

Preliminary Assessment of Summer Enrichment Program

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Abstract – The School of Engineering at Jackson State University initiated, in 2009, a ten week Summer Engineering Enrichment Program (SEEP) for first time freshmen School of Engineering majors to enhance retention rates and increase graduation rates. The program was repeated in 2010 and 2011 and is scheduled to continue through the summer of 2015. Design of the SEEP program and all its components are described in the paper. A comprehensive analysis of the performance and retention of SEEP participants was conducted based on two years of program data. Performance analyses include participants' enrollment and grades in Calculus I, Calculus II, Calculus III. One year and two year retention rates in the School of Engineering, in a STEM major and in JSU were computed. Performance, retention and graduation data for SEEP participants are compared with comparable historical data for first time freshmen at Jackson State University. Graduation rate projections are made for the 2009 cohort that are in their junior year. Results to date are encouraging.

Keywords: Retention; Summer Program; Graduation Rate;

BACKGROUND OF SEEP PROGRAM

Jackson State University (JSU) School of Engineering was established in 2000 and has been successful in educating competitive engineers, most of them (86%) African American. For the last decade, engineering enrollment has been steadily increasing. Yet, we are facing an urgent challenge, the engineering pipeline challenge, to significantly improve the retention and graduate rates.[1] According to historic data since 2000 when the School of Engineering was established, the 1-year retention rate of first time freshman has been fluctuating around 60%, and 2-Year retention rate of first time freshman has been fluctuating around 40%. The six year graduation rate in an engineering major for first time freshman is about 20%. Investigation and analysis of student retention shows that one of the major reasons causing the drop-out from an engineering major is that students find the course load – mainly fundamental mathematics courses for the first two years – to be overwhelming. Very often, poor first-year/second-year academic performance becomes the most important factor in students choosing to leave engineering studies for another major, or even more serious, to leave the university without any degree.

Based on a liberal admission policy, Jackson State University offers admission to students with a wide range of academic preparation levels. As shown in Figure 1, the average ACT Math score and ACT Comp score of first time freshman engineering majors are low, compared with most engineering schools in the nation. ASEE Engineering Management System contains the 75th and 25th percentile of ACT math score for newly enrolled engineering students at 173 universities. The average national percentiles (75th and 25th) were 31.5 and 25.6 respectively and the

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JSU percentiles were 22 and 16. Once admitted to an engineering program, it is not surprising that those freshmen who are less adequately prepared (especially those without a solid foundation in mathematics) find their course load to be overwhelming. Those students face a significant challenge in their college studies in an engineering curriculum. Enhancing the retention and graduation rate of those students calls for extra effort by the School of Engineering to help them with their studies, especially in mastering mathematics skills necessary for the successive engineering curriculum. Additionally, we believe success in mathematics courses will boost the students confidence and study ethic necessary to be a successful engineering student. Such an effort is essential for enhancing retention and graduation rates for engineering students at JSU. We are very confident that this effort will produce the results desired.

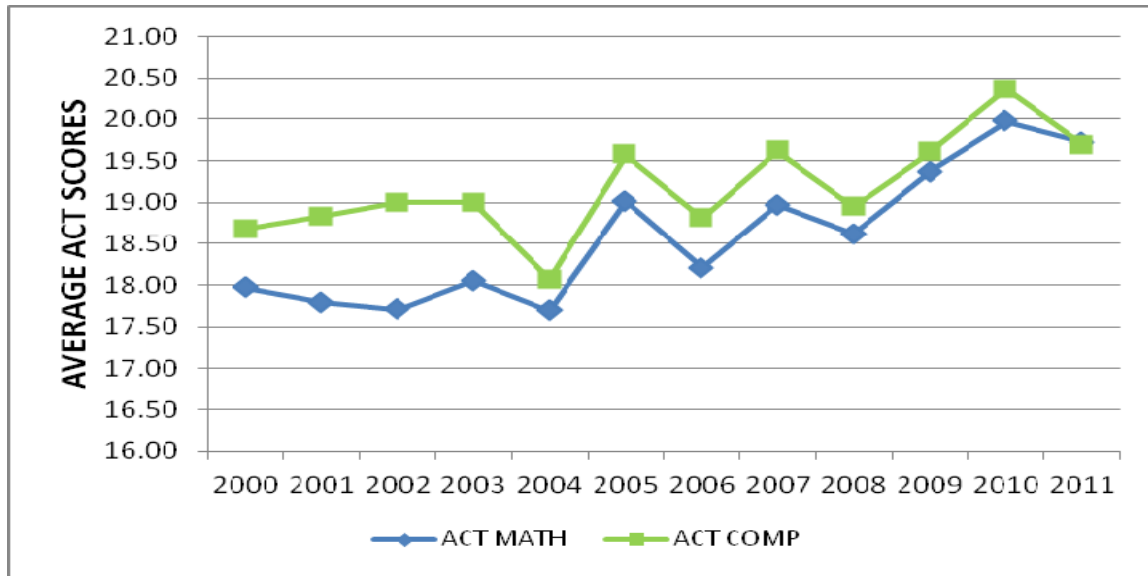


Figure 1. Average ACT scores for First-Time-Freshman School of Engineering Majors

DESIGN AND IMPLEMENTATION OF SEEP PROGRAM

A number of summer bridge/enrichment programs have been implemented nationwide with a variety of approaches and objectives [2, 3, 4, 5, 6]. In 2009, in order to respond to the challenge of enhancing retention and graduation rates, the School of Engineering at Jackson State University initiated a ten week Summer Engineering Enrichment Program (SEEP) for first time freshmen School of Engineering majors. The program was repeated in 2010 and 2011 and is scheduled to continue through the summer of 2015. This program is funded by the US Department of Education through a Title III grant to Jackson State University. Tuition, room and board, books and fees are all part of the program. Student costs for the summer program consist solely of incidental expenses. [7]

Admission to SEEP was open to students with ACT Math scores in the 17 to 25 range. Students with an ACT Math score of 26 and above are well prepared for success in calculus and do not need the summer program. Those students with ACT Math scores 16 and below are required to take an intermediate math course before taking College Algebra. For the summers of 2009 through 2011, 70% of first time freshman were eligible to enroll in the SEEP program, 25% had ACT Math score less than 17 (required to enroll in an Intermediate Algebra course) and 5% had an ACT math score of 26+ and were well prepared for success in Calculus I. SEEP participation was limited to a maximum of 40 School of Engineering student due to grant funding available.

In addition to preparing first time freshmen engineering majors with sufficient mathematics knowledge to succeed in Calculus I and successive mathematics courses, the program is designed to provide an acclimation to college life, an introduction to engineering careers, an increase in the students' self-confidence and an introduction to the study ethic required for success in an engineering curriculum.

Math lectures

The SEEP program enrolled first time freshmen in College Algebra during the first summer term and in Trigonometry the second summer term. Students were then advised by School of Engineering faculty to pre-register for the fall semester including enrollment in Calculus I. We are fully confident this will decrease the time to graduate for these students while enhancing first and second year retention rates. Both courses are 3 semester hours, and lectures are offered every morning 8:00am to 10:20am from Monday through Thursday. The lectures are taught by Professors in the Department of Mathematics and the classes are held in a tiered classroom seating 40 students in the new (2009) School of Engineering Building, shown in Figure 2.



Figure 2. School of Engineering Building

Study periods

The morning lectures are followed by a mandatory morning study period in an Open Computer Laboratory (40 seats) in the School of Engineering Building. The morning study period is from 10:30am to 12:00noon and graduate students who have attended the morning lecture are available for tutoring and they monitor the study period. Lunch is Noon to 1:00pm. During the first summer term, a non-credit Introduction to Engineering course is held from 1:00pm-1:50pm in the same classroom as College Algebra. During the second summer term the students have free time from 1:00pm-1:50pm. The students have an afternoon study period in the same location from 2:00pm to 4:00pm which is monitored by the same graduate students who are available for tutoring. This study period is not mandatory, however students who do not attend are supposed to have completed all their assigned homework. The Open Computer Labs are open for the student to use as desired during the weekend prior to the Final Exam and during evenings from 5:00pm to 9:00pm of the Final Exam week. One permanent staff member is available for tutoring on the weekend and in the evenings.

Tutoring

Graduate students are hired for the summer to be available 8 hours per day for tutoring in Algebra and Trigonometry. Before SEEP starts, the tutors attend meeting/training with instructors to gain an understanding of student assignments and schedules. During the SEEP program, they attend the morning lecture and they monitor the morning and afternoon study periods in the Open Computer Labs in the Engineering Building. There are typically 2 graduate students in each of two Computer Labs and another available in an adjacent student study room.

Introduction to Engineering

An Introduction to Engineering non-credit, somewhat informal lecture is mandatory during the first summer term from 1:00pm to 1:50pm. This lecture is held in the same Engineering Building classroom as College Algebra. This lecture is taught by a School of Engineering faculty member, Assistant Professor or Associate Professor, and has special guest lecturers including the Associate Dean, engineering alumni and volunteer student mentors from previous summers. Visits to every engineering laboratory in the building are conducted where students are briefed by either a faculty member who teaches in the laboratory or a graduate student. Student presentations of senior

projects, student demonstrations of robots used in competitions, and a student presentation about the concrete canoe constructed the previous year for competition is included.

Trips to engineering employers

Every Friday, an all day fieldtrip to an engineering employer is arranged. Examples of employers visited include Nissan, Army Engineer Research and Development Center, Mississippi Department of Transportation, Vicksburg District of the US Army Corps of Engineers, Entergy Corporation, New Orleans District of the US Army Corps of Engineers, Stennis Space Center, Mississippi Department of Environmental Quality, Diversified Technology, Freescale, and others. Those trips offer opportunities to participating students to interact with engineering professionals, and to gain a knowledge and appreciation of some of the roles engineers have in industry and government.

Student mentors from previous summers

After the first SEEP cohort in 2009, we have taken advantage of volunteer student mentors who are SEEP alumni. They speak about their experience and what it takes to be a successful engineering student during the orientation gathering of SEEP students the day they arrive. One especially effective and enthusiastic volunteer mentor from the 2009 cohort speaks passionately about dedication to excel in class and the study ethic required to be a successful engineering student. This student is a defensive back on the JSU football team, he maintains a GPA well in excess of 3.0, he is on track to graduate in 3 1/2 or 4 years and he has two summer internships at a nearby world renowned government engineering laboratory. This young man is destined for a stellar engineering career.

Learning Community

One of our objectives with the SEEP program is to develop a cohesive learning community among SEEP students which will strengthen itself during their matriculation at JSU. The students are housed together in the dormitories and they are together with one-another the entire summer including lectures and study periods. They are also together each Friday on field trips. In future years we may attempt to put the classes together on one floor of a dormitory throughout their undergraduate years. We plan to explore this concept with each of the first three cohorts that remain as engineering majors and document their recommendations during spring 2012.

PERFORMANCE AND RETENTION DATA

Preliminary assessment of the SEEP is conducted using up-to-date student data for 2009, 2010 and 2011 cohorts. The assessment contains various aspects of the participants retention and performance at Jackson State University, including their performance in SEEP summer courses, their enrollment and retention in School of Engineering departments, their performance in successive mathematics courses, namely Calculus I, II and III, and their one year and two year retention rates relative to the historic data for first time freshmen engineering majors with the same ACT math score range (17 – 25).

Performance in Summer Courses

SEEP participants take College Algebra and Trigonometry during the summer. Figure 3 illustrates that students performance in those courses is satisfactory. Most participants of the SEEP program passed Algebra and Trigonometry with a C or better grade. Having completed College Algebra and Trigonometry successfully in the summer, the students were able to enroll in Calculus I during their first fall semester as freshman.

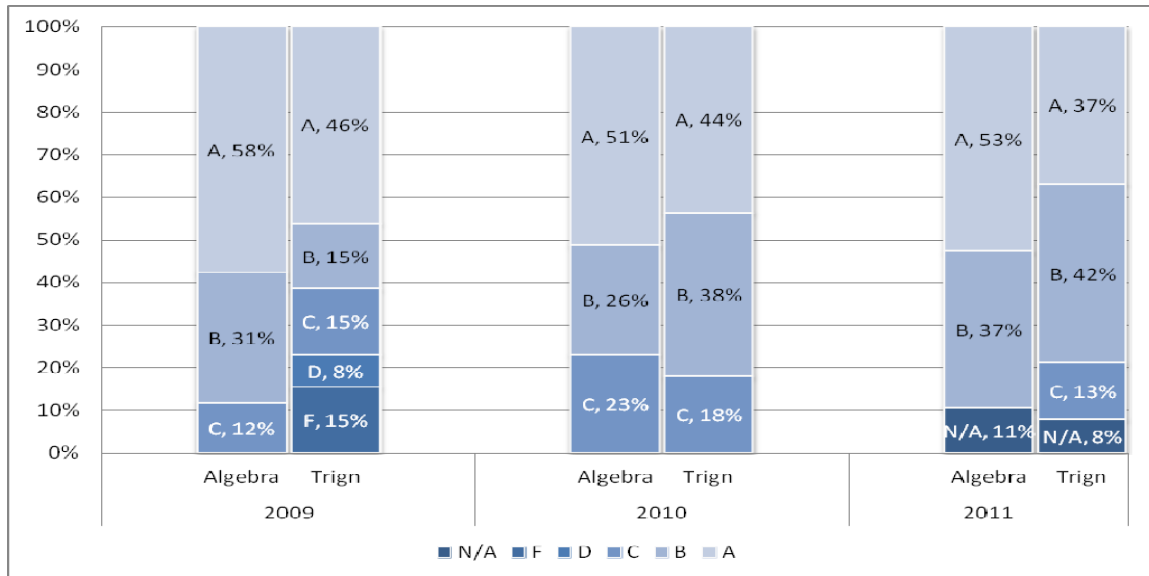


Figure 3. SEEP Grade Distribution of Summer Math Courses

Enrollment in JSU and in Engineering Departments the fall semester

After completing the summer program, most participants registered with College of Science, Engineering and Technology (CSET)/Engineering departments at Jackson State University the successive fall semester. CSET consists of the School of Engineering (Civil and Environmental Engineering, Computer Engineering and Computer Science Departments) and the School of Science and Technology (Biology; Chemistry; Mathematics; Physics and Technology). CSET contains all the STEM majors (Science, Technology, Engineering and Mathematics). Figure 4 illustrates enrollment data for SEEP participants with JSU, CSET and the School of Engineering for the fall semester immediately after SEEP. In these summers a total of 103 students attended the summer program and 102 or 99.3% enrolled in JSU for the fall semester. 81 or 78.64% enrolled in an engineering major. For 2009, out of 26 total participants in the SEEP program, 25 enrolled with JSU, among which 17 enrolled with CSET and 16 enrolled with the School of Engineering. For 2010, all of the 39 SEEP program participants enrolled with CSET, and 38 enrolled with the School of Engineering. For 2011, out of 38 total participants in SEEP program, all 38 enrolled with JSU, among which 33 enrolled with CSET, 27 enrolled with School of Engineering. At first glance, it may be a concern that only 27 out of 38 students enrolled in engineering after the summer program, however we view this as a plus. Among them six changed their major to Technology or Biology, each of which only requires Calculus I in their curriculum. The others changed the major to another college within JSU. These students learned they would rather pursue another major early in their college career, usually because of their academic struggles with Algebra and Trigonometry during the summer. We believe this is a plus for the student because they transfer to a major they enjoy more before lowering their GPA through poor academic performance in the math/physics/chemistry/engineering courses of an engineering curriculum.

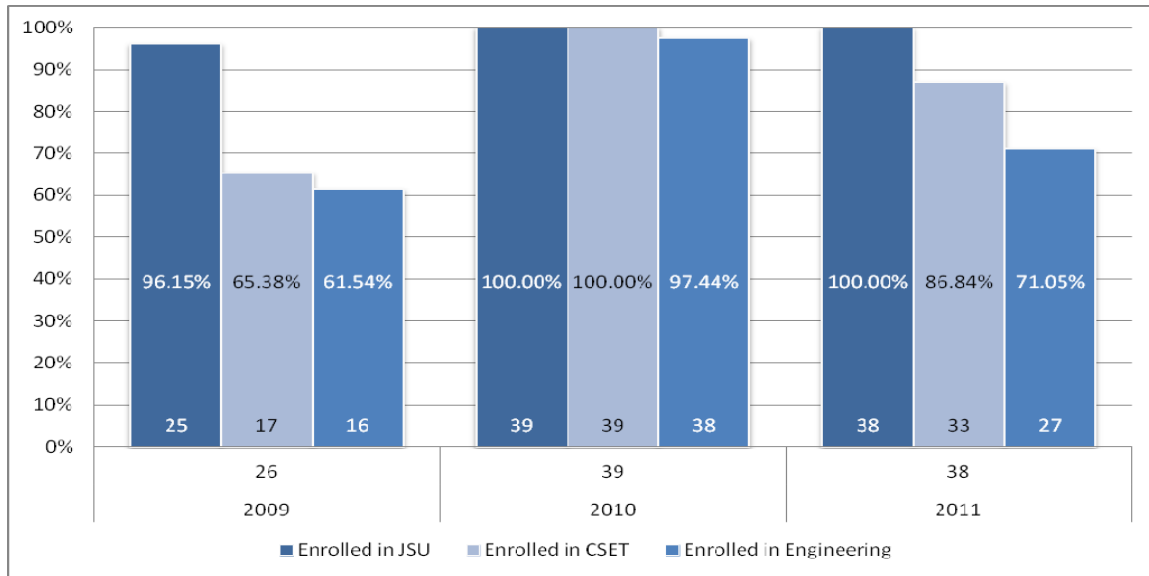


Figure 4. Enrollment Rate in JSU Fall Semester after SEEP

Performance in Calculus I, II and III.

After the SEEP participants finished their summer program, for those who enrolled with CSET departments, they started their series of mathematics courses in the regular curriculum for their major. The performance in Calculus I, II and III is illustrated in Figure 5 for engineering cohorts and Figure 6 for CSET cohorts. The not applicable group includes students who were enrolled in the course and dropped before the date for an official grade (including W), students who, after starting in an engineering major, later changed the major to an area not requiring the course or left the university, and students who may not have enrolled in the course.

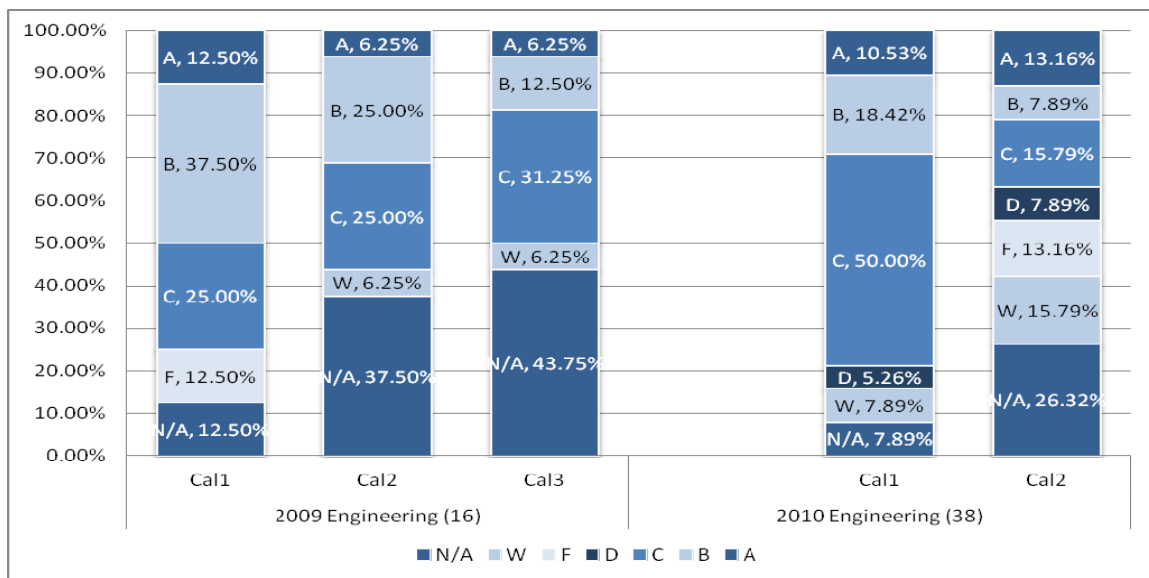


Figure 5. SEEP Engineering Cohort Performance in Calculus I, II and III

For the 2009 Engineering cohort of 16 students, 75.00% passed Calculus I, 56.25% passed Calculus II and 50.00% passed Calculus III with a C or above. For the 2010 Engineering cohort of 38 students, 78.95% passed Calculus I and 36.84% have passed Calculus II with a C or above.

For the 2009 CSET cohort of 17 students, 76.46% passed Calculus I, 52.94% passed Calculus II and 47.05% passed Calculus III with C or above. For the 2010 CSET cohort of 39 students, 76.92% passed Calculus I and 35.89% have passed Calculus II with a C or above. Some of the 2010 cohort students are taking Calculus II this current semester.

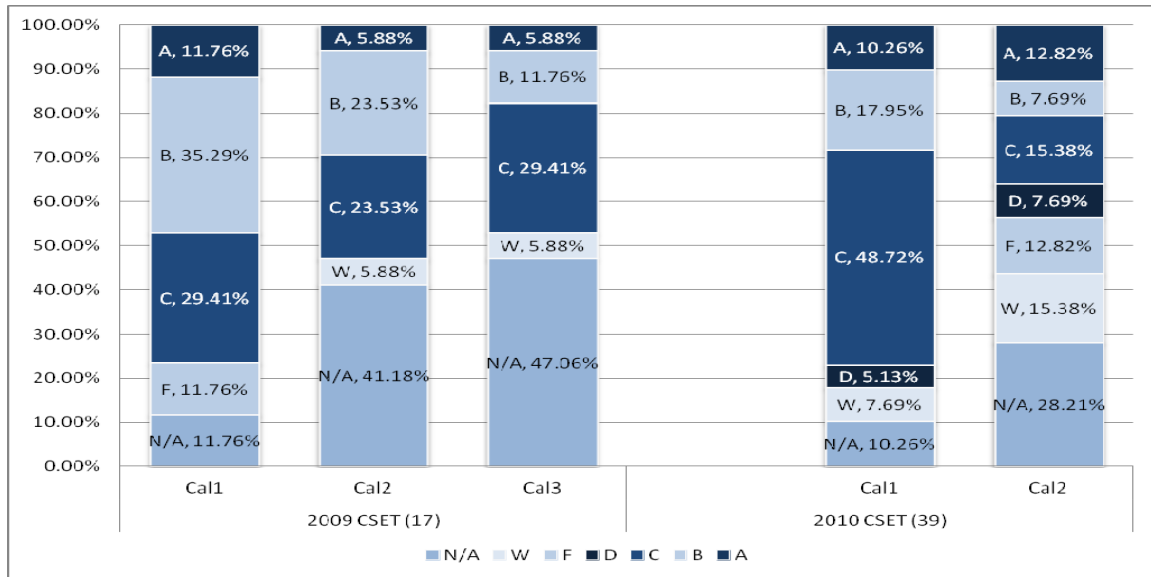


Figure 6. SEEP CSET Cohort Performance in Calculus I, II and III

Enrollment and performance of SEEP cohorts as of November 2011

Figure 7 illustrates the current enrollment status of each of the SEEP cohorts. It shows the percentage of each cohort

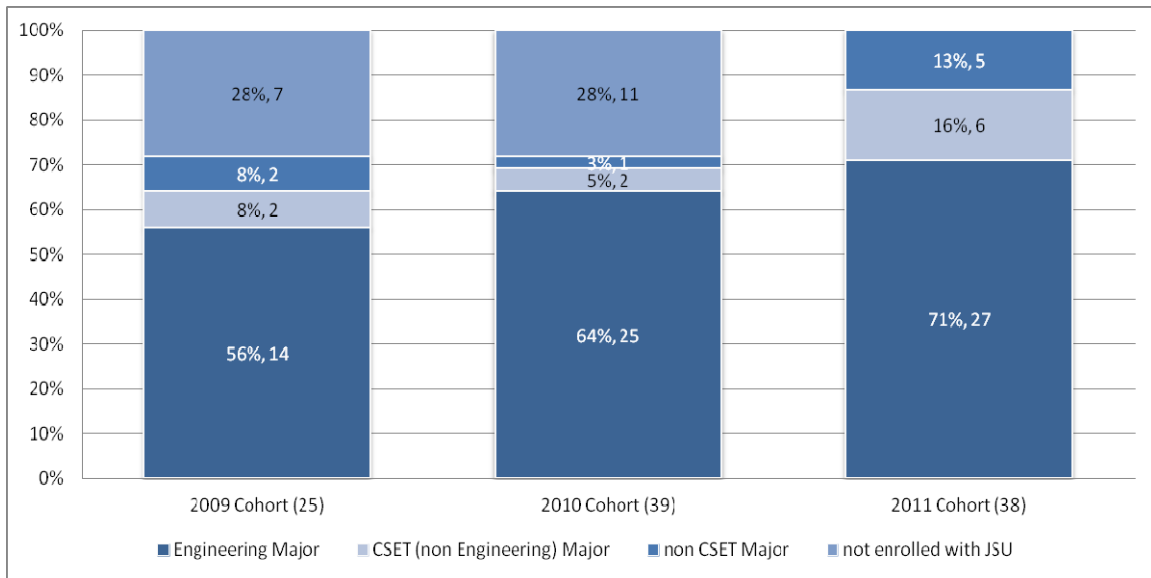


Figure 7. Current Enrollment Status of SEEP Cohorts

that are School of Engineering majors, other CSET majors (School of Science and Technology), non-CSET majors, and those currently not enrolled with JSU. Note that the sum of School of Engineering majors and School of Science and Technology majors is equal to the total number of STEM majors.

Figure 8 presents the summary of the up-to-date enrollment and performance data in calculus courses for all three SEEP cohorts of 2009, 2010 and 2011. It shows the percentage of each cohort that are enrolled with JSU, CSET and Engineering, as well as the percentage that have passed Calculus I, II and III with a grade of C or better.

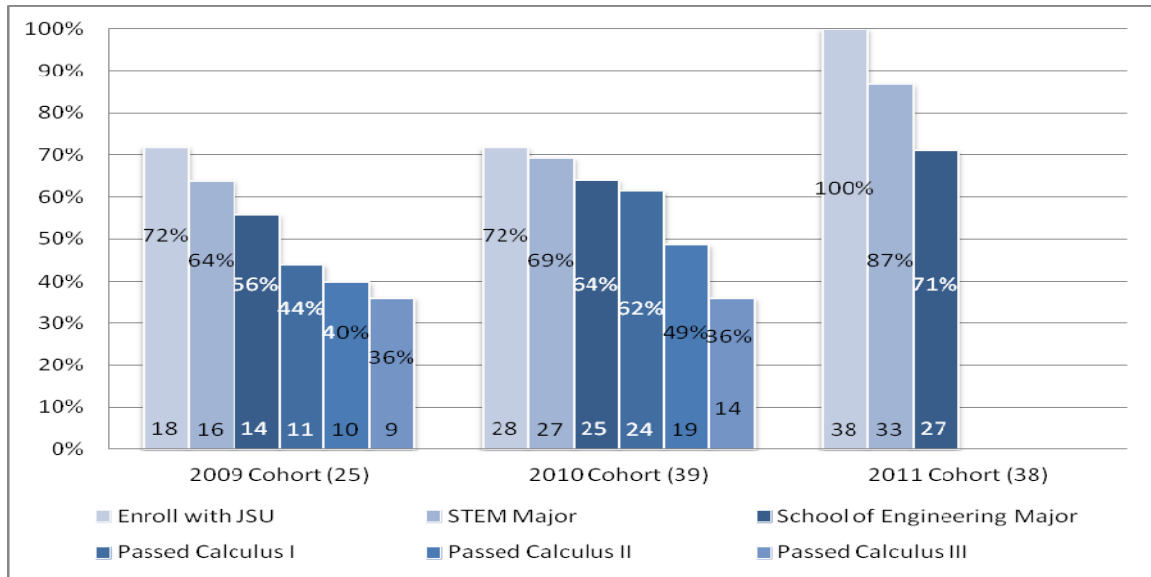


Figure 8. Performance Data of SEEP Cohorts Up-to-Date

Retention relative to historic data

The 1-year and 2-year retention rate for each SEEP cohort at Jackson State University (JSU), College of Science, Engineering and Technology (CSET), and School of Engineering is illustrated in Figure 9. It may appear strange that the two year retention rate for the 2009 cohort is higher than the one year retention rate for that cohort; however

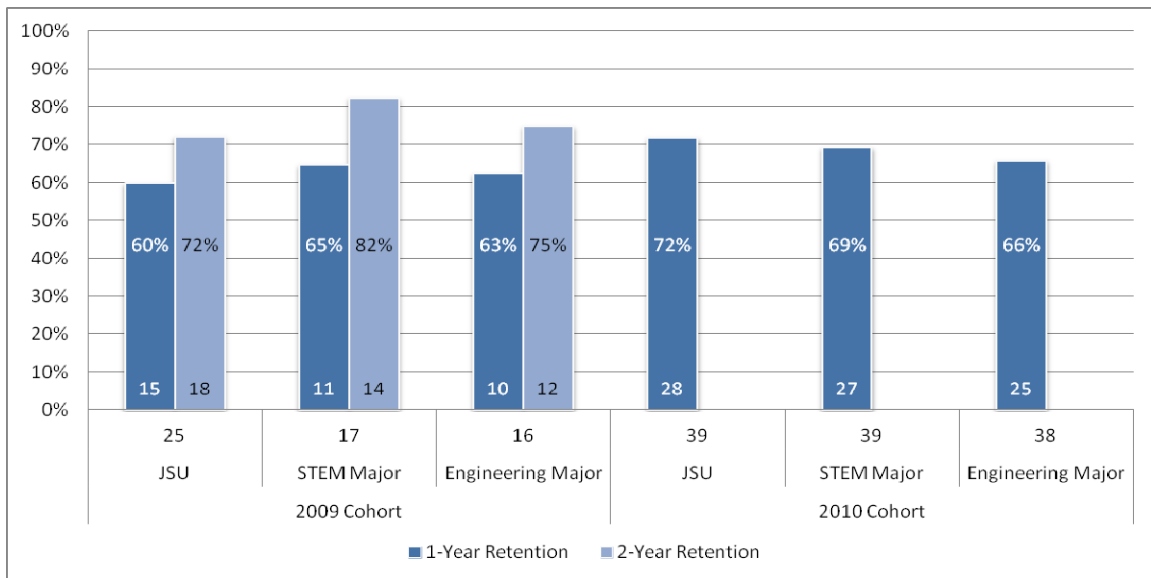


Figure 9. Retention Rate for SEEP Cohorts

this is exactly correct since two students who had left JSU after their first year, returned to JSU during the fall semester of their cohorts junior year.

Figure 10 illustrates the historical 1-year and 2-year retention data for first time freshman engineering majors with ACT MATH scores from 17-25 (identical to the ACT MATH scores for SEEP cohorts). Figure 10 also displays the 1-year and 2-year retention data for the 2009 and 2010 SEEP cohorts. SEEP cohorts do show an improvement of 10% to 20% in one year and two year retention in Engineering relative to the average retention data for the same year's entire cohort. When compared with the 1-year and 2-year retention data for the non-SEEP student in the 2009 and 2010 cohorts, the improvement in retention is from 10% to 30%. Another several years of one year and two year retention data are required, along with graduation data, to quantify the improvement in retention and graduation rates realized from the SEEP program. We fully intend to keep the program at its current level or higher until we accomplish quantifying the SEEP value and if results justify institutionalization of the program (as expected), we plan to make that happen.

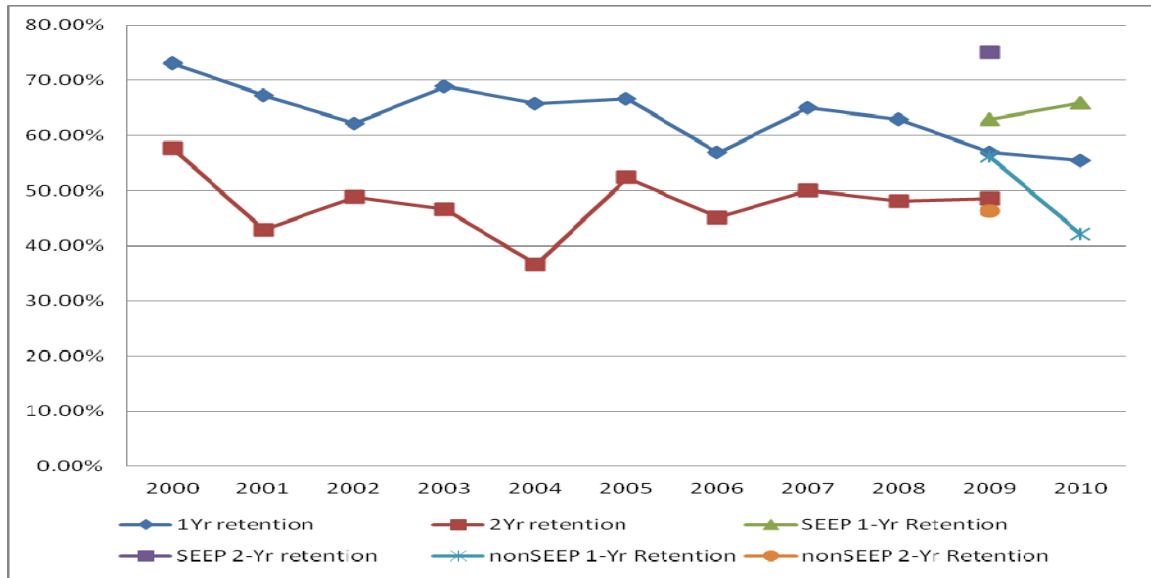


Figure 10. 1-year and 2-year Retention Rate for Engineering First-Time-Freshman with ACT Math 17-25

The historical graduation data for first time freshman in Engineering is illustrated in Figure 11. It shows the number

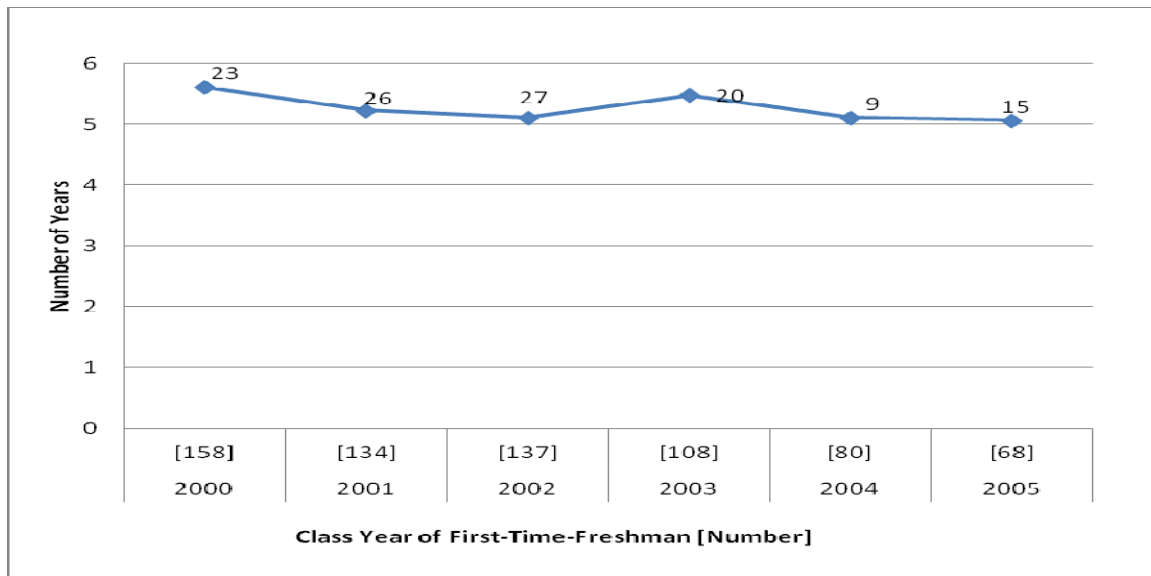


Figure 11. Average Number of Years to Graduate of Engineering First-Time-Freshman

of first time freshman each year from 2000 to 2005, and the number of students among them who graduated with a BS degree in a School of Engineering major. The average number of years taken to graduate for these students fluctuated between five to five and a half years. Our projected average time to graduate for a SEEP engineering cohort is about four and a half years or slightly less. If we are able to achieve this target, it has a significant impact on the output of engineering graduates, on decreasing education costs for the average engineering graduate and for enhancing student morale and enthusiasm.

CONCLUSIONS

A number of conclusions can be drawn from the assessment performed of the academic performance of our first three SEEP cohorts. Enrollment of the SEEP participants in JSU for the following fall semester is outstanding (102/103), and enrollment in a STEM major (89/103) is very satisfying. The student performance in Calculus I is somewhat gratifying at about 75%. The performance in Calculus II and Calculus III is a little less than we had targeted; however, we intend to place more attention on advising and tutoring during the academic year to try to enhance these performance data. The percent of each cohort that remain a School of Engineering major (as of today) is gratifying with a two year retention 75% for the 2009 cohort. We had hoped to achieve a one year retention in the 80%-90% range rather than the 60%-70% range achieved. Regardless, our one year and two year retention rate are nominally 10% to 30% higher than our historical rate. We project that the graduation rate should be double that for first time freshman with comparable ACT Math scores that do not participate in the SEEP program. We are highly encouraged by the preliminary assessment data and are confident that graduation data will validate the value of this program which we believe represents an outstanding investment for the nation.

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