Current Perceptions And Attitudes of Research And Engineering of Mechanical Engineering (ME) S-STEM Scholars And Regular ME Students

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Introduction: Due to current needs for a diverse skilled workforce in engineering, the NSF sponsored Mechanical Engineering (ME) S-STEM Scholarship Program at UMBC has focused their recourses on integration research into student experiences to improve retention and facilitate their degree attainment. Numerous studies have demonstrated that integrating research in education is an effective approach to improve retention rates, and that it plays a role in increasing the percentage of students pursuing graduate degrees.[1] Previous studies have suggested the importance of social relevancy played in students' mindset, especially how engineering can help humanity. Since 2009, our S-STEM program proactively implements many bioengineering research activities including research presentation in recruitment, in-depth lab tour, seminars, REUs, conference support, etc.[2] The objective of the current study is to measure perceptions and attitudes of research and engineering of both regular ME students and scholars in the ME S-STEM program, to evaluate effects of those research-related activities.

Materials and Methods: A survey was developed to provide quantitative measures. The first section of the survey consisted of 10 questions focusing on students' demographic information. The second section contained 6 Likert scaled items to include "Research Self-Efficacy" (9 questions), "Science/Engineering Identity" (5 questions), "Expectations and Goals" (4 questions), "Academic Integration" (5 questions), and "Senses of Belonging to Program (3 questions) and Campus (5 questions)". The survey was distributed online to four ME courses at all levels. The data collected in the study was numerically coded, at a scale from 0 to 100, with 100 indicating more positive levels of variables being measured, i.e., "Absolutely Confident" or "Strongly Agree" or "Very Easy". The data were tabulated and analyzed using the Statistical Package for Social Sciences (SPSS). Statistically difference between groups was evaluated using ANOVA and student *t*-test.

Results and Discussion: Sixty validated surveys were submitted, ranging from freshman to senior students. 65% of them are male, 35% are female, 37% are URMs (African American or Hispanic), and 37% are originally transferred from local community colleges. Additionally, out of the 60 students, 36 non S-STEM scholar students responded, providing a comparable population to the 24 ME S-STEM scholars in the surveys.

Among all the students surveyed, the male students consistently scored higher than the female students in their responses. A one-way ANOVA revealed that male ME students feel more confident in their ability to conduct research, have a stronger engineering identity, and identify clearer expectations and goals than their female peers. Assessing the transfer students as compared to the native population reveals no significant difference in any category. Results from different ethnic groups also suggest no significant differences. When examining all categories, students consistently feel that "Academic Integration" is somewhat difficult, with a score around 50 of 100. The next category is in "Research Self-Efficacy", with a score around 65 of 100. Remaining scores in other categories were above 80, implying "Absolutely Confident".

Results from the S-STEM scholars were compared to non-scholars. S-STEM scholars are more confident in "Science Identity", "Expectations and Goals", "Sense of Belonging to Program", and "Sense of Belonging to Campus". Their scores in "Research Self-Efficacy and "Academic Integration" were 4 points lower than non-scholars, although not statistically significant. Female students in the S-STEM program score better in all categories than their non-scholar counterpart, except in "Academic Integration". Hispanic students in the S-STEM program have higher scores (up to 7 points higher) than their counterpart in every category, however, the scores of African American scholars are lower than their peers, especially in "Research Self-Efficacy".

Conclusion: The survey results suggest that significant efforts are needed to help ME students integrate into academic program and improve their research self-efficacy. The additional activities sponsored by the ME S-STEM program may show that the S-STEM scholars' performance in attitudes and perceptions are stronger in most categories than their non-scholar peers. Female and Hispanic scholars in the program especially show higher scores in most categories in the survey, implying positive influence by the S-STEM program.

References: 1. Lopatto, D. CBE – Life Sciences Education, 6(4): 297-306, 2007.
2. Zhu, L. et al, Transforming STEM Higher Education, Atlanta, November 8-10, 2018, Paper number 74.