EVALUATION OF RETENTION FACTORS AT AN URBAN, PUBLIC UNIVERSITYY IN THE U.S. WITH LARGE, UNDERGRADUATE AND GRADUATE ENGINEERING PROGRAMS

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Abstract *- This paper reviews the methodologies and findings of a cluster of studies on retention at an urban, public university in the United States with large undergraduate and graduate engineering programs. These include: (1) A multiple regression analysis was performed to identify factors that most influence freshman-to-sophomore retention of a cohort of 459 freshmen. It was found that the cumulative grade point average and student level of commitment best predict first-year retention. Numerous additional factors that correlated with the cumulative grade-point-average and with level of commitment will be described. (2) A study of "barrier" courses examined average student pass rates for all program-specific entry and general university requirement (GUR) courses over a 6-year, 12-semester period. (3) A study of the relationship of financial aid to retention and graduation rates is in process. Significant differences by type, amount, and duration of aid are being identified to help optimize student retention and graduation rates.*

Index Terms ¾ retention, graduation rates, barrier courses, financial aid.

RETENTION STUDY

Student persistence and graduation are among the chief outcomes indicating student success in higher education. Numerous university functions are designed to support students in persistence and graduation, beginning with development of admissions standards, and including such diverse university activities as instruction, academic advisement, freshman orientation, tutoring, student life, and financial aid. The management of retention and graduation rates, and the management of university activities designed to optimize these rates, is enhanced by an understanding of factors that place students at risk for completion of the academic program. This study purports to clarify the relative importance, for NJIT students, of factors that place students at risk for persistence and graduation.

The study focuses on full-time, first-time freshmen (FTFTF). The graduation rate of FTFTF students is generally assessed as the appropriate standard for gauging the academic success of students at a particular institution of higher education. State and national accountability reports and data bases, in both the public and private sector, rely on this measure of academic strength. The graduation rates of non-native students (e.g., transfers) are generally higher, and academic performance is influenced by experience in other institutions for these students.

The study was begun in fall 1999, establishing the 1999 FTFTF cohort as the study sample. Plans include following this sample over a 6-year period in order to determine the relationship of student factors to persistence over time, and ultimately to graduation. This report includes results for the freshman-to-sophomore year.

Methodology

a) Design -
The study is a multiple regression analysis of factors correlating with retention (dependent variable) for a single cohort over time, using survey responses and performance data as independent variables. Students were surveyed at the time of entrance to NJIT. The survey captured data on items relative to student reported experience, feelings and beliefs at the time of entrance. Performance data, including persistence and academic performance, are retrieved from the student system (SIS) and added to cases in the study file.

b) Sample –
The sample includes 459 FTFTF students who were freshmen in the fall 1999 semester. This includes all FTFTF students who completed the Enrolling Student Survey *and* who provided the social security number on the survey form, allowing tracking student outcomes (persistence and academic performance) in the student SIS system. The total number of FTFTF students in fall 1999 was 658, and the sample therefore represents 70% of the total freshman class. A comparison the sample to the population of FTFTF students indicates that the sample is very similar to the total 1999 FTFTF.

c) Instrument –
The survey instrument was an op-scan, paper and pencil form that included 65 items. Twenty-seven scale items included descriptions of student goals and factors in the

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enrollment decision. Students were asked to describe their financial situations using 2 multiple-choice items. The high school average, and student academic plans and aspirations were captured, as were the reported emotional support provided by family and friends regarding the decision to pursue a degree. Five items related to the student level of commitment to earning a degree and to NJIT specifically. The remaining 12 items asked for demographic/descriptive information, including the social security number.

d) Procedures –

Students were asked to complete the enrolling student survey in freshman seminar courses during the first 2 weeks of the fall 1999 semester. All freshmen seminar faculty distributed and collected the forms during class time within the 2-week period, and these forms were returned by the faculty to the Office of Institutional Research and Planning. Forms were op-scanned into an electronic data base.

Once the student file was established, SAT scores (verbal and math) were collected from the SIS file and added to each student case. In fall 2000, student cumulative grade point averages were collected from SIS and added to the student case file. In addition, it was determined whether students in the cohort had returned for the fall 2000 semester. Students were then coded as retained or withdrawn based on presence (retained) or absence (withdrawn) in the fall 2000 semester. A total of 77 students were coded as withdrawn, and 383 were coded as retained.

e) Analysis –

The following steps were taken to analyze the data:

1. All items (64 survey items, excluding only the social security number) and SAT verbal and SAT math scores and cumulative grade point average (cumgpa) were correlated (Pearson correlation) with retention/withdrawal and with each other.
2. All items that correlated significantly with retention/withdrawal were entered into a stepwise multiple regression analysis.
3. Items that correlated significantly with items that contributed significantly to the stepwise multiple regression multiple R are summarized.
4. A profile comparing withdrawn/retained students was developed by performing a t-test on mean scores between groups on all items that correlated significantly with withdrawn/retained. Items that are significantly different for withdrawn and retained students are summarized.

Results

Two predictors, cumulative-grade-point-average (cumgpa) and commitment, contributed significantly in a 2-step, stepwise multiple regression multiple R of .31. No other variable contributed significantly to the prediction of retention. This means that if a student has a good cumgpa and is highly motivated to finish the degree, that student is likely to be retained. If the student has a poor cumgpa and is not highly motivated to finish the degree, it is probable that the student will withdraw.

Table l below shows parameters for the analysis:

Table 1
Steps in the Multiple Regression Analysis;
Dependent Variable–*retained*

a) Stepwise Selection: Step 1
Variable *cumgpa* Entered: R-Square = .3041

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	pr>F
Model	1	19.49071	19.49071	199.75	<.0001
Error	457	44.59208	0.09758		
Corrected total	458	64.08279			

b) Stepwise Selection: Step 2
Variable *commitmen*t Entered: R-Square = .3139

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	pr>F
Model	2	20.11279	10.05640	104.29	<.0001
Error	456	43.97000	0.09643		
Corrected total	458	64.08279			

c) Summary of Stepwise Selection

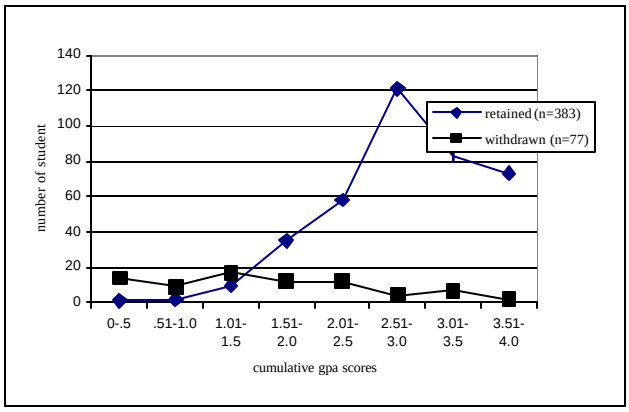
Step	Variable Entered	Number of Vars In	Partial R-Square	Model R-Square	F Value	Pr > F
1	cumgpa	1	0.3041	0.3041	199.75	<.0001
2	commitment	2				

Definitions/Description of Results

Cumgpa: The last recorded cumulative grade-point average for academic performance at the university. The mean cumgpa for withdrawn students is 1.54 and the mean cumgpa for retained students is 2.84.

Figure 1 shows the distribution of the cumgpa for retained and withdrawn students:

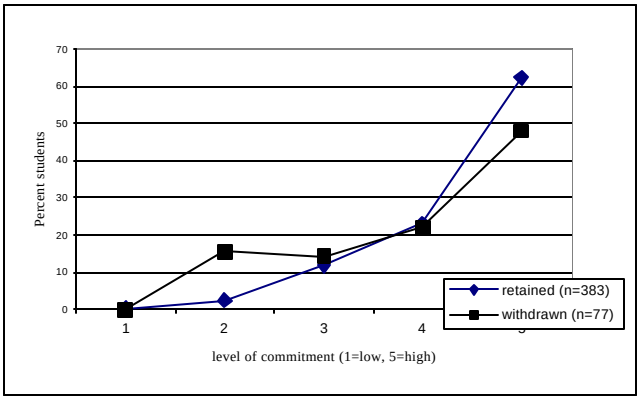
FIGURE 1
DISTRIBUTION OF CUMGPA SCORES FOR REATAINED AND WITHDRAWN STUDENTS



Commitment: Students were asked to rate their level of commitment on the question, "How committed are you to finishing your degree?" Responses were indicated on a 5-point scale as follows: (1) somewhat committed, (2) moderately committed, (3) strongly committed, (4) very strongly committed, (5) extremely strongly committed. The mean scale score for withdrawn students is 4.03 and the mean scale score for retained students is 4.45.

Figure 2 shows the distribution of the *commitment* scores for retained and withdrawn students:

FIGURE 2
PERCENT OF RETAINED AND WITHDRAWN STUDENTS REPORTED LEVEL OF COMMITMENT



Variables that Correlate with Predictors of Retention/Withdrawal

A pearson correlation was executed to test for variables that correlate with predictors of retention, and results are shown on tables 2 and 3.

TABLE 2
Variables that Correlate with *Cumgpa*

Variable	Pearson correlation coefficient	sign.<.05
High school average	.35	<.0001
Amount of working planned	-.17	.0002
SAT Math score	.15	.001
Commitment	.15	.001
Extent of need for financial aid	.12	.01

TABLE 3
Variables that Correlate with C*ommitment*:

Variable	Pearson correlation coefficient	sign.<.05
Cumgpa	.15	.001
High school average	.13	.004
Extent of need for financial aid	.10	.03

IMPLICATIONS OF THE RETENTION STUDY

In order to recruit students with the best probability of being retained, at least through the freshman-to-sophomore year, students should be selected who have the highest likelihood of succeeding academically, and who are highly committed to completing the degree. The evidence of this study converges on a profile of the successful NJIT student that includes solid high school and freshman year academic achievement, including math ability, and high motivation, unconstrained by a burden of intense financial need, or the need to work many hours during the school semester.

While the cumulative grade point average that will be earned by the student is not apparent at recruitment, several factors known at recruitment correlate significantly with cumulative grade point average earned during the freshman year. These include, in order of importance, high school average, amount of time the student will work outside of school, math SAT score, level of commitment to complete the degree, and level of need for financial support. The student with the higher high school average, prepared to work less at a job outside of school, a high SAT math score, a high level of commitment to completing the degree, and with contained financial need, will perform better academically.

In addition, the extent to which the student is committed to completing the degree contributes meaningful information about the likelihood that the student will persist. Factors that correlate significantly with level of commitment include the cumulative grade point average, the high school average, and the extent of need for financial aid. A high level of commitment probably is accompanied by a higher high school average, a moderate amount of need for financial aid,

and the probability that the cumulative grade point average to be earned will be higher.

There are numerous aspects of university instruction and support for students that may be influenced by these results. Because of the importance of student academic performance to student persistence, instructional strategies that most effectively allow students to succeed need to continue to be identified and should be broadly adopted. Given the importance of math performance (as demonstrated in the contribution of the math SAT score to academic performance), this may be especially true for the delivery of math instruction.

It may be useful to use the freshman seminar as an opportunity to develop the theme of the need for motivation, and the ultimate and considerable benefits to the student of persisting and graduating, in a very focused way. It may be useful, for instance, to share the results of this study with freshmen so that they may see the evidence of the importance not only of commitment in general, but the need, in most cases, to limit the amount of time spent working at a job outside school.

Advisement practices need to occur within a framework of allowing the student the best opportunity to succeed. This study suggests, for instance, that math may be an important precursor to academic success at NJIT, and that it should be scheduled early and should be carefully sequenced to optimize success in subsequent courses.

The availability and effectiveness of tutorial support should be further developed to ensure that students who are academically at risk have access to support and that barriers to obtaining tutorial assistance are minimized.

The financial aid program should identify and relieve, whenever possible, those students for whom financial assistance would effectively relieve the need to work excessive hours, especially if prior academic performance indicates that the student is motivated and able to do good quality academic work.

STUDY OF BARRIER COURSES

This study was an analysis of the extent to which required courses represent "barriers" to student progress and completion of academic programs at NJIT. Courses were assessed which are (1) the entrèe to specialized programs of study or (2) required for completion of the general university requirement (GUR).

Findings: Distributions of Passing Rates by Program-Specific and GUR Barrier Courses

In assessing student performance for a total of 20 program-specific barrier courses over a period of 6 years (12 semesters), it was found that the student passing rate exceeded 75 percent for 17 (85%) of those courses and 7,565 students (72% of total students). Low passing rates were confined to courses taught by a handful of faculty. Table 4 breaks out courses within passing rate percent ranges:

Table 4
Distribution of Program-Specific Barrier Course Pass Rates

Categories of Average Passing Rates	Total # of Program Specific Courses (n=20)	% of Program-Specific Courses within Avg. Pass Rate Categories
Less than 50%	0	0
51% - 55%	0	0
55% - 60%	1	5%
61% - 65%	1	5%
66% - 70%	0	0
71% - 75%	1	5%
76% - 80%	6	30%
81% - 85%	2	10%
86% - 90%	7	35%
91% - 95%	2	10%
96% - 100%	0	0

In assessing student performance for a total of 37 general university requirement barrier courses over a period of 6 years (12 semesters), it was found that the student passing rate exceeded 75 percent for 17 (46%) of those courses and 7,619 students (31% of total students). Low passing rates are more commonly observable for GUR courses than for program specific courses. Table 5 breaks out courses within passing rate percent ranges:

Table 5
Distribution of GUR Barrier Course Pass Rates

Categories of Average Passing Rates	Total # of GUR Courses (n=37)	% of GUR Courses within Avg. Pass Rate Categories
Less than 50%	1	3%
51% - 55%	1	3%
55% - 60%	3	8%
61% - 65%	2	5%
66% - 70%	6	16%
71% - 75%	7	19%
76% - 80%	8	22%
81% - 85%	6	16%
86% - 90%	3	8%
91% - 95%	0	0
96% - 100%	0	0

As a comparison of Table 4 and 5 shows, student performance in program-specific courses is generally higher than on GUR courses. Higher incomplete rates on program-specific courses tend to be associated with particular instructors rather than with courses. Student completion rates in GUR courses are generally more modest and therefore appears to relate more generally to room for improvement in the courses (content, outline, presentation of

concepts, delivery, materials, etc.) overall than to a particular group of instructors. Factors that account for variation need further study. Some factors that may be associated with instructor effectiveness include:

- teaching mode (e.g., face-to-face, distant learning, laboratory component)
- teaching style
- instructor enthusiasm
- teaching experience
- effectiveness of instructional aids
- texts and equipment
- consistency in department grading policy
- course content.

Findings: Course Scheduling Factors

Data analysis showed differences in passing rates between fall and spring semesters for some courses. Some possible explanations for differences by semester may be:

- course sequencing
- different faculty groupings (and faculty delivery of courses) in spring or fall semesters

IMPLICATIONS OF THE BARRIER COURSE STUDY

The intent of the barrier course study was to seek clarification for strategies for enhancing student completion of courses and to understand the role of entry level courses in the student's academic career success. The study results have promoted planning and implementation of projects to include instruction and delivery of both program specific and GUR courses. In addition, the project has focused new attention on the need for successful completion of math courses for engineering and other students. The result has been a strong collaborative effort across academic departments for discussion, re-conceptualization of courses, and additional academic planning. Study will continue to assess the results of changes and programs to determine whether desired improvements have been achieved.

STUDY OF FINANCIAL FACTORS

The study of financial aid seeks to identify optimal use of the different tools through which the institution helps its students pay for and complete their educations. It also seeks to identify the general level at which loans are perceived as a future burden and when they impede rather than aid graduation and retention.

Method

Conducting this research required the development of a comprehensive data set of all types of aid provided to each student from the target population. In this case, the 1994 first time, full time, freshman cohort was the target population and instruments such as work study aid, loans, and grants or scholarships were separated by the years in which students received them. The rates of graduation and retention were then compared for students based on their financial aid profile throughout their career as students. By conducting separate analyses for the amount of aid awarded and the amount finally accepted, it may be possible to identify the way students themselves balance the burdens of student work and loans.

Initial Findings

When comparing the work study aid awarded in every year, those who were offered aid were more likely to graduate than those who were not. In two out of six years, however, those who did not accept the awarded aid were more likely to graduate. Loans showed a similar, but stronger, pattern. For five of six years, those who were awarded loans were more likely to graduate than those who did not. In four out of six years, however, it appears that those who did not accept loans were more likely to graduate than those who did accept the loans they were awarded. For grants and scholarships in every year, those who received and those who accepted grants were more likely to graduate than those who did not receive or did not accept scholarships or grants. These findings suggest that financial aid is being offered to students based on good predictions about their the assistance they will provide to students in completing their programs and graduating. Some students who accept aid may not benefit as intended. For two of the six years in which students received aid, those who apparently did not work in part-time or even full-time jobs were more likely to graduate than those who did. In four out of six years, it appears that those who did not accept loans were more likely to graduate than those who did accept loans. Further analysis is planned to clarify relationships between aid and student who do and do not make good use of it.

CONCLUSIONS

This cluster of studies demonstrates an array of institutional projects that can be used to help address the issue of student retention and graduation rates. Each examines a specific aspect of the student's academic career that can impact the ability of the student to complete his or her program. In addition, the studies involve faculty, administrators, staff and students in a dialogue that enables all participants to contribute to planning and the development of programmatic changes and program improvements that can enhance student success.