

Summer Enrichment Program to Enhance Retention

Robert W. Whalin¹

Qing Pang²

Abstract – Engineering departments in Historically Black Colleges and Universities (HBCUs) typically provide admission to incoming freshmen with a wide range of ACT/SAT scores, reflecting a variety of college preparedness levels. The attrition rate is high for underclassmen in engineering majors at Jackson State University. A major barrier causing engineering underclassmen to transfer to another major is that they face challenges passing Calculus I and Calculus II, pre-requisite courses for almost all core courses in any engineering curriculum. To help resolve the attrition challenge and enhance retention and graduation rates, a Summer Engineering Enrichment Program (SEEP) was initiated in 2009. The Summer Engineering Enrichment Program is designed to prepare First-Time-Freshmen School of Engineering majors with sufficient mathematics knowledge to succeed in Calculus I, provide an acclimation to college life, provide an introduction to engineering careers and promote self confidence. Design and implementation of the Summer Engineering Enrichment Program is presented with results to date.

Keywords: retention; graduation rate; ACT; summer program;

BACKGROUND

Jackson State University (JSU), a Historically Black College and University (HBCU) where 92% of students are African American, offers admission to students with a wide range of academic preparation, resulting in a wide range of ACT scores for First-Time-Freshmen. The School of Engineering of Jackson State University consists of three departments (Civil and Environmental Engineering, Computer Engineering, and Computer Science) that offer BS degrees in Civil Engineering, Computer Engineering, Computer Science and Telecommunications Engineering and MS degrees in Computer Science and in Engineering. Any student admitted to JSU can choose to major in a School of Engineering discipline. ACT National Report 2010[1] shows while the nationwide average of ACT Composite scores remains within range 21.0 and 21.2 from 2006-2010, the average ACT Composite of African American students is within 16.9 and 17.1, which is about 4 points lower. Relative to College Readiness Benchmarks for 2010, 24% of ACT-tested high school graduates meet all four ACT College Readiness Benchmarks (English, Reading, Mathematics and Science). Four percent of African American high school graduates meet all four benchmarks. In Mathematics, 13% of African American high school graduates meet the College Readiness Benchmark for Mathematics, while 52% for Caucasians and 68% of Asia Americans meet this benchmark.

According to the ACT State readiness report for Mississippi [2], more than 96% of high school graduates take the ACT. From 2006~2010, the average of ACT Composite scores of Mississippi test takers is within 18.8 and 18.9, about 2.2 points lower than the national average. In year 2010, 10% of Mississippi high schools met all four ACT College Readiness Benchmarks, compared to 24% nationwide. For Mathematics, 20% of Mississippi high school graduates meet the College Readiness Benchmark for Mathematics, while the percentage is 43% nationwide.

A majority of Jackson State University's students is African American and are from Mississippi. As illustrated in Figure 1, the average ACT score of First-Time-Freshmen in School of Engineering from year 2000 to year 2010 varied between 17.6 and 20.1 for ACT Math, and between 18.0 and 20.6 for ACT Composite. Those scores, though noticeably increasing with time, are considerably lower than the national average. ACT scores reflect the students'

¹ Associate Dean and Professor of Civil Engineering, College of Science, Engineering & Technology, Jackson State University

² Research Associate, Center for Defense Integrated Data, College of Science, Engineering & Technology, Jackson State University

readiness for college. It is obvious that the level of readiness for college education of the incoming First-Time-Freshmen to the School of Engineering at Jackson State University is significantly lower than the average level of the First-Time-Freshmen in engineering schools nationwide. The challenge is to provide appropriate education to this student population, maximize the graduation rate for First-Time-Freshmen engineering majors, and prepare the graduates for successful engineering careers and/or successful graduate matriculation nationwide.

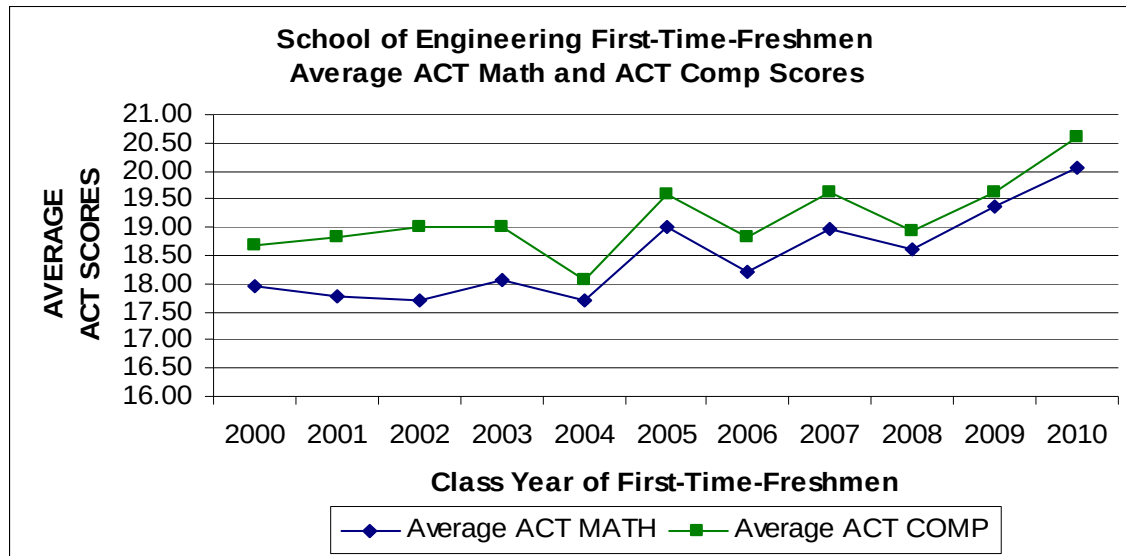


Figure 1. Average ACT Math Score

CHALLENGE

We believe the School of Engineering at Jackson State University has succeeded in nurturing its incoming student group with relatively low ACT scores and graduating competitive, successful and confident engineers. A total of 237 B.S. degrees were awarded from 2005 – 2010. Among those 237 students, we have official records of the ACT Math score for 184 students and the ACT Composite score for 188 students. The ACT Scores of most transfer students are missing. These students were admitted on the basis of their college record (community college or 4 year institution) and no records are maintained of their ACT/SAT scores. Based on the ACT score information available, the average ACT Math score for students awarded B.S degrees is 20.2, and average ACT Composite score is 20.4. In Figure 2 and Figure 3 show the number of students awarded B.S. degrees versus the ACT Math and ACT Composite scores they reported upon admission to Jackson State University. School of Engineering students awarded B.S. degrees had ACT Math scores between 12 and 32, and a majority of them – around 70% entered Jackson State University with ACT scores from 17 to 25. Almost all are performing well (personal communication with employers, alumni and graduate school professors) in engineering positions or in graduate or professional school. We currently have contact with 67% of our engineering alumni.

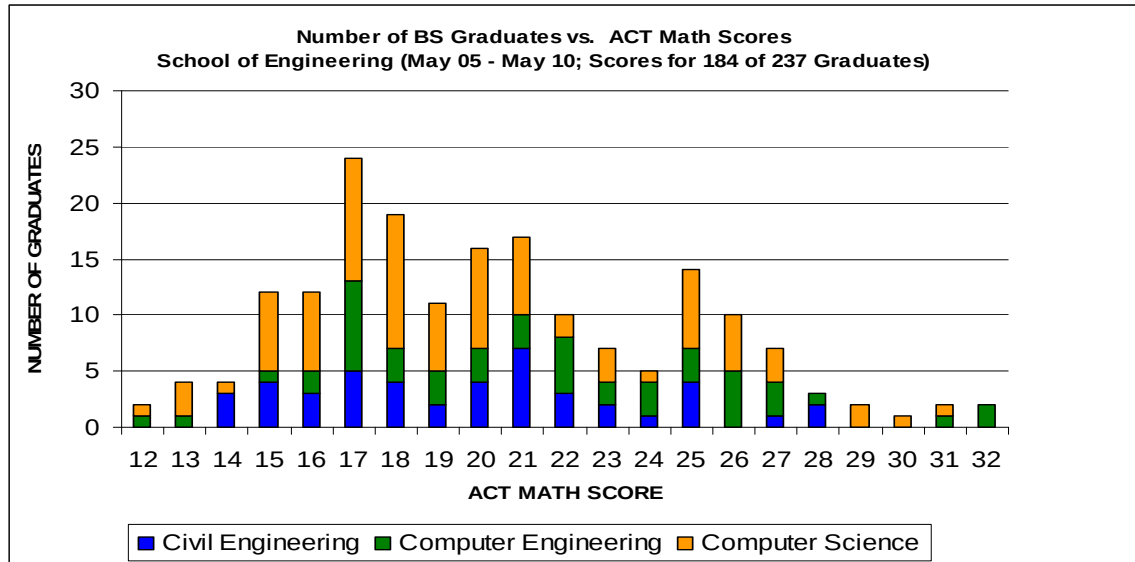


Figure 2. Number of BS awarded vs. ACT Math

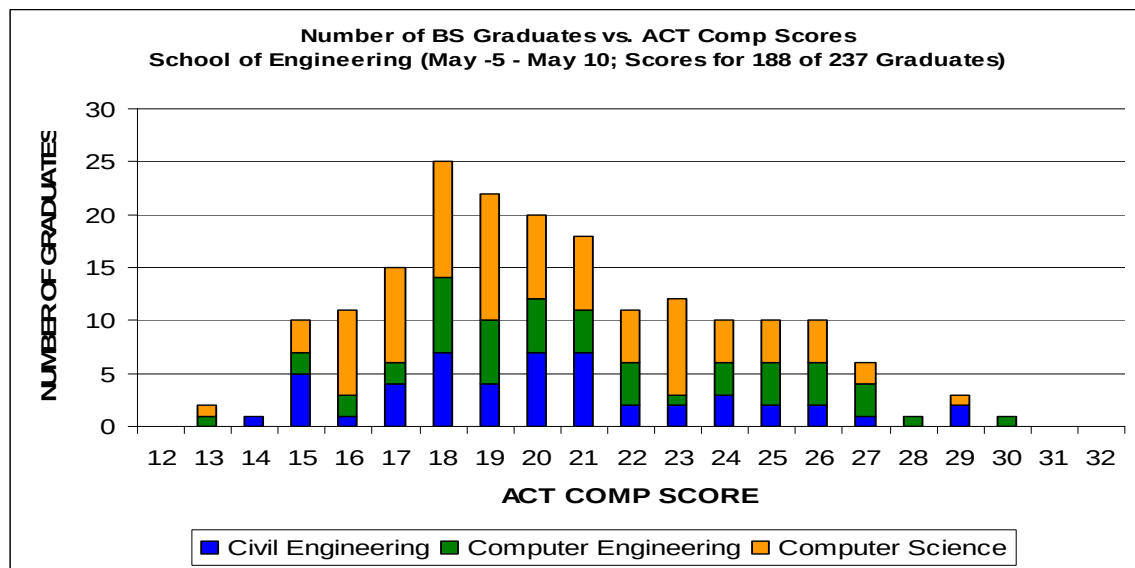


Figure 3. Number of BS awarded vs. ACT

Despite those accomplishments, we are facing a serious challenge. The historical attrition rate from a School of Engineering major for the past decade is high for First-Time-Freshmen. The retention rate and graduation rate of School of Engineering majors needs to be increased. Figure 4 shows the graduation rate for the group of students who entered the School of Engineering at Jackson State University as First-Time-Freshmen, in academic years 2000 through 2004. The graduation rate from the original major fluctuates between 8.75% and 19.71%; the graduation rate with a School of Engineering major fluctuates between 8.75% and 21.17%; the graduation rate from the College of Science, Engineering & Technology fluctuated between 13.75% and 36.72%, and the graduation rate from Jackson State University fluctuated between 26.47% and 47.47%. The attrition rate is high – 8 out of 10 students initially enrolled in the School of Engineering did not graduate with a BS degree in a School of Engineering major.

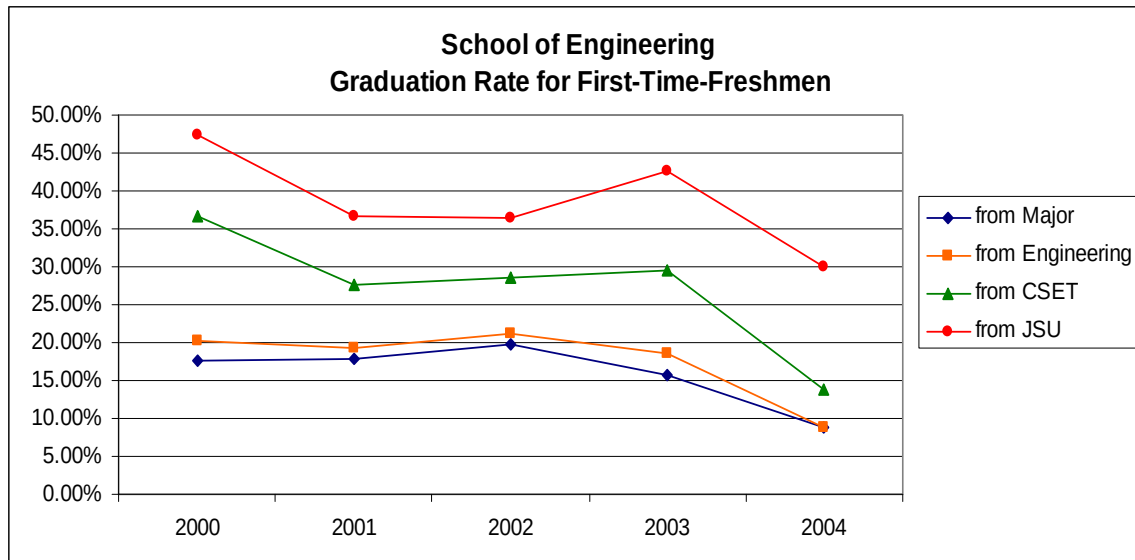


Figure 4. Graduation Rate

Figure 5 shows the 4-8 year graduation rate from the School of Engineering for the group of students who entered the School of Engineering at Jackson State University as First-Time-Freshmen in each academic year, from 2000 through 2006. It shows that most students, if they received their BS from a School of Engineering department, complete their education within 6 years. Few additional students received their degrees in 7 or 8 years. As demonstrated in Figure 4, Figure 5 also shows that the graduation rate from the School of Engineering is 20% or less, which we consider low and calls for a sustained effort to improve.

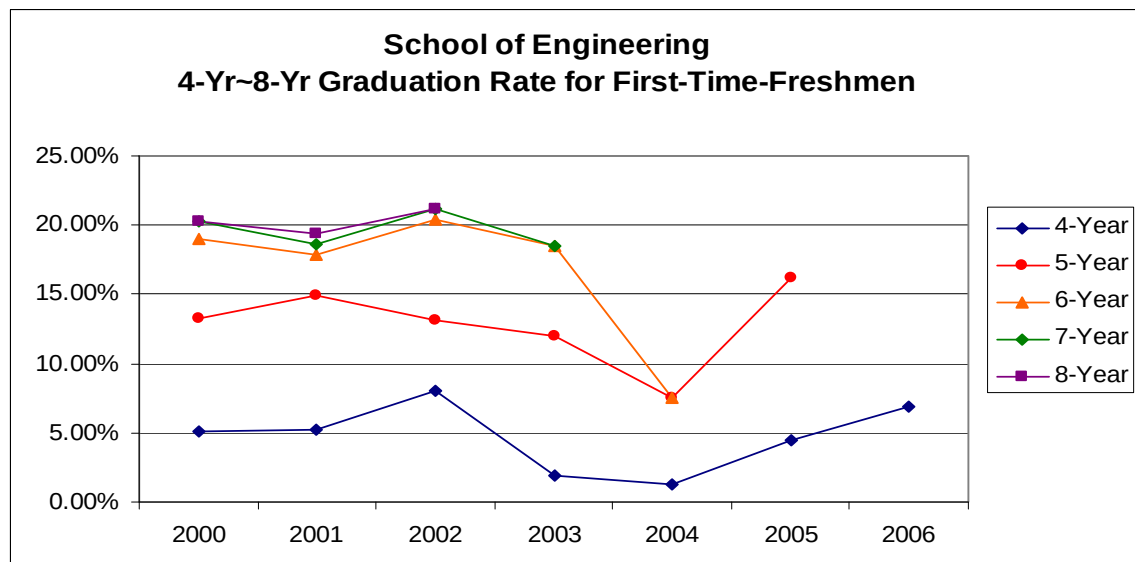


Figure 5. 4-8 Year Graduation Rate for First-Time-Freshmen

ANALYSIS

Analysis of the retention has been performed for First-Time-Freshmen School of Engineering majors at Jackson State University. As shown in Figure 6, the 1-year retention rate in School of Engineering departments has been around 60% and the 2-year retention rate has been around 40%, for the group of First-Time-Freshmen in School of

Engineering majors from 2000 through 2009. By the end of 2nd year, approximately 60% of the First-Time-Freshmen have either transferred to another major or left the university. Further investigation of the curriculums within the School of Engineering shows that for the first two years, the majority of technical courses taken by students are mathematics, physics (Calculus I, II and III, and/or prerequisites College Algebra and Trigonometry, calculus based Physics I and II and Laboratories), chemistry and a few general engineering courses. Students with ACT Math scores of 25 and below are required to take a 5 hour College Algebra and Trigonometry course before proceeding to Calculus I. Students with ACT Math scores below 17 must take one or two developmental mathematics courses plus both College Algebra and Trigonometry or the five hour combined College Algebra and Trigonometry course. One major challenge causing attrition (in first two years) is passing required mathematics courses, which are the prerequisites of almost all engineering courses in the curriculum. Students who have challenges passing Calculus I and Calculus II, can not proceed ahead to take most engineering courses in their curriculum. Mathematics has been such big challenge to those students that most of them (with low ACT Math scores), loose confidence and start to think engineering is not for them. They transfer to other majors with less mathematics requirements, or even depart the university.

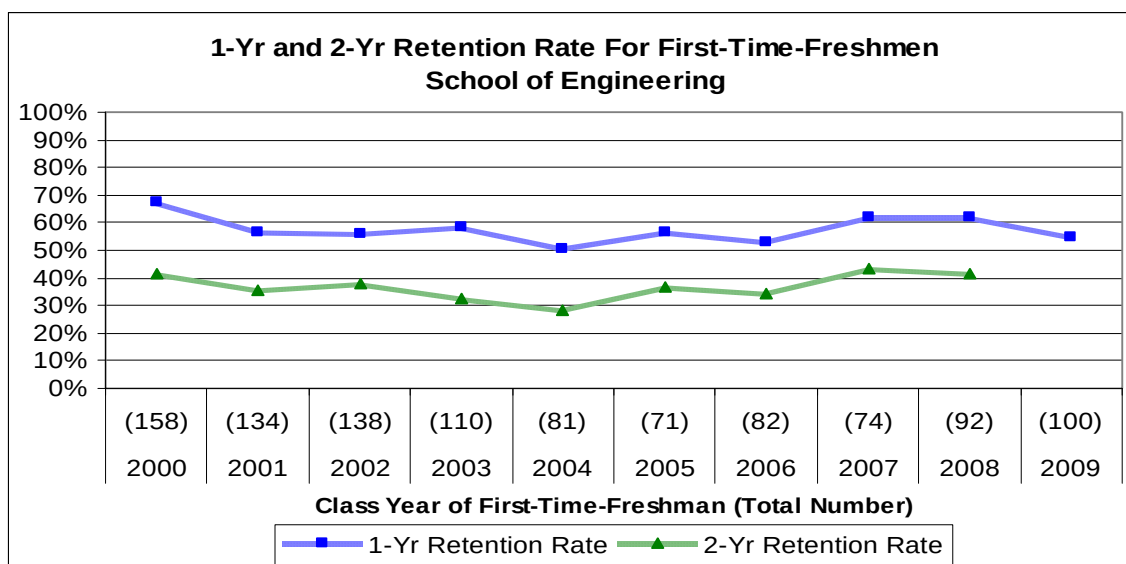


Figure 6. 1Year/2Year Retention Rate

Further research has been carried out to investigate the relationship between students ACT Math scores and their performance. It substantiates that ACT Math scores, reflecting incoming students' mathematics preparation level, are strongly related to student performance for School of Engineering majors.

We divided the first-time-freshmen into two groups – one group with ACT Math scores lower than 17, and the other group with ACT Math scores equal of larger than 17. This score was chosen because students making less than 17 must take one or more developmental mathematics classes before enrolling in College Algebra and Trigonometry. Figure 7 plots the 1-year retention rate for those two groups of First-Time-Freshmen, from 2000 through 2009. It shows that the 1-year retention rate of those with ACT Math score below 17 fluctuates between 28.57% and 54.17%, while the 1-year retention rate of those with ACT Math scores equal to or higher than 17 fluctuates between 57.69% and 72.22%. The difference in the 1-year retention rate of those two groups ranges between 11.54% and 37.28%, with an average of 21.64%. Consequently, the ACT Math score is strongly related to the 1-year retention rate for School of Engineering departments.

Figure 8 plots the 2-year retention rates for the two groups of First-Time-Freshmen with different ACT Math scores, from year 2000 through 2008. It shows that the 2-year retention rate of those with ACT Math scores lower than 17 fluctuates between 18.75% and 33.33%, while the 2-year retention rate of those with ACT Math scores equal to or higher than 17 fluctuates between 35.59% and 55.56%, The difference of the 2-year retention rate of those two groups ranges between 14.87% and 36.25%, with an average of 23.66%. Again it shows a strong correlation between ACT Math score and 2-year retention rate for these two groups of School of Engineering majors.

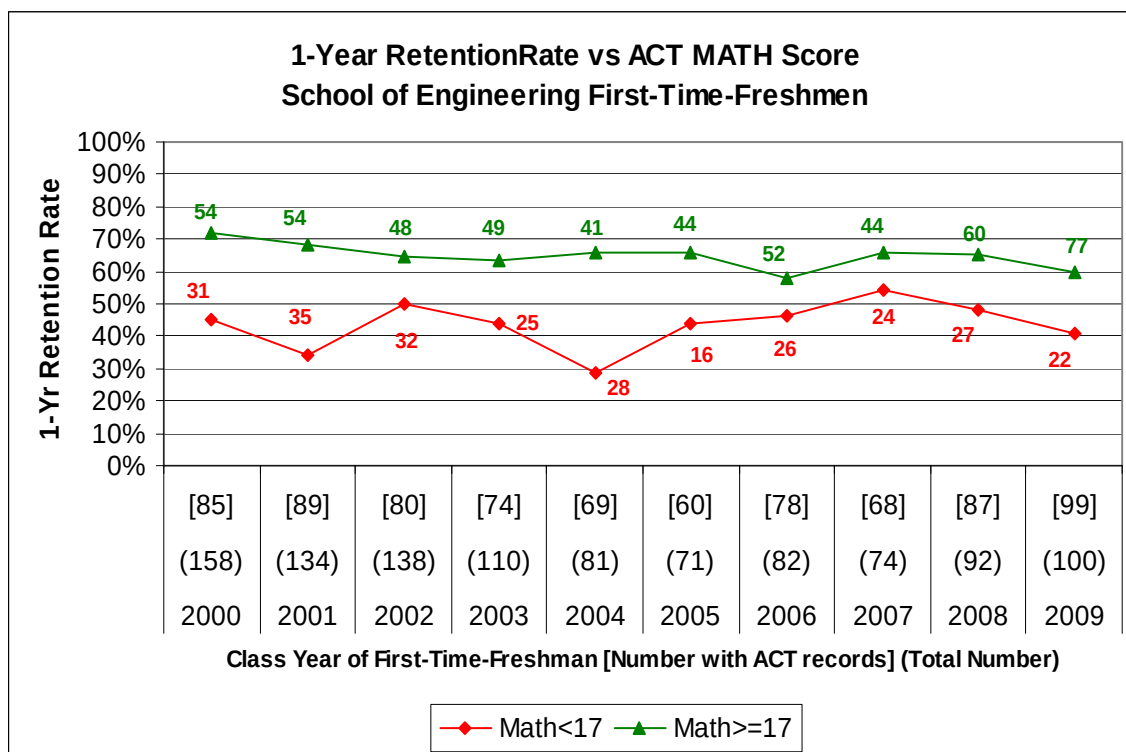


Figure 7. 1-Year Retention Rate vs. ACT Math

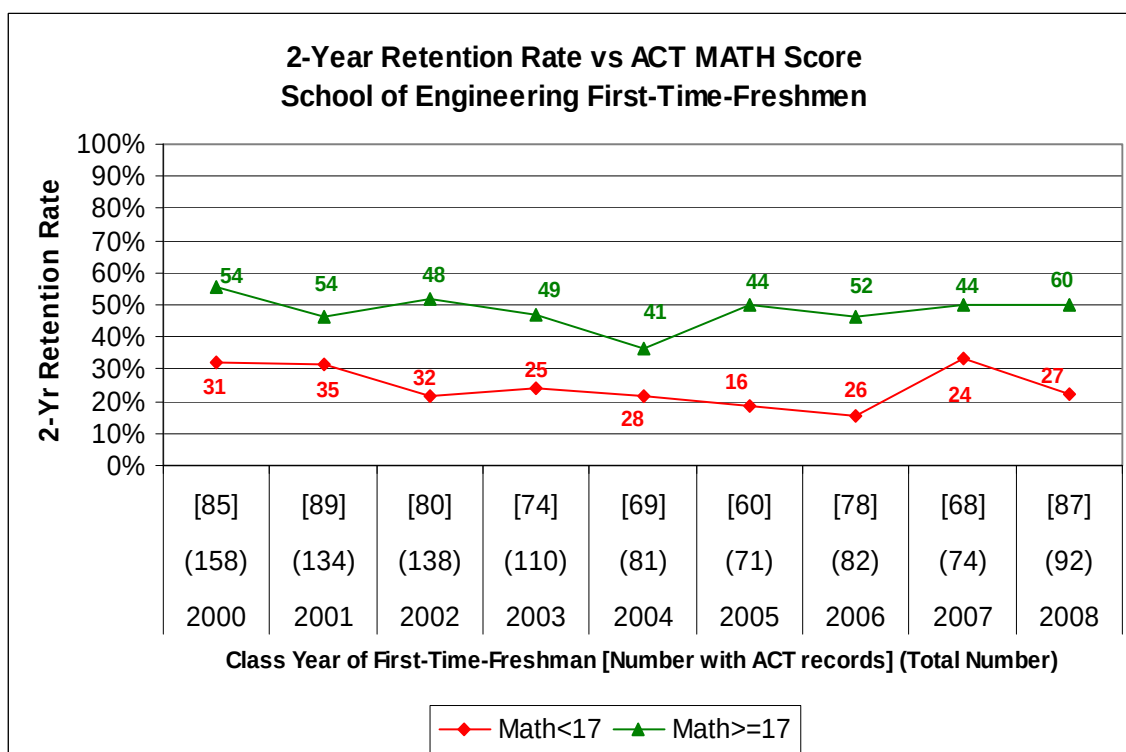


Figure 8. 2-Year Retention Rate in Engineering vs. ACT Math

Similarly, Figure 9 shows the graduation rate of the two groups of students. The graduation rate of students with ACT Math scores equal to or higher than 17 is significantly higher than the graduation rate of the other group.

All the research presented above leads to the conclusion that students' mathematics preparation level, represented by their ACT Math score, is strongly correlated to the retention and graduation rate of School of Engineering majors. It is essential to improve JSU First-Time-Freshmen School of Engineering majors mathematics preparation level, so that they are better prepared and more confident, before embarking on the series of mathematics courses required in an engineering curriculum.

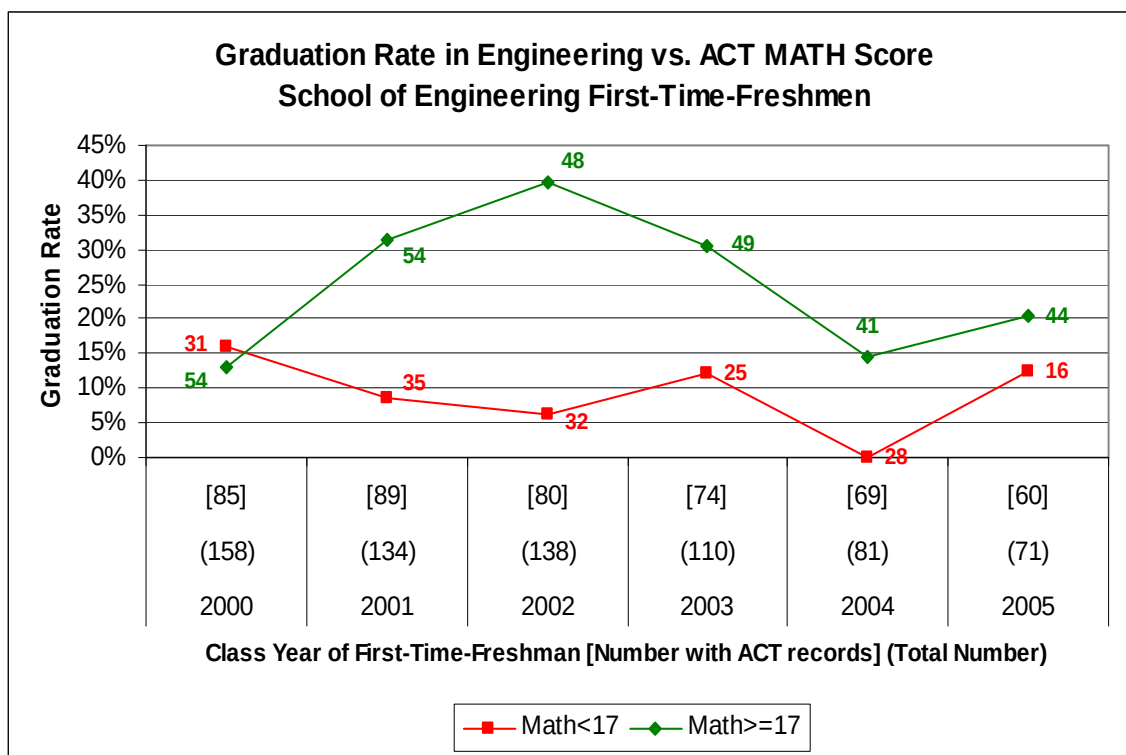


Figure 9. Graduation Rate in Engineering vs. ACT Math

THE EFFORT – SUMMER ENGINEERING ENRICHMENT PROGRAM (SEEP)

Based on the previous analysis, Jackson State University, School of Engineering devised a Summer Engineering Enrichment Program (SEEP) with the objective of significantly increasing the graduation rate and the one and two year retention rates for School of Engineering First-Time-Freshmen. The Summer Engineering Enrichment Program takes in First-Time-Freshmen accepted for admission to Jackson State University with a major in the School of Engineering and with ACT Math scores from 17 to 25, because 70% of our graduates are in this group and we want to significantly increase the graduation rate for this group of students. Students with ACT Math scores of 26 and above are enrolled in Calculus I for the fall semester since they already have adequate mathematics preparation to succeed. Students with ACT Math scores below 17 must take one or two developmental mathematics courses before enrolling in College Algebra or Trigonometry.

SEEP students are enrolled in College Algebra (3 hours) during the first Summer Term (4 weeks) and in Trigonometry (3 hours) during the second Summer Term (4 weeks). The courses are taught by full Professors in the JSU Mathematics Department. Graduate student tutors attend the morning classes and are available to tutor students during a three hour afternoon open computer laboratory study session. Students can use the laboratory for evening study if desired. The laboratory is located in the Engineering Building, enhancing the students sense of belonging to

the School of Engineering. A non-credit Introduction to Engineering course is offered one hour a day four days a week during the first summer term. Classes are taught four days a week and an all day fieldtrip to engineering employers is planned every Friday. 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.

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 consist solely of incidental expenses. SEEP participants are in dormitories with their student peers and have the opportunity to acclimate to college life while only taking one course per summer term. Should the student decide engineering is not for them, they can make that decision relatively early in their college career and transfer to another major that is less stressful from the mathematics perspective.

All students are enrolled in fall courses at the beginning of the second Summer Term after meeting with a faculty advisor from their respective Department in the School of Engineering. These First-Time-Freshmen view themselves as veteran college students when the fall semester begins, rather than students living a new experience for the first time. All successful SEEP students are enrolled in Calculus I for the fall semester and begin their 128 hour School of Engineering curriculum on a 4 year path to graduation at 16 hours per semester.

Our objective with the summer program is to substantially increase the percent of First-Time-Freshmen students in the 17-25 ACT Math score category that graduate within six years. Additionally, we project that an ancillary benefit will be to graduate these students in a nominal 5 year period rather than the current nominal 6 year period. We are confident we can double the nominal graduation rate for these students and our stretch goal is to achieve a graduation rate of 65% or more for the students, which would more than triple our graduation rate.

To date, we have had two SEEP summer cohorts (2009 and 2010). Information from the two cohorts is shown in Table 1.

	SEEP 2009 Cohort	SEEP 2010 Cohort
Total	26	39
Passed College Algebra with C or better	26	39
Passed Trigonometry with C or better	21	39
Enroll at JSU in Fall semester after SEEP	24	39
Currently(Jan, 2011) remain in JSU	24	36
Currently(Jan, 2011) remain in College of Science, Engineering and Technology	17	35
Currently(Jan, 2011) remain in School of Engineering	11	34
Completed Calculus I with C or better	12	30
Completed Calculus II with C or better	11	N/A

Table 1. SEEP 2009 and 2010 Cohort

Final grades for the Fall semester 2010 will be presented at the Conference. This program has been authorized (and expanded) by the Department of Education for another five years. We plan for 40 SEEP students each summer for the next five years and our objective is to reach a graduation rate of 65% by that time. We are fully confident of attaining at least a 50% graduation rate for this group (ACT Math scores between 17 and 25) of First-Time-Freshmen students. This program will help propel and maintain JSU as a top ten university in the production of

African American engineers by more than doubling the number of BS graduates and should serve as a model for increasing the number of US citizen engineers graduating from United States universities.

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REFERENCES

- [1] "The Condition of College & Career Readiness 2010", ACT National Report.
- [2] "Mississippi - The Condition of College & Career Readiness, class of 2010", ACT State Readiness Report.

Dr. Robert W. Whalin

Associate Dean and Professor of Civil Engineering, College of Science, Engineering & Technology, Jackson State University. He received his PhD in Oceanography from Texas A&M University in 1971 and he is a Registered Professional Engineer. He was Director of Army Research Laboratory (1998-2003 Adelphi, MD), and Director of Waterways Experiment Station (1992-1998 Vicksburg, MS). He has authored/co-authored over a hundred technical papers and reports. His current research interests are nearshore wave transformations, coastal structures, tsunami inundation, hurricane surges, and engineering education.

Qing Pang

Ms Qing Pang is Research Associate in the Department of Computer Engineering, School of Engineering, College of Science, Engineering & Technology, Jackson State University. She earned her MS in Electrical and Computer Engineering from Georgia Institute of Technology in 2000. She worked for several private companies before joining Jackson State University in 2007. Her current research interests are robotics, wireless sensor networks, signal processing, embedded software and engineering education.