

Implementation and Assessment of the Washington State Academic Red-Shirt (STARS) Program

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Abstract

To address concern for a lack of qualified applicants for STEM related positions in the State of Washington, Washington State University and the University of Washington partnered to create the Washington State Academic RedShirt Program (STARS). Based on the University of Colorado's GoldShirt Program, STARS provides a support structure for incoming first year engineering students through specialized curriculum, intrusive advising, and community. Results and best practices observed thus far are presented.

Introduction and Background Information

Throughout the country there are numerous employment opportunities requiring skills that can be acquired through attaining a degree linked to Science, Technology, Engineering, or Math (STEM). Unfortunately there is often a gap between the number of jobs available and the number of qualified applicants. This gap is especially acute in the State of Washington where there are an estimated 25,000 unfilled positions of which 80% are high-skilled STEM or health-care related¹.

Washington State is the base of operations for such engineering and technology giants as Microsoft, Amazon, and Boeing. The Puget Sound region is also home to many companies that may not be thought of as high tech companies but, in fact, require a highly trained technical workforce. For example, 15 million people use the Starbucks mobile phone application which generates 5 millions transactions a week, thus making Starbucks "one of the most successful software companies on the planet²." As another example of a company with headquarters in Seattle, Nordstrom's has nearly 1,000 employees working in their tech unit. Similar stories abound, resulting in the Puget Sound region being one of the most vibrant in the country for STEM-related employment. Nevertheless, growth is often accompanied by challenges and the current gap between the number of job openings and qualified employees is projected to increase to 50,000 positions by 2017¹.

Several large companies have the resources to seek talent from around the world, but this is more the exception than the rule. Thus, there is a strong desire to "locally produce" far more graduates who are prepared to participate in this thriving sector of the economy. In order to accomplish this, it is necessary to broaden the pool of students who feed into the STEM pipeline as well as help ensure the ultimate success of these students in attaining a degree.

The Washington State Academic RedShirt (STARS) program seeks to broaden the pool of qualified job seekers through facilitating the success of engineering and computer science students coming from economically and educationally disadvantaged backgrounds. We take Pell Grant eligibility to indicate an economically disadvantaged background and take graduation from

a high school where 30 percent or more of the students receive free or reduced-price lunches as a proxy indicator of coming from an educationally disadvantaged background (owing to the fact that these schools often lack the resources necessary to prepare their students for success in the first year of a standard engineering or computer science program).

The STARS program is modeled after the University of Colorado's GoldShirt Program and is a partnership between Washington State's two leading public institutions: Washington State University (WSU) and the University of Washington (UW). These universities have combined their efforts to achieve the following goals:

- Increase by 225 the total number of engineering and computer science degrees.
- Retain 75% of STARS students to the upper division of an engineering program.
- Increase by 50% the retention of Pell Grant-eligible students who enter directly as freshman to the upper division of an engineering program.
- Increase by 20% the number of underrepresented minorities pursuing engineering degrees.

Similar to a "redshirt" year taken by athletes in order to hone their abilities and develop new skills before competing in college athletics, the STARS program is available to provide a support structure for students in their first year of study in engineering or computer science. However, this program is not directed at athletes, but rather to all students who are Pell Grant-eligible, come from an under-resourced Washington high school, and are interested in pursuing a degree in engineering or computer science. Students admitted to the program take specialized courses, receive intrusive intentional advising, and have access to mathematics and chemistry tutoring. In addition, students receive scholarships, participate in academic workshops, and plug into a learning community of other engineering students from the same background. Each of these components contributes to the preparation of the STARS students for success in engineering or computer science. This paper provides an overview of the program and discusses results, lessons learned, and best practices.

Recruitment

The STARS program accepts a maximum of 64 students each year resulting in a 32-student cohort at each partner university. The recruitment process for the program differs at each university. However, each university maintains the same foundational selection criteria. Students who have expressed an interest in engineering or computer science are selected for the program based on their Pell Grant-eligibility, graduation from a Washington high school where 30 percent or more of the students receive free or reduced-price lunch, and the review of their program application. The application involves an interest form, three essays, and an interview.

At WSU (which is on a semester system), owing to the limited information provided on applications, a list of students who are potentially eligible was not generated until May when Pell

Grant eligibility becomes available. Consequently, eligible students were intercepted at their summer orientation session where they were informed about the STARS program and encouraged to complete the program application prior to the start of school in mid-August. Since recruitment occurred in the summer months before the start of the fall semester, the number of applicants roughly matched the number of available slots (there has not been an excess in demand at WSU). If a student applies, they are nearly guaranteed acceptance into the program provided their math placement is sufficiently high (roughly at the pre-calculus level).

At UW (which is on a quarter system), eligible students are encouraged to apply before summer, as early as March or April. (At the time of application, applicants to the UW provide some information related to estimated family contribution that facilitates such recruitment.) With additional time to recruit, UW is able to select highly motivated students with a higher level of mathematical preparedness. The results given in this paper should be viewed in light of the recruitment process at each university. The demographics for each cohort are given in Table 1. One thing to note is that at WSU, because nearly all the applicants were accepted, the demographics were not altered through a selection process other than selecting students who applied for and were eligible for the STARS program. At the university level, approximately 38% of the incoming freshmen are first generation and roughly 32% are minorities. The percent of the STARS students in these categories is far above the university averages reflecting the fact that minorities and first-generation students are more prevalent among those from economically and educationally disadvantaged backgrounds.

Table 1: 2013-2016 STARS student demographics

	Cohort I (2013-2014)		Cohort II (2014-2015)		Cohort III (2015-2016)	
	UW	WSU	UW	WSU	UW	WSU
First Generation	80%	58%	80%	79%	45%	70%
Underrepresented Minority	47%	45%	44%	48%	31%	48%
Female	40%	18%	40%	14%	41%	19%

Program Descriptions

The STARS program supports students through their first year. To retain students and encourage degree completion in engineering or computer science, the STARS program employs the following five strategies:

- Equip students with essential study skills and teach students “how to learn.”
- Ease the students’ financial burden.
- Provide an in-depth understanding of the engineering field.
- Promote group learning and community.
- Mentor students with advice and counseling tailored to their needs.

The program is adapted from the University of Colorado’s GoldShirt Program, which has achieved high retention rates of students in engineering especially of underrepresented minorities (URM), paying special attention to the needs of academically and economically disadvantaged students. Implemented differently at each partner university, the STARS program maintains the following core components:

- **First Year Curriculum:** The STARS curriculum has been especially designed to instill beneficial learning habits, build community, and prepare students for their mathematics and chemistry courses. Table 2 shows a sample of the curriculum of the STARS program at each university⁴. Worth noting are the differences in mathematics preparation at each university. In general, WSU accepts students into the STARS program with a lower level of mathematical preparation than UW. In order to reinforce algebra and pre-calculus skills necessary for success in calculus, WSU and UW designed a mathematics course where students solve problems from a number of engineering contexts. In addition, UW has developed a preparation course for chemistry and as of the start of the 2015-2016 academic year requires its students to take an *Introduction to Chemistry* course which will become a standard requirement for engineering students at UW starting in the 2016-2017 academic year. WSU has followed suit by including chemistry help in the weekly math review sessions. Since study skills are extremely important for success in engineering, UW and WSU each developed a year-long seminar course to emphasize these key skills. These seminar courses touch on topics such as note-taking, connecting to and building relationships with faculty, the importance of group study, utilizing resources and asking for help, effectively reading textbooks, and time management.

Table 2: Sample First year Curriculum for UW and WSU

Sample STARS Curriculum: UW		Sample STARS Curriculum: WSU	
<i>Autumn Quarter</i>		<i>Fall Semester</i>	
STARS Math Problem Solving	4 credits	STARS Engineering Study Skills	2 credits
STARS Seminar	1 credit	College Algebra	3 credits
English Composition	5 credits	English Composition	3 credits
University 101	2 credits	Intro to Biology	4 credits
Engineering Exploration	1 credit	Additional Course	3 credits
Introduction to Chemistry	2 credits		
<i>Winter Quarter</i>		<i>Spring Semester</i>	
Calculus I Course	5 credits	STARS Engineering Mathematics	3 credits
Calculus 1 Workshop	1 credit	Engineering Innovation of Design	2 credits
STARS Seminar	1 credit	Trigonometry	2 credits
STARS Chemistry Course	3 credits	Introduction to Chemistry	4 credits
Additional Course	3-5 credits	University History Course	3 credits

<i>Spring Quarter</i>			
Calculus II Course	5 credits		
Calculus II Workshop	1 credit		
STARS Seminar	1 credit		
General Chemistry I	5 credits		

- **Academic Advising:** The STARS staff provides individualized mentoring and advising. STARS students meet with an academic advisor at least six times a year to plan courses and discuss personal or academic issues.
- **Residential Living-Learning Community:** During the first year, STARS students are required to live on campus. At WSU, students are placed into the Engineering Living-Learning Community. At UW, residence in an engineering learning community is strongly encouraged. However, beginning the 2016-2017 academic year, UW will require STARS students to live in the Engineering Community during their first year and on campus for two years.
- **Community Building:** Group activities and social events outside of class are an integral part of developing a community within STARS. WSU includes a field trip to a local engineering firm as an additional component to the STARS seminar. UW incorporates an obstacle or ropes course. Additional activities like bowling, movie nights, and ultimate Frisbee have also been included.
- **Career Awareness and Vision:** Students receive multiple views of the engineering and computer science fields so they can think about themselves as engineers/computer scientists now and in the future. Activities are designed so that students can picture what their life as an engineer will look like. The STARS program at each university partners with the career centers on campus to provide access to engineering exploration workshops, career advice, and professional development skills.
- **Financial Aid:** To ease the financial burden of our students, STARS provides up to \$2000 in scholarship support. Students receive \$500 for joining STARS and \$500 each for the first three mathematics courses passed. Each university is committed to providing financial support to students from economically disadvantaged backgrounds. WSU guarantees tuition and fee scholarships for Pell Grant-eligible Washington residents through the “Cougar Commitment.” At UW, this program is called the “Husky Promise.”
- **Engagement in the Second Year:** Students in the first cohort of STARS have expressed a desire to be involved in STARS in their second year at university. At UW, students continue to meet with STARS staff throughout the autumn and spring quarters where struggling students are closely monitored. In addition, second year students are invited to participate in two community-building activities in the autumn and spring quarters. WSU has started a Peer Mentoring program inviting STARS students from the first and second

cohorts to mentor the third cohort. So far, the program consists of eight mentor-student pairs and is proving beneficial for all students involved.

Results

Table 3 shows the progress towards the goals and objectives of the STARS program for WSU³. WSU STARS students in the first cohort are retained at a higher rate than their non-STARS peers in engineering and at the university. The non-STARS comparison group is comprised of Pell Grant-eligible students from target Washington high schools who did not participate in the STARS program. The STARS students in the Second Cohort at WSU attained a higher average cumulative GPA, although this achievement was not statistically significant (using Levene's Test for Equality of Variances and a t-test for Equality of Means). In addition, the second cohort achieved higher math and science GPAs than their non-STARS peers although this difference is not statistically significant. Despite the lack of statistical significance, a possible explanation for the improvement is the change made from the first year of the STARS program at WSU to the second year to provide math and chemistry review sessions for the STARS students. The STARS students in the first cohort progressed to have a slightly lower math, science, and cumulative GPA than their non-STARS peers; however this difference is not statistically significant.

Table 3. Quantitative Comparison of STARS and Non-STARS Students, WSU

	First Cohort				Second Cohort	
	Freshman Year (2013-2014)		Sophomore Year (2014-2015)		Freshman Year (2014-2015)	
	STAR S	Non- STAR S	STAR S	Non- STAR S	STAR S	Non- STAR S
Year-to-year retention in Engineering	N/A	N/A	73%	62%	N/A	N/A
Year-to-year retention at university	N/A	N/A	77%	73%	N/A	N/A
Average cumulative GPA	2.26	2.34	2.64	2.80	2.74	2.35
Performance in math courses	1.96	1.68	1.85	2.04	2.68	2.35
Performance in science courses	3.15	2.31	2.25	2.34	2.72	2.52

Table 4 shows a summary of the progress at UW towards the goals and objectives of the STARS program and includes information on statistical significance (again, using Levene's Test for Equality of Variances and a t-test for Equality of Means)³. The most prominent achievement was that of the first cohort at UW attaining an average GPA of 0.70 points higher than that of their non-STARS peers. In addition, the first cohort performed better than their non-STARS peers by 0.70 in their math courses and by 0.93 in their science courses. The first cohort continued to perform better than their non-STARS peers in their second year achieving an

average cumulative GPA that was 0.20 points higher. The second cohort follows in the footsteps of the first cohort, boasting better GPA scores than their non-STARs peers in their math and science courses and on average.

Table 4. Quantitative Comparison of STARs and Non-STARs Students, UW

	First Cohort				Second Cohort	
	Freshman Year (2013-2014)		Sophomore Year (2014-2015)		Freshman Year (2014-2015)	
	STAR S	Non- STARs	STAR S	Non- STARs	STARs	Non- STARs
Year-to-year retention in Engineering	N/A	N/A	96%	53%	N/A	N/A
Year-to-year retention at university	N/A	N/A	100%	93%	N/A	N/A
Average cumulative GPA	3.35**	2.94**	3.13*	2.93*	3.49**	3.02**
Performance in math courses	3.25*	2.89*	2.97*	2.59*	3.48**	2.78**
Performance in science courses	2.90*	2.66*	2.86*	2.47*	3.55**	2.62**

* Differences between STARs and non-STARs significant at the $p < .05$ level

** Differences between STARs and non-STARs significant at the $p < .001$ level

Best Practices

In order to support students from economically and academically disadvantaged backgrounds, WSU and UW have identified five best practices for retaining STARs students. It is the belief of the STARs staff that the student retention results shown earlier in this paper are not likely to be replicated without these components⁴:

- Proactive Advising: STARs students receive personalized advising with an academic advisor six times over the school year. Meetings consist of a discussion of strategies that are working for the student, an evaluation of academic performance, and a welcoming safe space for personal matters. Struggling students meet with STARs staff more frequently.
- Mastery of the Basics: The program prepares students for the first-year courses within their majors. Supplemental preparation in mathematics and chemistry gives students a foundation for mastery in these courses.
- Learning How to Learn: The program emphasizes mastery of algebra and pre-calculus, utilization of group study, the importance of time management, and participation in the learning process.
- Study and Personal Skills Knowledge and Development: The STARs programs at each university incorporate Ray Landis' *Studying Engineering: A Road Map to a Rewarding Career* in the STARs seminar to outline how to be a successful engineering student.

Additionally, the instructors in their mathematics and chemistry courses are sending them the message to continually improve upon their study skills. This repeated message instills a sense of responsibility in each student to improve their study skills and habits.

- **Community Building:** By the end of each year, the STARS students have become a tight-knit group. The STARS program is very proactive in building relationships between students and encouraging students to work together during and outside of class. The students feel like they belong. Without sugar-coating any of the challenges of the disciplines, the STARS staff works hard to help ensure the students feel that they belong in engineering or computer science. The programs at each university also host social activities outside of class such as bowling, field trips, and going to the career fair.

Student Perspectives

The retention results speak for themselves, but the students have expressed their gratitude for the STARS program through surveys and informal feedback. Listed below are a few quotes from students who have participated in the program³.

- “STARS helped our group get closer, create friendships. It makes it easier to see familiar faces in classes.”
- “This program has made me feel very secure [in graduating with an engineering degree]. There are a lot of people who want me to succeed.”
- “If it weren’t for STARS, I’d be failing math and science classes, because I didn’t get the foundation.”

Conclusion

The STARS program provides a support structure for freshman in engineering that comes from academically and economically disadvantaged backgrounds, i.e., backgrounds that can be considered nontraditional when it comes to those seeking engineering or computer science degrees. Started in August 2013, the program is based on the University of Colorado’s GoldShirt program and is impacting student retention rates at both WSU and UW. Success of the program rides on key program components such as community-building, high-touch advising, mastery of mathematical concepts, and the development of study skills. STARS anticipates increased retention in the years to come as the program refines and enhances its model.

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