
AC 2012-3774: ENGINEERING ATTRITION AND UNIVERSITY RETENTION

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Attrition and University Retention

Abstract

Engineering attrition is a concern for first year engineering programs and engineering colleges. The stress related to making the transition from high school to college has been suggested as one reason for the high attrition rate. Not only is there a disruption to student-family relationships, but students need to learn how to manage their time and resources, as well as to meet deadlines without the guidance and close supervision of parents and relatives. Many first year engineering programs provide extensive academic and social support to help students make the transition and succeed academically. While necessary, are these programs sufficient to keep students in an engineering program? Are students who leave engineering academically successful in their non-engineering field of study? This study was designed not only to address why students transfer out of engineering, but to determine if those students who leave engineering are able to succeed in their new discipline and graduate from the university.

All “engineering” students at this large land grant university in the mid-Atlantic region, both calculus-ready and not calculus-ready,” must complete a common “first year experience” before moving to a discipline major. Students who are not calculus-ready at entry usually take 1.5 to 2 years to complete the required courses, depending on their initial math placement. The authors studied 527 students who transferred out of engineering during their first or second year of that general engineering program. The students were mostly men who changed majors between January 2007 and December 2010. An exit questionnaire administered at the time of the transfer was utilized to determine their exit grade point average (GPA) and the reason for the switch. Furthermore, university databases were utilized to determine if those students were able to graduate from, or are still pursuing a degree at, the university. The number of students who withdrew from the university, were suspended, or never returned to the university was also assessed, as was the percent of students who left engineering, but were later readmitted into the program.

Analysis of exit surveys provided insight into the academic characteristics of those first year students who transferred out of engineering, reasons why they left, and the degree to which these students persisted to degree completion in another major at the university. Results indicate that factors different from academic difficulty are leading to the change of discipline among general engineering students. Students who are in good standing academically are leaving engineering because they lack interest in the subject. Additional explanations are considered and presented, as well as the implications for potential intervention programs to address increasing student interest as well as academic success in engineering.

The percentage of students who leave engineering and who also leave the university is a source of concern for both engineering and university administrators. Influencing factors for leaving both engineering and the university are explored and presented.

Introduction

The United States is in need for well-qualified engineers. Obtaining high education degrees has been linked to economic growth and prosperity.¹ There are concerns about a declining interest among students in pursuing engineering and about the lack of diversity among engineering programs.² Another concern is the fact that qualified students are not completing their degrees in engineering; these students are transferring into non-engineering programs or dropping from college.

Engineering attrition is a source of concern and several studies have been conducted to understand why students transfer out of engineering.^{3,4,8} Hewitt and Seymour have written several articles and a book in which the authors explain that “switchers are academically similar to non-switchers”.^{3,4} The authors found that the main difference between these two groups is in the ability to cope with problems; non-switchers managed to cope, whereas switchers did not appear able to cope.^{3,4} Other studies attribute attrition to the lack of appropriate teaching techniques, and the student’s inability to identify with their corresponding academic majors.⁵

In a study of first year engineering students, Ohland and colleagues found that engineering students have the highest rate of persistence among disciplines.⁶ The study established that 57 percent of students who matriculated in engineering are still enrolled in engineering in their eighth semester.⁶ Their findings state that 93 percent of students enrolled in engineering after eight semesters had matriculated in engineering.⁶ Ohland and colleagues also found that “students who persist in engineering start out with a fairly low level of disengagement in both their engineering and liberal arts courses, then their level of disengagement in both types of courses increases over four years of study”.⁶

Many first year engineering programs provide extensive academic and social support to help students make the transition from high school to college, and succeed academically in college. While necessary, are these programs sufficient to keep students in an engineering program? Are students who leave engineering academically successful in their non-engineering field of study? This study was designed to address why students transfer out of engineering and to determine if students leaving engineering are able to succeed in their new major and graduate from the university. This information is essential to determine if an intervention is needed to assist those students leaving engineering in the successful completion of a degree.

Methodology

The study was conducted at West Virginia University. The authors studied 527 students that transferred out of engineering during their first or second year of a general engineering program. The students were mostly men who changed majors between January 2007 and December 2010. An exit questionnaire administered at the time of the transfer was utilized to determine their exit grade point average (GPA) and the reason for the switch. Furthermore, university databases were utilized to determine if those students were able to graduate from, or are still pursuing a degree (referred as active), at the university. The number of students who withdrew from the university, were academically suspended, or never returned to the university was also assessed, as was the percent of students who left engineering, but were later readmitted into the program.

Results

Freshman Engineering Program: All “engineering” students at this large land grant university in the mid-Atlantic region, both calculus-ready and not calculus-ready,” must complete a common “first year experience” before moving to a discipline major. Students who are not calculus-ready at entry usually take 1.5 to 2 years to complete the required courses, depending on their initial math placement. Once accepted into our “freshman engineering” program, students are classified as either a general engineering or as an engineering students, based on their High School GPA, and ACT composite or SAT results. This study includes both general engineering and engineering students. At the time of the transfer, none of the students have declared an engineering major.

Characteristics of the transfer population: The distribution of cumulative GPAs at the time of the transfer is shown in Figure 1. At the time of the transfer, 39.5% of the students had a GPA below 2.0. The average GPA for all transfer students was 2.70.

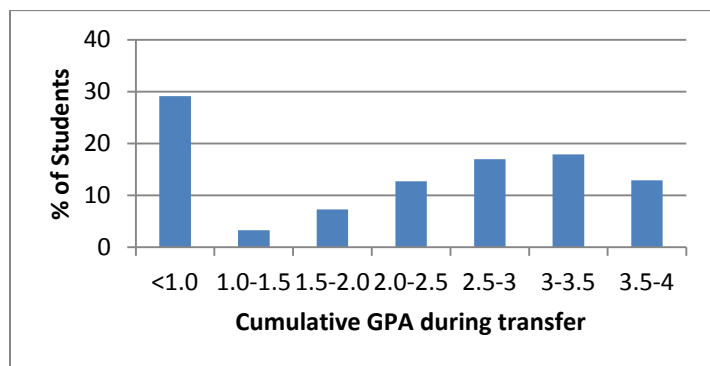


Figure 1. Cumulative GPA distribution at the time of the transfer.

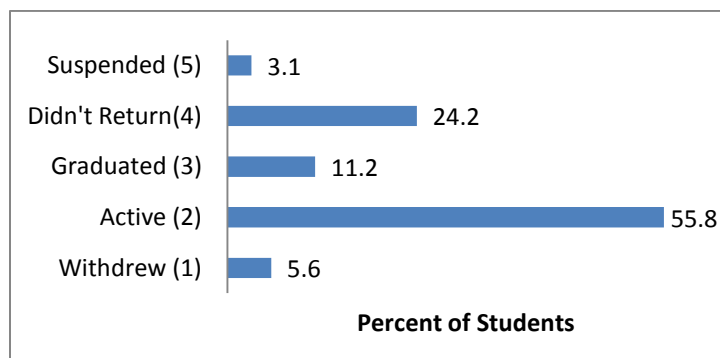


Figure 2. Percent of students pursuing a degree (active), who withdrew from college, were suspended, never returned to college, or completed their degree (graduated).

Twenty two percent of the students requested a transfer to general studies, which is a non-degree program designed to assist students in a selection of a major. Thirteen percent (13%) of the students requested a transfer to business administration, and 5% to accounting.

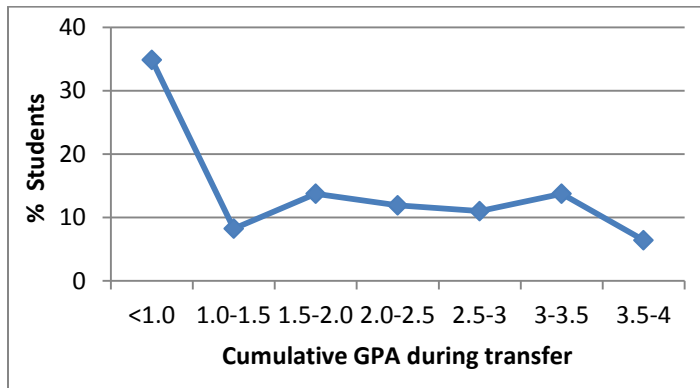


Figure 3. Cumulative GPA at the time of transfer for those students that switched to general studies

As Figure 3 illustrates, 56% of all students transferring into general studies had a GPA below 2.0, and therefore, were in academic probation.

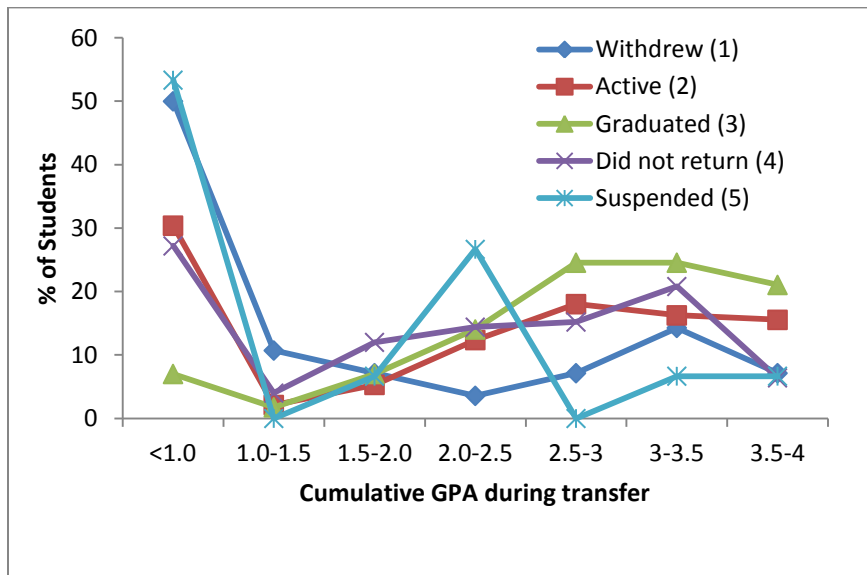


Figure 4. Distribution of cumulative GPA among each individual group (withdrew, active, graduated, did not return to college, and suspended). Data presented as a percent of the total number of students within each group.

Table 1. Reasons for switching to a non-engineering major and exit GPA

Reason for the Transfer	% Total Responses	Average Exit GPA
I am in academic difficult.	18.0	2.37
My classes are too large.	0.5	2.05
I do not think I can succeed in Engineering.	18.2	2.53
My high school did not offer proper college prep courses.	2.8	2.70
My high school did not prepare me for college courses.	4.5	2.61
I think I can make more money in another discipline.	2.1	2.71
Too much effort required when I am uncertain about what I want to do.	13.6	2.69
Engineering majors offered do not match my interests.	22.5	2.82
I have a job and the curriculum is too intensive.	1.3	2.45
Courses I want to take are not offered enough.	0.2	2.41
Engineering is not challenging enough for me.	0.2	3.30
I had problems with advising in Engineering.	0.6	3.30
Other	15.4	2.81

Main reason to transfer from engineering: According to the results from the questionnaire, the main reason to transfer out of engineering was that the engineering majors offered do not match student's interest; the second and third most popular answers were that the student was in academic difficulty or that they perceive an inability to succeed in engineering. For those students in academic difficulty (29% of the students), 34% of them described having difficulty in calculus I and 17% in general chemistry. As table 1 indicates, students that transferred due to problems with advising or that engineering is not challenging enough had the highest exit GPA among all students.

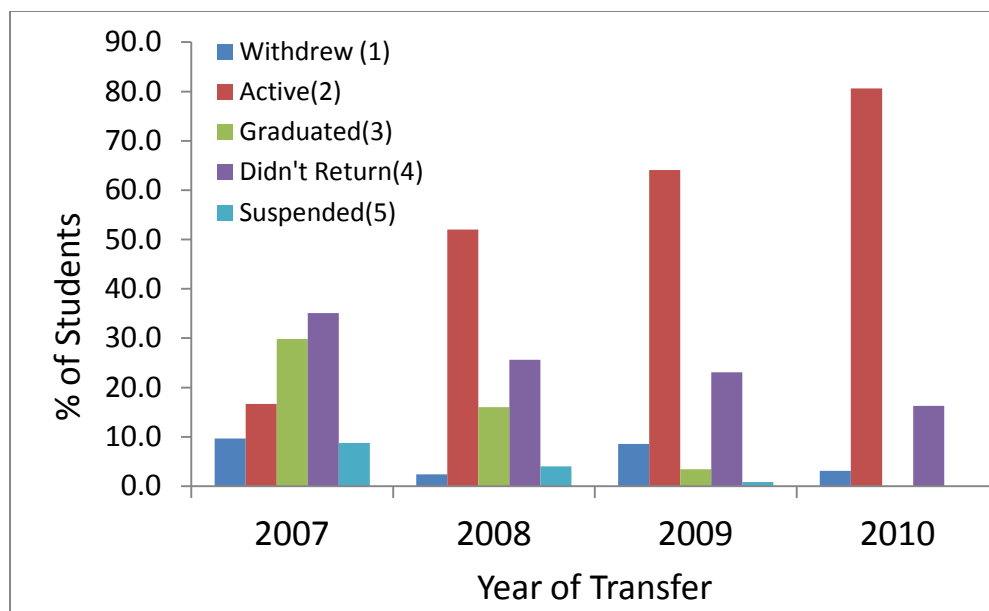


Figure 5. Percent of students who withdrew, graduated, never returned to college, were suspended, or are still pursuing a degree (active) in our college, identified by year of transfer.

Graduation rate after switching majors: A university database was utilized to determine if students who leave engineering are able to succeed in their new discipline and graduate from the university. The database was also utilized to determine the percent of students who left engineering, but were later readmitted into the program. Readmission to engineering was low; only 25 of the 527 students (4.6%) included in the study returned to engineering. Graduation rate was found to be related to the year of transfer. For instance, only 30% of the students that switched majors in 2007 completed a bachelor degree by fall 2011. For years 2008, 2009, and 2010, graduation rate was 16%, 3%, and 0%, respectively (see Figure 5).

Transferring out of engineering did not contribute to an improvement in student's GPA. For instance, after calculating the difference between the last reported GPA and the GPA at the time of the transfer, a difference of -0.19 ± 0.95 (mean \pm std deviation) was obtained; this difference is not significantly different from zero.

Discussion

Attrition is a source of concern for faculty and administrators in academic institutions. It is believed that student attrition may be prevented by carefully planned and timely institutional intervention. Also, the frequency and quality of student-faculty interaction appears to be related to college persistence.⁸ Studies also suggest that attrition rate is higher at the end of the freshman year.

This study showed that students from our freshman engineering program transferred out mainly due to the fact that the engineering majors offered do not match their interest. The second reason

for the transfer is that they feel unable to succeed in engineering. Seymour and Hewitt has presented evidence that the lack of interest in engineering drives students to switch from engineering to a non-engineering major.^{3,4} Although our students were not asked if the lack of interest lead to the switch, 32% of the students that indicated that they feel unable to succeed in engineering, attributed it to a lack of interest in pursuing engineering.

Unlike Ohland's study in which Business was the most common destination for students leaving engineering, a high percent of our students moved to general studies. In our study, the second educational choice was business. The fact that our engineering students are switching to general studies reflects either an inability to make a decision about which major to pursue at the time of the transfer or the fact that some of our students are in academic probation. At the time of the analysis, only 6.5% of all students that transferred to general studies completed a bachelor degree in a given discipline. Only 45% of the students that transferred to general studies are still enrolled in our college. The remaining 48% dropped from college, were suspended, or never returned to the university.

Another difference with Ohland's study, was the high percent of students transferring out of engineering with GPA below 2.0 (39.5% of all transfer students). Our findings suggest that switchers with a GPA below 2.0 are more likely to withdraw from college.

There is a need to develop programs that retains those engineering students committed to complete an education in engineering. Our freshman engineering program has been actively involved in engaging students and in assisting them during their early stages of their education.⁹ Table 2 presents examples of the programs implemented in our freshman engineering program to retain students in engineering. Our retention efforts involve an intensive "peer-mentoring" and "peer-tutoring" approach.⁹

Table 2. Several programs and techniques employed to retain students in engineering and to assist students in their selection of an academic discipline.

Method/Support	Description
1. Engineering Learning Center (ELC)	The learning center is fully equipped with computers and tutors with knowledge in Mathematics, Chemistry, Physics, and Computer Programming.
2. Advising Program	Students have daily access to an academic advisor; Monday-Friday from 9AM – 4PM.
3. 4.0 Mentoring Program	Tested this program in Fall 2011. Program guarantee a 4.0 if a student follows each of the proposed steps.
4. Private Tutors	Available for student in need of a one-one tutoring experience.
5. Out of Class Experiences	Students are exposed to scientific and non-engineering lectures and attend field trips, all activities outside the classroom.

6. Study Laboratory (also known as Study Lab)	Students are required to attend the Engineering Learning Center for at least 2 hours a week to spend time studying. Study Lab participation accounts for 10% of student's grade in first year engineering courses.
7. Department Visitations	Every semester, the program takes students to visit prospective departments. Students visit the facilities associated to a given engineering department and have the opportunity to interact with their faculty and students.

This study provides valuable information into the educational pathway followed by students once they transfer out of freshman engineering. This information can be used to devise strategies to help these students succeed in college. As we continue analyzing data available for those students, a question to ask is which intervention is needed to guarantee the academic success of students leaving engineering? Is it possible the early identification and retention of students with the potential to succeed in engineering?

Conclusions

In our institution, students are switching from engineering into a non-engineering major due to a lack of interest in engineering programs offered in our university. A high percentage of our switchers move into general studies, a program designed to assist students in the selection of a major. This study also indicates that the move from engineering to a non-engineering discipline does not guarantee a success in the new discipline. Students, especially those transferring to general studies, are not succeeding in their new major. A question to ask is, which type of intervention is required to guarantee the academic success of students switching from engineering into non-engineering major?

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