



Retention in a First Year Program: Factors Influencing Student Interest in Engineering

Dr. Lizzie Santiago, West Virginia University

Lizzie Y. Santiago, Ph.D., is Teaching Assistant Professor for the Freshman Engineering Program in the Benjamin M. Statler College of Engineering and Mineral Resources at WVU. She holds a Ph.D. in chemical engineering from the Pennsylvania State University and postdoctoral experience in neural tissue engineering from the University of Pittsburgh and National Institutes of Health (NIH). She teaches freshman engineering courses and supports the outreach and recruiting activities of the college. Her research interests include neural tissue engineering, stem cell research, absorption of air pollutants in human upper airways, attrition and university retention, increasing student awareness and interest in research and engineering, STEM education, and recruitment and retention of women and minorities.

Retention in a First Year Program: Factors Influencing Student Interest in Engineering

Abstract

Student retention continues to be a challenge in engineering education. US Academic institutions are reporting student retention rates in engineering that varies in the range of 40-60%. Engineering programs are recognizing the fact that students capable of completing an engineering degree are switching from engineering to pursue non-engineering disciplines.

Several studies, including one presented by our research group, have identified the lack of interest in engineering as a field of study, the lack of interest in pursuing an engineering discipline being offered at an academic institution, and academic difficulty, as the self-reported leading reasons for switching from engineering to pursue a non-engineering degree. Furthermore, Seymour and Hewitt have presented evidence that both “persisters” and “non-persisters” are academically similar. If lack of interest is the leading reason for the switch, a question to ask is, which factors and/or events trigger this change of interest in pursuing engineering?

The purpose of this study is to understand how the first semester experience influences student’s decision to continue a degree in engineering. Particularly, we are interested in understanding which factors and/or events trigger a change of interest in pursuing engineering. The authors studied 73 first semester engineering students enrolled at a large land grant university in the mid-Atlantic region. An entrance survey administered during the second week of classes provided an insight on student’s level of interest in pursuing engineering, the reason to pursue an engineering degree, and whether a student have chosen an engineering discipline to pursue. Several surveys administered at strategic time points during the semester were used to track level of interest in pursuing engineering and to identify key events that can be consider as precursors to leaving engineering. Reflection essays were also employed to understand how the first semester experience affects student’s perception of engineering as a career of choice.

An analysis of entrance surveys indicated a high level of interest in pursuing an engineering degree in most students surveyed. Key events, such as their first calculus test, triggered indecision in some of the students. Early results identified a group of students at risk of leaving engineering during the first semester of college. Key events identified as precursor to leaving engineering are discussed, as well as the implications for potential intervention programs to address increasing student interest as well as academic success in engineering.

Introduction

The first semester in college is full of learning experiences and adjustments. The level of study and dedication required to succeed in college is not comparable with the amount of work required to succeed in high school. Furthermore, student’s expectations during their first semester in college can be unrealistic, and we have to add a never-before experienced sense of independence and freedom.

Some students thrive during their first semester, while others struggle. This struggle can lead to a loss of motivation in their studies and eventually, to their failure to complete a degree in engineering.

Attrition is a well recognized problem in engineering education^{1,2,3,4,5,6,7,8}. Some students are not finishing their degrees in engineering; they are transferring into non-engineering programs or dropping from college. Attrition is observed at all levels, including during the first semester in an engineering program.

Several studies, including one from our research group, have shown that students that leave engineering during their first semester in an engineering program decide to leave due to a lack of interest in the engineering disciplines offered at the institution or simply, due to a lack of interest in engineering^{4,5}. Furthermore, it was also found that those students that switched during the first semester in college were less likely to complete a degree in college. Although significant resources have been allocated to deal with attrition, the problem has not been solved^{2,3}.

This study was aimed at understanding which factors and/or events trigger a change of interest in pursuing engineering during the first semester in an engineering program. This study was designed not only to address which events trigger the change in interest, but also to understand student's perception of their first semester in college. This information is essential to devise strategies to assist student in the successful completion of their degree in engineering.

Methodology

This study included 73 undergraduate students enrolled in their first semester of the freshman engineering program at West Virginia University. Students were mostly men and completed three surveys administered at the beginning, middle, and at the end of their first semester in the institution. Students also completed two reflective essays, administered at the middle and end of their first semester in the program. University databases were utilized to determine grade point average (GPA) at the end of their first semester and high school GPA.

Surveys

Questionnaires were administered at the beginning, middle, and end of their first semester in the program. The questionnaires were aimed at understanding the reason to select engineering as a discipline to pursue, their perception of their first semester experience in college, and the level of interest in pursuing engineering.

Reflective Essays

Students were asked to write reflective essays about their college experience. In those essays, student wrote about which engineering discipline they plan to pursue, about challenges faced during the semester, and about how their first semester affected their interest in pursuing engineering. Student submitted reflective essays at the middle and at the end of the semester.

Results

First Year Engineering Program: All engineering students at WVU must complete a common "first year experience" before moving to an engineering major. Prior to registration, a

mathematics placement test is administered to assess Calculus readiness. Students who are not calculus-ready at entry usually take 1.5 to 2 years to complete the courses required to move to an engineering major. This study only includes students in their first semester in college; none of the students have declared an engineering major.

Table 1: Characteristics of the sample studied

Parameter	Statistics
Gender	Male 69 Female 4
High School GPA (Mean \pm standard deviation)	3.54 \pm 0.53

Results from Survey and Reflective Essay: As indicated in Table 1, the majority of students included in the study were male with an average high school grade point average (GPA) of 3.54 \pm 0.53 (mean \pm standard deviation). The female to male proportion in this study is slightly lower than the ratio observed in our engineering program (between 10-15% of all engineering students are females).

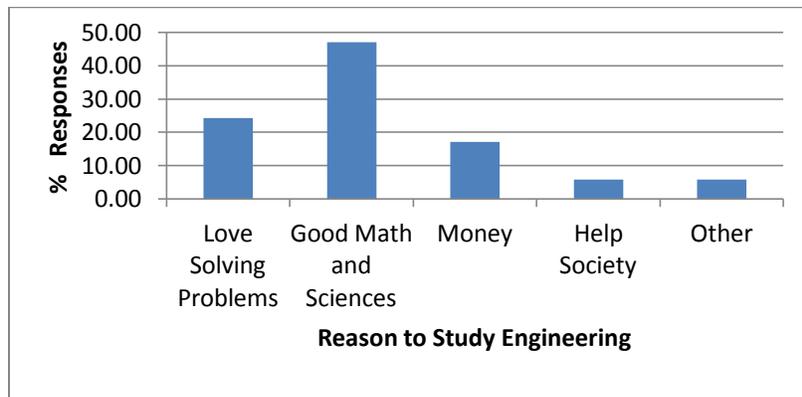


Figure 1. Main reasons to study engineering.

The initial survey indicated that the main reason to select engineering as a career choice was because students considered themselves good in math and sciences (Figure 1). The second reason to study engineering was because students love problem solving. At the beginning of the semester, the level of interest in pursuing a degree in engineering was high, with only 22% of the students indicating that they were interested, but not sure yet (Figure 2).

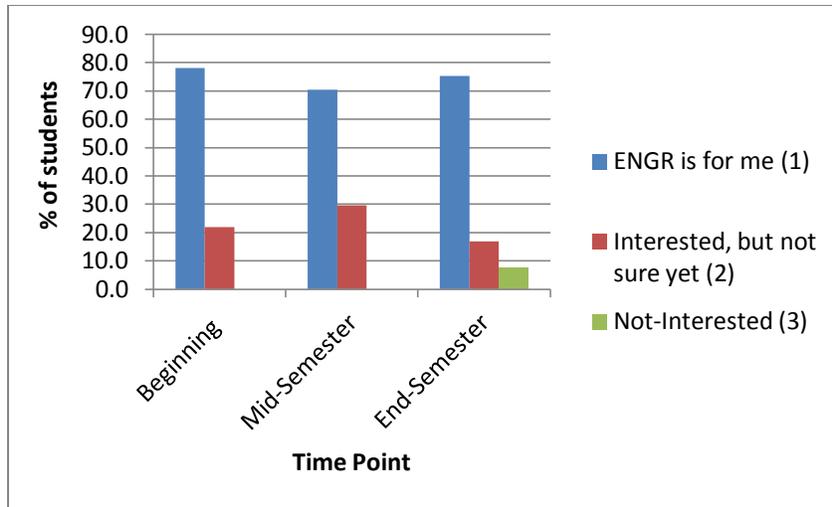


Figure 2. Level of interest in pursuing a degree in engineering assessed at three different time points during the semester

Although, throughout the whole first semester, 70-78% of the students indicated that they believed “engineering is for me” (refer to Figure 2), only 58.1% of the students reported that their first semester experience did not affect their level of interest in pursuing a degree in engineering. The remaining 41.9% of the students experienced a change in interest during their first semester. Not only the level of interest changed, but also their selection of engineering discipline to pursue, with 41% of the students changing their opinion on which engineering discipline to pursue.

In terms of perception of their first semester experience, at the end of the semester 49.4 % of the students labeled their first semester as stressful (Figure 3), whereas 31% indicated that the semester was as expected.

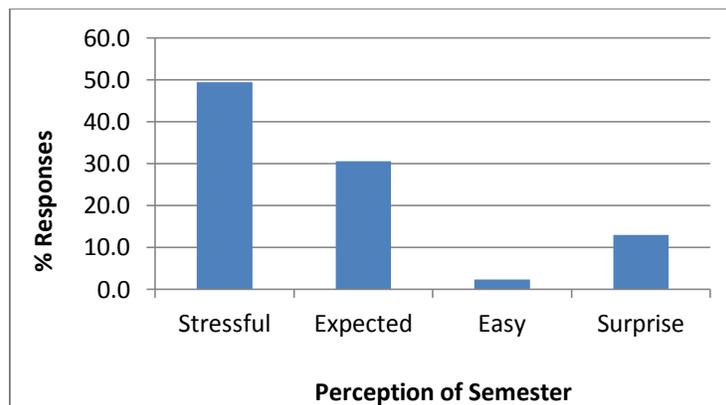


Figure 3. Perception of the first semester experience.

At the end of the semester (as Figure 2 indicates) several students decided to switch to a non-engineering discipline. For those students, academic difficulty (especially in Calculus 1) and

lack of interest were the main reasons for the switch. Those students indicating lack of interest, included students who were considering a different discipline at the beginning of the semester, and were using this semester to make a final decision on which discipline to pursue, and students who simply were exposed to other non-engineering disciplines and decided to leave.

Table 2. Comments from end of semester reflective essay, from some students no longer interested in pursuing a degree in engineering

Students	Comments from Reflective Essay
Student 1	I skipped classes and did not submitted homeworks. Motivation decreased due to difficulty keeping up with school work as the course material was becoming harder. Will switch from engineering to Chemistry.
Student 2	A degree in engineering no longer interests me the way it did before. I have instead turned by sights toward Computer and Information Technology, which is different from my original plan to pursue a degree in Chemical Engineering.
Student 3	My initial desired was in architecture, but the institution did not offer architecture major. I'm having difficulties in calculus 1, and realized that engineering is probably not the career for me. Will switch from engineering to psychology; everybody tells me I would be a great therapist.
Student 4	I like engineering and respect those who can maintain everything, but I cannot continue in this major. I cannot handle a calculus 1 course. Will switch to Russian, which is a major based around my second language.
Student 5	I have chosen Geology to be my alternate career path. At first engineering really intrigued me but after a while I found it to be not as satisfying.

Table 3. Comments from reflective essay, from students that selected “interested in engineering, but not sure yet” during the semester.

Student	Comments from Reflective Essay
Student 6	Earlier in the semester I was unsure whether to pursue a degree in Chemical Engineering or just a Chemistry degree. Talking to both my chemistry professor and attending the department visitation for Chemical Engineering made me came to a decision to study Chemical Engineering
Student 7	I pondered on changing my major to Geology rather than Petroleum Engineering. When I discovered the requirements for geology were just as difficult, I decided to stay in engineering.
Student 8	Upon entering the university I was still unsure of exactly what career I desired to pursue. Around mid-semester and the career fair is when my decision became evident. I began to learn more about the multiple engineering departments and I became more engrossed in the idea of engineering as my future career.
Student 9	My desire for engineering has not changed, however my major choice has. I have veered away from the mechanical engineering pathway and have decided to follow the industrial engineering pathway to match my passion for business
Student 10	During my mid-semester, I changed my major from engineering to business, I

	guess without really thinking it through. The sad thing is I figured that business is not for me, and I'm coming back to engineering.
Student 11	I feel I do not want anything to do with the life of an engineer but on the other hand, my plan from the start was to use an engineering degree to impress employers. Now, I have a new understanding of my desires. I also recognize that I simply cannot stay focused on doing work for a cause I see no reward in. In this case, my definition of reward goes so much further than economic potential, but rather quality of life.
Student 12	I still want to pursue a degree in engineering though; I am not going change my major just because it was a little harder than expected. I have learned that I should really go to the library a lot more to study and do work to avoid the distractions of other students who are majoring in something easy and not challenging. Mi biggest challenge this semester was keeping myself motivated.
Student 13	Since I am having difficulty in calculus 1, I am actually debating on switching my major to business, or something else, but I am not certain yet.
Student 14	My interest in an engineering degree has changed. The workload and the difficulty of the work caused the change in interest. It was hard the transition from high school where not much work is required.
Student 15	The biggest challenges faced this semester were definitely organization and time management. I still want to pursue a degree in civil engineering.
Student 16	I never came to this institution to be an engineer; my passion is on designing cars and products. I want a mechanical engineering degree just to have one.

Students faced a number of challenges during their first semester in college. When asked about challenges faced, some of the comments observed from the reflective essays are summarized in Table 4.

Table 4. Challenges faced by students during the first semester in college, indicated in reflective essays. Comments obtained from some of the students.

Challenges Faced by Students		
Academic Challenges		
Academic struggle trying to study for too many subjects at the same time. It's been hard to stay organized and get everything done.	Experienced problems with the demands of college life, work load from classes, and managing stress	It took me until mid-semester to truly get myself into a system of study and note taking that I found to work well with me.
Courses: Calculus 1 and General Chemistry	Not knowing how to study for college; I still don't know how to study well.	I found quite difficult to adjust the way I take in information from class. In high school, the teachers were more involved with the students, but now, professors don't have time and you need to schedule meetings

		to ask for help.
Study-Life Challenges		
Time Management	My bad study habits were partially to blame for my struggles. (procastination)	Balancing social life and school.
Adjust to life away from home and on my own. Learning how to live on my own and take care of myself.	I spent too much time watching Netflix	
Personal Challenges		
Lack of confidence in my ability to take exams; it's a fear from exams most of the time.	Keeping the stress down has been a challenge, because all of the tests and exams are close in schedule.	My biggest challenge I have had to overcome is being able to handle my independence.
I have missed my family and friends a lot more than I had expected to, and it has just been very emotionally stressful.	Keeping myself motivated. As the semester went on, I found it more difficult to find the motivation to get my homework done.	Had to control myself to resist the urge to enjoy myself a little too much and engage in activities that could hurt my chances to achieve the career I am working towards.
I got very homesick about halfway through the semester.		

Discussion

For students just starting college, the first semester is full of learning experiences and adjustments. Students not only need to learn how to balance their studies and life, but they also need to learn how to survive in an environment that is different from being at home. Academically, they need to learn how to study for tests, how to manage their time, how to organize their daily activities, and even how to work in groups. But probably the biggest learning experience comes from being able to become independent members of society, in charge of their own life.

This study provides a general overview of the first semester experience for engineering students. From this study we learned that a significant number of students enrolled in an engineering program, use their first semester to decide whether engineering is suitable for them. Those students joined the institution with a second career choice in mind, and depending on their first semester experience, they either leave or stay in the program. For our engineering students, exposure to career fairs, department visitations, and engineering fest (aimed at exposing students to student organizations), solidified student's decision to continue in the engineering program. For other students, the exposure to non-engineering disciplines was sufficient to trigger a desire to switch to a non-engineering program.

Several scenarios caused a change in interest in pursuing engineering. Academic difficulty was one of them, with calculus 1 and chemistry being the toughest courses faced by our students. We also found that classroom experiences appeared to be important to maintain student interest in engineering and their retention. For instance, in the reflective essays, students indicated that “Teamwork increased my desire in pursuing a degree in engineering”, “The competition is a factor that I enjoyed much more than I had predicted. It helps to drive me much more than a basic problem with a single solution”, and “This semester I have learned that I like being in charge of projects (project management)”.

Some students experienced homesickness, while others had a hard time trying to adjust to a new system of note taking, lectures, and exams.

Conclusions

Students face a multitude of challenges during the first semester in college. As a result, some students persist in engineering, whereas others lose interest. This paper not only documented the challenges faced by students during the first semester, but it also discussed factors associated to the loss of interest. Academic difficulty led to a loss of interest, but was not the only reason found. Student perception and interest in engineering was also affected by the material presented in their engineering courses. Extracurricular activities, such as career fairs and departmental visitations, also influenced student interest. In summary, engineering programs must constantly engage engineering students, inside and outside the classroom, to maintain student interest and enthusiasm in pursuing a degree engineering.

References

1. Roberts, Jalyann; Styron, Ronald. “Student Satisfaction and Persistence: Factors Vital to student retention” *Research in Higher Education Journal*, 6 (2010): 1-18. Web. 28 Dec. 2011.
2. Pendergrass, NA; Kowalczyk, Robert; Dowd, John; Laoulache, Raymond; Nelles, William; Golen, James; Fowler, Emily, “Improving First Year Engineering Education” *Journal of Engineering Education* (2001): 33-41.
3. Melsa, James. “Transforming Engineering Education through Educational Scholarship” *Journal of Engineering Education* (2007): 171-172.
4. Seymour, E., & Hewitt, N. *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press, 1997. Print.
5. Seymour, Elaine. “Tracking the Processes of Change in U.S. Undergraduate Education in Science, Mathematics, Engineering, and Technology.” *Science Education* 86 (2002): 79-105.
6. Crosling, Glenda; Heagney, Margaret; Thomas, Liz. “Improving Student Retention in Higher Education: Improving Teaching and Learning.” *Australian Universities Review* 51 (2009): 9-18 Web. 1 Jan. 2012.
7. Ohland, Matthew W.; Sheppard, Sheri D.; Lichtenstein, Gary; Eris, Ozgur; Chachra, Debbie; Layton, Richard A., "Persistence, Engagement, and Migration in Engineering Programs" *Mechanical Engineering* (2008) Web 1 Jan. 2012.

8. Ohland, Matthew W.; Zhang, Guili; Thorndyke, Brian; Anderson, Timothy J., "Grade-Point Average, Changes of Majors Selected by Students Leaving Engineering". 34th ASEE/IEEE Frontiers in Education Conference (2004), Session T1G.