Abstract – Lafayette College participates in the POSSE Program which has its own recruitment and retention strategies. We explore if these differences affect behavior, and subsequent commitment to engineering. While our small samples preclude general conclusions, the insights provide the foundation for more in-depth studies of similar programs within a similar campus context. Guided by Tinto’s theory of student retention, we surveyed group behavior in terms of academic and social integration. Our results show that POSSE students state a high commitment to engineering, and an ability to navigate the academic integration process. Minority students who are not part of the POSSE Program state a similar commitment to engineering, however they report less success navigating the academic integration process.

Index Terms – diversity, POSSE, retention, Tinto

BACKGROUND

In 2003, Hispanic Americans and African Americans comprised 6.2% and 7.9% respectively of those graduating with an undergraduate engineering degree from colleges in the US [1]. This compares to a general population of approximately 14% Hispanic Americans and 12% African Americans [2]. Chubin et al. [3] reports that fewer than two in five (40%) minority first-year students who enter engineering graduate with an engineering degree.

Lafayette College is a small, private, liberal arts college that offers engineering degrees. Because of its size and emphasis on undergraduates, a Lafayette College engineering education includes small classes, available professors, undergraduate research experiences, study abroad, hands-on laboratories and projects, free tutoring, and active advising. Over the last six years, Lafayette College has worked with the POSSE Foundation to enhance campus diversity.

The POSSE Foundation is a non profit organization headquartered in New York that aims to 1) increase the pool of qualified, diverse students ready for selective colleges, 2) increase those students’ success at selective colleges, and 3) make campuses more welcoming for diverse students and diversity in general [4]. The colleges in turn provide mentoring and financial resources for these student cohorts. Nationally, POSSE students have excellent retention and graduation rates. The POSSE program includes several components as follows:

- Student selection is based on a Dynamic Assessment Process that looks more at leadership skills, teamwork skills, and desire to succeed than traditional college admissions selection processes.
- POSSE selects and trains a 10-student cohort from for each participating College. The training includes an eight-month pre-college program on leadership, college culture, time/financial management, team building, cross cultural communication, and academic excellence.
- Students receive campus visits from POSSE staff every semester.
- Students are provided with an on-campus mentor from the college for the first two years who meets with the 10-student cohort every week, and meets with each student in that cohort every two weeks.
- The college sponsors an annual weekend spring retreat for the cohorts across class years (and their mentors) to discuss issues chosen by POSSE students.

The POSSE Foundation receives nominations of possible candidates (independent of race and income) from a network of guidance counselors, principals, teachers, and youth workers at community-based organizations in New York, Chicago, Boston, Los Angeles, Atlanta, and Washington DC. These community contacts nominate high school seniors based on leadership potential, high school activism, and academic promise for college success. These nominees are then considered in a very competitive application process. The application process takes four months with three major interviews that include observing the students as they interact in planned activities. The four-month POSSE application process is designed to gauge a student's level of persistence and potential.

The last interview of 20 finalists is conducted by the college that will award the leadership scholarships to the cohort of 10 students. By this time, all finalists have already been accepted through that college’s standard application process which includes grades, curriculum strength, test scores, recommendation letters, and so on. The application process does not consider a student’s major when making decisions. Five to 10 percent of the applicants to the POSSE Foundation ultimately receive leadership scholarships which are independent of financial need. The focus on inner-city schools typically results in a POSSE cohort of economically disadvantaged students, many of whom belong to ethnic minority groups.
In Lafayette’s case, several of the students who do not receive POSSE scholarships ultimately attend anyway because they have been accepted through the College’s application process, they often qualify for substantial financial aid, and by then, they are very familiar with the College. As such, the POSSE Foundation application process results in many of the minority students who matriculate at Lafayette College regardless of whether they are formally part of a POSSE scholarship cohort.

The demographic profile of Lafayette’s recent engineering student population is shown in Table 1. The College has very good overall engineering retention compared to the national average with a four-year graduation rate for engineering majors approaching 70% over the last 10 years and improving over time. First-year attrition for all engineering students at Lafayette College has been approximately 15% over the last 10 years. However, data from a previous National Science Foundation Scholarship Program shows that between 25% and 50% of Lafayette’s minority freshmen who start in engineering switch majors by the end of first year.

<table>
<thead>
<tr>
<th>Class Year</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students (Total)</td>
<td>112</td>
<td>112</td>
<td>137</td>
<td>170</td>
</tr>
<tr>
<td>African American</td>
<td>5 (4.5%)</td>
<td>1 (0.9%)</td>
<td>7 (5.1%)</td>
<td>7 (4.1%)</td>
</tr>
<tr>
<td>Hispanic American</td>
<td>4 (3.6%)</td>
<td>2 (1.8%)</td>
<td>4 (2.9%)</td>
<td>11 (6.5%)</td>
</tr>
<tr>
<td>Asian American</td>
<td>2 (1.8%)</td>
<td>2 (1.8%)</td>
<td>3 (2.2%)</td>
<td>5 (2.9%)</td>
</tr>
<tr>
<td># POSSE</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

Both academic integration and social integration form the basis of the classic theory that describes college retention, i.e. Tinto’s Model of Student Retention [5]-[7] shown in Figure 1. Tinto’s model theorizes that a student’s individual and family characteristics along with prior schooling contribute to his/her initial goals when entering college [5]-[7]. Tinto suggests that these initial goals are reshaped over time by how well integrated (socially and academically) the student is on campus; these revised goals are affected in part by the student’s external commitments [5]-[7]. Tinto argues that a student’s decision to persist in an academic program can be predicted by the student’s response to the transition process [5]-[7].

Nora et al. [8] define an “academically integrated” student as one who has developed a strong affiliation with what the college defines as its academic environment, e.g. interaction with faculty and academic staff for academic issues, participation in tutoring activities and/or study groups, and so on. They [8] similarly define a “socially integrated” student as one who has developed a strong affiliation with the typical social activities at a particular college campus, e.g. ongoing interaction with study group members socially, contact with faculty for non-academic reasons, student organizations, etc.

Tinto’s model was not developed specifically for either minority students, or for engineering students. There are also no published studies examining the POSSE Program’s success with retaining minority students in engineering majors. An extensive study of the effect of social integration factors on African American engineering students concludes that lower graduation rates are consistently associated with greater student perception of campus discrimination issues; this factor is not specifically addressed by Tinto [9].
group for four years, therefore a student may be the only minority student in a particular section of a course, or even in that class year for a certain major.

The objective of this study is to evaluate the effect Lafayette’s POSSE Program has on students’ (as a sub population) behavior patterns in terms of the academic and social integration factors that favor retention. Figure 2 illustrates the overall study design with three student sample populations: POSSE students, non-POSSE minority students, and for comparison, a similar size of randomly selected majority engineering students.

![Study Diagram](image)

We assume that all students have similar access to the College’s financial, academic, and social support programs. In other words, we assume the only difference between the three groups once they arrive on campus as engineering majors, is that Group A must meet the POSSE Program requirements. We also assume that despite differences in ethnicity and socioeconomics, these three groups of students enter college with similar admissions backgrounds. These background characteristics influence the incoming academic goals of the students.

Lafayette College has high academic thresholds for admission, and substantial academic support services. These factors, combined with the specific academic background and interests that tend to be associated with engineering majors, suggest that these assumptions are reasonable. The one significant difference between the groups that affects this study design is that the POSSE selection process screens for students with particular leadership potential and persistence. The above assumption about incoming goal commitment was confirmed in the survey we conducted (results are discussed on page 4).

We developed the initial research questions and hypotheses from focus groups conducted in the 2005-2006 academic year. We then used a student survey to qualitatively explore those practices that are known to lead to academically and socially integrated students. The survey includes open-ended, structured-response, and Likert-style close-ended questions to gain greater depth.

We purposefully identified three student groups from Lafayette College’s Class of 2010 as the subjects for our evaluations over 2006-2007. For confidentiality reasons, each student is identified by a number. We obtained initial data from the Admissions Office to compare groups in terms of the following academic measures: Lafayette admissions rating, high school GPA, SAT verbal and math scores. Lafayette uses a confidential admissions rating system based on several weighted factors including the strength of the high school curriculum, strength of the school, SAT scores, grades, etc. The average admissions rating for an accepted Lafayette College student is a three, while one is the highest rating a student can get. Due to the small numbers, we did not conduct statistical comparisons among these incoming academic measures. The groups are:

- All Class of 2010 POSSE students (eight) who began the 2006/2007 academic year as engineering majors and fall into one of the designated US minority groupings: Asian American, African American, and Hispanic American. All remain part of study as long as they started in engineering even if they leave engineering. These eight students form the cohort Group A.
- All of the Class of 2010 non-POSSE students who began the 2006/2007 academic year as engineering majors, and who belong to a designated US minority: Asian American, African American, and Hispanic American. For Lafayette’s Class of 2010, this total is 13 students, and they form the cohort Group B. All 13 students in Group B remain part of study even if they leave engineering by end of 2006/2007.
- A random sample of the Class of 2010 who began the 2006/2007 academic year as engineering majors. We chose the random sample from all Class of 2010 engineering majors who are US citizens (or legal residents), are not members of a designated US minority group, are not members of POSSE, and were enrolled in Calculus 1 for the Fall 2006 semester. Calculus 1 is the lowest level of calculus offered at Lafayette College for engineering majors. We used Calculus 1 enrollment as a criterion because based on recent history, most of the US-minority students at Lafayette College start their college career with Calculus 1. These 12 students form the cohort Group C. All 12 students remain part of study even if they leave engineering by the end of the 2006/2007 academic year.

We evaluated the behavior of the three cohort groups in terms of their academic and social integration using a qualitative survey. We used actual survey protocols from [98] and [11] to help us structure the questions. The final survey includes 30 Likert-style questions, eight structured-response questions, and 15 open-ended response questions. After receiving approval from Lafayette College’s Institutional Review Board, we conducted the surveys electronically during April 2007. We contacted the students in each of the three groups by e-mail, and asked them to
participate voluntarily. We made several repeated requests over a period of nineteen days to elicit maximum response. The on-line electronic survey tool kept track of the responses in aggregate, and according to each student. Students who participated received a $10 I-Tunes gift card.

The survey categories address the specific components of the Tinto model in terms of goal commitment, academic integration perception and behavior, social integration perception and behavior, and external influences. We supplemented the survey with questions regarding possible discrimination effects that we included in the social integration category. We used content analysis to assign a relative rating of high, medium, low based on the number of responses that agree with the various survey statements. The survey categories, and criteria used to formulate the questions within each category are shown below:

- **Academic Integration Factors:**
  - feel instruction quality adequate
  - feel adequately prepared for future courses
  - feel satisfied with academic performance
  - feel faculty encourage class discussion
  - feel faculty are available to help outside class
  - feel academic advising adequate
  - complete homework & attend class regularly
  - participate in class regularly
  - use study groups to complete assignments
  - make use of free tutoring services
  - participate in 1st year Divisional workshops
  - ask fellow students for academic help

- **Social Integration Factors:**
  - attend engineering student club events
  - interact with students of different background
  - spend social time on campus
  - feel student club support useful
  - feel treated same as others by professors
  - feel treated the same as others by peers

- **External Influences:**
  - outside of Engineering
  - outside of the College

- **Goal Commitment:**
  - graduate as an engineer

### RESULTS

As shown in Table 2, the SAT background measures are similar among groups A and C, and meet the average criteria for a Lafayette College student. Group B demonstrates lower academic background measures across all indicators. In general, the range of incoming academic measures for Group B is greater than for Groups A and C.

Of the 33 students contacted, 25 (76%) completed the survey. Of these 25 students who responded, the percent participation from each target group is 75% (6) for Group A, 69% (9) for Group B, and 83% (10) for Group C. Table 3 provides a side-by-side comparison of the survey results as well as other data for the three student cohort groups in terms of Tinto’s model: incoming qualifications, followed by academic and social integration during the first year, goal commitment at the end of the first year, and actual student retention at the end of the first year. These results are described further in the sections below.

<table>
<thead>
<tr>
<th>Lafayette College Admissions Rating</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Median</td>
<td>3</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Range</td>
<td>2 to 4</td>
<td>3 to 5</td>
<td>2 to 5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>High School GPA</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>3.7</td>
<td>3.5</td>
<td>3.7</td>
</tr>
<tr>
<td>Median</td>
<td>3.7</td>
<td>3.6</td>
<td>3.8</td>
</tr>
<tr>
<td>Range</td>
<td>3.5 to 3.9</td>
<td>2.8 to 3.8</td>
<td>3.3 to 4.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SAT (V/M)</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>555/661</td>
<td>525/595</td>
<td>627/675</td>
</tr>
<tr>
<td>Median</td>
<td>545/665</td>
<td>540/590</td>
<td>620/680</td>
</tr>
<tr>
<td>Range</td>
<td>520 to 620/550 to 780</td>
<td>450 to 690/460 to 720</td>
<td>500 to 770/580 to 740</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Highest High School Math Course Completed</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Calculus to AP Calculus</td>
<td>Trigonometry to AP Calculus</td>
<td>Pre Calculus to AP Calculus</td>
<td></td>
</tr>
</tbody>
</table>

I. Goal Commitment (beginning and end of the first year)

All the students we studied begin college with the stated commitment to major in engineering. The primary influence on initial major selection for all three cohort groups is overwhelmingly science and math enjoyment. Family influence had the least impact on students’ initial decision. By the end of the first year of college, 89% of the students surveyed are committed to graduating with an engineering degree, 88% feel they correctly chose engineering as a major, and over 87% feel they made the right choice attending Lafayette. The results vary across the three groups.

II. Academic Integration Factors

Eighty-four percent of students feel courses they took adequately prepared them for future engineering courses. All students in Groups A and B feel they have adequate preparation, but overall numbers are affected by 33% of students in Group C who disagree. Only 58% of students who responded are satisfied with academic performance, with group results of 67% for A, 44% for B, and 60% for C.

Only one student from Group C is not pleased with the quality of instruction. And, only two students from Group C feel the Division of Engineering is not committed to their success. In other words, no student in Groups A and B (the study groups of interest) attributes academic difficulties to instruction and Divisional commitment. On the other hand, about 40% of the students are displeased with academic advising they receive; overwhelmingly these students belong to Group B.
All students say they attend classes regularly, and complete assignments on time. On the other hand, only 50% of the students surveyed say they routinely participate in class discussions while 68% feel comfortable participating.

Related to this, about half of the students surveyed feel that they are not encouraged by professors to participate in the classroom. These results are very different when examined for each group, with 83% of Group A saying they routinely participate in class while the numbers drop to 56% for Group B and 20% for Group C. As expected, this spread is also seen in terms of students' comfort level participating in class. Although not as big of a spread, student groups also disagree about professors encouraging students to participate with 67% of Group A, 56% of Group B, and 40% of Group C agreeing with that statement.

Over 30% of students say that the first place they go for academic help is their peers while 25% see their professors. The remaining students seek help from study groups, a personal tutor, and tutoring sessions in that order. This varies somewhat among the three groups with all of Group C going first to their classmates for help, while students in Group B are more likely to seek help from their professors first. Only one student feels that professors are not available to help outside of classes.

About half of the students who responded say they routinely work in study groups to complete assignments with no noticeable difference among groups. This result contrasts with the 84% who say they feel studying in groups is the key to their success in engineering. When asked to state the aspects in the Division that need to be improved, most refer to the need for more study group sessions (not tutors) in AEC for gateway courses not offered by engineering professors such as science and mathematics. Only one student in Group C says there are no benefits of group study.

In terms of the number of hours students spend working on assignments in study groups, the data is heavily skewed towards less than seven hours per week with 31% of students spending zero to one hour. This self-reported result contrasts with the opinion expressed by most students that study groups are key to success with the engineering major. This discrepancy may indicate the difference between what students perceive to be needed for work outside the classroom versus what is actually needed. The group that uses study groups the most is Group B with Group C responding with the least amount of hours.

Few students use the free review and recitation sessions for Calculus 1 over the year even though 40% of students feel that the on-campus tutoring services are key to their success in engineering. Similar results are observed for the use of the free tutoring services (for all subjects) offered by the College's Academic Resource Center. Even worse results are observed for the free tutoring services offered by the Minority Scientists and Engineers (MSE) student club in the engineering building. While none of the three groups uses the services frequently, Group B students reported using the free tutoring services the most.

Of the Division of Engineering sponsored first-year workshops on co-curricular issues related to success in engineering, almost half of the students reported attending the session on time management. In Group A, only one of the six students who responded did not attend any workshops. In Group B, all of the nine students who responded attended at least one of the sessions. In group C, only half of the students who responded attended any of the workshops. Part of the reason for the poor attendance from Group C may be due to the advertisement for these workshops.
workshops that occurred primarily through two student chapters oriented towards underrepresented students.

III. Social Integration Factors

Responses show that across the three groups, students attended few events sponsored by the engineering student organizations. Fifteen students say they are not members of any of these organizations. Seventy-six percent of students feel that the engineering student organizations help them succeed, however over 44% feel the organizations did not contribute anything over the past year. Overwhelmingly, the students in Group C do not see any value from the engineering student organizations. In terms of non-engineering student organizations, 17 students are members of between one and three organizations while the rest do not belong to any.

Fifty-two percent of students have not interacted with engineering faculty for non-academic reasons in 2006-2007. On average, students interacted with non-engineering faculty on three occasions in 2006-2007 with one student having 15 such interactions. These results are similar among the three groups. In terms of the overall College experience, students list a variety of aspects that contribute positively with no observable trend. Seventy-six percent of students note that the administrative staff at the College is helpful.

Over 60% of students say they tend to interact with engineering students of a similar background, and about 37% say it has been hard to meet and make friends with other students at Lafayette. However, only 12% of students say that since coming to Lafayette, they did not make friends with students of different backgrounds. These results are similar among the three groups.

Two students reported feeling discomfort while on the campus, two students feel discomfort interacting with engineering peers, and four students feel as if peers do not treat them as capable. Four students say they feel uncomfortable interacting with engineering professors, while two feel as if professors do not treat them as capable, and one student feels his/her work is graded unfairly. However, these results are not limited to the minority students and occur across the three groups.

IV. External Influences

Overwhelmingly, students across the three groups report spending the majority of their time on campus. In terms of factors external to Lafayette that contributed to student’s satisfaction over the past year, students across all three groups cite family and friends most often.

DISCUSSION

There are distinct differences between POSSE students and non-POSSE students (minority and majority) at Lafayette College in terms of the recruitment process, pre-college leadership preparation, and the academic mentoring during the first two years. Consistent with other retention studies, we show that first-year engineering students (minority and majority) at Lafayette College do not necessarily take advantage of available campus support services without active outreach. This deficiency may place students with less-prepared backgrounds in gateway courses for engineering at even more of a disadvantage during the first year.

However, we also show that minority students who enter with adequate academic preparation and receive effective mentoring during pre-college and the first year demonstrate a high level of commitment to graduate as engineers. The POSSE Program’s impact on student retention for engineering majors may relate to all components of the Program including a recruitment process that may select better prepared students via the nomination process, and a mentoring process both before matriculating on campus and during the first year that facilitates students’ effective use of the campus’s academic support services.

ACKNOWLEDGMENT

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REFERENCES


