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Using Assessment to Continuously Improve the Retention & Persistence of At-Risk Engineering Students

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Objective

At the University of Portland, studies show that students who are behind in their degree progress are not retained at similar rates as their on-track cohort and can be considered "at-risk". For the past three years, with NSF support, we developed a voluntary retention program to support students who are considered "at-risk" of leaving the Shiley School of Engineering. "At-risk" students start behind or fall behind in their STEM courses, although they are in good standing academically i.e., they are not on academic probation. The Program includes multiple interventions targeted at increasing the persistence and ultimately the retention of these at-risk students, including, among others, year-long counseling focused on community building and academic support, and various opportunities for students to regain cohort status academically. Throughout the NSF-funded Program, we assessed particular interventions using both quantitative and qualitative studies. In this poster, our objective is to present the various iterations we made to the Program based on the ongoing assessments.

Rationale for the Retention Program

The University of Portland is a mid-sized, private university with approximately 3,700 undergraduate students in Fall 2016, 740 of whom are in the Shiley School of Engineering. 97.5% of the University of Portland undergraduate students receive up to eight semesters of financial aid. As a result, our engineering degrees are designed as four-year curricula that start with Calculus 1 and General Physics 1 in the fall of the first year.

In 2013, we were awarded a National Science Foundation (NSF) Graduate 10K+ Science, Technology, Engineering, and Mathematics Talent Expansion Program (STEP) grant to assist with increasing the retention of at-risk engineering students (Jones et. al., 2014; Jones et. al., 2015). At the University of Portland, the majority of engineering students who fall into this at-risk category are those who start the first year in pre-calculus based on a Calculus 1 readiness test that they complete during the summer before their first college semester. For engineering, our baseline (F2011-F2012) average 1st to 3rd semester retention rate is 80% for all students while the baseline (F2011-F2012) average 3rd to 5th semester retention rate is 90%. However, students who start their degrees in pre-calculus have a baseline (F2011-F2012) average 1st to 3rd semester retention rate of 62% and a baseline (F2011-F2012) average 3rd to 5th semester rate of 76%. We need to calculate the baseline (F2011-F2012) average graduation rate for the total and at-risk cohort. (*Note that we used the F2011 to F2012 as the baseline period because the Calculus 1 readiness test was first put into effect for F2011 and our Retention Program started in F2013.)*

On average, around 40 to 50 students out of an entering class of 200 students fall into this at-risk cohort annually due to lack of readiness for Calculus I. An additional 15-20 students join the at-risk cohort during the first and second years because they fail to adequately complete a required STEM course, but they stay in overall good academic standing. Although we did not target a particular demographic, over the first three years of the STEP Program, 50% of all eligible

students identify as non-white or more than one race, 21% are Pell-eligible, and 24% are first generation college students. These percentages are all higher than those for our total engineering student population.

Overview of Retention Program

With the NSF grant, we developed a Retention Program with a focus on at-risk first- and second-year students within engineering. We used Tinto's (1987) model of retention for the initial Program design; Tinto's model suggests both academic and social integration are needed for students to be retained at an institution. Given the reason for at-risk status at the University of Portland, the STEP Retention Program is primarily designed to help students catch up academically with the traditional cohort that is on track to graduate in four years. This emphasis on academic integration is based on the hypothesis that at an institution such as the University of Portland (private with a high financial need student body and financial aid limited to eight semesters), persistence in the major is primarily driven by the perceived ability to graduate in four years.

In addition to the main focus on helping students to catch up academically, we designed most of the Program elements to build community and belonging among the at-risk cohort (Tinto's social integration factor), while introducing them to the available resources and giving them a guide for how they can graduate in four years despite starting college in pre-calculus. We also designed the social integration component to focus on improving students' self-efficacy. Tinto (2015, p. 2) notes that "the impact of student college experiences on persistence can be understood as the outcome of the interaction among student goals, self-efficacy, sense of belonging, and perceived worth or relevance of the curriculum." We included a professional integration component from the beginning and learned through qualitative assessments that, for engineering students, the professional integration component may have equal weight with the social integration component (Jones et. al., 2017).

We conducted quantitative assessments that include comparisons of retention rates and graduation rates for the at-risk cohort versus the overall engineering student population, along with comparisons of similar indicators for participants versus non-participants in the Program, overall participation rates in each Program element, among others. The qualitative assessments include pre- and post-surveys for various Program elements, as well as focus groups at key milestones that are conducted by an independent evaluator. These qualitative assessments help us to better understand why we are achieving certain quantitative results.

Retention Program Elements

Below, we describe each of the seven Program elements to date, the academic/social/professional integration components for each element, the assessment tools used, and cost information. For each Program element, we also note the participation rate; with one exception, all elements are optional and some require a certain level of commitment to the Program. For the last seven semesters, the eligible at-risk participants are 46 first years and 25 sophomores in 2013/14, 51 first years and 46 sophomores in 2014/15, 68 first years and 34 sophomores in 2015/16, and 60 first years and 22 sophomores as of January 2017. (*Note that the Math department at the*

University of Portland increased the score to pass the Calculus 1 readiness test in summer 2015.)

A. Voluntary Pre-First-Year Six-Week Academic Summer Bridge

Target Audience: Entering first-year students who did not pass the Calculus 1 readiness test. All 42 eligible students invited, but participation was optional. In the only year offered (2014), nine students participated.

Cost for Students: meals, insurance, books

Cost for the University: faculty stipends, student housing, 20-hour per week peer mentor, transportation for field trips

Academic Integration Component: Students complete Pre-calculus II so that they can begin the fall semester on track with their cohort. They also complete a second course within the University's core curriculum.

Social Integration Component: Ice-breaker and team-building activities, field trip to downtown Portland, movie nights, service immersion trip to Saint Andre Bessette church, meet and greets with engineering faculty.

Professional Integration Component: Weekly site visits to local engineering companies.

Assessment Methods: A pre and post-program survey, and a focus group at the end of the program, along with tracking of retention and graduation rates.

B. Voluntary Two-Day Orientation with Online Pre-Calculus Course

Target Audience: Entering first-year students who did not pass the Calculus 1 readiness test. All 53 eligible students invited, but participation was optional. In the only year offered (2015), 18 students participated.

Cost for Students: self-funded at $150 per student

Cost for the University: N/A

Academic Integration Component: Students completed an online pre-calculus course so that they can retake the Calculus 1 readiness test and begin the fall semester on track with their cohort. Completion of the course was a requirement to participate in the orientation.

Social Integration Component: Team building activities, campus scavenger hunt, game night, lunch with engineering faculty.

Professional Integration Component: none

Assessment Methods: A pre-and post-assessment, along with tracking of retention and graduation rates.

C. Required One-credit Fall Semester Course for First-Year Students

Target Audience: Entering first-year students who did not pass the Calculus 1 readiness test. All 38 eligible students were registered for the course since it was required.

Cost for Students: none

Cost for the University: adjunct stipend for two sections of the course

Academic Integration Component: Various activities show students how to feasibly complete their engineering degrees in four years despite starting college in pre-calculus, along with information on resources and study skills necessary to be successful in engineering.

Social Integration Component: Ice-breaker and team-building exercises, small-group discussions/activities.

Professional Integration Component: class sessions on teamwork, diversity, long-term goal planning, and the value of non-technical skills in a professional setting

Assessment Methods: A pre and post-course survey along with course evaluations and tracking of retention and graduation rates.

D. Voluntary Academic Year Achievement Program

Target Audience: Entering first-year students who did not pass the Calculus 1 readiness test, as well as first-year students who fell behind in the first semester, and second-year students who are behind their cohort by at least one STEM course. All students must be in good academic standing, i.e., not on academic probation. All eligible students are invited, but participation is optional though there is an incentive of being considered for funding for STEM courses in the following summer. In the first three years of the program (2013/14, 2014/15, 2015/16) 38 out of 71, 30 out of 97, and 31 out of 102 students participated, respectively when the first-year and sophomore students are combined.

Cost for Students: none

Cost for the University: staff member with counseling expertise

Academic Integration Component: 1:1 discussions and group workshops on degree planning, study habits, time management, test-taking, effective writing, overcoming failure, and growth mindset/self-efficacy.

Social Integration Component: Monthly student socials.

Professional Integration Component: none for first-year students; alumni dinner for sophomore students with informal conversations about careers

Assessment Methods: A focus group for first year versus sophomore participants at the end of the academic year, along with tracking of retention and graduation rates

E. Voluntary Rising Sophomore Eight-Week Summer Bridge

Target Audience: Entering first-year students who did not pass the Calculus 1 readiness test, as well as first-year students who fell behind in the first year. All students must be in good academic standing. All eligible students who actively participated in year-long counseling are invited, but participation is optional. In the two years for this component to date (2015, 2016), 10 and 11 students participated, respectively.

Cost for Students: meals, insurance, books, and a $150 deposit as of 2016

Cost for the University: faculty stipends, student housing, 20-hour per week peer mentor, transportation for field trips

Academic Integration Component: Students complete Calculus II so that they can begin the fall semester on track with their sophomore cohort. They also complete a second course within the University's core curriculum.

Social Integration Component: Team building exercise and group activities including trips to the zoo, the beach, and a street fair, day-hikes, Portland boat tour, bowling, and game/movie nights.

Professional Integration Component: weekly site visits to local engineering companies, a one-day externship with an engineer in each student's interest area, workshops on resume and cover letter writing

Assessment Methods: A pre and post-program survey, a focus group at the end of the program, and tracking of retention and graduation rates.

F. Scholarships for Summer STEM Course

Target Audience: Entering first-year students who did not pass the Calculus 1 readiness test, as well as first-year and sophomore students who fall behind in STEM courses. All students must be in good academic standing and complete the course at the University of Portland due to logistical reasons with Financial Aid. All eligible students who actively participated in year-long counseling are invited, but participation is optional. In the three years for this component to date (2014, 2015, 2016), 8, 7, and 7 students participated, respectively.

Cost for Students: anything above $1,000 per course

Cost for the University: $1,000 per student

Academic Integration Component: Students complete the necessary courses so that they can begin the fall semester on track with their sophomore or junior cohort.

Social Integration Component: none

Professional Integration Component: none

Assessment Methods: Tracking of retention and graduation rates.

G. Sophomore Peer Tutoring for Key Engineering Courses

Target Audience: All sophomore students (not just at-risk students). In the two years for this component to date (2014/15, 2015/16), an average of 55-65 students (out of approximately 180 total sophomores per year) took advantage of the tutoring.

Cost for Students: none

Cost for the University: wages for tutors

Academic Integration Component: Students receive supplemental instruction to help them complete the necessary courses so that they stay on track with their cohort.

Social Integration Component: none

Professional Integration Component: none

Assessment Methods: Tracking of retention and graduation rates.

Preliminary Results - Quantitative

This is the fourth year for the STEP Program and we are able to begin looking at the retention results; we have not conducted statistical significance testing due to the small data set to date. Table 1 presents the participation rate for various aspects of the Program. Table 2 presents the overall retention rates to date as compared to the pre-project baselines, as well as our original goals for the Program. Table 3 shows the retention data just for the at-risk cohorts in terms of those who participated versus did not participate in the year-long academic achievement component of the Program (Element D). Tables 4 and 5 shows the retention data for the subset of first-year at-risk students who participated in the various ways to catch up with STEM courses over the summer (Elements A, E, and on their own).

The initial quantitative results are promising. For the at-risk cohort, the 1st to 3rd semester retention rate was 70%, 80%, and 66% for 2013, 2014, and 2015 respectively as compared to the baseline average of 62%. Unfortunately, less than a third of the students in those cohorts caught up with the relevant on-track cohorts by the start of sophomore year, however most of those who did catch up participated in the academic-year achievement component (Element D). The overall

1st to 3rd semester retention rates for all engineering students during this time period were the same, or slightly higher than the baseline average, but statistical significance testing is needed.

For the same at-risk cohorts, the 3rd to 5th semester retention rates were lower than the baseline average. We need to pay attention to the transition period between sophomore and junior year for the at-risk cohort to better understand the dynamics.

The quantitative assessment shows that although the at-risk students who participate in the Program are demonstrating higher retention, the voluntary programs are not reaching the majority of the cohort and this could affect our ability to meet the targeted goals for overall student retention.

Table 1. Participation Rates in the Shiley School of Engineering Retention Program

	2013-14	**2014-15**	**2015-16**
Total 1st year students	174	238	229
Eligible 1st year students	46	58**/51	68
% of class at-risk in 1st year	26%	21%	30%
Total 1st year participants in AY Program	24	18	26
Participation in AY Program	52%	35%	38%
UP Summer Bridge participants caught up by start of sophomore year	N/A*	18***	11
% of at-risk students caught up by start of sophomore year with UP Summer Bridge	N/A	31%***	16%
UP at-risk students caught up by start of sophomore year w/o UP Summer Bridge	7	5	8
% UP at-risk students caught up by start of sophomore year w/o UP Summer Bridge	15%	10%	12%
Total % UP at-risk students caught up by start of sophomore year (UP Summer Bridge + other programs)	15%	41%	28%

*There was no summer bridge offered for the 2013-2014 first-year cohort.
** This number also includes the students who participated in the pre-1st year summer bridge even though those who passed did not have to participate in the AY Program.
***This number includes the students who participated in the pre-1st year summer bridge and the pre-sophomore summer bridge. This was the only year this was possible.

Table 2. Overall Retention Data for the Shiley School of Engineering

	Baseline	Goal	2013-14	2014-15	2015-16
Average Math SAT	645		651	647	637
Math SAT Range	TBD		410-800	470-800	420-800
Average Verbal SAT	604		608	606	595
Verbal SAT range	TBD		340-800	410-800	390-800
1st – 3rd Semester Retention Goal		85%			
Pre-project Baseline (total)	80%				
Pre-project Baseline (at-risk)	62%				
Total Students			80%	87%	82%
At-risk Cohort			70%	80%	66%
3rd -5th Semester Retention Goal		90%			
Pre-project Baseline (total)	90%				
Pre-project Baseline (at-risk)	76%				
Total Students			85%	86%	--
At-risk Cohort			66%	71%	--
4-Year Graduation Goal					
Pre-project Baseline (total)	58%				
Pre-project Baseline (at-risk)	TBD				
Total Students			--	--	--
At-risk Cohort			--	--	--
5-Year Graduation Goal		75%**			
Pre-project Baseline (total)*	69%*				
Pre-project Baseline (at-risk)	TBD				
Total Students					
At-risk Cohort					

Baseline Cohorts are those who entered as first-time freshmen in F2011 & F2012
* Based on the F2011 cohort only since data not available for F2012 cohort as yet.
** Changed from grant to be more realistic.

Table 3. Retention Data - Academic Year Achievement Program for At-risk Cohorts in the Shiley School of Engineering

		Number	1st – 3rd Year Retention	3rd – 5th Year Retention	5th – 7th Year Retention
2013-14 At-risk cohort	Participants	24	67%	81%	92%
	Non-participants	22	73%	50%	88%
	Total	46	70%	66%	90%
2014-15 At-risk cohort	Participants	18	89%	75%	--
	Non-participants	33	76%	64%	--
	Total	51	80%	71%	--
2015-16 At-risk cohort	Participants	26	77%	--	--
	Non-participants	42	60%	--	--
	Total	68	66%	--	--

Table 4. Retention Data – Students in At-risk Cohorts who Caught up by Start of Sophomore Year via the Shiley School of Engineering Summer Bridge

	2014-15 Pre-freshman	2014-15 Pre-sophomore	2015-16 Pre-sophomore
Number	9	10	11
1st - 3rd semester retention	78%	N/A	N/A
3rd – 5th semester retention	86%	90%	--

Table 5. Retention Data – Students in At-risk Cohorts who Caught up by Start of Sophomore Year via Any Means

	2013-2014	2014-2015	2015-2016
Number	7	23	19
3rd – 5th semester retention	57%	87%	--

Preliminary Results – Qualitative

We assessed the year-long academic achievement program (Element D) each year using an online survey that was distributed at the end of the fall semester, along with a focus group that was conducted at the end of the spring semester. Results from the first three years of the program show that students appreciate the 1:1 counseling because it helped them develop a plan for getting back on track and tackle academic challenges. Students also felt that the year-long program helped them gain confidence in their major. In the first focus group, student feedback suggested that the initial messaging for the program was intimidating and/or stigmatizing (students particularly did not like the use of the word "retention"). After the messaging was revised to be more positive and reassuring, students in the second focus group found the messaging to be appropriate.

Despite the benefits described above, the quantitative results showed that the majority of at-risk students were not participating in the year-long academic achievement program (Element D). The qualitative feedback suggested that, even with the improved messaging, students might first need to attend some of the events to realize the benefits so that they continue participating. After trying various techniques to encourage more students to participate, we decided to require all entering at-risk first-year students (starting F2016) to enroll in a one-credit course that takes the place of Element D in the fall semester.

We assessed this required one-credit course (Element C) through pre and post-surveys and course evaluations. The surveys from F2016 showed that the students made positive gains in every metric: relationship with peers, understanding of academic expectations, developing an engineering student identity, awareness of the STEP program, and degree planning. Feedback from the course evaluations showed that students valued knowing how to get caught up in their degree and learning about skills necessary for success in engineering. A few students felt the course contained too much "fluff," so course content will be revised accordingly for the F2017.

We are currently evaluating if the students voluntarily continue with Element D in the spring semester and into the sophomore year.

Feedback from the first focus group for Element D also highlighted the lack of academic resources for sophomore engineering students; as a result, we implemented the sophomore peer-tutoring program (Element G).

We assessed the summer bridges through pre and post- surveys and a focus group at the end of each program. Feedback from both the post-surveys and the focus groups showed that taking math over the summer helped the students build foundational skills and gain more confidence in their academics. Students also benefited from building community with their peers and learning about the range of professional opportunities within engineering/computer science.

The qualitative assessment in the first year suggested that the logistics involved with attending a bridge before college starts prevent many from participating. As such, we tried another iteration to help entering students start on track with their cohort; the voluntary two-day orientation program for pre-first-year at-risk students who completed an online pre-calculus course the summer after high school (Element B). While this change proved unsuccessful in terms of helping students to start college in Calculus 1, it resulted in higher student participation in the year-long academic counseling program (Element D) that likely contributed to the slight increase in the number of students who caught up academically the following summer via Elements E and F. Qualitative assessments also suggested that a bridge between the first-year and the sophomore year may work better for students once they understand, from the year-long counseling sessions, the need to catch up with their cohort. Unfortunately, participation in the summer bridge has not increased significantly to date.

As we reflect on the overall assessment plan, we realize that while some Program elements have thorough assessments, we need to disaggregate the data even more so that we better understand the various cause and effect relationships.

Initial Conclusions

While there are some promising initial results in terms of 1st to 3rd semester retention rates, it is clear that participation in the Program elements that help students catch up academically has been low. Since implementation, we made several changes to the Program in an attempt to increase the number of students who take advantage of the Program to catch up academically.

In terms of the financial sustainability, we are optimistic. The current Program includes Elements C (required 1-credit course in fall of first year), D (academic-year counseling for 2nd semester first-year students and sophomores), E (sophomore summer bridge), F (scholarships for summer STEM catch-up courses), and G (sophomore peer tutoring in key engineering courses). This combination provides a holistic program of support for at-risk engineering students aimed at graduation within four years that was designed using evidence-based practices.

With the exception of E and F, the other elements are now included in the Shiley School of Engineering's operating budget. Element F can be supported in the long term with endowment

funds. The only concern at this time is Element E since it is a high cost program and we have not found a permanent source of funding. We are evaluating if Element F can substitute for Element E and how to strengthen the social and professional integration components in the remaining Elements. Given the home locations for many of the at-risk students (e.g., Guam), Element E may be the only way that they can catch-up academically.

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