

Increasing Enrollment of First-Time-Full-Time Freshman (FTFTF) in STEM Majors

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Abstract – Among high school students in the State of New Jersey and the United States there is an inadequate quantity of student graduating from high schools interested in pursuing degrees in engineering as well as the physical sciences, mathematics and some areas of technology. Of the 2006 New Jersey college bound seniors taking the SATs only 6% stated that their intended major was engineering and engineering technologies; for the United States, it was 8%. Multiple reports including the those of the U.S. Department of Education, National Center on Education and the Economy, and the National Academies of Sciences and Engineering found that there is a critical and urgent economic, health and security need to significantly expand the pipeline of students interested in the sciences, technology, engineering and mathematics (STEM) professions. New Jersey Institute of Technology (NJIT) has a long track record of aggressively recruiting more students to the STEM disciplines, particularly among the populations who have been historically underrepresented, women and minorities. NJIT does so through pre-college programs, joint admission programs with academy high schools, transfer/articulation agreement with community colleges, educational opportunity programs as well as a honors colleges. A new initiative, the APT to Succeed Program was begun fall 2006 to enroll students who traditionally would not be admitted into these majors at NJIT based on their high school transcript without the NJIT “average” SAT scores being a barrier to admission. The APT Program included a reduced student course load, a dedicated cohort advisor, mandatory tutoring and participation in “Wintersession.” Initial data analysis indicates these students have succeeded beyond expectations, and possibly beyond the performance of “regularly” admitted students who have NJIT average SATs.

In New Jersey and the United States there continues to be a decline in the number of students graduating from high school who are selecting science, technology, engineering as a major. A spate of national reports: “Rising Above the Gather Storm,” by the National Academies of Sciences and Engineering, and Institute of Medicine [1]; “Tough Choices or Tough Times,” by the National Center on Education and the Economy [2]; and, “A Test of Leadership, Charting the

Future of U.S. Higher Education,” by the U.S. Department of Education [3], concluded that the United States no longer leads the major industrialized countries in higher education attainment, particularly in the STEM fields.

In New Jersey, during the past decade there has been a decline from approximately 8.5% to 6% of students indicating engineering as an intended major upon taking the Scholastic Achievement Tests (SATs) [4]. This is further compounded by national retention rate of less than 50% of those students who enroll as engineering majors. Through the establishment of pipeline pre-college programs which yield over 10% of the entering freshman class, and the development of academic and co-curricular support and individual student intervention programs, NJIT has increased its freshman to sophomore retention rate to about 83%, a 10% increase over the past decade. Its graduation rate has increased by over 20% to 57%, well above the national average. NJIT is frequently recognized as being among the top 20 U.S. universities in graduating minority engineers with bachelors of science degrees.

In order to expand the entering pool of first-year students, NJIT has developed and is piloting its APT to Succeed Program, commonly referred to as APT. The program builds upon lessons-learned in the research literature, for example the longitudinal studies of E. Seymour and N. Hewitt (1997) [5], K. Cross (1993) [6] and A. Astin (1993) [7] as well as NJIT’s own program evaluation studies. Both the research literature and NJIT research have found that when “help” is available to students they are more often successful and retained.

The APT program design included:

>A targeted student population of SAT combined average scores in critical reading and mathematics of between 800-950 (approximately 200 points less than the average university SAT); a HS GPA of B or better, or rank in the top 25% of the graduating class; completion of a minimum of 3 years of math with an average grade of B; teacher or guidance counselor recommendation; and an optional personal interview.

>Students were admitted and enrolled in 9-11 credit hours in the fall semester, and enrolled a “Winter-Session” course for

an additional 3 credits. Winter-Session had been piloted for a prior three year with highly successful results for students who either wanted to accelerate their studies or decided to retake a course due to the lack of mastery.

Winter-Session is a 5 week period during the winter break with students taking 15 hours of a class which is comparable to a regular semester. This total of credits, 12 or more including Wintersession allows the student to be eligible for state and federal financial aid for the full academic year.

>Students were organized as a “cohort” with their own academic counselor, participate in prescribed tutorials and interventions based on the monitoring of test results early in the academic year; and, with signed waivers from the students, parents were also kept informed.

>Students were initially enrolled in a limited number of majors including engineering science and information technology.

>If students performed well during the fall and winter-sessions, they registered for 12 or more credit hours during the spring 2006 semester.

The students were tracked throughout the fall and winter-sessions, the preliminary statistical results, faculty, advisor and student feedback was highly positive . When comparing cumulative GPAs, grades in remedial/developmental and 100-level courses of the 40 APT students with those of regularly admitted students, Educational Opportunity Program (EOP) students and Honors students, the APT students out-performed the regularly admitted (See the attached “Freshman Analysis by Category.”).

Overall, the APT students had a higher fall semester GPA, 2.48 when compared to regularly admitted students (2.35 GPA). When comparing APT students in remedial /developmental courses (math and English) with regularly admitted students the GPAs were 2.64 and 2.41, respectively. For the 100 level courses typically taken by freshmen students, again the APT student out-performed the regularly admitted students.

For continuing study, these students will be tracked and the data analyzed at the end of the spring '07 semester, through to graduation and compared with the entering student class. In addition, on-going data collection through student and faculty surveys and focus groups will be analyzed to determine the relationship between the **help** the students received and their retention through to graduation.

Using the preliminary results from the fall 2006 cohort, an increased fall 2007 freshman APT cohort is being planned in order to increase the overall FTFTF enrollment in STEM majors.

Freshman Analysis by Category
(EOP, APT, Honors, Regular for Fall semesters 2004-2006)

Comparison of Cumulative GPA

Groups	Count	Average	Variance
APT	40	2.48	0.955
EOP	385	2.41	0.749
Honors	406	3.26	0.428
Regular	1274	2.35	0.767

ANOVA

Source of Variation	SS	df	MS	F	P-value
Between Groups	260.433439	3	86.8111464	123.71526	<.0001
Within Groups	1474.27416	2101	0.70170117		
Total	1734.7076	2104			

Conclusion: At least one of the groups is significantly different from the others in terms of GPA.

t-test	Mean Diff.	t-Value	P-Value	
APT, EOP	0.069	0.475	0.6348	
APT, Honors	-0.776	-6.801	<.0001	Significant
APT, Regular	0.129	0.915	0.3604	
EOP, Honors	-0.846	-15.547	<.0001	Significant
EOP, Regular	0.06	1.179	0.2385	
Honors, Regular	0.905	19.196	<.0001	Significant

Comparison of Cumulative Total SAT

Groups	Count	Average	Variance
EOP	252	1012	12104.4141
Honors	308	1290	10286.1405
Regular	900	1112	8798.8109

ANOVA

Source of Variation	SS	df	MS	F	P-value
Between Groups	11633957	2	5816978.51	600.82427	<.0001
Within Groups	14106184.1	1457	9681.66374		
Total	25740141.1	1459			

Conclusion: At least one of the groups is significantly different from the others in terms of SAT.

(APT ignored since only 3 SAT scores are available)

t-test	Mean Diff.	t-Value	P-Value	
EOP, Honors	-277.594	-31.014	<.0001	Significant
EOP, Regular	-100.116	-14.397	<.0001	Significant
Honors, Regular	177.478	28.064	<.0001	Significant

Comparison of Average Grades in 09X Level Courses

Groups	Count (Grades)	Average	Variance
APT	54	2.51	1.703
EOP	365	2.47	1.247

Honors	14	2.96	2.094
Regular	771	2.48	1.595

ANOVA

Source of Variation	SS	df	MS	F	P-value
Between Groups	3.289	3	1.096	0.715	0.5433
Within Groups	1841.26	1200	1.534		
Total	1844.549	1203			

Conclusion: There is no significant difference between various groups for grade points in 098/099 crs.

Comparison of Average Grades in 100 Level Courses

Groups	Count (Grades)	Average	Variance
APT	88	2.64	1.385
EOP	2567	2.36	1.590
Honors	3103	3.26	0.918
Regular	9447	2.41	1.615

ANOVA

Source of Variation	SS	df	MS	F	P-value
Between Groups	1819.3	3	606.44	413.17	<.0001
Within Groups	22311.6	15201	1.468		
Total	24130.9	15204			

Conclusion: At least one of the groups is significantly different from others in terms of avg. grade in 100 level courses

t-test	Mean Diff.	t-Value	P-Value	
APT, EOP	0.282	0.257	0.0319	Significant
APT, Honors	-0.618	0.257	<.0001	Significant
APT, Regular	0.228	0.254	0.0785	
EOP, Honors	-0.9	0.063	<.0001	Significant
EOP, Regular	-0.054	0.053	0.0469	Significant
Honors, Regular	0.846	0.049	<.0001	Significant

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