	STEM GATEWAY RESEARCH BRIEFING
GATEWAY	**TITLE: Stop, Shift or Graduate: Degree Outcomes Lens** Briefing Publication Date: 2/19/14

RESEARCH QUESTION(S): How do undergraduate students who graduate with STEM degrees differ from those who switch majors out of STEM, and from those who stop attending UNM prior to completing their degrees?

STUDY DESCRIPTION: The STEM Gateway Program studied 1503 first-time full-time freshmen students from the falls of 2005, 2006 and 2007 who initially stated they were interested in STEM degrees (see Table 1 below). These students indicated an interest in STEM majors when completing their admissions applications, or when visiting with academic advisors during their first semesters. At the time the data were pulled, these students fell into one of four student OUTCOME CATEGORIES:

- SHIFTED: Students who started with a STEM interest, but then switched to a non-STEM degree program at UNM
- GRADUATED: Students who started with a STEM interest and then graduated with a STEM bachelor's degree
- STOPPED: Students who started with a STEM interest, but then stopped attending UNM
- ENROLLED: Students who started with a STEM interest and were still enrolled in a STEM program at UNM in the fall of 2012

Table 1. Overview of Population	
Total Number of Students	1503
Number of students in SHIFTED cohort	639
Number of students in GRADUATED cohort	334
Number of students in STOPPED cohort	444
Number of students in ENROLLED cohort	86

FINDINGS

FINDING 1: ETHNICITY & GENDER AND STEM INTEREST

There was no marked difference between any ethnicity's representation in STEM and their representation in the general population of freshmen (see Table 2). However, gender appears to play a large role in STEM interest. Men make up 62% of the STEM students studied, but only 44% of the general UNM population. Women make up 38% of the STEM students, but 56% of the general population. Women at UNM are significantly less likely to express an interest in STEM degrees than men.

Table 2. Ethnicity and STEM Interest		
	THIS POPULATION OF STEM STUDENTS	**ALL FRESHMEN (FROM UNM FACTBOOKS, Falls 05,06,07 combined)**
Percent American Indian	6.4%	5.3%
Percent Asian/Pacific Islander/Native Hawaiian	5.5%	4.2%
Percent Black/African American	2.3%	3.3%
Percent Hispanic	35.5%	37.6%
Percent White, Non-Hispanic	46.2%	45.5%

Table 3. Gender and STEM Interest		
	THIS POPULATION OF STEM STUDENTS	**THE GENERAL POPULATION OF UNM MAIN CAMPUS UNDERGRADUATE STUDENTS (FALL 2011)**
Percent Male	62.3%	44.6%
Percent Female	37.7%	55.4%

FINDING 2: ETHNICITY & GENDER AND STEM ACHIEVEMENT

Ethnicity and gender are important to understanding student OUTCOME CATEGORIES.

- **American Indian STEM students** are 2.55 times as likely to stop attending UNM (p<.001) and are 0.30 times as likely to graduate with STEM degrees (p<.001) as non-American Indian students.
- **Hispanic STEM students** are .65 times as likely to graduate with STEM degrees as non-Hispanic students (p=.001).
- **Black/African American STEM students** are 1.96 times as likely to switch majors out of STEM as non-African American students (p=.001).
- **Female STEM students** are .48 times as likely to pursue STEM degrees, and are 1.36 times as likely to switch majors out of STEM (p=.005) as male students.
- **White females** are .69 times as likely to stop attending (p=.024), 1.34 times as likely to graduate (p=.069), 1.32 times as likely to switch majors out of STEM (p=.044) and .23 times as likely to still be enrolled as students who are not white females (p=.001).
- **Non-white females** are .63 times as likely to graduate as students who are not non-white females (p=.086).
- **White males** are 1.35 times as likely to graduate as students who are not white males (p=.029).
- **Non-white males** are .86 times as likely to shift out of STEM degrees (p=.086) and are 1.91 times as likely to still be enrolled as students who are not non-white males (p=.004).

Table 4. Number of students in each OUTCOME CATEGORY by ethnicity					
Ethnicity	Stopped	Graduated	Enrolled	Shifted	Total
American Indian	48	8	4	36	96
Asian/Pacific Islander	17	25	6	33	81
Black/African American	7	7	0	20	34
Hispanic	169	94	41	229	533
Non-Resident Alien	0	1	1	0	2
Native Hawaiian	2	0	0	0	2
Race/Ethnicity unknown	15	17	7	22	61
White, non-Hispanic	186	182	27	299	694
TOTALS	444	334	86	639	1503

Table 5. Percentage of students by ethnicity in each OUTCOME CATEGORY					
	Stopped	Graduated	Enrolled	Shifted	
American Indian	50.0%	8.3%	4.2%	37.5%	100.0%
Asian/Pacific Islander	21.0%	30.9%	7.4%	40.7%	100.0%
Black/African American	20.6%	20.6%	0.0%	58.8%	100.0%
Hispanic	31.7%	17.6%	7.7%	43.0%	100.0%
Non-Resident Alien	0.0%	50.0%	50.0%	0.0%	100.0%
Native Hawaiian	100.0%	0.0%	0.0%	0.0%	100.0%
Race/Ethnicity unknown	24.6%	27.9%	11.5%	36.1%	100.0%
White, non-Hispanic	26.8%	26.2%	3.9%	43.1%	100.0%

Table 6. Number of students in each OUTCOME CATEGORY by gender					
	Stopped	Graduated	Shifted	Enrolled	Total
Male	286	215	372	64	937
Female	158	119	267	22	566
Total	444	334	229	86	1503

Table 7. Number of students in each OUTCOME CATEGORY by gender and ethnicity					
	Stopped	Graduated	Shifted	Enrolled	Total
White Male	126	114	176	23	439
Non-White Male	160	101	196	41	498
White Female	60	68	123	4	255
Non-White Female	98	51	144	18	311
Total	444	334	639	86	1503

Table 8. Percentage of students by gender and ethnicity in each OUTCOME CATEGORY					
	Stopped	Graduated	Shifted	Enrolled	Total
White Male	28.7%	26.0%	40.1%	5.2%	100.0%
Non-White Male	32.1%	20.3%	39.4%	8.2%	100.0%
White Female	23.5%	26.7%	48.2%	1.6%	100.0%
Non-White Female	31.5%	16.4%	46.3%	5.8%	100.0%
Total	29.5%	22.2%	42.5%	5.7%	100.0%

FINDING 3: SOCIO-ECONOMIC STATUS AND STEM ACHIEVEMENT

Both family income level (measured by Pell Grant eligibility) and first-generation student status correlate to student OUTCOME CATEGORY. The impacts of both of these variables are similar.

- **Pell-Eligible STEM students** are 1.43 times as likely to stop attending UNM (p=.007) and are .46 times as likely to graduate (p<.001) as non-Pell-eligible students.
- **First Generation STEM students** are 1.62 times as likely to stop attending UNM (p<.001) and are .42 times as likely to graduate (p<.001) as non-First Generation students.
- Based on data from the Free Application for Federal Student Aid (FAFSA), students who graduated with a STEM degree had an average estimated family contribution (EFC) of $13,371. Students who stopped attending UNM had an average EFC of $5,114.

FINDING 4: COMMONLY STUDIED VARIABLES AND STEM ACHIEVEMENT

Most of the variables listed in Table 9 are commonly cited in national studies as predictors of persistence and graduation in higher education. Our research strengthens the validity of those studies. Each of these variables show the same pattern: most favorable for those students who graduate, next most favorable for students who shift majors but remain at UNM, and least favorable for students who drop out of UNM. For instance, only 13% of students who GRADUATE are Pell Eligible, compared to 23% of students who SHIFT and 27% of students who STOP.

TABLE 9. Commonly Studied Variables			
VARIABLE	GRADUATE	SHIFT	STOP
Percent of this group who are Pell Eligible[1]	13.5%	23.6%	27.3%
Average of High School GPAs within this group[2]	3.75	3.45	3.27
Average of ACT Composite scores within this group[2]	25.8	22.9	22.2
Average of ACT Math scores within this group[2]	26.3	22.8	22.0
Percent of this group who are First Generation[1]	19.5%	34.2%	40.6%
Average of College GPAs within this group[2]	3.51	2.95	2.09
Percent of students in this group who required remediation[1]	12%	30.7%	39.5%
Percent of students in this group who required MATH remediation[1]	4.2%	18.2%	26.4%
Percentage of students in this group who received a Lottery Scholarship[1]	91%	77.5%	36.9%
Percentage of Lottery-receiving students in this group who lost their Lottery Scholarship[1]	18.4%	28.7%	42.1%

[1]*When comparing GRADUATE to non-GRADUATE (SHIFT and STOP combined) and STOP to non-STOP (GRADUATE and SHIFT combined), these differences in proportions were statistically significant*
[2]*When comparing GRADUATE to SHIFT, GRADUATE to STOP and SHIFT to STOP, these differences in means were statistically significant*

FINDING 5: REMEDIAL EDUCATION

Enrollment in remedial courses correlates strongly with student OUTCOME CATEGORY. Of students who enrolled in remedial courses at UNM, 40% stopped attending UNM before graduating, 45% switched degrees out of STEM, and only 9% graduated with a STEM degree. For students who did not enroll in remedial courses at UNM, 25% stopped attending, 42% switched out of STEM, and 28% graduated with a STEM degree.

For students who enrolled in MATH remedial courses at UNM, 45% stopped attending, 45% switched majors, and only 5% graduated with STEM degrees. For students who did not enroll in remedial MATH courses, 26% stopped attending, 21% switched majors, and 26% graduated with STEM degrees.

The greatest impact of remediation on student OUTCOME CATEGORY is on GRADUATE and STOP, with minimal impact on SHIFT. Students who take remedial courses are more likely to give up on their higher education goals than students who do not take remedial courses.

FINDING 6: HIGH SCHOOL ORIGIN, INCOME LEVEL AND STEM ACHIEVEMENT

Though sample sizes are small, the percentage of a high school student population that is economically disadvantaged does appear to be somewhat connected to student OUTCOME CATEGORY (see Table 10 and Figure 1). This variable should be studied in a larger context before drawing conclusions.

TABLE 10. HIGH SCHOOLS AND GRADUATION OUTCOME			
HIGH SCHOOL NAME	UNM STUDENTS	GRADUATED	AYP Students PCT Econ Disadvant
MORIARTY HIGH SCHOOL	27	**11.1%**	40.3
DEL NORTE HIGH SCHOOL	**45**	**13.3%**	**52.6**
RIO RANCHO HIGH SCHOOL	90	**15.6%**	37.9
HIGHLAND HIGH SCHOOL	**36**	**16.7%**	**71.8**
MANZANO HIGH SCHOOL	**59**	**16.9%**	**45.5**
LOS LUNAS HIGH SCHOOL	25	**20.0%**	66.9
SANDIA HIGH SCHOOL	**80**	**23.8%**	**24.6**
CIBOLA HIGH SCHOOL	**96**	**25.0%**	**30.1**
VALLEY HIGH SCHOOL	**38**	**28.9%**	**47.5**
SAINT PIUS X HIGH SCHOOL	59	**30.5%**	na
ELDORADO HIGH SCHOOL	**80**	**33.8%**	**15.2**
ALBUQUERQUE ACADEMY	26	**38.5%**	na
LA CUEVA HIGH SCHOOL	**104**	**39.4%**	**9.6**

FIGURE 1. HIGH SCHOOLS AND GRADUATION OUTCOME
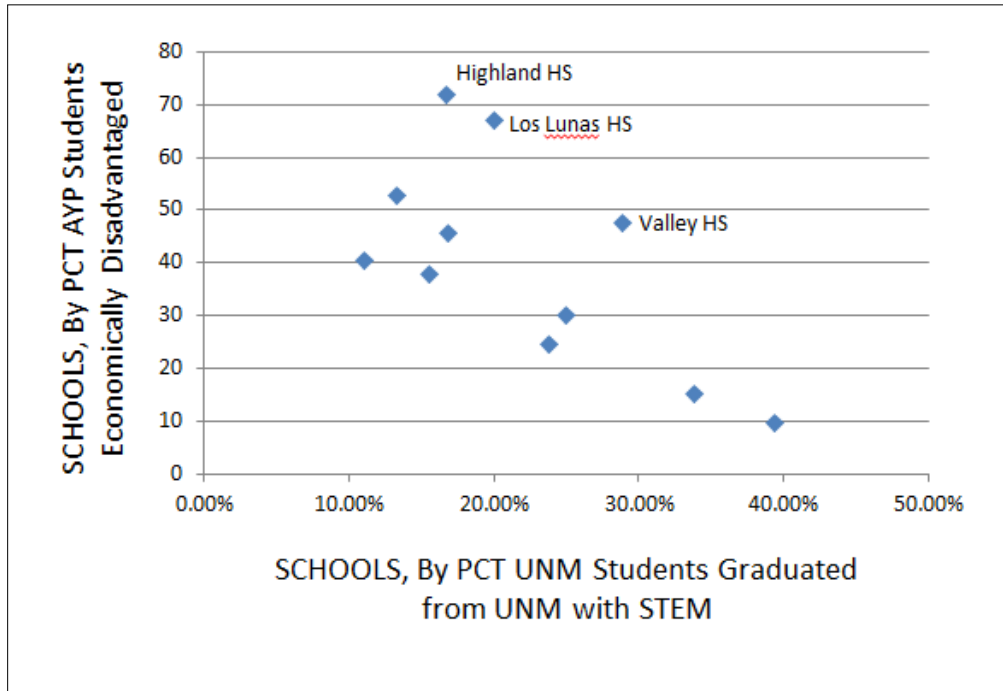
FINDING 7: MAJORS

Some majors were significantly correlated with student OUTCOME CATEGORY (see Table 11). Biochemistry and General Engineering were both more likely to result in GRADUATED than other majors, while Mechanical Engineering, Computer Science, Civil Engineering and Computer Engineering were less likely to result in GRADUATED. Students in General Engineering and Electrical Engineering were less likely to SHIFT out of STEM than other majors, and students in Biology were more likely to SHIFT out of STEM. Students in Biochemistry were less likely to STOP attending UNM than other students, and students in Computer Engineering and Electrical Engineering were more likely to STOP than other students.

Table 11. Number of Students in Each of the OUTCOME CATEGORIES Within Each Major					
	Eventual OUTCOME CATEGORY				
Major at Semester #1	**Stopped**	**Graduated**	**Enrolled**	**Shifted**	**Total**
Astrophysics	7	6	0	5	18
Biology	132	101	21	234	488
Biochemistry	8	17	3	23	51
Chemistry	18	16	8	35	77
Computer Science	24	5	5	33	67
Earth Sciences	2	5	0	5	12
Environmental Sciences	8	2	0	14	24
Mathematics	14	10	0	17	41
Physics	8	7	2	10	27
Statistics	2	1	0	0	3
Chemical Engineering	4	1	0	2	7
Civil Engineering	21	5	2	29	57
Computer Engineering	22	1	2	23	48
Electrical Engineering	27	8	4	15	54
Engineering Science	0	0	0	3	3
General Engineering	109	130	29	139	407
Mechanical Engineering	32	16	10	46	104
Nuclear Engineering	6	3	0	6	15

FINDING 8: STOP AND SHIFT TRIGGERPOINTS

Students who STOP do so on average after 3.5 semesters, which is the same timeframe for when students SHIFT. However, students who STOP do so after completing an average of 38 credit hours, while students who SHIFT have completed 45. Students who STOPPED did so with an average GPA of 2.09, while students who SHIFTED did so with an average GPA of 2.95.

Both of these findings support the assertion that academic success breeds college persistence, even if not in the same major as originally intended. This finding also indicates that students who leaving UNM are generally not transferring to more exclusive universities.

FINDING 9: TIME TO GRADUATION

The 2005 cohort represents the most recent cohort for which seven-year graduation tracking was possible at the time the data was pulled (see Table 12). For this cohort, the most common time to graduation for first-time students was five years (40%), followed by four years (23.5%) and then six years (18.3%). These trends appear to be holding form for the 2006 and 2007 cohorts as well.

Seventy five percent of the 2005 cohort did not graduate within four years. While these findings do not identify the possible causes of long times-to-graduation, they do indicate the need for further study in this regard.

Table 12. Time to Graduation							
Cohort	Grad in 3 yrs	Grad in 4 yrs	**Grad in 5 yrs**	Grad in 6 yrs	Grad in 7 yrs	Still Enrolled	**Total Grad or Still Enrolled**
2005	2	27	**46**	21	6	13	115
Percent	*1.7%*	*23.5%*	***40.0%***	*18.3%*	*5.2%*	*11.3%*	*100.00%*
2006	2	25	**54**	30	NA	23	134
Percent	*1.5%*	*18.7%*	***40.3%***	*22.4%*		*17.2%*	*100.00%*
2007	2	42	**77**	NA	NA	50	171
Percent	*1.2%*	*24.6%*	***45.0%***			*29.2%*	*100.00%*
TOTAL	**6**	**94**	**177**	**51**	**6**	**86**	**420**

IMPLICATIONS

The following implications and recommendations are not comprehensive. They are provided only to stimulate discussion. They reflect only the views of the STEM Gateway program.

IMPLICATION 1: THE STATUS QUO IS NOT HIGHLY EFFECTIVE FOR TRADITIONALLY UNDERSERVED POPULATIONS

As seen in Finding 2, women are underrepresented in pursuing STEM fields as freshmen (see Table 3). Hispanic students, African American students and American Indian students are all underrepresented in earning STEM degrees or overrepresented in switching majors out of STEM (see Tables 4 and 5).

White males represent the subpopulation most likely to graduate with a STEM degree (35% more likely than non-white males) and represent the subpopulation that currently produces the most STEM bachelor's degrees (114, compared to 101 for non-white males, 68 for white females, and 51 for non-white females).

Yet the demographics at UNM are changing. The proportions of American Indian and Hispanic students in the undergraduate populations are both increasing, while the proportions of African American, American Indian, Hispanic and female students in the graduate populations are all increasing. Among freshmen, the proportions of American Indian and Hispanic students are both increasing (see Table 13). The proportion of White male students in among undergraduates, graduates, freshmen and degree earners are all declining (see Table 14).

At the same time, first-generation and low-income students make up a sizeable portion of UNM's undergraduate enrollment. In the fall of 2013, 43% of undergraduate degree-seeking students were Pell-eligible and 20% met the FAFSA definition for first-generation student.

Based on changing enrollment patterns, if UNM is going to increase the number of STEM degree produced, it must start with traditionally underrepresented students.

Table 13. Underserved Student Populations as Proportions of Enrollments, Freshmen Classes and Bachelor's Degree Earners			
	Fall 1996	Fall 2012	Difference
Undergraduate student enrollment			
African American students	2.7%	2.7%	0.0
American Indian students	5.0%	6.4%	+1.4
Hispanic students	28.7%	43.0%	+14.3
Female students	56.7%	55.7%	-1.0
Graduate student enrollment			
African American students	1.4%	1.7%	+0.3
American Indian students	2.3%	3.9%	+1.6
Hispanic students	12.5%	23.5%	+11.0
Female students	53.5%	57.6%	+4.1
Freshman student enrollment			
African American students	3.1%	2.6%	-0.5
American Indian students	5.1%	5.6%	+0.5
Hispanic students	35.0%	48.5%	+13.5
Bachelor's degree earners			
African American students	2.1%	2.8%	+0.7
American Indian students	4.9%	4.9%	0.0
Hispanic students	24.9%	38.1%	+13.2

Source, UNM Factbook

Table 14. White Male Populations as Proportions of Enrollments, Freshmen Classes and Bachelor's Degree Earners			
	Fall 1996	Fall 2012	Difference
Undergraduate student enrollment			
White students	57.5%	38.3%	-19.2
Male students	43.3%	44.3%	-1.0
Graduate student enrollment			
White students	72.1%	49.9%	-22.2
Male students	46.5%	42.4%	-4.1
Freshman student enrollment			
White students	50.5%	33.3%	-17.2
Bachelor's degree earners			
White students	63.5%	44.4%	-19.1

Source, UNM Factbook

Recommendations: Develop and/or strengthen UNM programs that assist students to achieve higher grades in their core STEM courses and to persist through their STEM degrees to graduation. This is especially important for low-income students, students from low-income high schools, and students from underserved ethnicities. These program improvements should be connected to and supported by UNM programs that are designed to specifically serve these populations (such as College Enrichment and Outreach Programs for first-generation students, and El Centro for Hispanic students).

Develop and/or strengthen UNM programs that encourage female students to explore STEM degree programs. These improvements should be connected to UNM programs and student communities that

are designed to specifically serve women (such as the Women's Resource Center and Women in Science and Engineering).

Develop UNM programs that reinforce long-term student goals in the early stages of their STEM coursework. For instance: create avenues for students to explore their vocational interests during their first two semesters; provide greater opportunities for students to be involved in their communities within their chosen disciplines; increase the number and depth of undergraduate research opportunities in first and second year courses.

Develop institutional STEM achievement goals and performance indicators, inclusive of goals for traditionally underserved populations. For instance: (1) improve STEM 4-year graduation rate by 5% by AY2014-2015, and (2) increase the number of STEM bachelor's degrees earned by traditionally underserved students by 10% over the next three years.

IMPLICATION 2: WHEN STUDENTS GIVE UP ON STEM OR UNM, THEY USUALLY DO SO EARLY IN THEIR EDUCATIONAL CAREERS

When STEM students leave UNM, they do so after completing an average of 38 credits over the course of 3.5 semesters, and with an average cumulative GPA of 2.09. When STEM students switch majors out of STEM, they do so after completing an average of 45 credits over the course of 3.5 semesters, and with an average cumulative GPA of 2.94. In both cases, students change their STEM degree aspirations during their first two years, well before becoming immersed in their upper division degree program courses.

In addition, 34% of STEM students who eventually left UNM or changed majors out of STEM required remedial coursework compared to only 16% of STEM students who eventually graduated with STEM degrees. Students who are at risk for leaving or switching majors are more likely to take remedial courses, and consequently must wait longer before completing their math sequence and taking their upper division degree program courses.

UNM asks students to identify their long-term STEM goals when completing their admissions applications. However, these goals are not directly acted upon for the next 2-3 years, during which students complete their core courses and pre-calculus math sequence. During these years, some students lost interest in STEM and switch majors, and some students decide to leave UNM altogether.

Recommendations: It is crucial that UNM address student long-term STEM goals during each semester of their first two years. This process involves developing strategies for students that help them progress towards these goals each semester.

These strategies could include: (1) expanding 1st and 2nd year research opportunities, (2) assisting students further explore career options within their chosen area, (3) introducing students to tenured and tenure-track faculty mentors as soon as possible, (4) building mentorships where graduate students assist pre-major students prepare for their disciplines, (5) outreach programs that allow students to participate in community STEM awareness and education, (6) academies that teach leadership skills to STEM students, and that introduce students to role models in the community, (7) workshops that introduce students to cutting edge technologies, (8) multi-disciplinary workshops or conference that emphasize the liberal arts value of the core [for instance, an Art and STEM conference that introduces students to the relationship between form and function] and (9) drawing stronger connections between the curriculum of core STEM courses and upper division degree courses.

Likewise, improved strategies are needed to improve graduation rates for students with lower than average high school GPAs and ACT scores, and for students needing remedial coursework. These strategies could include support programs that improve student performance (such as expanded supplemental instruction, peer learning facilitators and embedded tutoring), or course redesign projects that allow students to progress through them rapidly in order to begin taking their core and degree program courses sooner.

From anecdotal evidence, it appears that the majority of entry-level STEM core courses and pre-calculus mathematics courses are taught by teaching assistants, adjunct instructors or lecturers. If this evidence is confirmed, then instructional improvement strategies and professional development opportunities should be focused on these instructors.

IMPLICATION 3: STUDENTS MAY NOT KNOW WHAT THEY WANT TO BE WHEN THEY DECLARE THEIR STEM INTEREST

The strength of this study is also its most glaring limitation. In order to study the UNM STEM experience from beginning to end, we were interested in students who indicated a STEM interest during their first semesters or on their admissions applications.

However, at this stage in each student's education, they have not yet been exposed to the expectations or benefits of any specific STEM degree program. There is no way to determine students' realistic assessments of their degree choices.

For instance, *Student A* may have wanted to be an engineer since first grade, may have actively sought out engineers to learn more about the profession, may have selected courses in high school specifically to meet their engineering goals, and may have already visited the various engineering departments at UNM prior to admission. *Student B* may have liked their high school geometry course, and when time came to fill out the admissions application, simply checked the engineering box because it resonated with that experience. Cleary the level and sophistication of engineering interest of *Student A* differs radically from that of *Student B*. Indeed, it would be reasonable to expect that *Student B*'s STEM intent is far more likely to change than *Student A*'s, and that that change may be entirely healthy and appropriate.

Recommendation: In order to better measure the ability of UNM to educate students within any degree program, UNM must first develop better methods for determining and measuring student degree interest. Specifically, advisors should be equipped with specific questions and rating scales to quantify student interest in their degree choice. In addition, advisors should be provided with enough time to administer this inventory at least once per year.