



## The Washington State Academic RedShirt (STARS) in Engineering Program

### Prof. Eve A. Riskin, University of Washington

Eve Riskin received her BS degree in Electrical Engineering from M.I.T. and her graduate degrees in EE from Stanford. Since 1990, she has been in the EE Department at the University of Washington where she is now Associate Dean of Diversity and Access in the College of Engineering, Professor of Electrical Engineering and Director of the ADVANCE Center for Institutional Change. With ADVANCE, she works on mentoring and leadership development programs for women faculty in SEM. Her research interests include image compression and image processing, with a focus on developing video compression algorithms to allow for cell-phone transmission of American Sign Language. She was awarded a National Science Foundation Young Investigator Award, a Sloan Research Fellowship, the 2006 WEPAN University Change Agent award, the 2006 Hewlett-Packard Harriett B. Rigas Award, and the 2007 University of Washington David B. Thorud Leadership Award. She is a Fellow of the IEEE.

### Ms. Dawn Wiggin, University of Washington

#### DAWN WIGGIN BIOGRAPHICAL SKETCH

Dawn Wiggin is the Associate Director of Diversity & Access for Student Academic Services (SAS) at the University of Washington, College of Engineering. Dawn is responsible for overseeing the College's recruitment, outreach, and diversity initiatives including the recruitment and inclusion of educationally and economically disadvantaged students in order to increase the percentage of underrepresented minorities and women considering higher education in engineering.

#### Professional Preparation

University of Washington 2011 MPA Public Administration University of Washington 2001 BA Psychology Costa Rica Language Institute 2002 Spanish

Appointments Associate Director of Diversity & Access, Student Academic Services, University of Washington College of Engineering, Box 352180 Seattle, WA 98195-2180 (2014-Present)

Associate Director of Recruitment & Outreach, Student Academic Services, University of Washington College of Engineering, Box 352180 Seattle, WA 98195-2180 (2011-2014)

Associate Director of Experiential Learning, Student Academic Services, University of Washington College of Engineering, Box 352180 Seattle, WA 98195-2180 (2009-2010)

Program Manager, Engineering Co-op & Internship Program, Engineering Advising & Diversity Center, University of Washington College of Engineering, Box 352180 Seattle, WA 98195-2180 (2005-2009)

Program Coordinator, Engineering Co-op & Internship Program, Diversity & Student Services, University of Washington College of Engineering, Box 352180 Seattle, WA 98195-2180 (2003-2005)

#### Publication

Jeremy Kingma, Eve Riskin, John Schneider, Robert Olsen, Sonya Cunningham, Dawn Wiggin, Kirk Reinkens, and Scott Winter, "The Washington State Academic RedShirt (STARS) in Engineering Program," Proceedings of the 2014 American Society for Engineering Education Annual Conference, June 2014.

#### Synergistic Activities & Projects in Education

Co-Principal Investigator, Washington State Academic RedShirt Program (STARS). Grant increases the retention rate of economically and educationally disadvantaged students in Engineering, (2013-present).

Principal Investigator, Early Engineering Institute. Grant increases the math aptitude and interest in engineering for 144 middle and high school students from rural Washington communities, (Summers 2012-present).



Affiliate Associate Director, NSF Research Experience & Mentoring. Grant provides funding for six incoming UW freshmen to conduct research on the "Towards zero-energy buildings based on energy-harvesting electrochromic window (EH-ECW) and thermoelectrics (TE) systems" project, (2012-present).

Associate Director, Mathematics Academy. Program creates access to engineering for educationally and economically disadvantaged students, (2011-2014).

Associate Director, Engineering Discovery Days. The largest UW College of Engineering annual event brings over 8,000 students and families to campus to explore engineering through interactive activities, (2012-2014).

Board President, NW Career Educators and Employers Association. Organization brings together career educators and employers to improve the economic vitality of the Pacific Northwest, (2008).

Collaborators

Dr. Robert G. Olsen, Professor of Electrical and Computer Engineering, Washington State University  
Dr. John Schneider, Associate Dean of Engineering and Architecture and Professor of Electrical and Computer Engineering, Washington State University  
Kirk Reinkens, Instructor, Recruitment & Retention Coordinator, Washington State University

**Mr. Jeremy Kingma, Washington State University**

**Dr. John B. Schneider, Washington State University**

John Schneider is an associate professor in the School of Electrical Engineering and Computer Science (EECS) and the Associate Dean for Undergraduate Programs in the Voiland College of Engineering and Architecture. He has been with WSU since 1991. He conducts research in the areas of acoustics, optics and electromagnetics; wave propagation and scattering; computer solutions to electromagnetic and acoustic problems; and remote sensing. He has received the Reid Miller Teaching Excellence award from the College and has been the EECS researcher of the year. He was the recipient of a prestigious U.S. Office of Naval Research Young Investigator Award. In 2012, he was named a fellow of the Institute of Electrical and Electronics Engineers (IEEE), where he was recognized for contributions to the field of computational electromagnetics.

# **Results and Lessons Learned from Years One and Two of the Washington State Academic RedShirt (STARS) Program**

## **Background and Introduction**

United States companies have proclaimed the urgent need for more students graduating from college with science, technology, engineering, and math (STEM) degrees. This issue is particularly germane to the State of Washington where 50,000 jobs will go unfilled by 2017 as a result of the job skills gap.<sup>1</sup> Despite awareness of this need, populations that are underserved in engineering are a largely overlooked demographic. We have an opportunity to make a difference right here in Washington, where in 35 percent of school districts more than half of the students receive free- or reduced-price lunches.

The Washington State Academic RedShirt (STARS) Program, based on the University of Colorado's GoldShirt Program, aims to increase the number of students from economically- and educationally-disadvantaged backgrounds who graduate with engineering degrees from either the University of Washington or Washington State University. Washington's leading state universities are partnering to achieve the following goals:

- Increase by 225 the total number of engineering and computer science degrees awarded at UW and WSU.
- 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 WSU and UW directly as freshman to the upper division of an engineering program.
- Increase by 20% the number of underrepresented minorities pursuing engineering degrees.

The STARS program offers first-year Pell Grant-eligible students from under-resourced high schools an extra year of support services to maximize their success in persisting in the engineering curriculum at UW and WSU. A targeted curriculum, individualized advising, academic support workshops, tutoring, social support, and financial assistance are all components of the program. The activities associated with STARS participation are intended to remove personal and structural obstacles to persisting in engineering.

Results from the first year are promising. At UW, of the thirty students who originally joined the program, twenty-one (70%) entered Engineering departments. One student is enrolled in Aeronautical and Astronautical Engineering, two in Bioengineering, one in Chemical Engineering, four in Civil and Environmental Engineering, six in Computer Science and Engineering, three in Electrical Engineering, one in Human Centered Design & Engineering, one in Industrial & Systems Engineering, and two in Mechanical Engineering. All departments were happy to receive these outstanding, hard-working, and diverse students in their majors and will work with College of Engineering staff to continue to support the students throughout their engineering studies. At WSU, of the thirty-three students who originally joined the program, nineteen (58%) are continuing within their engineering departments. One student is enrolled in Bioengineering, five students in Civil Engineering, three in Computer Science, four in Electrical

Engineering, and six in Mechanical Engineering. All of these students should certify within their major in the next year and have joined their peers as successful students in engineering.

In this paper, we present an in-depth view of the program as well as evaluation results from the first two years of the program. We also showcase best practices and lessons learned in supporting at-risk students in engineering.

## **STARS Program**

### ***Recruitment and Selection***

STARS enrolls approximately 32 students from low socio-economic backgrounds each year at each university. To qualify for the program, a student must be Pell Grant-eligible, graduate from a Washington high school with thirty percent or more of the students receiving free- or reduced-priced lunches, and express interest in pursuing engineering, among other requirements.

Students' applications, including their academic performance, are reviewed holistically by a culturally-competent selection committee. The selection process identifies students, based on academic parameters and essays, who will benefit most from the services offered through the STARS program. The selection process also includes an interview in which students answer questions about their application, perceived challenges when coming to college, and vision for their futures. Student demographics are given in Figure 1.

Figure 1: STARS student demographics from 2013-2015

	UW Cohort 1 (2013-2014)	WSU Cohort 1	UW Cohort 2 (2014-2015)	WSU Cohort 2
First Generation	80%	58%	80%	79%
Underrepresented Minority	47%	45%	44%	48%
Female	40%	18%	40%	14%

### ***Program Components***

STARS students begin the program as soon as they start at the University. STARS incorporates five strategies to promote retention and degree completion in STEM fields:

1. Building students' academic preparation and learning skills;
2. Connecting students to a supportive academic and social community;
3. Providing personal and effective academic advising and counseling;
4. Building a clear and compelling understanding of the engineering profession; and
5. Providing scholarships when funding is available.

The STARS Program includes the following primary program components:

- First Year Curriculum: STARS staff developed a unique curriculum to: advance STARS students' academic preparation in mathematics and chemistry; develop their learning skills;

and help them connect to campus (see Figure 2). UW and WSU both developed a unique math course to solidify algebra and pre-calculus skills, develop the ability to read and write within a mathematical context, and apply mathematical concepts to problems in engineering and the sciences. Similarly, UW additionally has developed a STARS chemistry prep course. WSU has incorporated structured problem sessions where students work in small groups on problems directly related to their current math and chemistry classes. Each university also designed a year-long STARS Seminar series to build study and learning skills. Seminars include topics such as time management, group study, regular reflection on goal-setting and keys to success, learning to learn and cultivating an open mindset, note-taking, asking for help and utilizing resources, reading textbooks, and developing relationships with faculty.

Figure 2: Sample UW and WSU First Year Curriculum

<b>University of Washington Sample STARS Curriculum</b>		<b>Washington State University Sample STARS Curriculum</b>	
<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
<i>Winter Quarter</i>		<i>Spring Semester</i>	
Calculus I Course	5 credits	STARS Engineering Mathematics	3 credits
Calculus I 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		
Introduction to Chemistry	3 credits		
Additional course	5 credits		

- **Academic Advising:** Each STARS student receives individualized advising by trained staff members. Students meet with advisers at least six times per year to discuss academic and personal challenges.
- **Residential Living-Learning Community:** STARS students are required to live on campus during their first year. At UW students are strongly encouraged to live in the Engineering community. WSU places students in the Engineering Living-Learning Community. In results from the National Study of Living-Learning Programs, Brower and Inkelas demonstrate that living-learning programs (LLPs) produce strong, positive student outcomes.<sup>2</sup>
- **Community-Building:** STARS students participate in a variety of team-building activities throughout the year to establish a reliable network of peers with which to discuss academic and social matters. For example, activities include bowling, an obstacle or ropes course, and an end of year celebration program.
- **Career Awareness and Vision:** Activities designed to promote STARS students' understanding of the engineering profession and a vision of themselves as engineers are integral to both the curricular and extracurricular components of STARS. By partnering with the UW Advancement team and UW Career Services Office and the WSU Career Services Office, STARS students have access to professional development skills, industry-related activities, engineering exploration workshops, personalized career advising, and engineering internships.
- **Financial Aid:** At UW, the 2014-2015 budget for a student who lives on campus is \$27,112, of which \$12,394 is for tuition and mandatory fees. At WSU, the 2014-2015 budget for an on-campus student is \$23,674, of which \$12,398 is for tuition and mandatory fees. Both universities are strongly committed to providing access to students from low-income backgrounds and guarantee full tuition and fee scholarships for Pell-eligible Washington residents. At UW it is called the "Husky Promise," and at WSU this program is called the "Cougar Commitment." Beyond this, both universities have provided STARS students with additional scholarship funding for program participation. At UW and WSU, STARS students receive \$2,000 after completing the program.
- **Provisional Direct Freshman Admission:** STARS students who complete the STARS curriculum requirements and obtain at least a 3.00 cumulative GPA are offered Direct Freshman Admission into an engineering or computer science department. Engineering departments at both universities welcome STARS students into their majors.

## Results

Program results reveal that the STARS program is contributing to the retention of students from educationally- and economically-underserved backgrounds in engineering fields. Nationally, this student population is retained in engineering at a lower rate than students from non-underserved backgrounds. For example, at UW, between 40 percent and 45 percent of UW

entering freshmen students who intend to study engineering complete their engineering degrees. The success rate is even lower—approximately 28 percent—for students from low-income backgrounds.

At UW, 70% (21/30) of the students from the first cohort were retained in the program and entered engineering departments after their first year. Students learned the foundational skills needed and are continuing to progress toward their degree requirements. After the first quarter, 94% (30/32) of the second student cohort are continuing in the program. One student left in the first quarter due to personal matters and the other student decided to pursue engineering on her own.

At WSU, 58% (19/33) of the students from the first cohort remained within the college of engineering after their first year. Students are incorporating the study skills learned and are progressing towards certification within their major. After the first semester, 76% (22/29) of the second cohort are continuing in the program. Four students failed to return for financial or unknown reasons, two decided to pursue other interests despite making satisfactory progress, and one student decided to pursue computer science on his own.

The first year program evaluation from the Center for Workforce Development at UW revealed that “STARS has made a direct impact on individual participants, primarily through the social and academic support in their transition to college. Compared to peers, early indications of the benefit to STARS students can be seen in higher grades in math and science courses and higher overall GPAs at UW and in higher math grades among WSU STARS students.”<sup>3</sup>

Figure 3: STARS Student Retention Table

	<b>UW Cohort 1 (2013-2014)</b>	<b>WSU Cohort 1</b>	<b>UW Cohort 2 (2014-2015)</b>	<b>WSU Cohort 2</b>
Percent of students retained	70% (to second year)	58% (to second year)	94% (to second quarter)	76% (to second semester)

### **Best Practices and Lessons Learned**

UW and WSU have identified five best practices from the suite of program elements that are essential to supporting educationally- and economically-underserved students as they transition from high school to college. Without these components, it is unlikely that the student retention results can be replicated.

- **Proactive Advising:** The STARS program utilizes proactive academic advising. Proactive advising is individualized communication based on students’ unique needs. Students are required to meet with the STARS advisor twice per quarter or three times per semester and most students work with their advisor more. Conversations range from academic planning to personal and family challenges.

- **Mastery of the Basics:** In 2011 National Governors Association Center for Best Practices , determined that K-12 math and science standards vary widely from state to state and in general “do not test students’ abilities to utilize concepts and solve problems”. Further, courses taken in preparation for a STEM degree are typically not “sufficiently challenging.”<sup>4</sup>
- STARS helps students ‘learn how to learn’ and recognize the importance of mastering the fundamental aspects of math, chemistry, and physics to be successful in pursuing engineering. Some examples that highlight their learning are: 1) students in individual and group study; 2) students’ improved time management skills; 3) students’ active participation and asking for help.
- **Study and Personal Skills Knowledge and Development:** As mentioned in the Program Components section, STARS includes a personal development aspect. Learning how to study is like learning any other skill; it is complex and requires practice. Both STARS programs use a Study Flow Chart and the textbook by Ray Landis, *Studying Engineering: A Road Map to a Rewarding Career*. This curriculum teaches students how to become master engineering students. The focus is repetition and forming positive habits before, during, and after class. Additionally, all instructors in math, chemistry, physics, and the STARS seminar work to reinforce the same messages about becoming a Master Student.
- **Community-Building:** Students benefit from being included in a small learning community of 32 peers when they enter college. Due to participation in summer orientation and transition week before classes start, students already have a group of friends, know their way around campus, as well as their support system of advisers and resources. Lack of belonging has been cited as a primary reason students leave engineering.<sup>5</sup> STARS combats this anxiety from the day students are admitted to the program. In addition, non-academic, community-building activities, such as professional development events, industry tours, and ‘Bowling with the STARS,’ are important aspects of the STARS program.

## Conclusion

The STARS program is a high-touch retention program for students from educationally- and economically-underserved backgrounds. The model, which is based on the GoldShirt program at the University of Colorado Boulder, has developed since the inception of the program in May 2013. The STARS program is impacting student success based on its high retention rates. Program components, such as proactive advising, ‘mastery of the basics,’ study and personal skill development, and community-building are essential to the success of the program. We anticipate that the student retention rate will continue to increase as we improve and refine the program.



## Acknowledgments

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<sup>1</sup> Great Jobs Within Our Reach: Solving the Problem of Washington state's growing job skills gap. The Boston Consultancy Group and the Washington Roundtable. March 2013.

<sup>2</sup> Brower, Aaron M., and Karen K. Inkelas. "Living-Learning Programs: One High-Impact Educational Practice We Now Know a Lot About." *Liberal Education* 96. 2, (2010): 36-47. Web. 5 June 2014. [http://www.aacu.org/liberaleducation/le-sp10/LESP10\\_Brower.cfm](http://www.aacu.org/liberaleducation/le-sp10/LESP10_Brower.cfm)

<sup>3</sup> Mody-Pan, Priti and Knaphus, Emily. STARS Year 1 Evaluation. Center for Workforce Development University of Washington Seattle, Washington. September 2014.

<sup>4</sup> <http://www.nga.org/files/live/sites/NGA/files/pdf/1112STEMGUIDE.PDF>.

<sup>5</sup> Litzler, Elizabeth and Samuelson, Cate. "How Underrepresented Minority Engineering Students Derive a Sense of Belonging from Engineering." ASEE Paper: ID #6685