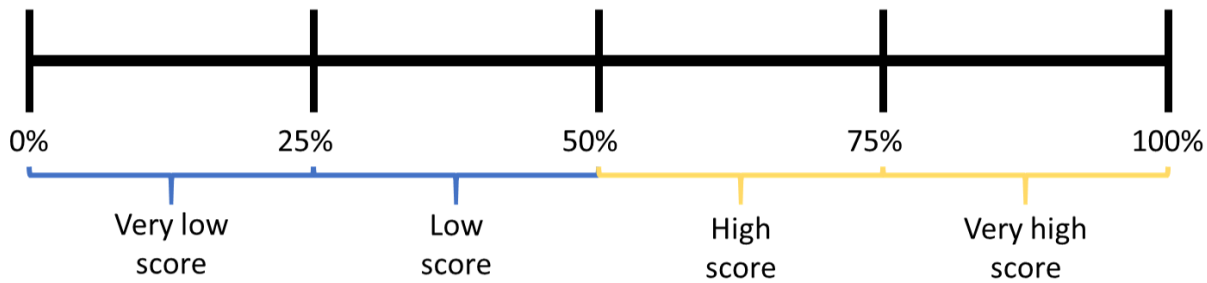
The student is very likely studying engineering because of its benefits to the welfare of society. The student likely believes that engineers can make the world a better place.

Recommendations for Improvement of Motivation: Social Good Score/Influence:

- Join an engineering organization, such as ASME or Engineers without Borders, that work with local schools for tutoring, mentorship within the department, and/or volunteers to make a difference in the local or larger communities.
- If you enjoy teaching and mentorship, apply to be a Teaching Fellow to make a difference and/or to help assist in the education other engineering students.
- Take courses non-engineering or engineering related, such as Global Engineering, around improving the community, becoming more self-aware, or societal issues.

I'm Motivated to Study Engineering because of a Mentor or Mentorship program

(Motivation: Mentor Influence)



Very low motivation because of mentor/mentorship: 0-24%

The student is not likely motivated to study engineering due to the influence of mentor or has never had a mentor encouraging them to pursue engineering.

Low motivation because of mentor/mentorship: 25-49%

The student is slightly motivated to study engineering due to the influence of mentor.

High motivation because of mentor/mentorship: 50-74%

The student is likely motivated to study engineering due to the influence of mentor.

Very motivation because of mentor/mentorship: 75-100%

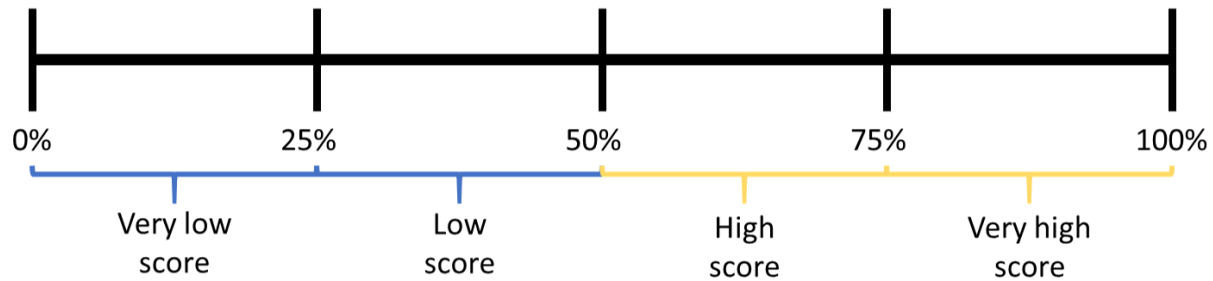
The student is very likely motivated to study engineering due to the influence of mentor. This mentor may have exposed the student to different opportunities in engineering.

Recommendations for Improvement of Motivation: Mentor Influence Score/Influence:

- Join an engineering organization, society, or program as an affiliate to pursue mentor-ship figure.
- Discuss with professors or adviser about upperclassmen students who are interested in becoming a mentor and/or involved within the department to seek out mentor-ship figure.

I'm Motivated to Study Engineering for its Own Purpose

(Motivation: Intrinsic Psychological)



Very low motivation due to enjoyment of engineering for its own purpose: 0-24%

The student likely does not enjoy engineering related activities and is not motivated to study engineering for this reason.

Low motivation due to enjoyment of engineering for its own purpose: 25-49%

The student may find engineering to be somewhat enjoyable.

High motivation due to enjoyment of engineering for its own purpose: 50-74%

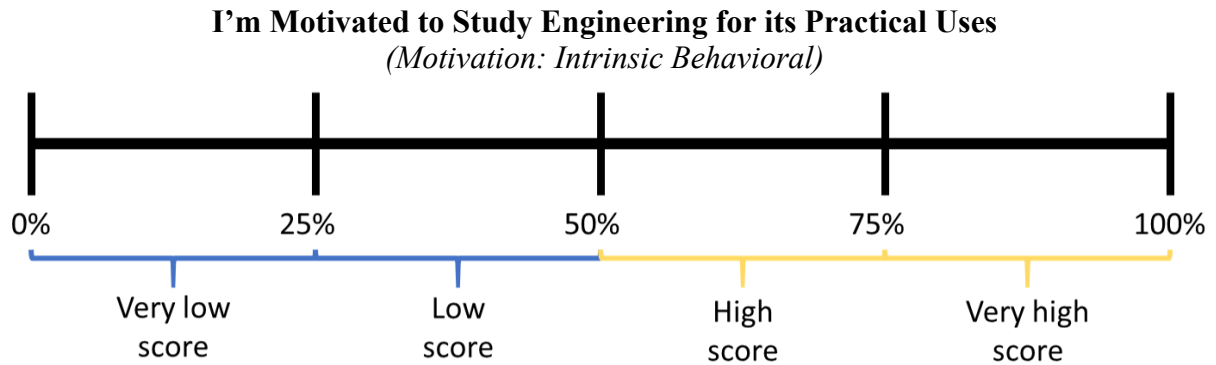
The student is likely motivated to study engineering because it is inherently enjoyable.

Very high motivation due to enjoyment of engineering for its own purpose: 75-100%

The student is very likely motivated to study engineering because it is inherently enjoyable.

Recommendations for Improvement of Motivation: Engineering for its Own Purpose:

- Find an area of study in engineering that is fascinating to you and uses your strengths to contribute to positive, internal motivation.
- Form study groups to work closely with peers on homework and quizzes/exams to teach, learn from, and support each other.
- Go to office hours and take time outside of class to feel comfortable with the material and improve on knowledge, problem-solving, and general confidence



Very low motivation because of practice uses of engineering: 0-24%

The student is not likely motivation related to practical and hands-on aspects of engineering. (e.g. I like to figure out how things work; I like to build stuff)

Low motivation because of practice uses of engineering: 25-49%

The student is slightly motivated related to practical and hands-on aspects of engineering. (e.g. I like to figure out how things work; I like to build stuff)

High motivation because of practice uses of engineering: 50-74%

The student is likely motivated related to practical and hands-on aspects of engineering. (e.g. I like to figure out how things work; I like to build stuff)

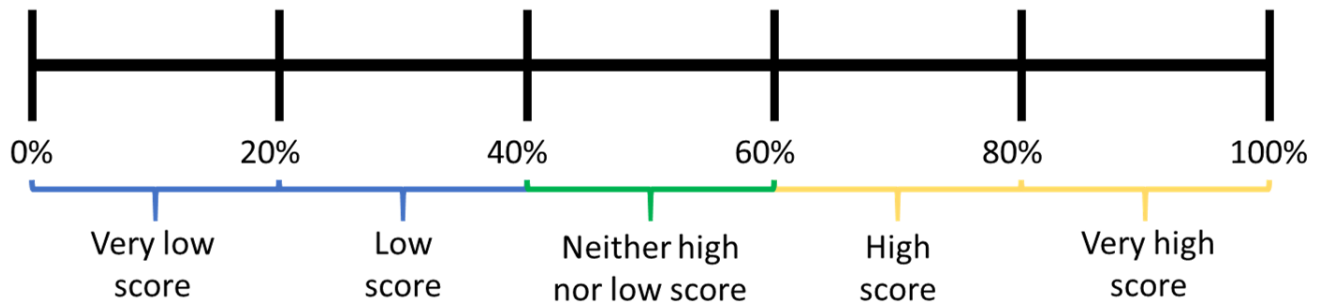
Very high motivation because of practice uses of engineering: 75-100%

The student is very likely motivated related to practical and hands-on aspects of engineering. (e.g. I like to figure out how things work; I like to build stuff)

Recommendations for Improvement of Motivation: Intrinsic Behavioral Score/Influence:

- Attend hands-on workshops held by the department and engineering organizations on campus, such as ASME, AIAA, IEEE.
- Start a student led engineering project.
- Talk to professors about research and project opportunities to gain hands-on experience.
- Tinker and re-build household equipment to understand how it works

Necessary Engineering Skills Mastery Experiences



Very low necessary engineering skills score: 0-19%

The student may have little to no confidence in engineering related skills and could have very negative feelings toward professional skills.

Low necessary engineering skills score: 20-39%

The student may lack confidence in engineering related skills and may have negative feelings toward professional skills.

Neither high nor low necessary engineering skills score: 40-59%

The student has some confidence in engineering related skills and has neutral feelings toward professional skills.

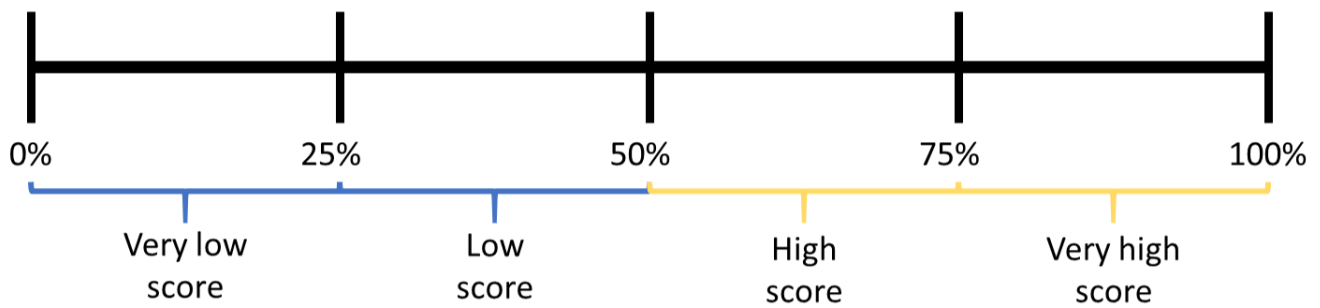
High necessary engineering skills score: 60-79%

The student is proficient with math and science skills and has strong professional skills.

Very high necessary engineering skills score: 80-100%

The student is strong in math and science skills and professional skills. The student may also be highly confident utilizing these skills to solve engineering problems.

I Feel Math and Science Skills are Essential to Becoming an Engineer
(Perceived Importance of Math and Science)



Very low perceived importance of math and science: 0-25%

The student believes that math and science skills are not important in becoming a successful engineer.

Low perceived importance of math and science: 25-50%

The student believes that math and science skills are somewhat unimportant in becoming a successful engineer.

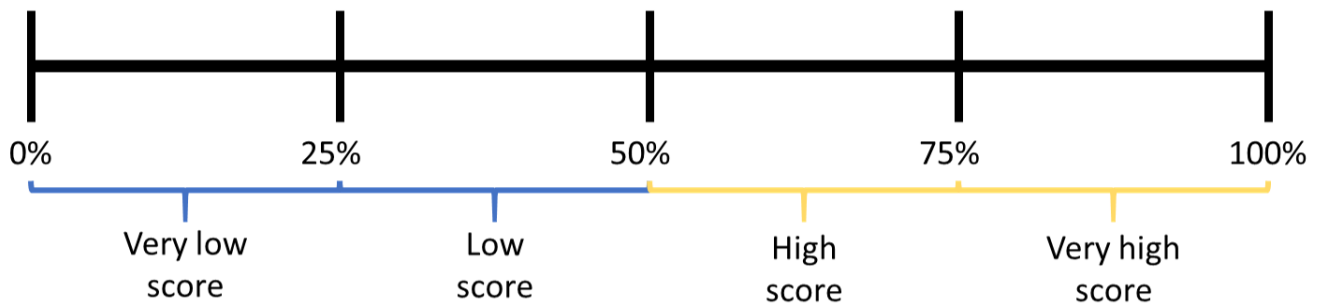
High perceived importance of math and science: 50-75%

The student believes that math and science skills are somewhat important in becoming a successful engineer.

Very high perceived importance of math and science: 75-100%

The student believes that math and science skills are very important in becoming a successful engineer.

I feel Professional and Interpersonal Skills are Essential to Becoming an Engineer
(Perceived Importance of Professional and Interpersonal Skills)



Very low perceived importance of professional and interpersonal skills: 0-24%

The student believes that professional and interpersonal engineering knowledge and skills are of no importance to becoming a successful engineer. Students with this score may be unaware of the importance of these skills in the workplace.

Low perceived importance of professional and interpersonal skills: 25-49%

The student does things that professional and interpersonal skills are somewhat unimportant in becoming a successful engineer.

High perceived importance of professional and interpersonal skills: 50-74%

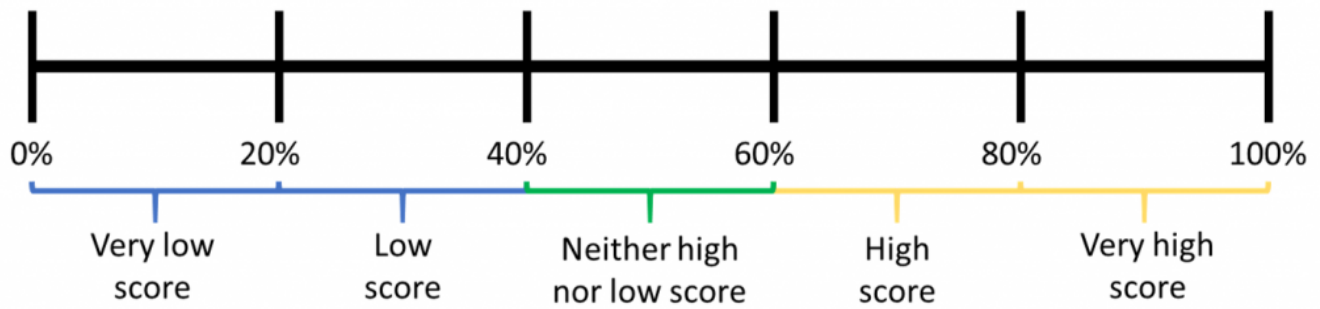
The student believes that professional and interpersonal skills are important in being a successful engineer.

Very high perceived importance of professional and interpersonal skills: 75-100%

The student believes that professional and interpersonal skills are required to become a successful engineer. Students with this score may value the importance of soft skills in the workplace.

How do I feel about being an engineer?

Emotional States



Very low feelings about being an engineer: 0-19%

The student finds it incredibly difficult to find a place in engineering and may have incredibly negative career expectations. This can also result in struggling to cope with challenges.

Low feelings about being an engineer: 20-39%

The student may not feel accepted in the engineering community and may have poor engineering career expectations. They can seldom cope with challenges.

Doesn't feel strongly either way: 40-59%

Student may not have a set place in engineering, but may feel accepted. The student can sometimes cope with challenges.

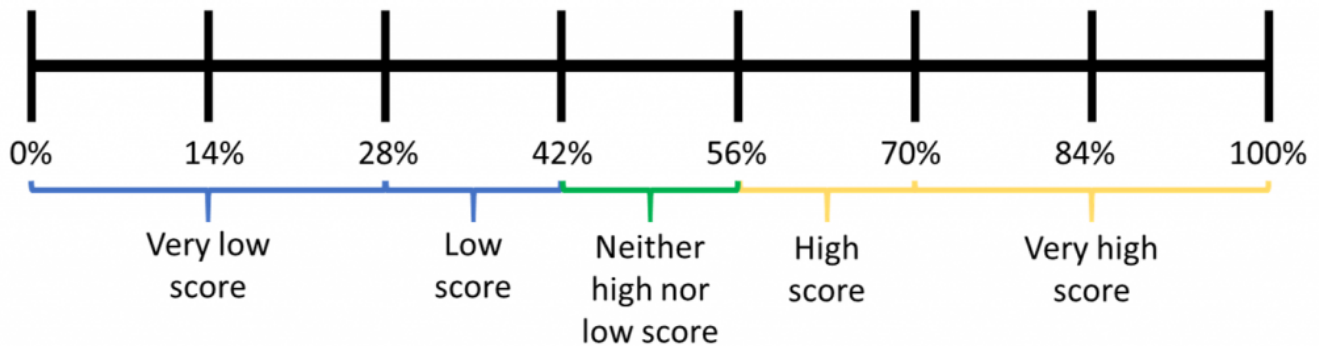
High feelings about being an engineers: 60-79%

Student feels accepted and has a place within the engineering community. The student has positive career expectations and is aware of resources to overcome the challenges of engineering.

Very high feelings about being an engineer: 80-100%

Student feels supported within the engineering community and has many resources available for support through the challenges of engineering. They also like have very positive career expectations.

I feel I can relate to people in my class or activities
(Feeling of Inclusion)



Very low feelings of being able to relate: 0-28%

Student responded primary “Strongly disagree” and “Disagree” to the statements. Feels a strong sense of exclusion from the community and rarely feels included within the academic community.

Low feelings being able to relate: 28%-42%

Student responded with mostly disagree and some agree to the statements. Mostly feels excluded, but at times, may encounter inclusive situations.

Doesn’t feel strongly either way: 42% – 56%

Student doesn’t necessarily feel exclusive but doesn’t feel a strong sense of inclusion in their academic environment.

High feelings being able to relate: 56% – 70%

Student responded with mostly agree and some disagree to the statements. Mostly feels inclusive, but at times, may encounter exclusive situations.

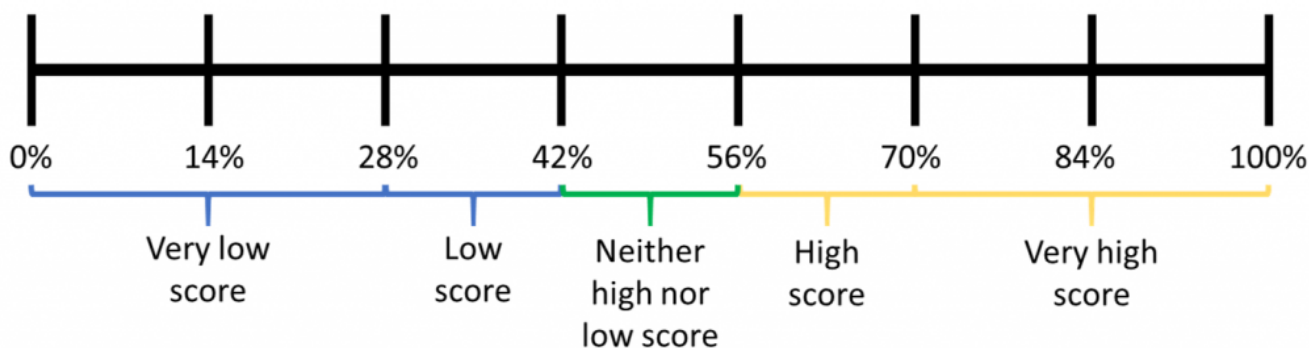
Very high feelings being able to relate: 70%- 100%

Student responded with mostly Strongly agree and Agree to the statements. Feels a strong sense of inclusion from the community and rarely feels excluded within their academic community.

Recommendations for Improvement of Feelings of Inclusion Score/Influence:

- Join engineering organization, program, or society to connect to other engineers and students of similar majors.
- Find common ground regarding engineering interests with peers and discuss class interests or even struggles with them.
- Research ways of effective methods of collaboration and teamwork. Attend a seminar or workshop with CWIT, Meyerhoff, or the Counseling Center around these topics.

I feel I can fit into an engineering career and be treated fairly
(Engineering Career Success Expectations)



Very low feeling of fitting in and being treated fairly: 0-28%

Student has a very low perspective of themselves “fitting” and “succeeding” in an engineering career. Student at this level is usually very unconfident in their abilities and likely has had bad experiences in their classes and/or work experience.

Low of fitting in and being treated fairly: 29-42%

Student has a low perspective of themselves “fitting” and “succeeding” in an engineering career.

Doesn’t feel strongly either way: 43-56%

Student may feel somewhat able to fit and succeed in a career in engineering.

High of fitting in and being treated fairly: 55-70%

Student has a strong perspective of themselves “fitting” and “succeeding” in an engineering career. At this level, the student will feel confident in their field, although may have some doubt at times.

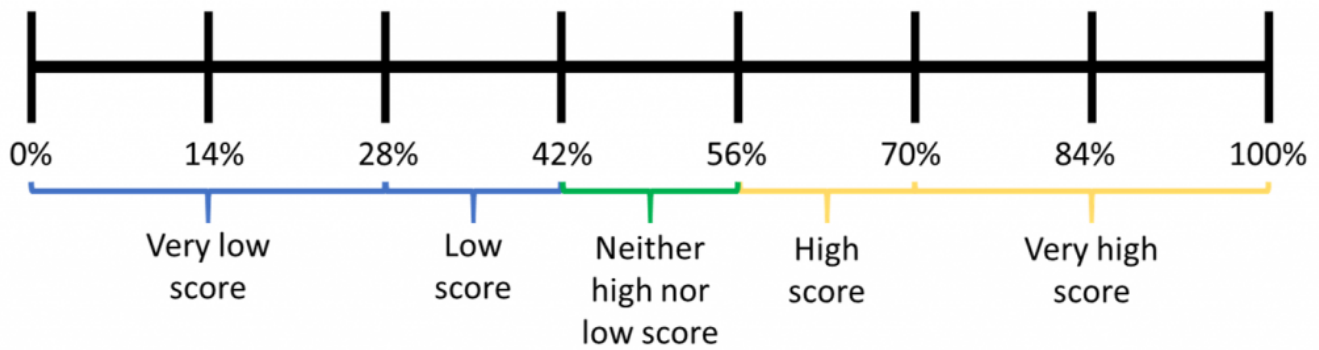
Very high of fitting in and being treated fairly: 71-100%

Student has a very high perspective of themselves “fitting” and “succeeding” in an engineering career. The student may doubt occasionally, but overall is very confident in their ability to be successful.

Recommendations for Improvement of Engineering Career Success Expectations Score/Influence:

- Attend a seminar or workshop with CWIT, Meyerhoff, or the Counseling Center around topics of interviewing, impostor syndrome, resume building, etc.
- To improve success in landing an internship/research/other experiences, talk with a peer mentor, upperclassmen students, students in your courses about their methods of obtaining their internship/research/etc.
- Work to improve engineering knowledge/confidence in courses. Identify your strengths and how you can best use them to be an effective engineer with resources such as the Career Center.

I feel I can deal with or overcome problems and difficulties
(Coping Self-Efficacy)



Very low of being able to deal with or overcome problems: 0-28%

The student has a very low ability to deal with and attempt to overcome problems and difficulties. This person may feel they are a failure and may apply this attitude toward most of their classes. They may also struggle to cope with disapproval from their peers.

Low feeling of being able to deal with or overcome problems: 28-42%

The student has a very low ability to deal with and attempt to overcome problems and difficulties. Occasionally, the student is able to persevere and overcome some challenges, but they are few.

Doesn't feel strongly either way: 42-56%

The student at this level may be able to deal and overcome some challenges, but will still find themselves in various situations unable to deal with some failures or difficult situations.

High coping of being able to deal with or overcome problems: 56-70%

The students has a fairly high ability to deal and overcome problems and difficulties.

Very high coping of being able to deal with or overcome problems: 70-100%

The student is able to deal and overcome most, if not all, problems and difficulties. Likely can easily cope with disapproval or disagreements with peers or other members of the engineering community.

Recommendations for Improvement of Coping Self-Efficacy Score/Influence:

- Make an appointment with the Counseling Center to discuss good coping mechanisms on challenges/difficulties.
- Form study groups to work closely with peers on homework and quizzes/exams to teach, learn from, and support each other.
- Talk to mentor/advisor/professor about tools of success in courses and engineering, discuss stress, and ways they may deal with them.

Appendix G

Summary Table of Engineering State of Mind Instrument Results	
Upper level Classman (Juniors and Seniors) – Aim #1	
Confidence in Completing Degree – Junior & Senior	
<ul style="list-style-type: none"> Beginning confidence averaged lower than present confidence (Present Confidence high in 90's) Fifth year students showed Lower beginning confidence (<i>significant</i> compared to fourth year) than other years (fairly-high at 64%) Programmed Affiliated students indicated higher levels of beginning confidence than non-programmed students and CWIT. 	
Social Persuasion and Vicarious Experiences -Junior & Senior	
<p>Overall Population</p> <ul style="list-style-type: none"> Highest Motivation: Intrinsic Behavioral, Social Good, Intrinsic Psychological Moderate Motivation: Financial Rewards Least Motivation: Mentor and Parent Influences General Impressions: Overall high impressions of Engineering, except S-STEM students (69%) Overall Motivation to pursue engineering: Fairly highly remaining in 60's to 70's <p>Gender</p> <ul style="list-style-type: none"> No significant differences shown. Females are more motivated by Mentors, although low at 51%, more than males. Males more Financially motivated, moderately high, than Females <p>Ethnic</p> <ul style="list-style-type: none"> No significant differences shown African American/Black students, although low, more motivated by Mentors and Parents than other Ethnic groups. <p>Program Affiliated groups</p> <ul style="list-style-type: none"> All groups were more motivated by Mentor influences than Non-programmed. CWIT Students is <i>significantly</i> motivated more by Mentors and Parent than other Programmed affiliated groups. 	
Correlations SPVE -Junior & Senior	
<ul style="list-style-type: none"> Strong Relationship: <ul style="list-style-type: none"> ➤ General Impression of Engineering, Intrinsic Behavior and Psychological, and Mentor Influence with Overall SPVE ➤ Intrinsic Behavioral with Intrinsic Psychological 	
Mastery Experiences – Junior & Senior	
<p>Overall Population</p> <ul style="list-style-type: none"> Moderate Strong views of both Math and Science and Professional and Interpersonal Skills <p>Gender</p> <ul style="list-style-type: none"> Females valued Professional and Interpersonal Skills more than Males No significant differences <p>Ethnic</p> <ul style="list-style-type: none"> African/American Black perceived the importance of engineering skills (on all variables) <i>significantly</i> more than White American <p>Programmed Affiliation</p> <ul style="list-style-type: none"> Non-programmed students valued the skills lower than their programmed affiliated colleagues. No significant differences 	
Correlations Mastery Experiences Junior & Senior	
<ul style="list-style-type: none"> Strong Relationship: <ul style="list-style-type: none"> ➤ Perceived Importance of Math and Science and Professional and Interpersonal skills with Mastery Experiences 	

Emotional States Juniors & Senior	
Overall Population	<ul style="list-style-type: none"> Fairly high sense of Inclusiveness, Coping Self-Efficacy and Engineering Career Expectations Fifth year students' lower sense of Engineering Career Expectations than Fourth year (not significant)
Gender	<ul style="list-style-type: none"> Males have <i>significantly</i> higher Coping Self-Efficacy than Females
Ethnic	<ul style="list-style-type: none"> African American/Black averaged lower than their other ethnic colleagues in all emotional state variables. (however, moderately high) No significant differences
Program Affiliation	<ul style="list-style-type: none"> All groups were moderately high in all the Variables, except S-STEM. S-STEM students was the lowest (62%), compared to other Program Affiliated groups in their Engineering Career Expectations No Significant Differences
Correlations Emotional States Juniors & Seniors	
	<ul style="list-style-type: none"> Strong Significant Relationships <ul style="list-style-type: none"> ➤ Overall Emotional States with Feelings of Inclusion, Coping Self-Efficacy and Engineering Career Success Expectations.

Summary Table of Engineering State of Mind Instrument Results	
Pre-Assessment Group One and Two – Aim #2	
Confidence in Completing Degree – Group One and Two	
	<ul style="list-style-type: none"> Beginning confidence averaged slightly higher than present confidence (both in the 70's) Tuesday 2pm beginning confidence significantly lower than Tuesday 12pm and Thursday 12pm Thursday 10am beginning confidence was significantly lower than Tuesday 12pm No Significant differences found between Group One and Group Two
Social Persuasion and Vicarious Experiences	
Overall Population	<ul style="list-style-type: none"> Highest Motivation: Financial Rewards, Intrinsic Behavioral, Intrinsic Psychological, and Social Good Least Motivation: Mentor and Parent Influences General Impressions: Overall moderately to very high impressions of Engineering Overall Motivation to pursue engineering: were moderately low to moderately high remaining in 50's to 60's Mentor Influence variable showed significant difference between different discussion times.
Gender	<ul style="list-style-type: none"> All genders equally motivated the most by Intrinsic Psychology, Intrinsic Behavioral and Social Good, Financial Rewards Males are <i>significantly</i> more motivated Intrinsic Behavioral than Females
Ethnic	<ul style="list-style-type: none"> American Indian <i>significantly</i> more motivated by Parent influences than White American And Black/African American Asian & Pacific American <i>significantly</i> more motivated by Parent Influences than Black/African American Students Latina/Hispanic students are <i>significantly</i> less motivated in Intrinsic Psychological and Behavioral than Black/African American, White American and Asian & Pacific American.
Program Affiliated groups	<ul style="list-style-type: none"> All groups highest motivations Intrinsic Psychological, Behavioral and Social Good. S-STEM students were <i>significantly</i> less motivated by a Mentor than CWIT and Meyerhoff. Meyerhoff students were significantly more motivated to pursue engineering (overall SPVE) than S-STEM and Non-Programmed Students.
Correlations SPVE -Group One and Two	
	<ul style="list-style-type: none"> Strong Relationship: <ul style="list-style-type: none"> ➤ Intrinsic Behavioral with Intrinsic Psychological ➤ Mentor Influence, General Impressions of Engineering, Intrinsic Psychological and Social good with overall motivation.
Mastery Experiences – Group One and Two	
Overall Population	<ul style="list-style-type: none"> Strong Perceived Importance of Math and Science skills higher than Professional and Interpersonal Skills, which were moderately strong. No Significant differences
Gender	<ul style="list-style-type: none"> Females <i>significantly</i> valued Math and Science and Professional more than Males Females <i>significantly</i> overall valued of engineering skills (Mastery Experience) more than Males
Ethnic	

- Black/African American, Latina/Hispanic American, White American and Other group, perceived engineering skill sets the same
- Asian & Pacific Americans felt the skill set were less important, 70's, than other groups.
- No significant differences

Programmed Affiliation

- Programmed Affiliated students valued Math and Science than Non-Programmed.
- No significant differences

Correlations Mastery Experiences Group One and Two

- Strong Relationship:
 - Perceived Importance of Math and Science and Professional and Interpersonal skills with Mastery Experiences

Emotional States Group One and Two

Overall Population

- Moderate high sense of Coping Self-Efficacy and Engineering Career Expectations, and overall Emotional State
- Moderately low to moderately high Feelings of Inclusion
- Thursday at 10am had *significantly* low Engineering Career Expectations than Tuesday 10am and Thursday at 12pm.
- Tuesday at 12pm had *significantly* higher Engineering Career Expectations than Tuesday 2pm, 10am and Thursday 2pm.

Gender

- Males and Females were similar in all of their Emotional State variables. Feelings of inclusion was moderately high (60's), Coping Self-Efficacy and Engineering Career Expectations (80's)
- Other gender affiliation has *significantly less* Coping Self-efficacy than Males and low Emotional States than both Females and Males.

Ethnic

- All Ethnic population groups had similar overall Emotional States.
- The lowest Emotional State was Feelings of Inclusion.
- Black/African American students had *significantly* higher Coping Self-efficacy than white Americans and Asian & Pacific Americans.

Program Affiliation

- All groups were similar in all Emotional State values, feelings of inclusions being the lowest emotional variable
- Non-programmed students had *significantly* less Engineering Career Expectations than Meyerhoff and S-STEM students.

Correlations Emotional States Group One and Two

- Strong Relationship
 - Overall Emotional States with Feelings of Inclusion, Coping Self-Efficacy and Engineering Career Success Expectations.

Summary Table of Engineering State of Mind Instrument Results	
Post-Assessment Group One through Four – Aim #2	
Confidence in Completing Degree – Groups One-Four	
<ul style="list-style-type: none"> All groups Present confidence dropped from their Beginning Confidence (82% to 77%) Thursday 10am had a <i>significant</i> decrease in confidence from Beginning to Present 	
Social Persuasion and Vicarious Experiences Groups One-Four	
<p>Overall Population</p> <ul style="list-style-type: none"> Highest Motivation: Intrinsic Behavioral, Social Good, Intrinsic Psychological Moderate Motivation: Financial Rewards Least Motivation: Mentor and Parent Influences General Impressions: Overall moderately high impressions of Engineering 76% Overall Motivation to pursue engineering: Fairly highly remaining in 60's. Group Three is <i>significantly</i> more motivated by Intrinsic Psychological compared to Group One and Group Four. Group Two is <i>significantly</i> more motivated by Intrinsic Psychological Compared to Group Four. <p>Gender</p> <p><u>Overall Gender Post Population</u></p> <ul style="list-style-type: none"> Males and Females are motivated by Intrinsic Psychological and Social Good. However, Males also were motivated by Intrinsic Behavioral. Other Gender Affiliation, motivated by Intrinsic Psychological and Behavioral. Females are <i>significantly</i> more motivated by a Mentor compared to the Males. Females are <i>significantly less</i> motivated by Intrinsic Behavioral than Males and Other Gender Affiliation groups. <p><u>Between Groups</u></p> <ul style="list-style-type: none"> No Significance was found between groups. <p><u>Within Groups</u></p> <ul style="list-style-type: none"> In Group 3, Females are <i>significantly</i> less motivated by Intrinsic Behavioral than Males. In Group 4, Females are <i>significantly</i> more motivated by Mentors than Males. In Group 4, Males are <i>significantly</i> more motivated by Intrinsic Psychological than Females. <p>Ethnic</p> <p><u>Overall Ethnic Post Population</u></p> <ul style="list-style-type: none"> Black/African American, Asian and Pacific American, Latin/Hispanic and other group affiliations are primarily motivated to study engineering for Social Good White Americans are more motivated by the Intrinsic Behavior Asian & Pacific students were significantly more motivated by their Parents than Black/African American and White American. Asian & Pacific students had <i>significantly</i> less General Impressions of Engineering than Black/African American and White American. <p><u>Between Groups</u></p> <ul style="list-style-type: none"> Asian & Pacific American students in Group two and three were <i>significantly</i> more motivated by Parent Influence than other ethnic population in the groups. Asian & Pacific American students in Group two and four, were <i>significantly</i> least motivated by Social Good compared to other ethnic population groups. <p>Program Affiliated groups</p> <p><u>Overall Program Affiliated Post Population</u></p> <ul style="list-style-type: none"> CWIT Scholar, S-STEM and Non-programed students are primarily motivated to practice engineering for Social Good Meyerhoff and CWIT affiliates were more Intrinsic Psychologically motivated 	

- CWIT Scholars are significantly more motivated by Mentor Influence than Non-programmed students.
- Non-Programmed students are significantly more motivated by Mentor Influence than CWIT affiliates.
- Non-Programmed students have significantly less General Impressions of Engineering than Meyerhoff and CWIT Scholars.
- S-STEM students were significantly more motivated, overall (SPVE), to study engineering compared to Non-Programmed students and CWIT Affiliates.

Between Groups

- Non-Programmed students were significantly less motivated by Mentor influences than all Program Affiliations in each group.
- Group #2 S-STEM students were significantly less motivated by Mentor Influences compared to Group #4 Meyerhoff and CWIT students and Group #2 CWIT Affiliates.
- Group #4 Meyerhoff and CWIT students are significantly more motivated by Mentor compared to other Program Affiliated groups.
- Group #4 CWIT affiliates were significantly less motivated by Intrinsic Psychological compared to all other Program Affiliated groups.
- Group #1 Non-Programmed Students are significantly less motivated by Intrinsic Psychological compared to Group#2 and #3 Non-Programmed students and Group #1, #3, and #4 Meyerhoff students.

Correlations SPVE – Groups One-Four

Strong Relationship:

Overall Population

- SPVE variable with Parent Influence, Mentor Influence, Intrinsic Psychological and Behavioral.
- Intrinsic Psychological with General Impressions of Engineering and Intrinsic Behavioral

Specific Groups

- Group One
 - Intrinsic Psychological with Behavioral and General Impressions of Engineering
 - SPVE variable with Intrinsic Behavioral, Intrinsic Psychological, Parent Influence, and Mentor Influence
 - General Impressions with Intrinsic Psychological
- Group Two
 - SPVE variable with Mentor Influence, Intrinsic Behavioral, and Parent Influence
 - Intrinsic Psychological with Behavioral and General Impressions of Engineering
- Group Three
 - Intrinsic Psychological with General Impressions of Engineering
 - SPVE variable with Mentor Influence and Intrinsic Behavioral
- Group Four
 - SPVE with Intrinsic Psychological, Mentor Influence, Intrinsic Behavioral, and Parent Influence
 - Intrinsic Behavioral with Intrinsic Psychological

Mastery Experiences – Groups One-Four

Overall Population

- Moderately Strong views of both Math and Science
- Strong toward Professional and Interpersonal Skills
- Group One's values were higher than the other groups.
- No Significant differences were found between groups.

Gender

Overall Gender Post Population

- Females valued Professional and Interpersonal Skills more than Males and Other gender affiliated groups
- Females and Males Perceived Math and Science skills significantly more important than Other Gender Affiliated Groups.

Between Groups

- Group #1 Female's Perceive Math and Science significantly more important than Group #1 Males and Group#1 and #3 Other gender affiliation.
- Group #1 Female students overall valued the engineering skill set (ME) significantly more compared to all other gender groups.
- Group #2 Other gender affiliated group significantly perceived the Mastery Experiences less than Group #3 Males and Group #4 Females.

Ethnic

- All Ethnic groups valued Math and Science more than Professional and Interpersonal skills
- African American/Black and Asian & Pacific Americans perceived the importance of engineering skills (on all variables) *significantly* more than White American.
- White American students' overall value of engineering skills (ME) was significantly less than Black/African American and Asian & Pacific students.
- No Significant difference between the groups.

Programmed Affiliation

- Program Affiliated groups showed higher value than Non-Programmed students in Mastery Experiences on all variables.
- No significant differences between overall population or groups

Correlations Mastery Experiences Groups One-Four

Strong Relationship:

Overall Population

- Mastery Experience with Perceived Importance of Math and Science and Professional and Interpersonal

Specific Groups

- All four groups showed a strong relationship between Mastery Experiences and Perceived Importance of Math and Science and Professional and Interpersonal

Emotional States Group One and Two

Overall Population

- Group #1 had the highest Coping Self-Efficacy, Group #4 had the least
- Group #2 had the highest Engineering Career Expectations, Group #4 had the least
- Group #4 had the highest Feelings of Inclusion, Group #3 had the least
- Group #1 and #2 had the highest overall Emotional States compared to Group #3 and #4
- No Significant differences between the groups

Gender

Overall Gender Post Population

- Males, Females and Other Gender had similar Engineering Career Expectations
- Females Coping Self-Efficacy is *significantly* less than Males.
- Females overall Emotional States is *significantly* less than Males.

Between Groups

- Group #1-#3 Males have significantly higher Coping Self-Efficacy than Females in Group #2-#4 and Other Gender in Group #2.
- Group #1 Other Gender has a significantly higher Coping Self-Efficacy than Group#3 Female and Group#2 Other Gender.

Ethnic

Overall Gender Post Population

- African American/Black students has the highest Coping Self-Efficacy, but the lowest Feelings of Inclusion.
- Latin/Hispanic American population has the highest Engineering Career Success Expectations.
- Other Ethnic Affiliation has the highest Feelings of Inclusion.
- Asian & Pacific students had the lowest Engineering Career Success Expectations and Coping Self-Efficacy

Between Groups

- Group #4 Other Ethnic Affiliation has significantly less Coping Self-Efficacy than any of the other Ethnic groups.
- Group#1 Asian Pacific American has a significantly lower Coping Self-Efficacy than Group #1 White American and Group#3 Black/African American.
- Group #4 Latin American's have significantly less Feelings of Inclusion than compared most Ethnic Groups.
- Group #1 Asian Pacific American have significantly less Feelings of Inclusion than Group # Black/African American students
- Group #4 Asian Pacific American students have significantly higher Feelings of Inclusion compared to Group #2 and #4 Black/African American students.
- Group #1 Asian Pacific American Students has a significantly lower Emotional State compared to most of the Ethnic groups.
- Group #3 Other Ethnic groups has a significantly lower Emotional State compared Group #1 Ethnic Group.
- Group #2 Black/African American Students have a significantly lower Emotional State compared to Group #4 Asian Pacific students.

Program Affiliation

- Meyerhoff Student have the highest Coping Self-Efficacy, Engineering Career Success Expectations, and Emotional States
- CWIT Affiliates have the highest Feelings of Inclusion and lowest Engineering Career Success Expectations.
- CWIT Scholars Coping Self-Efficacy was the lowest.
- No Significant Differences between groups or population

Correlations Emotional States Group One and Two

- Strong Relationship

Overall Population

- All variables had a strong significant relationship with the overall Emotional States

Specific Groups

- Group #3 Engineering Career Success Expectations with Coping Self-Efficacy

Summary Table of Engineering State of Mind Instrument Results	
Comparison of Pre & Post Group One and Two – Aim #3	
Confidence in Completing Degree	
<ul style="list-style-type: none"> Group #1 Post Beginning confidence was higher than its Pre- Beginning confidence (+4.46). Their Post-Present confidence was less than their Pre-Present Confidence (-4.59). Group #2 Pre-Beginning Confidence was slightly less than their Post-beginning confidence (-1.03) and their Pre-Present Confidence was slightly less than their Post-Present Confidence (-.6) Tuesday 2pm Pre-Beginning Confidence was significantly less than its Post-Beginning Confidence. No significant differences between Pre& Post 	
Social Persuasion and Vicarious Experiences	
Overall Population	
<u>Group One</u>	
<ul style="list-style-type: none"> Increased Motivation in Social Good +5.57 Increased Motivation in Financial Rewards +2.77 Increased Intrinsic Psychological +4.09 Decreased General Impressions of Engineering -4.79 No Significant differences between Pre-Post 	
<u>Group Two</u> (All variables increased in Group#2 in all Discussions)	
<ul style="list-style-type: none"> Increased Financial Rewards +3.54 Increased Social Good +7.87 Increased Mentor Influence +6.04 Increased Intrinsic Behavioral +6.58 Increased Intrinsic Psychological +6.59 Increased Overall Motivations (SPVE) +4.64 Thursday 2pm had a significant increase in Financial Rewards from Pre to Post Thursday 12pm had a significant increase in Social Good (+10.86), Mentor influence (+13.84), and overall motivation SPVE (+7.77) 	
Gender	
<u>Group One</u>	
➤ Females	
<ul style="list-style-type: none"> Increased Social Good (+9.89) and Intrinsic Psychological (+3.12) Decreased Financial Rewards (-5.56) and Mentor Influence (-3.31) 	
➤ Males	
<ul style="list-style-type: none"> Increased Financial Rewards (+.68), Social Good (+3.48), Mentor Influence (+3.47) and Intrinsic Behavioral (+4.16) Decrease General Impressions of Engineering (-6.16) 	
➤ Other Gender Affiliation groups increased on all variables, but the population size was too small to compare.	
<u>Group Two</u> (Only Increased)	
➤ Females (average increase of +11.19 on all variables)	
<ul style="list-style-type: none"> Increase Mentor Influence (+14.92), Parent Influence (+13.96), Social Good (+12.95), Overall motivation SPVE (+9.38) 	
➤ Males (average increase of +5.02 on all variables)	
<ul style="list-style-type: none"> Increase Social Good (+7.7), Intrinsic Psychological (+6.85), and Overall motivation SPVE (+3.45) 	
<u>Significance</u>	

- Group #2 Post-Males Social Good was significantly higher from their Pre-results and Pre-Female results
- Group #2 Post-Males Intrinsic Behavioral was significantly higher than Pre-Females.
- Group #2 Males Overall motivation (SPVE) increased significantly higher from Pre to Post.

Ethnic

Group One *(Latina/Hispanic American were not assessed due to no existing post group)*

- Black/African Americans increased on Parent Influence (+7.86) and decreased on Intrinsic Psychological (-15.56)
- White Americans increased on Social Good (+8.51) and decreased in General Impressions of Engineering (-4.07)
- Asian Pacific American Students only decreased with the highest on Intrinsic Psychological (-18.65)
- Other Ethnic Populations increased on Intrinsic Psychological (+28.2) and decreased on General Impressions of Engineering (-2.7)
- White American students significantly increased their motivation in Social Good
- Asian Pacific significantly decreased on Social Good (-17.15) and General Impressions of Engineering

Group Two

- Black/African American increased in Social Good (+3.88) and decreased on Parent Influence (-12.76)
- White American increased in Intrinsic Behavioral (+10.76) and decreased in General Impressions (-1.14)
- Asian Pacific increased in Parent Influences (+11.58) and decreased in General Impressions of Engineering (-3.8)
- Latin/Hispanic American Intrinsic Behavioral increased (+53.3) and decreased on Mentor Influence (-7.6).
- Other Ethnic populations increased on Mentor Influences (+24.1) and decreased in Financial Rewards (-17.0)
- White Americans significantly increased on Social Good (+8.94)

Program Affiliated groups

Group One *(CWIT Scholars and Affiliates are not discussed due to missing either Pre or Post group)*

- Meyerhoff Scholars increased in Social Good (+4.72) and decreased Mentor Influence (-9.57)
- S-STEM students increased in Intrinsic Behavioral (+10.89) and decreased in General Impressions of Engineering (-11.43)
- Non-Programmed increased in Social Good (+3.24) and decreased in General Impressions of Engineering (-5.34)
- No significant differences

Group Two *(CWIT Scholars and Affiliates are not discussed due to missing either Pre or Post group)*

- Meyerhoff Scholars increased in Social Good (+11.0) and decreased on Mentor Influence (-54.0)
- S-STEM students only increased on all variables with the highest in Parent Influences (+31.3)
- Non-Programmed increased Intrinsic Behavioral (+9.1) and decreased in General Impressions of Engineering (-1.59)
- S-STEM students significantly increased in Mentor Influence (+12.33)

Correlations SPVE

Correlations can be found in Post-Assessment groups

Mastery Experiences

Overall Population

Group One

- All groups slightly increased on the overall engineering skill set (ME)
- Tuesday 2pm has the highest increase in Perceived Importance of Math and Science skills (+3.42)
- Tuesday 12pm had a minor decrease in Math and Science skills (-4.43)
- No significant differences

Group Two

- All groups increased slightly in Perceived Importance of Professional and Interpersonal Skills.
- Thursday 10am decreased on the Math and Science skills (-6.01)
- No significant differences

Gender

Group One

- Females increased on all variables with highest Professional and Interpersonal skills (+11.89)
- Males increased on all variables with highest Professional and Interpersonal skills (+3.74)
- Other Gender Affiliation increased in Professional and Interpersonal (+19) and decreased in Math and Science (-16.5)
- Females significantly increased in Professional and Interpersonal skills Pre to Post

Group Two (*Other Gender affiliation group was not assessed to due missing pre-group*)

- Females had a minor increase Professional and Interpersonal (+.64) and decrease Math and Science Skills (-7.85)
- Male population had only increases with their highest increase being in the Perceived Importance of Professional and Interpersonal skill (+4.0)
- No Significant differences

Programmed Affiliation

Group One (*CWIT Scholars and Affiliates are not discussed due to missing either Pre or Post group*)

- Meyerhoff students increased in the Perceived Importance of Professional and Interpersonal skills (+5.6) and decrease in the Perceived Importance of Math and Science skills (-14.14)
- S-STEM students also increased in the Perceived Importance of Professional and Interpersonal skills (+5.0) and decrease decreased in the Perceived Importance of Math and Science skills (-2.9)
- Non-Programmed students only had increases with the highest in Professional and Interpersonal skills (+4.3)

Group Two (*CWIT Scholars and Affiliates are not discussed due to missing either Pre or Post group*)

- Meyerhoff students only increased with the highest change in the Perceived Importance of Math and Science skills (+16.5)
- S-STEM students only increased with the highest change in the Perceived Importance of Professional and Interpersonal skills from (+19.8)
- Non-programmed students increased Professional and Interpersonal skills (+2.78) and decreased in Math and Science (-3.14)
- S-STEM students significantly increased on the Perceived Importance of Professional and Interpersonal

Correlations Mastery Experiences Groups One-Four

Correlations can be found in Post-Assessment groups

Emotional States Group One and Two

Overall Population

Group One

- All variables increased in all discussions
- Tuesday 12pm Feelings Inclusion (+8.15)
- No significance between pre-post groups

Group Two

- All variables increased in all discussions
- Thursday 2pm Feelings of Inclusion significantly increased (+13.47) and Engineering Career Expectations (+5.91), and overall Emotional State (+6.11)
- Thursday 12pm significantly increased in overall Emotional State (+5.79)

Gender

Group One

- Females increased in Coping Self-Efficacy (+3.55)
- Males increased in Feelings of Inclusion (+6.27) and decreased in Engineering Career Success Expectations (-.52)
- Other Gender Affiliated increased in Coping Self-Efficacy (+23) and Feelings of Inclusion (+23)

Group Two

- All variables increased in all gender groups
- Males significantly increased in Engineering Career Success Expectations (+4.47), Feelings of Inclusion (+12.14), and overall Emotional State (+5.95)

Ethnic

Group One *(Latina/Hispanic American were not assessed due to no existing post group)*

- Black/African American increased in feelings of Inclusion (+7.67) and decreased on Engineering Career Expectations (-4.27)
- White Americans increased in all emotional variables with Feelings of Inclusion being the greatest change (+8.33)
- Asian Pacific increased on all variables except, Feelings of Inclusion which decreased (-8.17)
- Other Ethnic groups increased on all variables.
- White American increased significantly in overall Emotional states (+4.57)

Group Two

- Black/African American increased in all variables with the highest in Feelings of Inclusion (+6.99)
- White American increased overall with the highest in Feelings of Inclusion (+12.65)
- Asian Pacific only decreased on Coping Self-Efficacy (-2.62)
- Latina/Hispanic increased overall with the highest in Coping Self-Efficacy (+11.87)
- Other Ethnic increased overall
- White Americans increased significantly in Feelings of Inclusion.

Program Affiliation

Group One *(CWIT Scholars and Affiliates are not discussed due to missing either Pre or Post group)*

- Meyerhoff students had the highest increase in Feelings of Inclusion (+19.72) and decrease in Engineering Career Success Expectations (-2.86)
- S-STEM students' Feelings of Inclusion increased (+3.63) but slightly decreased on their Engineering Career Success Expectations (-5.97)
- Non-programmed students increased in all variables with the highest being on Feelings of Inclusion (+3.6)
- No significant differences

Group Two *(CWIT Scholars and Affiliates are not discussed due to missing either Pre or Post group)*

- Meyerhoff increased in Feelings of Inclusion (+18.6) and decreased in Coping Self-Efficacy (-2)

- S-STEM increased in Feelings of Inclusion (+16.93) and decreased in Coping Self-Efficacy (-1.17)
- Non-Programmed increased on all variables but significantly increased in Feelings of Inclusion (+11)

Correlations Emotional States Group One and Two
Correlations can be found in Post-Assessment groups

References

- ABET. 2019. Criteria for Accrediting Engineering Programs, 2019 – 2020.
<https://www.abet.org/accreditation/accreditation-criteria/criteria-for-accrediting-engineering-programs-2019-2020/>.
- Ambrose, S. A., M. W. Bridges, M. DiPietro, M. C. Lovett & M. K. Norman. 2010. *How learning works: Seven research-based principles for smart teaching*. John Wiley & Sons.
- Amelink, C. 2008. Overview: Mentoring and Women in Engineering. ed. S.-A.-C. A. R.-M. a. W. i. Engineering.
- Anderson-Rowland, M. P. 2001. Understanding Freshman Engineering Student Retention. In *ASEE Conference*. Milwaukee, Wisconsin.
- Angelique, H., K. Kyle & E. Taylor (2002) Mentors and muses: New strategies for academic success. *Innovative Higher Education*, 26, 195–209.
- ASEE. 2012. Going the Distance: Best Practices and Strategies for Retaining Engineering, Engineering Technology, and Computing Students. . ASEE.org.
- . 2018. Transforming Undergraduate Education in Engineering. Phase IV- Views of Faculty and Professional Societies. Meeting Report 2018. <http://tuee.asee.org/phase-iv/report/>.
- Atkin, A. M., R. Green & L. McLaughlin (2002) Patching the Leaking Pipeline. *Journal of College Science Teaching*, 32, 102-108.
- AWE. 2009. STEM Assessment Tools - Assessing Women and Men in Engineering. www.aweonline.org: Pennsylvania State University and University of Missouri.
- Baber, T. & N. Fortenberry. 2008. The academic value of cooperative education: a literature review. In *2008 ASEE Annual Conference and Exposition, June*.
- Baillie, C. (1998) Addressing first-year issues in engineering education. *European journal of engineering education*, 23, 453-465.
- Bandura, A. 1986. *Social foundations of thought and action: a social cognitive theory*. NJ:Englewood Cliffs: Prentice-Hall.
- . 1997. *Self-efficacy: The Exercise of Control*. New York: W.H. Freeman and Company.
- Bender, D. S. (2001) Effects of study skills programs on the academic behaviors of college students. *Journal of college Reading and Learning*, 31, 209-216.
- Besterfield-Scare, M. B. M., L. J. Shuman & C. J. Atman (2001) Gender and Ethnicity Differences in Freshman Engineering Student Attitudes: A Cross Institutional Study. *Journal of Engineering Education*, 86.
- Bielefeldt, A. R., K. G. Paterson & C. W. Swan (2010) Measuring the value added from service learning in project-based engineering education. *International Journal of Engineering Education*, 26, 535-546.
- Biggs, J. (1988) The role of metacognition in enhancing learning. *Australian Journal of Education*, 32, 127-138.
- Blair, B. F., M. Millea & J. Hammer (2004) The impact of cooperative education on academic performance and compensation of engineering majors. *Journal of Engineering Education*, 93, 333-338.
- Bonfert-Taylor, P. Impact of First-Year Programming for Underprepared Students.
- Boyer Commission on Educating Undergraduates in the Research University, S. B., Ny. 1998. *Reinventing undergraduate education: A blueprint for America's research universities*. Boyer Commission on Educating Undergraduates in the Research University.
- Brainard, S. (1998) A Six-Year Longitudinal Study of Undergraduate Women in Engineering and Science. *Journal of Engineering Education*.

- Brainard, S. G., S. Laurich-McIntyre & L. Carlin (1995) Retaining female undergraduate students in engineering and science: 1995 annual report to the Alfred P. Sloan Foundation. *Journal of Women and Minorities in Science and Engineering*, 2.
- Breuning, L. 2016. Stop Anxiety by Adjusting Expectations. Psychology Today: Retrieved Online 1-16-2020.
- Bruce, L. B. (2001) Student self-assessment: Making standards come alive. *Classroom Leadership*, 5, 1-6.
- Brush, K. 2013. Women in Engineering: The Impact of the College Internship on Persistence into an Engineering Field In *School of Education*. The College of William and Mary in Virginia.
- Budny, D. 1995. Mathematics bridge program. In *Proceedings Frontiers in Education 1995 25th Annual Conference. Engineering Education for the 21st Century*, 2a4. 11-2a4. 15 vol. 1. IEEE.
- Campbell, A. & G. Skoog (2004) Preparing undergraduate Women for Science Careers. *Journal of College Science Teaching*, 33, 24-26.
- Carberry, A. R., H. S. Lee & M. W. Ohland (2010) Measuring engineering design self-efficacy. *Journal of Engineering Education*, 99, 71-79.
- Carnegie Mellon University, C. o. E. 2019. First Year Experience.
<https://engineering.cmu.edu/education/undergraduate-programs/student-life/first-year-experience.html>.
- Center, G. T. a. R. 2019a. Cognitive Constructivism. <https://gsi.berkeley.edu/gsi-guide-contents/learning-theory-research/cognitive-constructivism/>: Berkeley Graduate Division.
- Center, N. R. 2019b. Current Term Enrollment – Spring 2019. Retrieved Online.
- Center., N. R. Current Term Enrollment – Spring 2019. Retrieved Online (2019).
- Coaley, K. 2014. *An introduction to psychological assessment and psychometrics*. Sage.
- Coyle, W. C. O. E. J., R. Fortek, J. Gray, L. H. Jamieson, J. Watia & R. Wukasz (2000) EPICS: Experiencing engineering design through community service projects. *age*, 5, 1.
- Creamer, E. 2011. Representation of Women and Perceptions of Support in Engineering. In *ASEE/IEEE Frontiers in Education Conference*. Rapid City, SD.
- Creswell, J. W. 2003. *Research design: Qualitative, quantitative, and mixed methods approaches*. Thousand Oaks, CA: Sage Publications.
- Cronan-Hillix, T., L. K. Gensheimer, W. Cronan-Hillix & W. S. Davidson (1986) Students' views of mentors in psychology graduate training. *Teaching of psychology*, 13, 123-127.
- Cronbach, L. J. (1946) A case study of the splithalf reliability coefficient. *Journal of educational psychology*, 37, 473.
- CWIT. 2019. Center for Women and Information Technology.
- Dictionary.com. 2018. Self-Assessment. In *Dictionary.com*.
- Duffy, J., E. Tsang & S. Lord (2000) Service-learning in engineering: what why and how. *age*, 5, 1.
- Eccles, J. S., T. F. Adler, R. Futterman, S. B. Goff, C. M. Kaczala, J. L. Meexe & C. Midley. 1983. Achievement and achievement motives: Psychological and sociological approaches. In *Expectancies, values, and academic behaviors*. In J.T Spence (Ed.). San Francisco.
- Eyler, J. & D. E. Giles Jr. 1999. *Where's the Learning in Service-Learning?* Jossey-Bass Higher and Adult Education Series. ERIC.
- Felder, R. M. & R. Brent (2005) Understanding Student Differences. *Journal of Engineering Education*, 57-72.
- Fiske, E. B. (1988) The undergraduate Hispanic experience: A case of juggling two cultures. *Change: The Magazine of Higher Learning*, 20, 29-33.
- FLANNERY, M. E. 2018. The Epidemic of Anxiety Among Today's Students. *News and Features from the National Education Association*.
- Fleming, L. N. & K. C. Smith (2013) Engineering identity of Black and Hispanic undergraduates: The impact of minority serving institutions. *age*, 23.

- Fletcher, S. L., D. C. Newell, L. D. Newton & M. R. Anderson-Rowland. 2001. The WISE summer bridge program: Assessing student attrition, retention, and program effectiveness. In *Proceedings, American Society for Engineering Education*.
- Foundation, R. W. J. 2008. Qualitative Research Guidelines Project.
- Fox, M. 2018. Girls get better grades than boys, even in STEM subjects. NBC news.
- Fraenkel, J. R. & N. E. Wallen. 2003. *How to Design and evaluate research in education*. New York: McGraw-Hill.
- Galbraith, M. W. & G. Ostrowski. 2000. The Mentor facilitating Out-of-Class Cognitive and Affective Growth. In *Teaching alone, Teaching together: Transforming the Structure of Teams for Teaching*. San Francisco, CA: James L.Bess and Associates, Eds.
- Ginorio, A. 1995. Bridging the Gender Gap in Engineering and Science. In *A Culture of Meaningful Community*. Pittsburgh, PA.
- Gist, M. E. & T. R. Mitchell (1992) Self-efficacy: A theoretical analysis of its determinants and malleability. *Academy of Management Review*, 17.
- Glenn, R. & R. Landis (1985) Matriculation and summer bridge programs. *Improving the Retention and Graduation of Minorities in Engineering*, 00, 19-25.
- Gregg, D. 2019. Effects of "High-Impact Practices" on First-Generation College Students' Academic Success. In *Language, Literacy, and Culture*. University of Maryland Baltimore County.
- Guay, F., R. J. Vallerand & C. Blanchard (2000) On the assessment of situational intrinsic and extrinsic motivation: The Situational Motivation Scale (SIMS). *Motivation and emotion*, 24, 175-213.
- Gurganus, J. 2011. Assessing and Evaluating Mentorship programs affecting student's retention at the University of Maryland, Baltimore County in Mechanical Engineering. In *Mechanical Engineering*. UMBC: University of Maryland Baltimore County
- Gurganus, J. R. & L. Zhu. 2019. NSF S-STEM Program: Recruitment, Engagement, and Retention: Energizing and Supporting Students with Diverse Backgrounds in Mechanical Engineering (Work-in-Progress). In *ASEE annual conference & exposition*.
- Haag, S. & J. Collofello. 2008. Engineering undergraduate persistence and contributing factors. In *2008 38th Annual Frontiers in Education Conference*, T4D-8-T4D-14. IEEE.
- Hadjoannou, X., Shelton, N., Danling, F., & Dhanarattigannon, J. (2007) The road to a doctoral degree: Co-travelers through a perilous passage. *College Student Journal*, 41.
- Halpern, D. F., C. P. Benbow, D. C. Geary, R. C. Gur, J. S. Hyde & M. A. Gernsbacher (2007) The science of sex differences in science and mathematics. *Psychological science in the public interest*, 8, 1-51.
- Hanidu, G. A., M. Rachedine, A. Oladipupo, K. Jothimurugesan & A. A. Adeyiga. 1996. The impact of academic enrichment program at Hampton University. In *Technology-Based Re-Engineering Engineering Education Proceedings of Frontiers in Education FIE'96 26th Annual Conference*, 774-776. IEEE.
- Henderson, N., M. S. Fadali & J. Johnson. 2002. An investigation of first-year engineering students' attitude toward peer-tutoring. In *32nd Annual Frontiers in Education*, F3B-F3B. IEEE.
- Henderson, T. 2017. Exploring the Post-graduation Benefits of High-Impact Practices in Engineering: Implications for Retention and Advancement in Industry. In *ASEE annual conference*. Columbus, Ohio.
- Henderson, T. S. Exploring the Post-graduation Benefits of High-Impact Practices in Engineering: Implications for Retention and Advancement in Industry.
- Hermond, D. (1995) Measuring the retention strategies of a minority engineering program: A service quality perspective. *Journal of Engineering Education*, 84, 395-400.
- Hilpert, J. 2008. An Exploratory Factor Analysis of the Pittsburgh Freshman Engineering Attitudes Survey. In *ASEE/IEEE Frontiers in Education Conference*. Saratoga Springs, NY: IEEE.

- Hrabowski III, F. A. 2019. *The Empowered University: Shared Leadership, Culture Change, and Academic Success*. JHU Press.
- Huffman & S. T. J., G. J., Grubbs, M. E., & **Gurganus, J.** (2018) Engineering: A national imperative. *Technology & Engineering Teacher*, 78, 22.
- Hutchison, M. A., D. K. Follman, M. Sumpter & G. M. Bodner (2006) Factors influencing the self-efficacy beliefs of first-year engineering students. *Journal of Engineering Education*, 95, 39-47.
- Ingle Jr, H., K. K. Craven, E. A. Powell, E. L. Hutchins, L. C. Randolph & C. McGee. 2017. R3: A Three-Pronged Model for Engineering Student Success. In *2017 FYEE Conference*.
- Inoue, Y. 2006. *Technology and Diversity in Higher Education: New Challenges: New Challenges*. IGI Global.
- Interactive, H. 2011. STEM Perceptions: Student and Parent Study. Center for Advanced Automotive Technology.
- Jacoby, B. 1996. *Service-Learning in Higher Education: Concepts and Practices. The Jossey-Bass Higher and Adult Education Series*. ERIC.
- Kahveci, A., S. Southerland & P. Gilmer (2006) Retaining Undergraduate Women in Science, Mathematics, and Engineering. *Journal of College Science Teaching*.
- Kitsantas, A., A. R. Robert & J. Doster (2004) Developing self-regulated learners: Goal setting, self-evaluation, and organizational signals during acquisition of procedural skills. *The Journal of Experimental Education*, 72, 269-287.
- Kleinhenz, P., M. Pinnell, G. Mertz & C. Eger. 2005. Student perspectives of curriculum integrated international service-learning internships. In *Proceedings Frontiers in Education 35th Annual Conference*, F4F-11. IEEE.
- Kram, K. E. 1985. *Mentoring at Work: Developmental relationships in organizational life*. Glenview, IL: Scott, Foresman.
- Kuh, G. D. (2008) Excerpt from high-impact educational practices: What they are, who has access to them, and why they matter. *Association of American Colleges and Universities*, 19-34.
- Lenning, O. T. & L. H. Ebbers. 1999. *The Powerful Potential of Learning Communities: Improving Education for the Future. ASHE-ERIC Higher Education Report, Vol. 26, No. 6*. ERIC.
- Leong, F. T. & F. C. Serafica (1995) Career development of Asian Americans: A research area in need of a good theory. *Career development and vocational behavior of racial and ethnic minorities*, 67-102.
- Lidren, D. M., S. E. Meier & T. A. Brigham (1991) The effects of minimal and maximal peer tutoring systems on the academic performance of college students. *The Psychological Record*, 41, 69-77.
- linkengineering.org. 2019. Habit of mind.
- Litzinger, T., L. R. Lattuca, R. Hadgraft & W. Newstetter (2011) Engineering education and the development of expertise. *Journal of Engineering Education*, 100, 123-150.
- Lloyd, A., J. Gore, K. Holmes, M. Smith & L. Fray (2018) Parental influences on those seeking a career in STEM: the primacy of gender. *International Journal of Gender, Science and Technology*, 10, 308-328.
- Lopatto, D. (2004) Survey of undergraduate research experiences (SURE): First findings. *Cell biology education*, 3, 270-277.
- Lou, H. C. (2015) Self-awareness—an emerging field in neurobiology. *Acta Paediatrica*, 104, 121-122.
- Lucas, B. & J. Hanson (2016) Thinking like an engineer: Using engineering habits of mind and signature pedagogies to redesign engineering education. *International Journal of Engineering Pedagogy*, 6, 4-13.
- Mamaril, N. A., E. L. Usher, C. R. Li, D. R. Economy & M. S. Kennedy (2016) Measuring undergraduate students' engineering self-efficacy: A validation study. *Journal of Engineering Education*, 105, 366-395.

- Marques, L. & N. LeBlanc. 2019. Anxiety in college: What we know and how to cope. Harvard Health School.
- Marra, R., B. Bogue, K. Rodgers & D. Shen. 2007. Self Efficacy of Women Engineering Students: Three Years of Data at U.S. Institutions. In *American Society for Engineering Education*. Honolulu, Hawaii.
- Marra, R., M. Schuurman, C. Moore & B. Bogue. 2005. Women Engineering Students' Self-Efficacy Beliefs-The Longitudinal Picture. In *Proceedings of the Annual Meeting of the American Society for Engineering Education Annual Conference*.
- Marra, R., D. Shen, K. Rodgers & B. Bogue. 2009. Leaving Engineering: A Multi-Year Single Institution Study. In *Annual Meeting of the American Educational Researcher's Association*. San Diego, California.
- Marra, R. M., C. Moore, M. Schuurman & B. Bogue (2004) Assessing women in engineering (AWE): assessment results on women engineering students beliefs. *age*, 9, 1.
- McCarthy, A. M. & T. N. Garavan (1999) Developing self-awareness in the managerial career development process: the value of 360-degree feedback and the MBTI. *Journal of European Industrial Training*, 23, 437-445.
- McCormick, M., C. Swan & D. Matson. 2008. Reading between the lines: Evaluating selfassessments of skills acquired during an international service learning project. In *American Society for Engineering Education (ASEE) Annual Conference. Paper AC*.
- McDonell, K. 2017. Addressing the Changing Demographics of the New College Student. In *The Evollution*.
- McMillan, J. H. & J. Hearn (2008) Student Self-Assessment: The Key to Stronger Student Motivation and Higher Achievement. *Educational Horizons*, 87, 40-49.
- Morrison, C., K. Griffin & P. Marcotullio (1994) Retention of Minority descendents in Engineering. *NACME Research Letter*, 5, 45-47.
- NACE. 2012. NACE position statement on U.S. internships: A definition and criteria to assess opportunities and determine the implications for compensation. <https://studentaffairs.fiu.edu/academic-success/career-and-talent-development/internships/policies-and-procedures/assets/nace-statement-on-internships.pdf>.
- National Academies of Sciences, E., and Medicine. 2018. *How people learn II: Learners, contexts, and cultures*. National Academies Press.
- NSF. 1989. Report on the National Science Foundation Disciplinary Workshops on Undergraduate Education. . Washington, D.C.
- NSSE. 2019. Disciplinary Area Report. <http://nsse.indiana.edu/>: National Survey of Student Engagement.
- Oakes, W., J. Duffy, T. Jacobius, P. Linos, S. Lord, W. W. Schultz & A. Smith. 2002. Service-learning in engineering. In *32nd Annual Frontiers in Education*, F3A-F3A. IEEE.
- Pajares, F. 2005. *Gender differences in mathematics self-efficacy beliefs*. In A.M Gallagher & J.C Kaufman (Eds). New York: Cambridge University Press.
- Panganiban, G. Jul 18, 2017. THE IMPORTANCE OF SELF-AWARENESS. <https://www.psychometrics.com/mbtiblog/practitioners-corner/importance-self-awareness/>.
- Pellegrini, E. & T. Scandura (2005) Construct Equivalence Across Groups: An Unexplored Issue in Mentoring Research. *Educational and Psychological Measurement*, 65, 323-335.
- Perry, W. G. 1999. *Forms of ethical and intellectual development in the college years: A scheme*. San Francisco: Jossey-Bass.
- Philipp, S. B., T. R. Tretter & C. V. Rich (2016) Undergraduate teaching assistant impact on student academic achievement.

- Pipeline, C. o. U. G. a. t. E. o. t. S. a. E. W. 2011. *Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads*. National Academies Press Washington, DC.
- Powers, K., H. Chen, K. Prasad, S. Gilmartin & S. Sheppard. 2018. Exploring How Engineering Internships and Undergraduate Research Experiences Inform and Influence College Students' Career Decisions and Future Plans. In *Proceedings of the American Society for Engineering Education Annual Conference, June 24-27, 2018. Salt Lake City, Utah*.
- Price, L. R. 2016. *Psychometric methods: Theory into practice*. Guilford Publications.
- Price-Mitchell, M. 2015. Metacognition: Nurturing Self-Awareness in the Classroom. <https://www.edutopia.org/blog/8-pathways-metacognition-in-classroom-marilyn-price-mitchell>: Edutopia.
- Author. 2018. STEM Worker Shortage at a Crisis, Survey Shows. *U.S.NEWS*.
- Raelin, J. A., M. B. Bailey, J. Hamann, L. K. Pendleton, R. Reisberg & D. L. Whitman (2014) The gendered effect of cooperative education, contextual support, and self-efficacy on undergraduate retention. *Journal of Engineering Education*, 103, 599-624.
- Ragins, B. & J. Cotton (1999) Mentor Functions and Outcomes: A Comparison of Men and Women in Formal and Informal Mentoring Relationships. *Journal of Applied Psychology*, 84, 529-550.
- Reichert, M. & M. Absher (1997) Taking another look at educating African American engineers: The importance of undergraduate retention. *Journal of Engineering Education*, 86, 241-253.
- Resiburg, R., M. Bailey, C. Burger, J. Hamann, J. Raelin & D. Whitman (2010) The Effect of Gender on Support and Self-Efficacy in Undergraduate Engineering Programs.
- Rheigans, P., A. Brodsky, J. Scheibler & A. Spence (2011) The Role of Majority Groups in Diversity Programs. *ACM Transactions on Computing Education*, 11.
- Rheingans, P., E. D'Eramo, C. Diaz-Espinoza & D. Ireland. 2018. A Model for Increasing Gender Diversity in Technology. In *Proceedings of the 49th ACM Technical Symposium on Computer Science Education*, 459-464. ACM.
- Rittmayer, A. & M. Beier (2008) Overview: Self-Efficacy in STEM.
- Rogers, P. & R. J. Freuler. 2015. The 'T-Shaped' Engineer. In *Proceedings of the 2015 ASEE Annual Conference, Seattle, Paper*.
- Rolheiser, C. (1996) Self-evaluation: Helping Kids get Better at it: A Teacher's Resource Book. *Ontario Institute for Studies in Education, Univ. of Toronto, Toronto*.
- Rolheiser, C. & J. A. Ross (2001) Student self-evaluation: What research says and what practice shows. *Plain talk about kids*, 43, 57.
- Russell, J. E. & D. M. Adams (1997) The changing nature of mentoring in organizations: An introduction to the special issue on mentoring in organizations. *Journal of Vocational Behavior*, 51, 1-14.
- Saboonchi, F. & L.-G. Lundh (1997) Perfectionism, self-consciousness and anxiety. *Personality and Individual Differences*, 22, 921-928.
- Saloman, L. 2019. Depression and Anxiety in College Students: A True Epidemic? <https://www.psycom.net/depression-anxiety-college-students/>: PSCYCOM.
- Scandura, T. A. & E. A. Williams (2001) An investigation of the moderating effects of gender on the relationships between mentorship initiation and protégé perceptions of mentoring functions. *Journal of Vocational Behavior*, 59, 342-363.
- Schaefer, K. G., D. L. Epperson & M. M. Nauta (1997) Women's career development: Can theoretically derived variables predict persistence in engineering majors? *Journal of Counseling Psychology*, 44, 173.
- Scheffler, R. 2019. Berkeley Institute for the Future of Young Americans. Anxiety Disorders on College Campuses: The New Epidemic. . <https://news.berkeley.edu/2019/04/18/anxiety-epidemic-brewing-on-college-campuses-researchers-find/>.

- . April 2019. Berkeley Institute for the Future of Young Americans. Anxiety Disorders on College Campuses: The New Epidemic. . <https://news.berkeley.edu/2019/04/18/anxiety-epidemic-brewing-on-college-campuses-researchers-find/>.
- Schlosser, L. Z. & C. J. Gelsco (2001) Measuring the working alliance in advisor-advisee relationships in graduate school. *Journal of Counseling Psychology*, 157-167.
- Schunk, D. H. 2012. *Learning theories an educational perspective sixth edition*. Pearson.
- Schuurman, M. K., R. N. Pangborn & R. D. McClintic (2008) Assessing the Impact of Engineering Undergraduate Work Experience: Factoring in Pre-work Academic Performance. *Journal of Engineering Education*, 97, 207-212.
- Selltiz, C., L. Wrightsman & W. Cook (1976a) Research Methods in Social Relations Holt. *Rinehart and Winston, New York*.
- Selltiz, C., L. S. Wrightsman, S. W. Cook, G. I. Balch, R. Hofstetter & L. Bickman (1976b) Research methods in social relations.
- Seymour, E. & N. M. Hewitt. 1997. *Talking about leaving : why undergraduates leave the sciences*. Boulder, Colo.: Westview Press.
- . 2000. *Talking about Leaving: Why Undergraduates Leave the Sciences*, Westview Press, 2000.
- Seymour E. & Hewitt, N. 1994. Talking about Leaving: Factors Contributing to High Attrition Rates Among Science, Mathematics, & Engineering Undergraduate Majors. In *Final Report to the Alfred P. Sloan Foundation, Boulder: University of Colorado Ethnography and Assessment Research Bureau of Sociological Research*.
- Shapiro, N. S. & J. H. Levine. 1999. *Creating Learning Communities: A Practical Guide to Winning Support, Organizing for Change, and Implementing Programs*. Jossey-Bass Higher and Adult Education Series. ERIC.
- Sheppard, S., G. S., H. L. C., K. Donaldson, G. Lichtenstein, E. Özgür, M. Lande & G. Toye. 2010. Exploring the Engineering Student Experience: Findings from the Academic Pathways of People Learning Engineering Survey (APPLES). Center for the Advancement for Engineering Education.
- Shields, N., H. R. Grodsky & W. P. Darby (1996) Access to engineering: A description and an evaluation of a pre-collegiate program for minorities and women. *age*, 1, 1.
- Shishineh, L. 2019. BUILDING GRIT: A QUANTITATIVE STUDY ON THE IMPACT OF SUMMER BRIDGE PROGRAMS In *College of Education*. Frostburg State University.
- Shushok, F. & R. Sriram (2009) Exploring the Effect of a Residential Academic Affairs-Student Affairs Partnership: The First Year of an Engineering and Computer Science Living-Learning Center. *Journal of College & University Student Housing*, 36.
- Steele, C. M., and J. Aronson. (1995) Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology*, 69, 797-811.
- Stolle-McAllister, K. (2011) The Case for Summer Bridge: Building Social and Cultural Capital for Talented Black STEM Students. *Science Educator*, 20, 12-22.
- Sullivan, K. T. & R. Davis. 2007. Increasing retention of women engineering students. American Society for Engineering Education.
- Sullivan, M. D., C. C. de Cohen, M. J. Barna, M. K. Orr, R. A. Long & M. W. Ohland. 2012. Understanding engineering transfer students: Demographic characteristics and educational outcomes. In *2012 Frontiers in Education Conference Proceedings*, 1-6. IEEE.
- Team, A. N. 2019. The 10 Most Common Myths About Engineers. NewEngineer.com.
- The National Academy of Sciences, E. & I. o. Medicine. 1997. *Adviser, Teacher, Role Model, Friend: On Being a Mentor to Students in Science and Engineering*. Washington, DC: NATIONAL ACADEMY PRESS.
- Tinto, V. 2010. From theory to action: Exploring the institutional conditions for student retention. In *Higher education: Handbook of theory and research*, 51-89. Springer.

- U.S.NEWS. 2019. UNIVERSITY OF MARYLAND--BALTIMORE COUNTY. <https://www.usnews.com/best-colleges/umbc-2105/student-life>: U.S. News and World Report.
- UMBC. 2019a. Academic Success Center.
- UMBC, A. S. C. 2019b. Academic Advocacy.
- UMBC, H. C. a. Honors College. UMBC: UMBC.
- Vesilind, P. (2001) Mentoring Engineering Students: Turning Pebbles into Diamonds. *Journal of Engineering Education*.
- Vitasari, P., M. N. A. Wahab, A. Othman, T. Herawan & S. K. Sinnadurai (2010) The relationship between study anxiety and academic performance among engineering students. *Procedia-Social and Behavioral Sciences*, 8, 490-497.
- Vogt, M. V., D.Hocevar & L. S. Hagedorn (2007) A Social Cognitive Construct Validation: Determining Women's and Men's Success in Engineering Programs. *The Journal of Higher Education*, 78, 337-364.
- Wallace, J. & V. Haines (2004) The Benefits of Mentoring for Engineering Students. *Journal of Women and Minorities in Science and Engineering*, 10, 377-391.
- Weil, L. G., S. M. Fleming, I. Dumontheil, E. J. Kilford, R. S. Weil, G. Rees, R. J. Dolan & S.-J. Blakemore (2013) The development of metacognitive ability in adolescence. *Consciousness and cognition*, 22, 264-271.
- Yanik, P., Y. Yan, S. Kaul & C. Ferguson. 2016. Sources of anxiety among engineering students: Assessment and mitigation. In *American Society for Engineering Education*.
- Yoder, B. 2012. Going the distance in engineering education: Best practices and strategies for retaining engineering, engineering technology, and computing students. In *American Society for Engineering Education*.
- York, C. M. & S. A. Tross (1994) Evaluation of Student Retention Programs: An Essential Component.
- Zeldin, A. L. & F. Pajares (2000) Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal*, 37, 215-246.
- Zydney, A. L., J. S. Bennett, A. Shahid & K. W. Bauer (2002) Impact of undergraduate research experience in engineering. *Journal of Engineering Education*, 91, 151-157.

