Board 181: Work in Progress: Language-based Dual Degree Engineering Program: Increasing Women in Engineering?

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Abstract

It has been well documented that females are generally underrepresented in many engineering academic programs as well as the profession. This paper suggests one way to lessen female underrepresentation in engineering academic programs. Female engineering students at the University of Georgia tend to minor in Spanish more than their male counterparts. This trend suggests that female students are drawn to the combination of engineering and Spanish. In response to this finding, the University of Georgia is developing an Engineering/Spanish dual-degree program to improve the gender imbalance in the engineering field. If successful, this program could serve as a model for other universities seeking to address gender disparities in STEM fields. This study has significant implications for the future of engineering education, highlighting the need for greater diversity and inclusivity in STEM fields. By creating more appealing programs to a broader range of students, universities can help ensure that the next generation of engineers is more representative of the population. Numerous studies suggest a clear need for universities to address gender imbalances in STEM fields, and programs like Engineering plus Spanish could be an effective way to do so. By providing students with a unique and valuable skill set, these programs could help attract more women to engineering and other STEM fields, ultimately leading to a more diverse and innovative workforce.

Introduction

The University of Georgia (UGA), located in Athens, Georgia, USA, elevated its engineering program to a comprehensive engineering college in 2012. Building on the strength of UGA's international programs, the College of Engineering and the Department of Germanic and Slavic Studies developed a successful Five-Year Engineering plus German dual degree program in 2012.

In recent years, undergraduate engineering students requested the college's leadership for a similar program in Engineering plus Spanish. To gauge the interest in a dual degree program in Engineering plus Spanish, we searched the university database for engineering students majoring or minoring in Spanish. In Spring 2023, 29 engineering students were minoring in Spanish. There were no engineering students with a Spanish major. Interestingly, 60 percent of the students majoring in engineering and minoring in Spanish are females (Figure 1).

The University of Georgia's College of Engineering is committed to increasing the number of underrepresented minority students, especially women, first-generation college students, and students from rural backgrounds. The College of Engineering is currently 71 percent male and 29 percent female (Figure 1). We hypothesize that a formal dual degree program in Engineering and Spanish will increase the percentage of female engineering students at UGA.

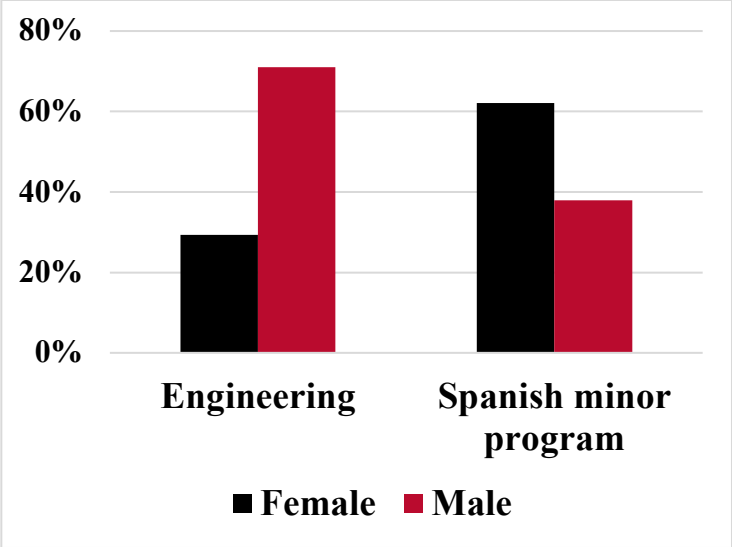

Figure 1 Gender Distribution of All Engineering Majors and Engineering Majors Minoring in Spanish

Table 1: Number of engineering students by discipline and the number of Spanish minors in each engineering discipline, Spring 2023.

Major	Engineering	Eng. plus Spanish minor
Agricultural	**27**	**-**
Biochemical	**147**	**1**
Biological	**208**	**5**
Civil	**351**	**4**
Computer Systems	**171**	**1**
Electrical and Electronics	**199**	**3**
Environmental	**138**	**5**
Mechanical	**884**	**10**
TOTAL	**2,125**	**29**

Methodology

This exploratory data analysis is designed to understand the gender distribution of UGA engineering students across majors and to determine how students' selection in a Spanish minor differs from the general population of engineering students. All data is from the University of Georgia Office of Institutional Research.

Results / Discussion

As shown in Figure 1, UGA engineering has a higher percentage of male undergraduate enrollment than female enrollment at approximately a 4:1 ratio. However, the gender breakdown is inconsistent across engineering majors, with biochemical, biological, and environmental engineering ratios close to 1:1 (Figure 2).

Meanwhile, the more traditional engineering majors, such as agricultural, civil, electrical, and mechanical engineering, have noticeable imbalances in gender. Biological and environmental engineering can be perceived as disciplines that are more "socially conscious" and make a difference in people's lives (Silbey 2016). These disciplines tend to attract more female students. Bossart and Bharti found that the percentage of undergraduate women engineering graduates at the University of Florida is highest in engineering disciplines that female students perceived as being more socially engaged, especially environmental engineering, agricultural & biological engineering, and biomedical engineering (2017). While a direct comparison with UGA is not possible because UGA offers separate undergraduate majors in agricultural engineering and biological engineering, the same trend holds. As seen in Table 1, only 27 UGA students are agricultural engineering majors in Spring 2023. The more physical-based (as compared to the more biological-based) engineering disciplines have a much higher percentage of male students.

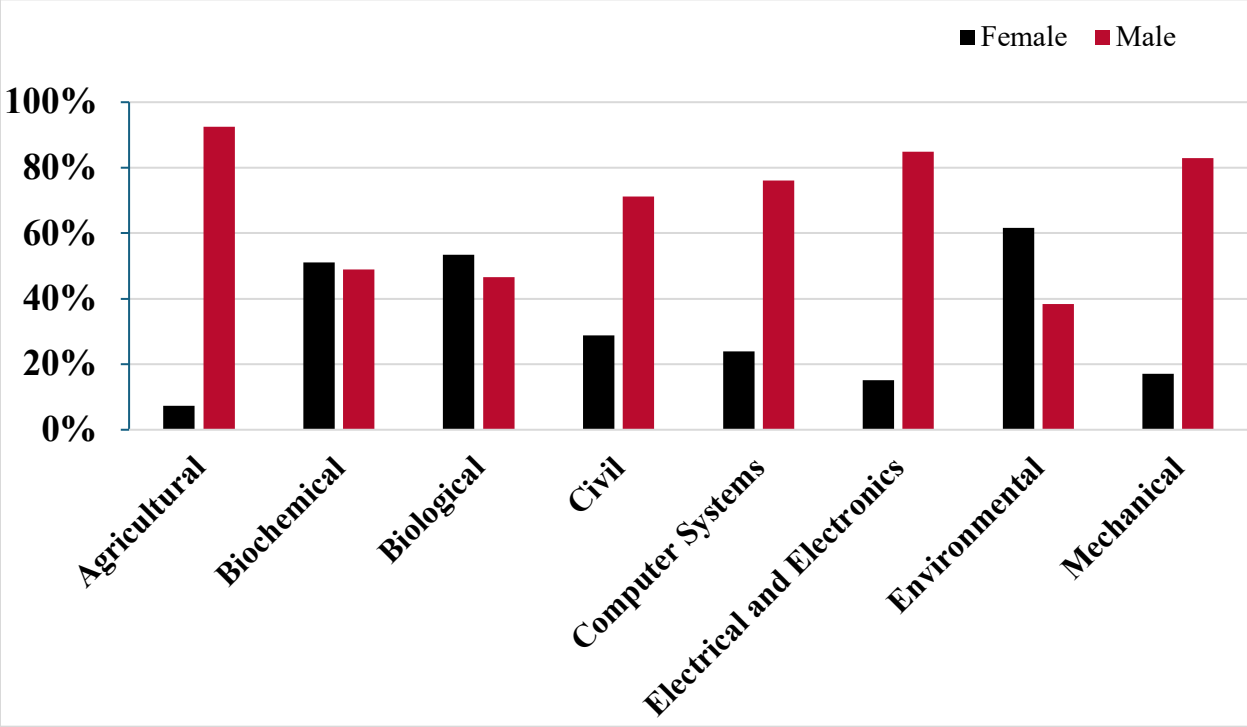

Figure 2. Gender by Engineering Majors

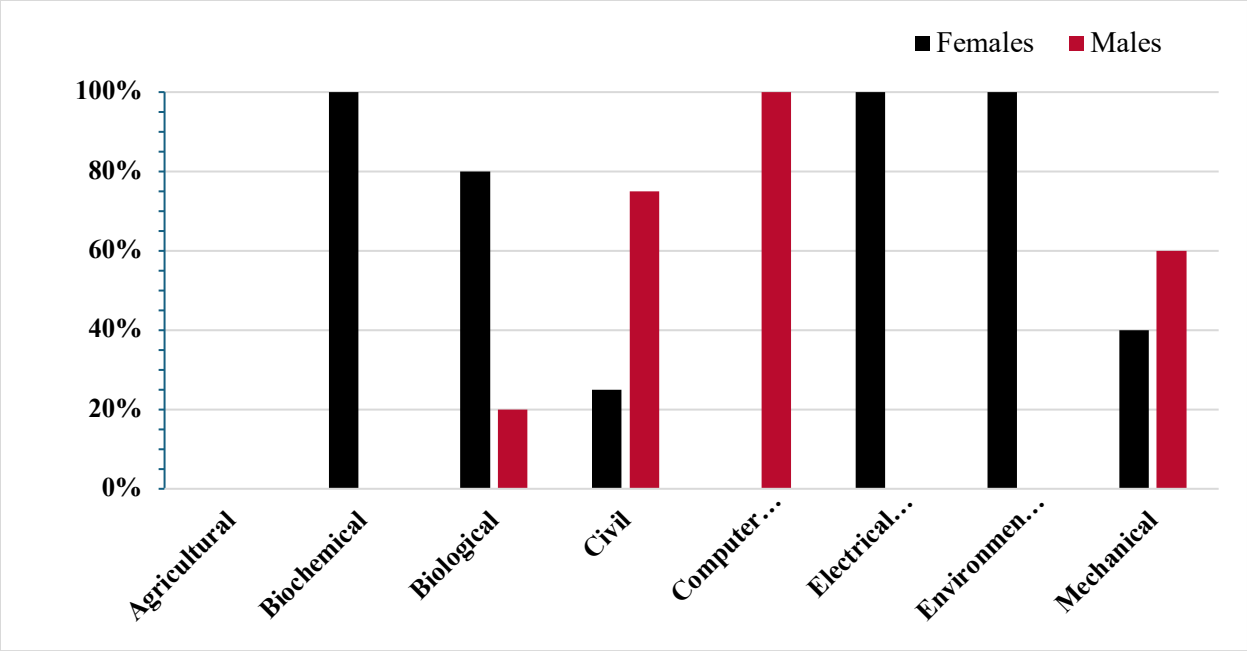

Figure 3. Gender by Engineering majors plus Spanish minor

Students with a major in engineering and a minor in Spanish show a different gender pattern than engineering majors in general. Female students are dominant in three majors: biochemical, electrical, and environmental engineering (Figure 3). The most significant change is observed in mechanical engineering, where 40 percent of the Spanish minoring students are female. The percentage of women in biomedical engineering is around 40%, more than twice the overall engineering average. This observation is particularly significant as it highlights a unique pattern among students pursuing a major in engineering and a minor in Spanish. While the overall distribution of female students across engineering majors may vary, the presence of Spanish-minoring students introduces an interesting shift in this pattern. Specifically, female students emerge as the dominant cohort in majors such as biochemical, electrical, and environmental engineering. However, the most noteworthy change is evident in mechanical engineering, where a substantial 40 percent of students minoring in Spanish are female. This suggests a potential correlation or influence between pursuing a Spanish minor and the participation of female students in traditionally male-dominated engineering fields, shedding light on the intersections between language studies and engineering education. This is more than double the percentage of females enrolled in the mechanical engineering major. Similar enrolment has been observed in an engineering design class where collaboration is done in a Spanish-English environment (data not shown). It is important to approach these numbers with caution as the available data is limited. In the field of engineering, it is increasingly evident that females are often drawn to the profession not just for its technical challenges but also for its potential for social impact and humanitarian contributions. Unlike their male counterparts, who may be primarily motivated by the technical aspects of engineering, many women in engineering are driven by a desire to address social injustices and make meaningful contributions to society. As a result, fields within engineering that directly impact improving people's lives, such as civil, environmental, and biomedical

engineering, tend to attract a higher proportion of female students and professionals. These women bring a unique perspective to their work, prioritizing social justice and humanitarian values alongside technical excellence, and are instrumental in driving positive change within the engineering profession and beyond. Consequently, we witness female students gravitating to biomedical, environmental, and electrical areas.

Conclusions

Harrison and Klotz (2010) have argued that increasing the opportunities for more "socially conscious" endeavors could increase the number of female engineering students and female engineers. With a higher percentage of female engineering students minoring in Spanish than male engineering students, we speculate that a formal program in Engineering plus Spanish will increase the percentage of female engineering students. If this is correct, the developing Engineering plus Spanish program at UGA should increase the percentage of female engineering students.

Acknowledgments

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References

Bossart, Jean and Neelam Bharti (2017) "Women in Engineering: Insight into Why Some Engineering Departments Have More Success in Recruiting and Graduating Women." American Journal of Engineering Education, Vol 8, Iss. 2: 127-140.

Harrison, Jennilee and Leidy Klotz (2010). "Women as Sustainability Leaders in Engineering: Evidence from Industry and Academia." Int. J. Engng. Ed. Vol 26, No. 3: 727-734.

Meiksin, Peter, Claudia Vanessa Garcia, Natali Huggins. Maya Menon, and Olivia Ryan (2024). "Women in Engineering: A Review of the 2022." SWE: Magazine of the Society of Women Engineers Vol. 70, No. 1. https://magazine.swe.org/lit-review-23/.

Patrick, Anita, Catherine Riegle-Crumb, and Maura Borrego (2021). "Examining the Gender Gap in Engineering Professional Identification." J. Women Minor. Sci. Eng. Vol. 12, No. 1: 31-55. doi: 10.1615/jwomenminorscieneng.2020030909.

Silbey, Susan S. (2016) "Why Do So Many Women Who Study Engineering Leave the Field?" Harvard Business Review. https://hbr.org/2016/08/why-do-so-many-women-who-study-engineering-leave-the-field?r.

Wang, Ming-Te and Jessica L. Degol (2017). "Gender Gap in Science, Technology, Engineering, and Mathematics (STEM): Current Knowledge, Implications for Practice, Policy, and Future Directions." Educ. Psychol Rev. Vol. 29, No. 1: 119-140. https://pubmed.ncbi.nlm.nih.gov/28458499/.

Wilson, Denise and Jennifer VanAntwerp (2021). “Left Out: A Review of Women’s Struggle to Develop a Sense of Belonging in Engineering.” Sage Open, 25 August 2021. https://journals.sagepub.com/doi/full/10.1177/21582440211040791