Identifying Potential Causes of Attrition in the Biomedical Engineering Specialization at Mercer University

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Abstract

Biomedical and bioengineering programs have grown in recent years due to an increased demand for new and improved medical devices and disease therapies. Enrollment in the Biomedical Engineering (BME) specialization at Mercer University has followed this trend. However, while often initially garnering the majority of incoming engineering freshman, BME at Mercer sees a decrease in its freshman cohort of more than 60% by graduation. This is unlike traditional engineering tracks at Mercer and other universities that typically see a 40-50% decrease in class size over four years. Through a review of student enrollment data collected by Mercer University's Admissions Office, the Office of Institutional Effectiveness and Academic & Advising Services, we determined BME attrition rate, at what point in the curriculum BME is losing students and how those students' academic careers progress.

Keywords

Biomedical engineering, bioengineering, attrition

Introduction

Mercer University School of Engineering (MUSE) was founded in 1985. MUSE students earn bachelors of science degrees in engineering, and specialize via coursework in the disciplines of mechanical, electrical, computer, environmental, industrial and biomedical engineering (BME). The BME specialization at Mercer is supported by four tenure-track faculty members. The curriculum includes engineering core courses and currently emphasizes bioinstrumentation and biomechanics in upper division courses. An upper division course in cell and tissue engineering will be introduced in spring 2017 to address the growth and interest in that field of BME.

Engineering is considered a difficult or at least challenging degree program. Perhaps this perception is unfounded, but historically engineering program retention rates for all types of colleges and universities hover near 50%[1,2]. According to the U.S. National Council for Education Statistics (NCES), retention for all undergraduate degrees is 61%[3]. In recent years many top ranked engineering schools have launched initiatives to improve retention, targeting >90% retention for freshman and >80% for graduation[4,5,6]. Studies show that increasing admission standards for incoming students significantly improves success rates; schools that are selective and accept 25% or less of their applicants have retention rates that approach 90%[3].

In recent years Mercer University has sought to increase retention across all of its colleges and schools. In accordance with the study mentioned above that indicated recruiting and admitting more prepared students increased retention rates[3], MUSE adjusted its admission standards to include a minimum 600 SAT math, and 650 recommended SAT math score, for incoming students in the fall of 2009. Early data (see Figure 1) indicate that the change has pushed our retention rates in the right direction. Retention through sophomore year climbed from 65% in 2009 to 79% in 2015. In spite of the more rigorous admission criteria, attrition rates for BME students have not consistently declined.

This paper addresses our initial effort to better understand the attrition in BME at Mercer. The data was compiled to determine 1) at what point in the curriculum are students leaving BME? and 2) what academic path do students take when they leave BME? The data discussed below were gathered from Mercer University admissions' records, the Office of Academic and Advising Services, the Office of Institutional Effectiveness, and engineering freshman coordinators (2009 2015) under the IRB protocol H1610297.

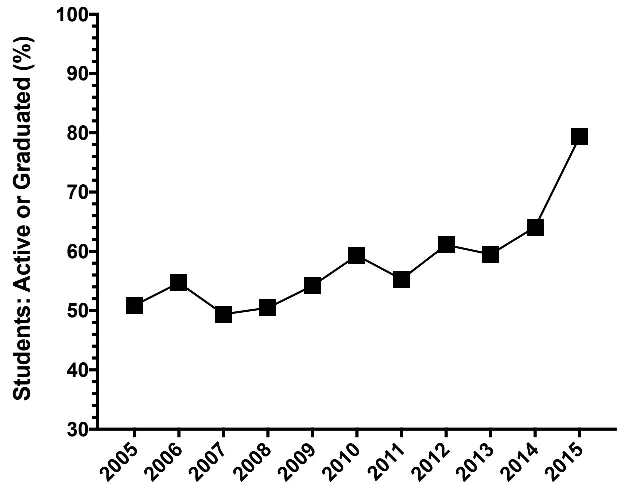

Figure 1. MUSE retention. '05-'12 represent 4 year retention. '13 -'15 data reflect 3, 2 and 1 year retention respectively.

Results and Discussion

During MUSE freshman orientation, incoming engineering students are asked to identify which engineering specialty they plan to pursue. The BME attrition/retention data presented in this paper is based on tracking the academic choices and progress of the cohort of these self-selected BME freshman (for a given academic year). Student who began as undecided or transferred into MUSE were not included in this analysis.

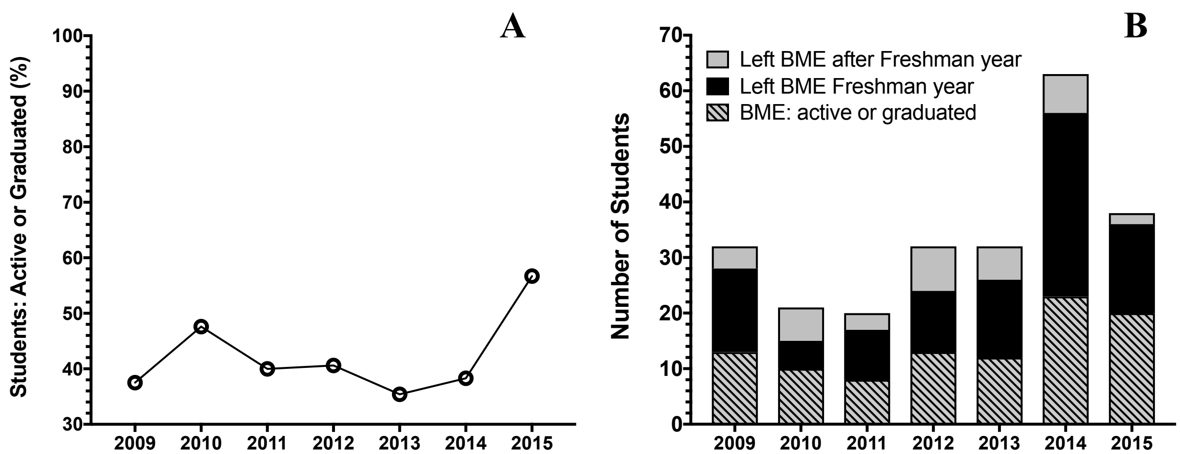

Figure 2. BME Retention in MUSE. A) '09 -'12 data represent 4 year retention. '13 -'15 data reflect 3, 2 and 1 year retention respectively. **B)** BME retention and attrition with time of attrition indicated.

How many do we lose, when do we lose them and where do they go?
Until MUSE adjusted its admission criteria, BME retention ranged from 35% to 45% (see Figure 2A). While it's difficult to predict long-term retention, retention for 2015 (Figure 2A) demonstrates marked improvement over previous years (56.7% vs 38.3%). For all years except 2010, BME attrition was greatest during or immediately following freshman year (64% ± 12 of total BME attrition, see Figure 2B). Attrition after freshman year occurs primarily during sophomore year. BME students take their first BME course 'Introduction to Biomedical Engineering' fall semester of sophomore year in addition to their first engineering core courses, so what drives their exodus is not easily identified. Instances of students achieving junior or senior status and still not completing their degree were not altogether uncommon and appear to be due to poor classroom performance (data not shown).

The academic fate of students leaving the BME specialization between 2009 and 2015 is shown in Table 1. This table includes students that have graduated, remain at MUSE in a different engineering discipline, remain at Mercer in a different school or college, or have left Mercer altogether. Each year, the majority of students leaving BME choose to leave Mercer altogether. This number varies from year to year, but accounts for up to 58% of the student loss from BME. In addition, with the exception of 2011, some students transition from BME to other engineering disciplines (including Technical Communications and Industrial Management). Students also leave BME for the College of Liberal Arts or the School of Business. Justification for these decisions, aside from suspension from the university due to academic performance, was not easily determined based on academic records alone.

Table 1. Biomedical Engineering Enrollment and Attrition in MUSE. TCO = Technical Communications, IDM = Industrial Management, CLA = College of Liberal Arts. *Includes students that did not enroll in BME288 as sophomores

	2009	2010	2011	2012	2013	2014	2015
Freshman BME Enrollment	32	21	20	32	31	63	37
Total leave BME	20	11	12	19	20	40	16*
Leave for other Engg	2	2	0	6	4	9	2
Leave for TCO or IDM	3	1	2	3	0	3	1
Leave for CLA	6	4	1	1	6	9	4
Leave for Business	1	0	2	1	3	6	0
Leave Mercer	8	4	7	8	7	13	2

Conclusion

As expected, the majority of student attrition from BME occurs during the freshman year. Surprisingly, no clear pattern emerged from the data to predict where students go when they leave BME. In the future, former and active Mercer students who left BME will be surveyed to ascertain key factors in their decision to leave. With that knowledge in hand, we hope to identify unforeseen vulnerable student groups and critical points in the BME curriculum with the intent to generate a course of action to target the issues brought to light.

References

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3 U.S. Department of Education, National Center for Education Statistics. (2016). *The Condition of Education 2016* (NCES 2016-144), Undergraduate Retention and Graduation Rates

4 http://studentresearch.ucsd.edu/_files/stats-data/retention/Retention1516.pdf

5 http://www.irp.gatech.edu/publications/student-achievement/

6 http://dmi.illinois.edu/stuenr/#retention

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After earning her BS in Electrical Engineering, Bioinstrumentation specialization from Kansas State University Dr. Thomas completed her MS in Chemical Engineering at Colorado State University. Next, she completed her PhD in Bioengineering at the University of California San Diego. This fall Dr. Thomas joined the faculty at Mercer University as an Assistant Professor of Biomedical Engineering. She is currently interested tissue engineering utilizing electrospinning to incorporate novel linkers and therapeutic targets into nanofibers for vascular and neural applications. In addition, she continues to investigate mitochondrial function and morphology as it relates to successful cell growth on engineered materials.