Student Flow from Initial Major to Final Degree

--How to Track Graduation Rates for Individual Programs and Related Studies

Office of Institutional Research

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Tracking Graduation Rates for Individual Programs:

There has been a long time effort in the field of Institutional Research in relation to accurately calculating the graduation rates of individual programs. Such efforts are essential toward establishing faculty and administration buy-in of efforts that positively impact student graduation, as well as having many other policy implications. However, the accurate calculation of graduation rates by program is a very complex task. Several issues arise when addressing this topic, such as; how to count students who do not declare a major at their first term, should those students be added to the original cohort of each program, and should students who changed majors be counted back to their initial majors or counted forward toward their final degree programs in terms of calculating graduation rates?

To address these issues, two concepts have been adopted: student inflow and outflow among majors. Inflow refers to those students who had no major of intent at their first term but declared a major at a later point and graduated from that major, as well as students who flowed into a major from other majors. Outflow refers to students who had an initial major of intent but flowed out to other majors and graduated from majors other than their initially declared ones. Utilizing this methodology, we then calculate and display three different graduation rates on the student flow chart:

1. Graduation from initial major. This rate is calculated by dividing the number of students who graduated from their initial major by the number of students in the original cohort.

2. Add inflow students. This rate is calculated by dividing the number of students who graduated from their initial major plus inflow students by the number of students in the adjusted cohort (original cohort plus inflow students minus outflow students). This is the actual graduation rate of each program.

3. Add outflow students. This rate is calculated by dividing the number of students who graduated from their initial major plus outflow students by the number of students in the original cohort. This is the official graduation rate for each program as it is in line with the calculation method utilized for the graduation rate of the university as a whole.

Such tracking not only aids in the accurate calculation of graduation rates for each program, but more importantly provides valuable data for advanced research, especially in relation to student academic behaviors. Thus far, studies of this data have focused on following areas:

- Student flow trends (inflow and outflow) among colleges.
- Identification and analysis of programs with high attrition rates and the establishment of criteria for the pre-screening of students for these types of majors.
- The impact that timing of declaration of major has on 6-year graduation rates.
- The effect that changing majors has on students' academic performance.

Sample and Methodology:

The 2001-2003 (n=7,366) native freshmen cohort was used since this was the most recent sample which allowed for the calculation of 6-year graduation rates. Within these cohorts, 3,062 students graduated within 6 years for a graduation rate of 42%.

The first section of this study seeks to identify programs with high attrition rates (high percentages of withdrawal and outflow) and low 6-year graduation rates from initial majors. This combination (high withdrawal and high outflow rate) can be useful in determining whether or not a certain program is more challenging than other programs. All students from within the "more challenging programs" were divided into two groups: students who succeeded in graduating from within the "more challenging programs" within 6 years (regardless of whether or not this was their initial major) were labeled as being successful, while those who initially declared those programs but did not graduate from them (or dropped out entirely) were termed as being unsuccessful. Five measurements for comparison were utilized, including; high school GPA (academic background), first and second term college GPA, and first and second term pass rate (academic performance at first college year). This study intends to compare the academic background and first year college performance between these two groups in order to determine whether or not significant differences existed. Furthermore, the performance gap between the two groups could explain the reasons behind why those programs had such high attrition rates, as well as provide support for the concept of pre-screening students for those types of majors.

The second section of this study is related to the timing of declaring majors as well as the impact of such behaviors on graduation. By tracking students who declared majors versus those who remained undecided on a term by term basis, this study attempts to identify the turning point by which declaring a major has the most impact on facilitating graduation.

When comparing graduation rates, high school GPA's, college GPA's, and pass rates, Chi-Square Tests and Independent Samples T-Tests were adopted to insure that any differences found among the comparison groups did not occur by chance.

More research on student flow will be conducted in the future. One such endeavor will examine trends in relation to student flow among the majors. With a focus on student outflow from initial majors to final degree programs, this study intends to reveal where students who failed to graduate in their initially declared majors actually end up. Further trend analyses could lead to more advanced study on the reasons why students flow in or out through certain paths.

Another analytical undertaking will analyze the effect that changing majors has on student academic performance and the relationship between the number of major changes and time-to-degree.

Analyses of Programs with High Attrition

In order to discern which majors exhibited the highest rates of withdrawal and/or outflow, as well as to identify the causes behind these actions, it was necessary to first review and rank all programs in terms of their withdraw rate and outflow rate. The 2001-2003 native freshmen cohort was used since this was the most recent sample which allowed for the calculation of 6-year graduation rates. The first step in this analysis was to sort the entire cohort by the number of students who had withdrawn from college within 6 years of their initial admission by their first declared majors. Based on sorting and ranking, the top five majors with the highest number of withdrawals (*while remaining statistically comparable in relation to their population sizes) were selected for further study.

Among the five programs selected, the student headcount of the smallest program was not less than a third of the headcount of largest program in keeping with the statistical "Rule of Thumb" of comparative analysis.

The majors selected were: Biology (BIO), Computer Engineering (CPE), Computer Science (CSC), Kinesiology (KINS) and Psychology (PSYCH). These majors all had withdrawal rates of over **40%** and outflow rates of over **20%** while also being within range in terms of comparable population sizes. In addition to high attrition rate, less than **10%** of those who declared Computer Engineering or Computer Science as their initial major actually graduated from that major within 6 years. Similarly, only **13%** of those who declared Biology actually graduated from this program within 6 years. The remaining two programs (KINS and PSYCH), although still affected by high withdrawal, had better graduation rates (above 20%) than the other programs in this study.

The following table illustrates the rates of withdrawal, continuing enrollment after 6 years, graduation from initial majors, and graduation from other majors (outflow) for the five majors (most challenging) selected in this study.

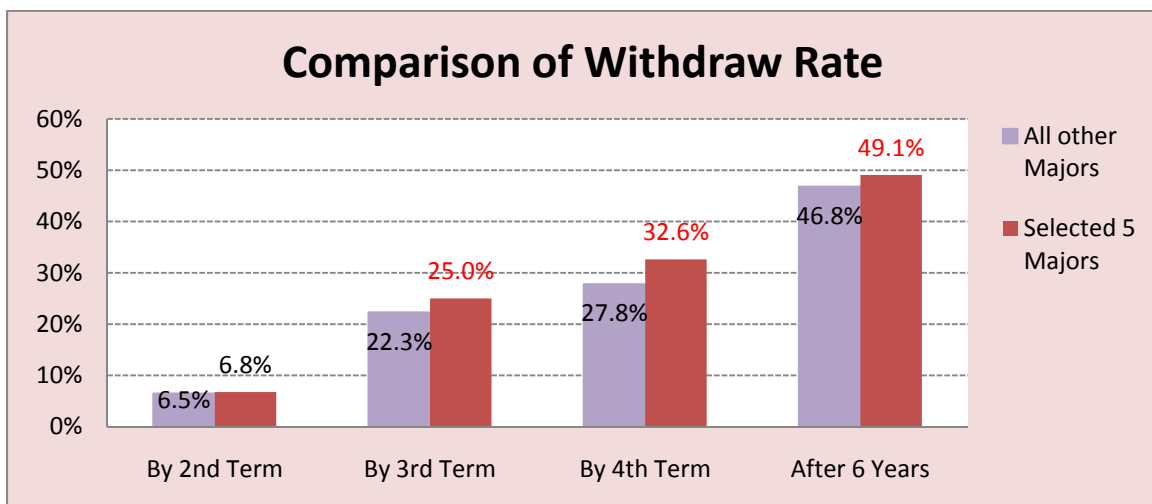| Table 1. Majors with High Withdrawal and Outflow Rate (2001-2003 Freshmen Cohort)										
Major	Withdrew		Enrolled after Six Years		Graduated from Initial Major		Graduated from Other Majors		Total Original Cohort (First declared)	
	Count	%	Count	%	Count	%	Count	%	Count	%
BIO	129	42.7%	63	20.9%	39	12.9%	71	23.5%	302	100.0%
CPE	129	49.4%	58	22.2%	9	3.4%	65	24.9%	261	100.0%
CSC	150	46.9%	50	15.6%	23	7.2%	97	30.3%	320	100.0%
KINS	109	44.1%	30	12.1%	59	23.9%	49	19.8%	247	100.0%
PSYC	181	48.4%	27	7.2%	80	21.4%	86	23.0%	374	100.0%

When comparing withdrawals from the second term to fourth term, this study revealed that the withdraw rate of the 5 programs selected was significantly higher than that of all other programs after the first year (25% vs. 22%). This gap became even wider by the fourth term, and after 6 years (See Table 2 and graph on next page).

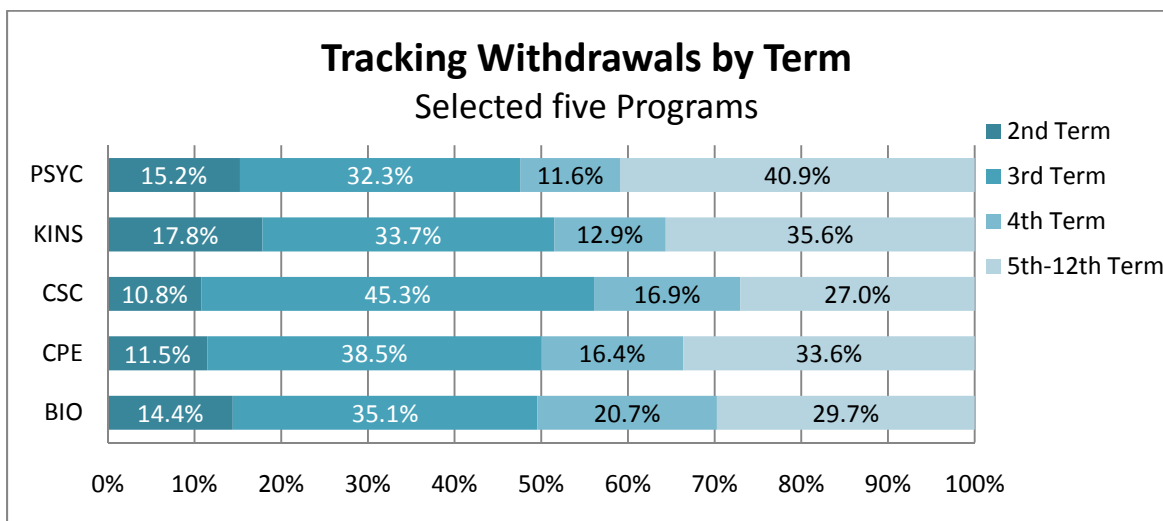**Table 2. Tracking Withdrawals (2001-2003 Freshmen Cohort)**

Major	By Second Term		By Third Term		By Fourth Term		Total Declared at first
	Count	%	Count	%	Count	%	Term
BIO	16	7.0%	55	23.9%	78	33.9%	230
CPE	14	5.6%	61	24.5%	81	32.5%	249
CSC	16	5.2%	83	26.8%	108	34.8%	310
KINS	18	8.6%	52	24.9%	65	31.1%	209
PSYC	25	7.9%	78	24.6%	97	30.6%	317
5 Majors		6.8%		25.0%		32.6%	1315
Other Majors		6.5%		22.3%		27.8%	6051

Note: Withdrawals are cumulated counts. The withdraw rates are based on declared majors at first term.

Chi-Square Test, p<.05 or p<.001; Higher values are in red.

Comparison of Withdraw Rate

Among the 1,315 withdrawals which occurred within 6 years from the five selected programs, an average of 51% of them dropped out by the end of their first college year and did not return by the third term. (See graph below).

Tracking Withdrawals by Term
Selected five Programs

In relation to investigating the causes and reasons behind the high attrition rates for these five programs, it became necessary to compare the characteristics of those students who had successfully graduated from those majors with those who had not. Five measurements related to the academic background and early academic performance of students were selected for the purpose of identifying possible pre-screening characteristics as well. To this end, the High School GPA, First Term College GPA, Second Term College GPA, First Term College Pass Rate, and Second Term College Pass Rate (GPA >= 2.0) of the successful group and unsuccessful group were compared in order to determine whether or not significant differences between these two groups existed. Moreover, based on previous studies conducted by the OIR, these elements have proven to be strong predictors of the probability of succeeding to graduation. The results of the comparative analyses were as follows:

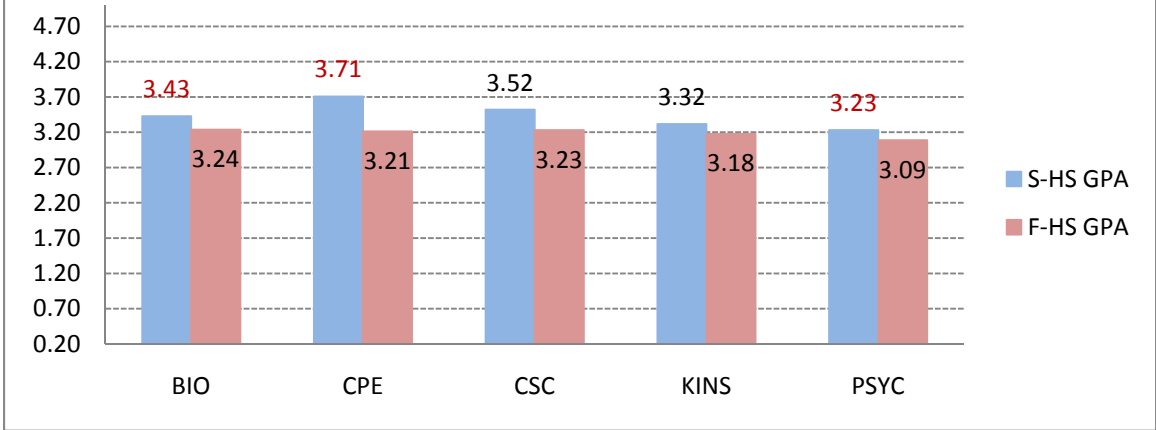**Table 3. Comparative Analyses with Five Indicators**

Indicators	Biology		Computer Engineering		Computer Sciences		Kinesiology		Psychology	
	Graduated	Not	Graduated	Not	Graduated	Not	Graduated	Not	Graduated	Not
High School GPA										
Count	75	268	12	250	26	295	74	189	129	298
Mean	3.43	3.24	3.71	3.21	3.52	3.23	3.32	3.18	3.23	3.09
First Term College GPA										
Count	77	270	13	252	29	301	75	191	130	298
Mean	3.19	2.67	3.32	2.26	3.07	2.41	3.12	2.46	2.95	2.42
Second Term College GPA										
Count	77	253	13	238	28	286	75	171	128	272
Mean	3.13	2.58	3.28	2.23	3.06	2.36	3.00	2.48	2.99	2.45
First Term Pass Rate										
Count	77	270	13	252	29	301	75	191	130	298
%	92.0%	82.0%	100.0%	68.3%	96.6%	70.1%	96.0%	75.9%	93.8%	73.8%
Second Term Pass Rate										
Count	77	253	13	238	28	286	75	171	128	272
%	99.0%	81.0%	100.0%	64.7%	92.9%	70.6%	98.7%	76.6%	97.7%	75.0%

As illustrated in the tables shown above, there were significant differences (shown in red) in several key areas between the successful group and the unsuccessful group within the five majors. T-tests were utilized to determine whether these differences were significant at a confidence level of 99%.
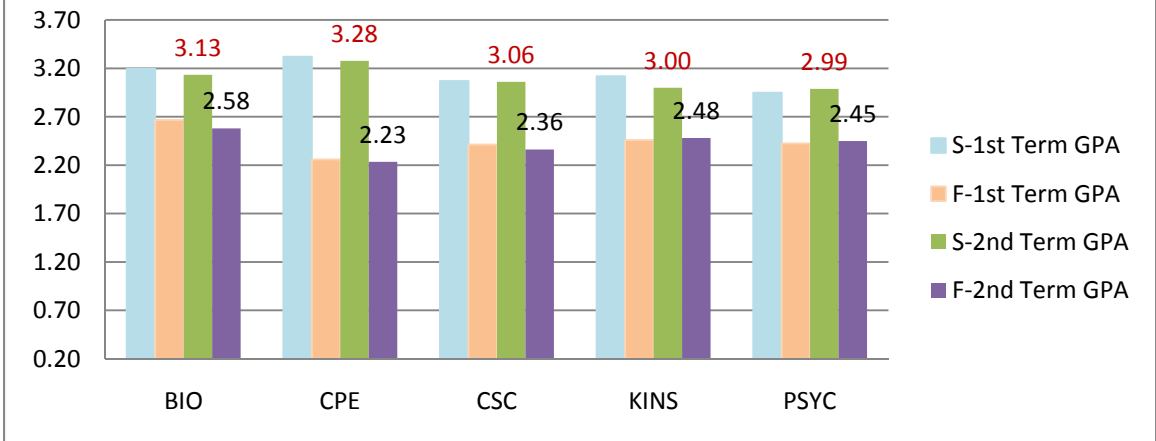
1. For Biology, the differences between successful students and unsuccessful students were significant in terms of all measurements except first term pass rate.
2. For Computer Engineering and Psychology, successful students had significantly higher mean scores and pass rates than unsuccessful students based on all five measurements
3. For Computer Sciences and Kinesiology, mean High School GPA was not significantly different between successful and unsuccessful students. However, the first college year academic performance (first term and second term college GPA, first term and second term pass rate) of successful students was much higher than that of unsuccessful students.

The graphs on the following page provide a comparison of the five measurements for the five selected programs (Note: S refers to Successful students and F refers to unsuccessful students. The numbers in red show the statistically higher values between the two groups):
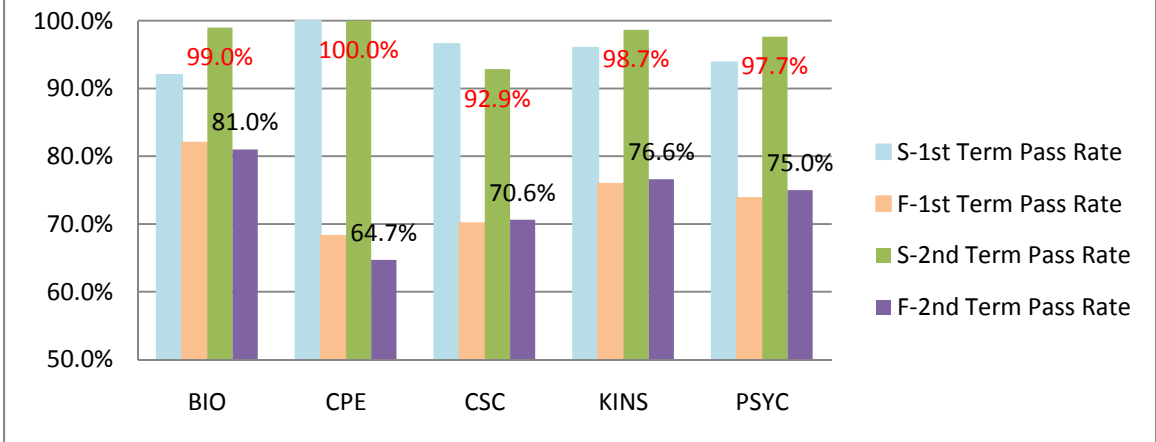
Comparison of High School GPA

	BIO	CPE	CSC	KINS	PSYC
S-HS GPA	3.43	3.71	3.52	3.32	3.23
F-HS GPA	3.24	3.21	3.23	3.18	3.09

Comparison of First Year GPA

	BIO	CPE	CSC	KINS	PSYC
S-1st Term GPA					
F-1st Term GPA					
S-2nd Term GPA	3.13	3.28	3.06	3.00	2.99
F-2nd Term GPA	2.58	2.23	2.36	2.48	2.45

Comparison of First Year Pass Rate

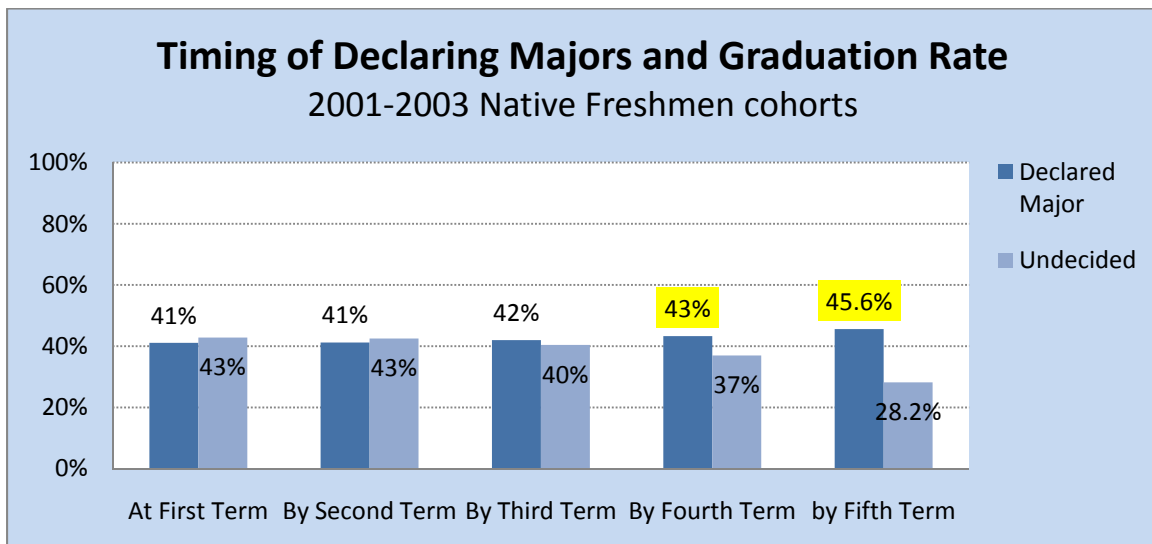|	BIO	CPE	CSC	KINS	PSYC
S-1st Term Pass Rate					
F-1st Term Pass Rate					
S-2nd Term Pass Rate	99.0%	100.0%	92.9%	98.7%	97.7%
F-2nd Term Pass Rate	81.0%	64.7%	70.6%	76.6%	75.0%

The Timing of Declaring Majors:

This study also tracked students who declared a major ("Declared") and those who remained undecided ("Undecided") from the first to fifth term. As such, the counts for "Declared" and "Undecided" are cumulative for each term provided. However, students who withdrew in any given term were designated as being either "Declared" or "Undecided" based upon their declared status at the term prior to their actual withdrawal.

The results show that declaring a major *by the fourth term* is actually the turning point for 6-year graduation: the declared group achieved much higher 6-year graduation rates than the undecided group by the period of the fourth term (please refer to Table 3 and the graph below).

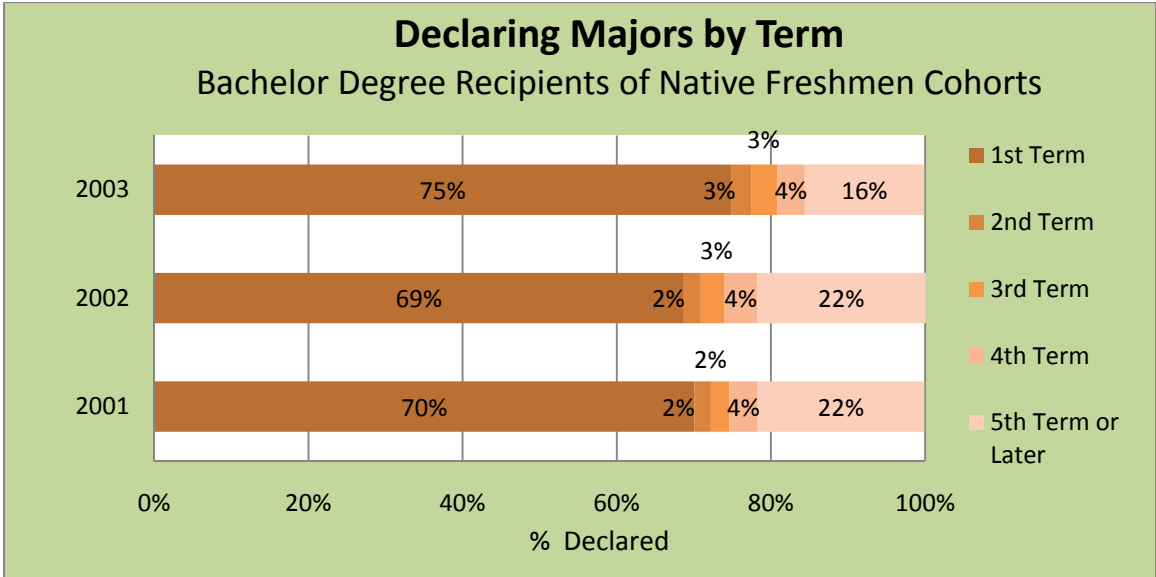**Table 3. The Timing of Declaring Major and Graduation Rate**

	Declared Major		*Undecided*		*Difference*
	# Graduated	Rate	# Graduated	Rate	
Native Freshmen:					
Declared Major at First Term	2,183	41.1%	879	42.8%	-1.7%
Declared Major by Second Term	2,176	41.2%	886	42.5%	-1.3%
Declared Major by Third Term	2,210	42.0%	852	40.4%	1.6%
Declared Major by Fourth Term	2,310	43.3%	752	37.0%	6.3%
Declared Major by Fifth Term	2,582	45.6%	480	28.2%	17.4%

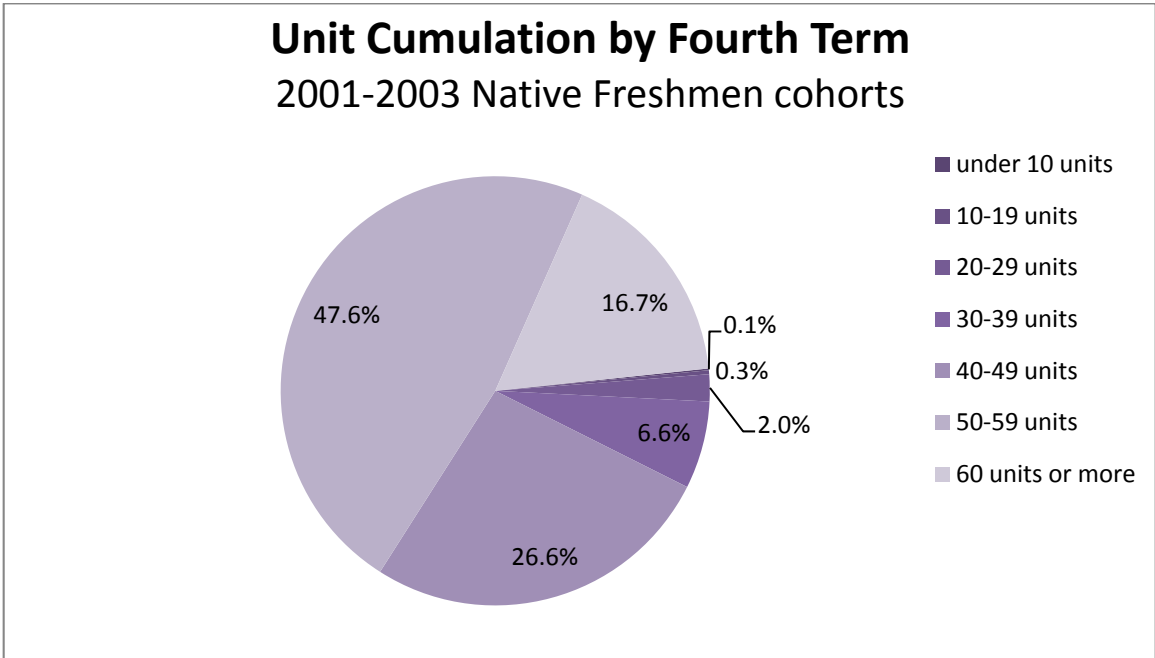** Chi-Square Test, p< .001 and higher value is highlighted in yellow.*

Another way to look at the timing of declaring a major is to analyze the behavior patterns of students who successfully graduated within six years. The graph on the following page illustrates that a majority of Bachelor's degree recipients declared majors at the first term (an average of 71% of all graduates), while 80% of them had declared majors by the fourth term.

Declaring Majors by Term

Bachelor Degree Recipients of Native Freshmen Cohorts

Year	1st Term	2nd Term	3rd Term	4th Term	5th Term or Later
2003	75%	3%	3%	4%	16%
2002	69%	2%	3%	4%	22%
2001	70%	2%	2%	4%	22%

% Declared

According to current academic policies, students should declare majors once they have accumulated 60 units. This study revealed that among the 5,253 students who were continuously enrolled at the fourth term, only 16% had actually reached the 60-unit threshold by that time (please refer to the graph below). However, 62% of the fourth term enrollees had accumulated at least 50 units by the end of term, and 73% of the fourth term enrollees had already declared majors by the end of term.

Unit Cumulation by Fourth Term

2001-2003 Native Freshmen cohorts

Units	Percentage
under 10 units	0.1%
10-19 units	0.3%
20-29 units	2.0%
30-39 units	6.6%
40-49 units	26.6%
50-59 units	47.6%
60 units or more	16.7%

Conclusions and Recommendations:

6-year Graduation Rates are often used as a measurement of student success in college. However, a mismatch between student academic backgrounds and/or early academic performance and program requirements could be a major reason why students change their majors and thus prolong their graduation. Moreover, this mismatch likely causes a higher withdraw rate for the selected programs when compared with other programs. A large portion of students simply gave up their college education altogether after having struggled with the major requirements after two semesters. As such, it may be necessary to identify programs with high attrition rates as being "more challenging" and to set up pre-screening processes for them. Such processes should be implemented no later than the second term, as over 51% of those who withdrew left after their second term (based on the analysis on the five selected programs in this study).

From the data presented, it would appear as though academic backgrounds and early academic performance are strong indicators in relation to determining which students are most likely to progress to eventual degree attainment in their initially declared majors. The five measurements, including high school GPA, first and second term college GPA, and first and second term pass rate, could be used to set up a pre-screening process at the end of the first year to assist students in selecting a major that fits best with their specific skill set. For example, the average high school GPA, considered along with the average first and second term GPA, could be used to establish cutoff lines for entry into the five programs analyzed in this study. Similarly, first and second term pass rates could be used as a minimum standard for acceptance of students into those programs. Based upon the findings of this study, it is strongly recommended that any program with high attrition rates be reviewed for the possible implementation of a pre-screen policy. Such policies would not only help students to develop confidence in their college careers, but would serve to promote persistent in college while also accelerating time to degree.

In terms of the timing of declaring a major, the results of this study also revealed that declaring a major at the first term may be optimal with regard to graduation. A majority of the students who succeeded in graduating within 6 years declared their majors at the first term. However, the possibility of graduation is not significantly impacted by the declaring of a major as long as the major is declared no later than the fourth term. When using Multiple Regression (declaring majors from first to fourth term), the odds for graduation increased significantly if students declared majors by the fourth term. More specifically, students who declared majors by the fourth term were 3 times more likely to graduate within 6 years than those who did not.

In relation to current academic policies, since only 28% of the students in this study were able to accumulate 60 units by the fourth term, a new policy regarding declaring majors may be warranted in order to increase 6 year graduation rates. This could involve consideration of both number of terms and unit accumulation, such as; requiring students to declare a major by the end of the fourth term or after having accumulated at least 50 units, whichever comes first.