



## Development and Implementation of a Pathway Assessment Model for the ASPIRE Program

### **Dr. Maria-Isabel Carnasciali, University of New Haven**

Maria-Isabel Carnasciali is an Assistant Professor of Mechanical Engineering at the Tagliatela College of Engineering, University of New Haven, CT. She obtained her Ph.D. in Mechanical Engineering from Georgia Tech in 2008. She received her Bachelors of Engineering from MIT in 2000. Her research focuses on the nontraditional engineering student – understanding their motivations, identity development, and impact of prior engineering-related experiences. Her work dwells into learning in informal settings such as summer camps, military experiences, and extra-curricular activities. Other research interests involve validation of CFD models for aerospace applications as well as optimizing efficiency of thermal-fluid systems.

### **Dr. Jean Nocito-Gobel, University of New Haven**

Jean Nocito-Gobel, Professor of Civil & Environmental Engineering at the University of New Haven, received her Ph.D. from the University of Massachusetts, Amherst. She has been actively involved in a number of educational initiatives in the Tagliatela College of Engineering including KEEN and PITCH, PI of the ASPIRE grant, and is the coordinator for the first-year Intro to Engineering course. Her professional interests include modeling the transport and fate of contaminants in groundwater and surface water systems, as well as engineering education reform.

### **Dr. Christopher Martinez, University of New Haven**

Christopher Martinez is an assistant professor of computer engineering at the University of New Haven. His area of research is in the field of human computer interaction with a focus on embedded system interfacing.

### **Mark J Graham Ph.D., Yale University**

As Evaluation Director at the Center for Teaching and Learning of Yale University, Mark Graham directs program evaluation initiatives as part of a national effort to transform undergraduate science teaching. His primary responsibility is evaluation of the National Academics Summer Institutes for Undergraduate Education with financial support from the Howard Hughes Medical Institute. He also co-directs a National Science Foundation (NSF) supported investigation of the Summer Institutes' impact on faculty teaching and student achievement. In addition, Dr. Graham collaborates with university departments and offices on how to evaluate the success of a program or initiative. He received a B.A. in economics with honors (magna cum laude) from the University of Massachusetts-Amherst, and a Ph.D. in educational psychology from Teachers College, Columbia University. His prior experience includes a one-year National Institutes of Health (NIH) supported post-doctoral traineeship in biomedical informatics, and then seven years as director of education research at Columbia University's College of Physicians & Surgeons. At Yale since 2011, Dr. Graham has assumed positions of increasing responsibility and evaluation project management. He has published a number of peer-reviewed articles on evaluation, assessment, and, recently in the journal *Science*, student persistence in Science Technology Engineering and Mathematics (STEM) fields. At New Haven Reads, Mark works as a volunteer with New Haven K-12 kids on their reading skills and homework.

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## Abstract

The University of New Haven received S-STEM funding for *A Scholarship Program to Increase Retention in Engineering (ASPIRE): Improving Work-Study-Life Balance*. The goal of the 5 year program is to improve retention, particularly in the sophomore and junior years, for engineering students who show academic potential but are at risk of not completing their studies due to financial concerns and/or life-work-study balance issues. The ASPIRE program aims to accomplish this by: providing scholarships for sophomore and junior level matriculated students based on both financial need and merit; recruiting and providing scholarships to community college transfer students; providing support services including peer tutors, conferences, lectures, presentations, and career planning workshops; and increasing student engagement in college- and university-wide activities that contribute to persistence.

This paper details the process of development and implementation of a systems approach to evaluation, where the assumption is that our program is itself lodged in a larger system with various stakeholder interests and desired outcomes. The assessment plan was created by using logic and pathway models that relate activities in the ASPIRE Program to short term, medium term, and long term outcomes. The assessment plan further identifies how activities support outcomes and also shows how outcomes at one level support outcomes at a different level. Measurement tools were designed and implemented on the first group of scholarship recipients. Modifications were made based on collected data. Currently, 3 cohorts have received ASPIRE awards. The paper concludes with the challenges and successes of the implementation and assessment of the NSF S-STEM award.

## Motivation

The mission statement of the University of New Haven and the Tagliatela College of Engineering (CoE) is to provide an undergraduate education that is focused on experiential education. The CoE offers ABET accredited BS degrees in Chemical Engineering, Civil Engineering, Computer Engineering, Electrical Engineering, Mechanical Engineering, and System Engineering. The university as well as CoE has experienced significant enrollment growth over the last 10 years. During this 5 year period, the CoE undergraduate enrollment of 297 students in 2006 increased 47% to 438 students in 2010. The retention of first time, full time freshman students is approximately 80%, with 20% of the freshmen leaving the university or changing majors to non-engineering fields. Institutional data shows that less than 80% of these remaining students are retained after their sophomore year. Modest improvements in the retention rate of students during the first two years can substantially increase the number of engineering graduates entering the workforce<sup>1</sup>.

The university is a small but growing institution in urban coastal Connecticut and our student body is drawn from the region with wide variability in terms of family economic background. Approximately 60% of the students are first generation college students as self-reported by incoming freshmen. The university, particularly over the last 5 years, has increased funding available for grants and scholarships. The additional support has enabled us to attract students who are better prepared to meet the challenges of the engineering curriculum. However, although funding has been increasing, the average net price for full time, undergraduate students attending CoE has also steadily increased.

During the 2009-2010 academic year, 98% of full time, first time undergraduate students received grants or scholarship aid, including 30% who received Pell or other federal grants and 82% who received student loan aid. Based on students enrolled during the 2009-2010 academic year, 73% of incoming sophomore and junior level students were eligible for financial aid of at least \$20,000. Current data shows that 85% of students need financial aid; however, the university cannot fully meet their needs. The average gap (difference between financial aid received and what is still needed) for engineering students who were enrolled for 2010-2011 was \$7,400. The greatest impact of the shortfall between need and support is on traditionally underrepresented STEM students. For students with family obligations, in particular women, child care costs may limit the number of classes in which they enroll, delaying time to graduation.

Since 2008, the university has been documenting the reasons why students choose either to withdraw from the university or take a leave of absence. Table 1 summarizes the number of students in the CoE who have withdrawn or taken a leave of absence since 2008. Academic advisors have reported that these numbers are likely higher than the self-reported numbers since students are sometimes reluctant to disclose personal information.

Although 20% of the freshmen class is not retained within engineering, the reason is not solely due to financial reasons. It is not uncommon that students discover that engineering is not what they expected, and many switch to other majors with some remaining at UNH. The factors that influence upperclassmen retention are usually not academic choice related but rather are due to external factors such as finances, family or health.

After the initial support given during the freshman year in the form of financial and programming activities, the university loses some students who become overwhelmed by the cost of continuing education. Many students, particularly in the CoE, find it necessary to work part- or full-time while pursuing their degrees. There is a trend that after the freshman year the university loses students due to financial reasons, or students enter the workforce and maintain part-time status in order to offset the rising average net price for their education. Between 2006 and 2009, each year a range of 16-28% of full-time students switched to status of part-time.

Table 1: Withdrawals/Leave of Absences due to Financial Reasons

	Total Number of Students LOA/W from CoE	Self Reported LOA/W from CoE due to Financial Reasons	Freshmen (< 27 credits)	Sophomore (< 57 credits)	Junior (<87 credits)	Senior
2008-2009	39	10 (26%)	0	4	4	2
2009-2010	38	9 (24%)	3	5	1	0
2010-2011	44	11 (25%)	5	5	1	0
Fall 2011	9	3 (33%)	1	1	1	0
LOA: Leave of Absence; W: Withdrawal						

### S-STEM Funding

The CoE at the University of New Haven received NSF S-STEM funding for *A Scholarship Program to Increase Retention in Engineering (ASPIRE): Improving Work-Study-Life Balance*. The goal of this project is to improve student retention, particularly in the sophomore and junior years, for engineering students who show academic potential but are at risk of not completing their studies due to financial concerns and/or life-work-study balance issues. This goal will be accomplished through the following objectives:

1. Provide scholarships for matriculated students based on both financial need and merit to sophomore and junior level students over 5 years.
2. Recruit and provide scholarships to high academic performing community college transfer students over 5 years.
3. Provide support services that include engineering tutors to complement the current university-tutoring center.
4. Increase student engagement in college- and university-wide activities that contribute to persistence such as mentoring STEM students, participating at academic conferences in their field, service learning activities, and graduate and professional networking events.

The ASPIRE project provides scholarships to sophomore and junior level students with the goal of maximizing student success. For instance, a student working 20 hours/week for 45 weeks/year at \$10/hour would earn \$9000 per year with estimated take-home earnings of \$7500 per year. ASPIRE would allow for financial awards of up to \$7,500 based on financial need and academic standing. When students are working 20 hours or more a week, they are not able to dedicate

100% of their effort to coursework. The engineering curriculum is challenging for most students, but particularly so for those who have limited time available to study due to work commitments. Thus, reducing the need for students to work during the academic year would allow them to focus more on their coursework as well as become involved in professional and extracurricular activities offered by the university. Greater social and professional engagement will increase the likelihood of persistence and graduation.

### **Application and Selection Process**

The ASPIRE project has created a carefully designed process for selecting the students who will receive ASPIRE scholarships. The selection process follows all the guidelines set out by the NSF S-STEM program. The following criteria are given for eligibility for the scholarship:

- Be citizen of the United States, national of the United States (as defined in section 101(a) of the Immigration and Nationality Act), aliens admitted as refugees under section 207 of the Immigration and Nationality Act, or aliens lawfully admitted to the United States for permanent residence;
- Enrolled full time in an engineering program during award period;
- Demonstrate financial need, defined by the US Department of Education rules for need-based Federal financial aid;
- Sophomore or junior level students in good standing with the CoE.

The awarding of the ASPIRE scholarship is granted by using a point-based matrix. The matrix has the following categories:

- Financial Need (20 points): Using the need-based Federal financial aid guidelines a ranking is given so that the students with the greatest need are given preference.
- Academic Success (12 points): Points are given based on the students GPA.
- Academic Potential (12 points): Recommendations from engineering faculty is used to determine the academic potential of students.
- Underrepresented group (12 points): To increase the number of underrepresented students, additional preference is given.
- Co-curricular activities (8 points): Points are given based on student involvement activities including professional student chapters, clubs, community service, etc.
- Potential impact (20 points): Student applicants submit a 1-page essay describing the potential impact of the award on their academic success. For example, the funding awarded through the program might allow a student to make changes in extracurricular demands (such as part-time work, childcare, etc.) so that he/she may focus more time and effort on classes.

The selection of scholarships is based on a point matrix outlined in Appendix Table 1. Total points awarded is equal to the sum of the points assigned for a band multiplied by the weighting factor for each criteria. The maximum points awarded is 84 points. Scholarships in an average amount of \$108,000 annually will be distributed with an aim of awarding: approximately 10 scholarships of \$7,500; approximately 6 scholarships of \$5,000; and a bridge fund of \$3,000 will be set aside for students who have had a change in financial circumstances (e.g. parents or student lost job; unanticipated financial crisis, etc.). For transfer students from community colleges the top three students on the matrix will be awarded scholarships, with the amount based on financial need and other matrix criteria. Adjustments will be made in the number and dollar amount of scholarships given so as to maximize the benefits of the program in a particular year. Junior level students who received the scholarship as sophomores will be eligible to apply for the scholarship again.

### **Complementary and Supplemental Activities**

The ASPIRE project builds directly and indirectly on the success of current activities at the University of New Haven to provide complementary and supplemental support services and opportunities for scholarship recipients. Programs and activities specifically designed and targeted at the scholarship recipients include: mentoring, undergraduate research opportunities, networking with alumni, applying to graduate school, and opportunities to participate in academic service learning projects.

#### *Welcome Breakfast*

Each year, the new cohort of students are asked to attend a *Welcome Breakfast*. This is an opportunity for the students to meet each other; to be congratulated on their award and continued academic success by the Dean or Associate Dean of Engineering; to become aware of the resources provided or available to scholarship winners; and to be introduced to their ASPIRE mentor. Each of the PIs serves as a mentor to the students. The cohort gets divided and each student is assigned to one of the PIs - ideally, one who is not in the students' same academic area. At the *Welcome Breakfast* we discuss the value of having a mentor and networking.

#### *Undergraduate Research Opportunities*

The University runs a 10-week summer program for undergraduates to be involved in conducting undergraduate research. The program is advertised/emphasized to the scholarship cohort and the PIs share with the students their own experience at having carried out undergraduate research. In addition, the scholarship cohort students are asked to complete an online tutorial on the responsible conduct of research available through the National Center for Professional & Research Ethics. An in-person session is conducted to discuss with the students the importance of ethics and why responsible conduct of research is important to all - not only to researchers.

### *Networking Socials*

The community of ASPIRE scholars have the opportunity to meet once each semester with faculty, alums and other local industry professionals. Alumni can provide valuable insight and motivation to the students to persist to degree completion. Direct networking with local industry professionals can supplement career placement services to enhance employment opportunities for ASPIRE scholars.

### *Graduate School Panel Discussion*

Annually, graduate students from regional institutions are invited to participate in a panel discussion with scholarship recipients and other University of New Haven undergraduate STEM students. These panelists are selected to represent a range of engineering disciplines and degree programs and provide perspective for our students on various aspects of graduate school, such as the application procedure, employment prospects, program selection, fellowship opportunities, selecting an academic advisor, etc.

### *Academic Service Learning Opportunities*

ASPIRE senior faculty partner with the University of New Haven Experiential Education office to provide opportunities for scholarship recipients to do academic service learning projects. These projects are done in the service of a local non-profit entity and give students opportunities to apply classroom engineering concepts to real-world needs. Examples of academic service learning projects within the engineering context have included the design of devices tailored for differently-abled individuals, design of water treatment systems for developing communities, and design of structures for non-profit organizations.

### *Attending Professional Conferences and Meetings*

Attending and/or presenting at professional conferences provides opportunities for students to develop their professional identity and affinity. It also provides an opportunity to network and seek career information which may not be directly available on campus. ASPIRE recipients have the opportunity to apply for funds to cover registration fees, travel and lodging costs. Applications are accepted on a rolling basis and consist of explaining what they expect to get out of their attendance. Upon their return, recipients of the funds are asked to submit a short reflection of their experience.

### *Supplemental Instruction Tutoring*

ASPIRE funding is being used to support the Supplemental Instruction (SI) tutoring program, introduced during the fall 2013 semester by the Center for Learning Resources (CLR). Tutors work with instructors from a number of engineering courses taken by students during the first two years of the curriculum to provide additional assistance to students. ASPIRE recipients were hired as SI tutors.

## **Program Evaluation and Assessment**

The overall goal of ASPIRE is to improve the success of academically deserving sophomore and junior level students at the University of New Haven who are struggling to finance their education. Project success will be defined by whether the financial support provided by the scholarship allowed students to complete their degree within 4-5 years (e.g. 8-10 semesters) and whether their academic experience was enhanced.

With the assistance of the external evaluator of the grant, the PIs created an evaluation plan using a pathway model approach<sup>2</sup> that relates activities in the ASPIRE Program to short term, medium term, and long term outcomes. A list of the activities and various outcomes is included in the appendix. The evaluation plan goes one additional step and identifies how activities support outcomes and also shows how outcomes at one level support outcomes at a different level.

Specifically, the following measures will be used to assess the success of ASPIRE. For persistence and completion of degree, measures of retention rate, number of credit hours/year, GPA, and time to graduation will be used. For enhanced experience, the main measure will be engagement both internally and externally to the University. Data will be gathered to address whether participation in the proposed project results in the following:

- increase in retention rate;
- increase in number of credit hours/year;
- increased engagement in university extracurricular activities
- increased engagement with students and faculty;
- increase in GPA;
- decrease in time to graduation.

### *Outcome measures of retention rate*

An increase in retention rate should occur if students are not burdened with excessive work demands to pay for their education. Thus retention rate is an overall measure of student success. The ability of a student to complete his/her degree within 4-5 years is dependent on the number of credits taken/year. Typically, students who work (to pay for their education) limit the number of courses they take per semester either because they want to ensure that they have sufficient time to focus on fewer courses or because the selection of courses is limited due to work schedules. It is reasonable to expect then that the proposed project should result in students being able to increase the number of credits taken each semester, in accordance with full-time status (average of 16 credits/semester). A direct consequence of scholarship recipients taking more credits is that they should be able to graduate within 4-5 years. Thus, the proposed project should also result in a reduction in the amount of time it takes for these students to graduate.

### *Outcome measures of innovative support services*

In addition to financial support, the proposed project includes innovative support services for students aimed at improving the persistence of students to complete their degree. If the financial burden is reduced for students, they should be able to focus more on their coursework. Thus, GPA will be tracked to determine whether student performance improves through participation in this project. The proposed support services will give students opportunities to interact more with faculty and other students. Thus, it is reasonable to expect an increased engagement of scholarship recipients with faculty and other students in the College of Engineering. These activities should also result in increased engagement of students with the university community as evidenced by increased participation in extracurricular activities, students clubs and student government.

### **Overview of the cohorts**

The ASPIRE program has awarded scholarships to 3 cohorts. The ASPIRE cohorts are identified by the spring semester including 2013, 2014, and 2015. The 2013 cohort was made up of seven students, the 2014 cohort had eleven students, and the 2015 cohort had fourteen students. In total 31 students have received awards, some students were in multiple cohorts.

Examining the 31 students across from all cohorts the demographics of the ASPIRE program are as follows:

- 35% of awardees have been female;
- 39% of awardees have self-identified as belonging to an underrepresented ethnic group (23% African-American and 16% Hispanic);
- Student major breakdown: 9 Civil Engineering, 8 Mechanical Engineering, 7 Electrical & Computer Engineering, 3 Chemical Engineering, 3 System Engineering, and 1 General Engineering;
- 2015 cohort average GPA at time of award 3.42;
- 2014 cohort average GPA at time of award 3.50;
- 2013 cohort average GPA at time of award 3.33.

The ASPIRE program has achieved its goal of increasing support for underrepresented group in engineering. The 39% inclusion of African-American and Hispanic students and 35% of female participation is above the overall demographic for the College of Engineering.

Data collected for NSF on the scholarship recipients indicates that the overall GPAs of the majority of students who received the scholarship did not significantly change during the 2013-2014 academic year. The differences in GPAs changed by no more than +/- 0.13 of the recipients' cumulative GPA from the previous year. Only 1 of the recipients had a decrease of 0.2 in their GPA.

## **Challenges and Recommendations**

Students applying for an ASPIRE Scholarship must have their family file a FAFSA form used by aid providers to determine the amount of the student's Expected Family Contribution (EFC). During the past two years, some issues pertaining to the FAFSA that have impacted student's eligibility for the scholarship have been brought to the attention of the PIs.

First, the intent of the ASPIRE program is to provide students with financial support so that they can reduce the number of hours they need to work, allowing them to spend more time on studies and participating in the life of the university. Financial aid eligibility is determined based on the previous year's FAFSA that includes student wages in some cases that the student may have needed to earn in order to attend college. However because the student worked, their financial aid eligibility is reduced. This seems somewhat contrary to the purpose for the scholarship. Second, changes in a student's EFC might result in a scholarship recipient's eligibility changing from year to year. There have been instances where parents have needed to liquidate entire stock positions in order to pay a tuition bill the year a recipient has received the ASPIRE scholarship. Because sale of the stocks is reflected in the following year's FAFSA, this has impacted the student's eligibility to receive the scholarship in the second year.

Distribution of bridge funds remains a challenge for the PIs. Our experience is that some students don't fully understand the conditions for financial aid eligibility. We are working with the Financial Aid Office to determine an approach for identifying students who are eligible for bridge funding.

Our experience with students applying to the ASPIRE Scholarship program over the past two selection cycles has raised an issue we would like to bring to the attention of NSF. This past year a student in financial need applied who is a legal alien and now has a social security number through the DREAM Act in Connecticut. This relatively new legislation raises questions as to the eligibility of these students for federal funding.

The PIs have dealt with challenges other than financial related to potential candidates. While academic success is important to measure the success of the ASPIRE program, the PI's were hoping to have students with lower than a B average as part of the awardee's in the program. Our cohorts have shown that the high achieving students are taking advantage of the ASPIRE program. PI's recognize more work is needed in advertising to a wide range of GPA students to achieve some long-term goals.

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## References

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2. Urban, J. and W. Trochim. (2009) *The Role of Evaluation in Research Practice Integration Working Toward the "Golden Spike"*. American Journal of Evaluation.

## Appendix A

ASPIRE Scholarship Scoring Matrix

Band Points	4	3	2	1	Weighting Factor	Points Awarded
Financial Need	$\geq$ \$10,000.00	\$7,000.00 - \$9,999.99	\$3,000.00- \$6,999.99	<\$3,000.00	5	= Points x Factor
Academic Success	3.5-4.0	3.0-3.5	2.5-3.0	2.0-2.5	3	
Academic Potential	Very strong	Strong	Moderate	Weak	3	
Underrepresented group	'Minority' student in terms of race, ethnicity, gender, or disability status	--	'Majority' engineering student	--	3	
Co-curricular activities	Very strong	Strong	Moderate	Weak	2	
Potential impact	Very strong	Strong	Moderate	Weak	5	
					Total (Max 84)	= Sum of Points Awarded

## Appendix B

### List of Activities and Outcomes for Pathway Assessment Model

Inputs	Activities	Outputs	ST Outcomes	MT Outcomes	LT Outcomes
	Develop application template		Coordinate application review process with financial aid	Mid-term review of satisfactory ASPIRE program progress	Long-term evaluation of ASPIRE program progress
	Publicize scholarship availability		ASPIRE program management	Mid-term review of satisfactory academic student progress	[blank]
	Review applications		Award scholarships	[blank]	Increased student retention
	Use matrix as a tool for selecting recipients		Implementation of networking events for scholarship recip...	Increases in students who don't fall behind in their cour...	Increased integration of engineering skills with communit...
	Create ASPIRE web page		Assign mentors to scholarship recipients	Increased development of a mindset and culture that engin...	Increases in 4-5 year graduation rate
	Organize networking events for scholarship recipients		[blank]	Better academic standing, improved GPAs	Improvement in 6-year graduation rates
	Strategy sessions with external evaluator to finalize ass...		Increased number of credit hours per year (for part-time ...	Increased dissemination to regional audience to broaden i...	Increased dissemination at national level for broader impact
	Outreach to community colleges		Reduction in number of hours devoted to outside employmen...		
	[blank]		Increased student awareness of support programs		
	Meetings in the first year to establish the program mecha...		Increased engagement in student activities and clubs		
	Research opportunities		Increase number of visits to tutors		
	Award scholarships		Increased conversion of part-time students to full-time s...		
	Networking events		Reduced need for substantial off-campus employment		
	Mentoring		Increased participation in presentations at conferences		
	Attend conferences		Increased UNH campus buy-in and expansion to other programs		
	Student peer tutoring				
	Academic service learning projects				
	Magnet school student opportunities				
	Recruit at community colleges				
	Dissemination				