

When a Traditional Scholarship is Simply Not Enough: Addressing the Digital Divide to Recruit and Motivate Engineering Technology Students through Graduation

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Abstract

Traditional scholarships provide tuition. Some extend support to books and supplies. For two-year college students, however, this is often not enough to overcome barriers to success for financially needy, academically talented students. An innovative scholarship program developed and implemented at Florence-Darlington Technical College, Florence, SC has achieved an 81.8% on-time graduation rate for students in engineering technology programs and other advanced technologies by addressing a barrier referred to as the “digital divide” (NSF DUE #0422405, #0806514, #1259402). A technology support element was added to a National Science Foundation-funded S-STEM scholarship program in 2004 to address a well-documented need among prospective scholars. Many scholarship recipients did not have access to a personal computer with the software and capability to do assigned work when off campus. To be successful, students were making extra trips to the campus to work in an on-campus computer lab. Very often, this also created additional child-care needs and costs. To remove this barrier, a loan-to-own laptop computer with appropriate software was added to the scholarship award along with books, tuition, and supplies required by the student’s program of study.

Students selected for S-STEM scholarships are assigned a powerful laptop computer that is pre-loaded with software specific to the student’s program of study. The laptop is inventoried by the college library but remains checked-out to the student throughout his or her semesters of study at the college. The student scholar has the computer to use through graduation as long as scholarship criteria are met. Upon graduation, laptop computer ownership is transferred from the college to the student to promote continued success either in the workplace or at the senior institution to which the student transfers. Students failing to maintain the required 3.0 GPA or who leave the college for more than one semester for any reason other than military service must return the computer to the college and forfeit their scholarship.

Based on data about Internet access issues for scholarship recipients between 2004 and 2012, an additional barrier for S-STEM scholarship recipients was removed in 2012 by adding a free mobile wireless Internet device to the scholarship package. Every course offered by the college requires students to have access to the Internet, and this device enables students to connect to the Internet, study, and complete assignments wherever they are between classes.

Scholars are also required to follow the curriculum outline for their chosen program of study. Following the curriculum layout helps ensure on-time graduation, whereas taking courses out of sequence is a major contributor to delayed graduation.

The combination of the scholarship with technology support and adherence to the curriculum layout has made on-time graduation and success possible for students who otherwise would not have been able to complete associate degrees in engineering technology or related advanced technologies covered by the S-STEM scholarship program. The model has been documented and includes procedures used by the college for implementation, data pertaining to student success, and program costs.

Introduction

The National Science Foundation S-STEM Scholarship Program and Student Eligibility:

The overall support provided by a Tech Stars scholarship is enabling many students to complete associate degrees in engineering technology, industrial technology or computer technology well prepared for work or college transfer. Most scholarship recipients also graduate debt free with no college loans to repay. By applying the S-STEM scholarship after other financial aid sources, S-STEM scholarship funds fill any unmet need for tuition, fees, and books for five consecutive semesters and makes attendance in the summer possible for many who otherwise would be unable to graduate on time. The powerful technology tools have prompted and facilitate more off-campus study and reduced out-of-pocket expenses for transportation and childcare for students who otherwise would be required to return to the college to use computers.

S-STEM, Scholarships in Science, Technology, Engineering and Mathematics (formerly CSEMS, Computer Science, Engineering, and Mathematics Scholarships) is a National Science Foundation (NSF) funding program that supports scholarships. The S-STEM program, like the NSF-funded CSEMS program that preceded it, “seeks to increase the success of low income academically talented students with demonstrated financial need who are pursuing associate, baccalaureate, or graduate degrees in science, technology, engineering, and mathematics (STEM)”¹ The S-STEM program is funded by H-1B visa fees collected by the US government. The US H-1B visa is a non-immigrant visa that allows US companies to employ foreign workers in specialty occupations that require theoretical or technical expertise in specialized fields such as in architecture, engineering, mathematics, science, and medicine. As revenue from H-1B visa fees has increased over time making more funds available, the NSF S-STEM program has broadened the technology-based STEM programs of study to which the scholarships may apply and increased the maximum award amounts per institution and per student award. A new three-year solicitation (NSF 15-581) published in 2015 represents the first major revamping of the program since the program’s inception in 1999. The program now anticipates awarding \$50-70,000,000 in awards each year.²

Overarching program requirements for scholarship eligibility have remained unchanged as one can see from the following excerpt from the current S-STEM solicitation:

“Criteria for eligibility for the NSF S-STEM supported scholarships will be established by the institution(s). S-STEM scholarship recipients will be selected by the awardee institution(s), but must

- be citizens of the United States, nationals 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;
- be enrolled full time in a program leading to an associate, baccalaureate, or graduate degree in one of the following disciplines for each term for which a student receives a scholarship:
 - biological sciences (except medicine and other clinical fields);
 - physical sciences, including physics, chemistry, astronomy, and materials science;
 - mathematical sciences;
 - computer and information sciences;
 - geosciences;
 - engineering; or
 - technology areas associated with the preceding fields (for example, biotechnology, chemical technology, engineering technology, information technology, etc.);
- demonstrate academic ability or potential; and demonstrate financial need, defined for undergraduate students by the US Department of Education’s rules for need-based Federal financial aid, Free Application for Federal Student Aid (FAFSA), or, for graduate students, defined as financial eligibility for Graduate Assistance in Areas of National Need (GAANN).”³

History of NSF-funded scholarships in STEM:

The following press release statement announced this new H-1B visa-funded NSF program on March 29, 1999: “The National Science Board...approved plans by the National Science Foundation (NSF) to provide some \$21 million to fund 8,000 one-year scholarships of up to \$2,500 each to low income students who pursue degrees in computer science, engineering or mathematics. These Computer Science, Engineering, and Mathematics Scholarships (CSEMS) are authorized by the American Competitiveness and Workforce Improvement Act of 1998. The \$21-million education fund created during the first year of the program (FY 1999) is derived from a \$500 fee that U.S. employers pay to the federal government for each high-technology non-immigrant employee they employ under terms of an H-1B visa application. Additional funds will be provided in FY 2000 and FY 2001.”⁴ From the beginning, the grant awards to fund scholarships represented an exciting opportunity to support and incentivize students to choose postsecondary STEM programs of study leading to in-demand jobs.

At the time, Luther S. Williams, Director of Education and Human Resources at NSF stated: “These scholarships are not expected to be a ‘magic bullet’ ...they are but one component of what necessarily must be a multi-pronged approach to ameliorating the nation’s current need for people trained in the sciences, math and high-technology in order to aide industry, government and education in the United States.”⁵ Today, educators across the country continue the quest for effective ways to produce a highly-skilled technical and scientific workforce.

While both CSEMS and S-STEM programs have acknowledged the importance of student cohorts and effective student support services, as well as scholarships, in promoting student success, these strategies alone may not be enough to retain students or to attract students to enroll in STEM majors in the first place.

Methods

Reducing barriers and providing incentive for student’s to choose a STEM program of study:

S-STEM scholarships require that scholars be full-time, academically talented students with demonstrated financial need. At two-year colleges, a student who meets these criteria will typically have access to multiple sources of financial aid, including Federal Pell Grants that do not require repayment. For this reason, having a scholarship that pays for tuition, fees, and books may not provide enough incentive for choosing an academically challenging STEM major.

From research conducted during a NSF CSEMS scholarship award implementation at Florence-Darlington Technical College, Florence, South Carolina in the early years of the program, a previously unrecognized barrier was identified that negatively impacts success rates for many students entering two-year college STEM programs, particularly in rural regions and other areas where poverty levels are high. This paper examines an innovative approach to addressing this particular barrier which is referred to as the “digital divide.”

From the end of the 1990s onward, the **digital divide**, commonly defined as the gap between those who have and do not have access to computers and the Internet, has been a central issue on the scholarly and political agenda of new media development.⁶ More generally, “The digital divide refers to the perceived gap between those who have access to the latest information technologies and those who do not. If we are indeed in an Information Age, then not having access to this information is an economic and social handicap.”⁷ In 2008, Steven Jones reported that about “48% of students are required to use the Internet in at least some of their classes.”⁸ Today, this is true for 100% of students, but not all have the financial resources necessary to own

powerful computers, purchase discipline-specific software, and subscribe to a high-speed Internet service at home. In looking at at-risk students, Craddock et al noted that, “Constrained access to the Internet and new communication technologies is commonly associated with social disparities related to income, education, immigration status, age, and geography. Policymakers in many sectors—and particularly, in education—have placed their bets on increased technology access having the potential to mitigate broader social disparities.”⁹ Not having adequate computers and software and/or not having broadband Internet access have been identified as barriers to success for many two-year college students who are eligible for S-STEM scholarships as these have become basic tools for academic work in STEM disciplines. The Tech Stars S-STEM scholarship model was developed and implemented to address the digital divide, level the playing field, and promote success for all S-STEM scholars.

The strategy that has been implemented through a series of three S-STEM grant awards to Florence-Darlington Technical College (National Science Foundation DUE #0422405, #0806514, and #1259402) closes the digital divide and provides an incentive for choosing a targeted STEM major. Each scholarship includes an individually-assigned laptop computer equipped with program-specific software and (more recently) a mobile wireless Internet service. Engineering technology students who are awarded Tech Stars (S-STEM) scholarships receive a powerful laptop computer equipped with CAD and other software used in these programs of study, whereas computer science students receive laptops equipped with different program-specific software, and automotive technology students receive a curriculum-specific computerized diagnostic tool. These academic tools eliminate the need for students to return to campus to complete assignments, increasing the time available for study and reducing the cost of transportation and child care. This is important because in rural areas, the drive from home or work to the college may be more than 50 miles each way. Time spent commuting is time not available for family, study, or work.

The technology provided with the scholarship is a **loan-to-own** program. Ownership of laptop computers and diagnostic tools used by Tech Stars scholarship recipients at the college is transferred to the student at the time he or she graduates from a targeted STEM program. There is direct impact on retention that results from the Tech Star scholarship program’s loan-to-own incentive. Loan-to-own provides technology support to increase academic success and provides a pathway to ownership if a student retains scholarship eligibility and earns an associate degree in a targeted STEM major. Ownership transfer equips the student for college transfer and advanced study or added productivity in his or her first job after graduation.

Scholarships eligibility includes a requirement that a 3.0 GPA or higher be maintained and that a student follow the program of study outline provided in the college catalog. The program of study outlined for each curriculum is designed to guide a student to “on-time” graduation, and

helps ensure that prerequisites are taken at appropriate times. On-time graduation is defined as earning an associate degree within the number of semesters outlined for the student's program of study as outlined in the semester-by-semester curriculum as displayed in the college catalog. For the STEM target areas, degree completion is outlined for five or six semesters of study. The US Department of Education Integrated Postsecondary Education Data System (IPEDS) typically reports graduation rates for 150% of program length. If a four-semester program of study has been established, IPEDS will report graduation rates for those who complete a degree in six semesters or 150% of the four semester plan.

Since students who are awarded S-STEM scholarships are required to follow their program of study outline, this often creates another barrier: the need to attend college during the summer in order to graduate on time. The Tech Star scholarship eliminates this barrier. In the summer, when Federal Pell grants are not available, the Tech Star scholarship pays full tuition for the student. In the fall and spring, the S-STEM scholarship is applied after other financial aid sources. This allocates S-STEM scholarship resources unevenly throughout the year in a way that makes the student's S-STEM scholarship funds available to fill any unmet need for tuition, fees, and books for five consecutive semesters. This strategy makes attendance in the summer possible for many who otherwise would be unable to graduate on time due to financial need.

A scholarship model that works:

Tech Star scholarship recipients are selected from a pool of financially-and academically-eligible scholarship candidates who have completed the college scholarship application. Although the college scholarship application form is used in the Tech Star scholarship award process, the Tech Stars S-STEM scholarship program is managed separately from other scholarships awarded by the college to focus associated support services specifically on the targeted majors. Recipients are selected by the Principal Investigator, four Co-Principal Investigators, and a project manager. Students may be newly entering or returning to the college. Scholarship recipients must enroll as full-time students in a targeted major which include programs of study in engineering technology, industrial technology, and computer science. Tech Stars are advised and supported in cohorts within each major, and scholars have access to a wide range of student support services offered by the college as well as opportunities that are specific to Tech Stars. Tech Stars receive tuition support as needed in the first semester of selection, and they become eligible for a laptop or diagnostic tool after attaining a GPA of 3.0 or higher following completion of one semester of curriculum course work toward graduation. Students enrolling in developmental (pre-curriculum) studies are not eligible for Tech Stars scholarships until all prerequisites for their program of study are completed. Once a student is selected to receive a scholarship, scholarships are automatically renewed in subsequent semesters until the student graduates provided he or she continues to meet all eligibility requirements. One semester of probation is

allowed should a Tech Star's GPA drop below 3.0 at any time or other conditions of eligibility are not met. Students who lose eligibility or leave the college for any reason (other than military service) forfeit their scholarship and must return technology tools to the library.

A college librarian manages Tech Stars equipment loans. The laptop computers and diagnostic tools are included in the library inventory within the college's equipment inventory system. The student retains the loan and use of a specific laptop or diagnostic tool throughout his or her time of study at the college. Library systems are tied to the business office in a way that can automatically lock down a student's records and even prompt legal action should loaned equipment not be returned or the ownership transfer process completed.

Table 1: The Tech Star Scholarship Model

Type of Support	Support	Support Description
Financial	Tuition, fees, and books	<ul style="list-style-type: none"> •The scholarship fills any unmet need after other financial aid for the student has been met by Pell, VA or other source. •Scholarships automatically renew as long as he student remains eligible (meets all criteria and maintains required GPA).
	Reimbursement for industry-recognized certification exams (e.g., Cisco, Manufacturing Skill Standards Certification (MSSC) certifications	Tech Stars are eligible for reimbursement of certification exam fees, one reimbursement per exam.
	A scholarship-through-graduation guarantee	A special fund supported by industry and managed by the college foundation guarantees financial support for scholarship-eligible Tech Stars to enable each one to complete associate degrees should scholarship funds from the NSF grant be exhausted prior to the student's graduation.
Technology	Laptop computer and/or diagnostic tool along with program specific software	•Tech Stars receive technology equipment after

	<p>based on program requirements (e.g., automotive technology students receive computerized automotive diagnostic tools and carrying cases in lieu of laptop computers)</p>	<p>successfully completing one semester in their program of study after being awarded an S-STEM Scholarship to cover tuition, fees and books.</p> <ul style="list-style-type: none"> •Each scholar retains the same technology tools as long as he or she remains scholarship eligible. •Items remain the property of the college until ownership is transferred at graduation. •An ownership transfer protocol is followed when the Tech Star becomes eligible for graduation that requires registrar, business office, and project management approval.
	<p>Inventory and distribution of laptop computers and diagnostic tools management by the college library (e.g. checked out from the college library and assigned to the student)</p>	<ul style="list-style-type: none"> •Scholars are required to briefly return their personally-assigned technology support item to the library once each semester to be scanned for inventory purposes until the Tech Star becomes eligible for ownership-transfer at graduation. •Library staff provide technical support to scholars.
<p>Coursework Curriculum Schedule</p>	<p>Tech Stars are required to follow the program of study outlined for their major to prevent delays in graduation (e.g., each program of study is outlined in the college catalog, typically in a five or six semester sequence leading to an associate degree).</p>	<p>Each scholarship recipient’s enrollment in courses by semester is monitored by a program assistant to make sure that each Tech Star follows his or her program of study. Any scheduling issues that require administrative attention are noted.</p>
<p>Industry Collaboration & Industry Consortium</p>	<p>Tech Stars are encouraged to participate in paid internships that are facilitated by the college to gain experience while completing their associate degrees.</p>	<ul style="list-style-type: none"> •Paid internships typically pay twice minimum wage or more and thus can provide an income for 20 hours of work per week that might have

		<p>taken 40 hours of work to earn otherwise.</p> <ul style="list-style-type: none"> •Internships are for work that may extend across multiple semesters. •Internships are optional for Tech Stars and do not generate college credit. •In most cases, interns are offered full-time employment with their internship sponsor upon graduation.
	The project ensures that each Tech Star maintains a current resume.	<ul style="list-style-type: none"> •The caliber of students who receive S-STEM scholarships has resulted in high industry demand for Tech Stars. •Employers who participate in the college’s internship program agree to not hire students for full-time positions prior to graduation.
College	The college offers a broad range of support services to students.	Support services range from tutoring to on-campus child care.
	The project offers support services specific to Tech Stars.	Support services include lunch-and-learn programs featuring speakers from industry, a one-stop Tech Stars program office, and priority in paid internship placement related to the student’s program of study.
	The project offers opportunities for travel and professional development.	Tech Stars have an opportunity to apply for separate financial support to attend and participate in national professional development conferences. Typically 2-4 students each year are selected for this opportunity.

Results

From 2008 until 2015, a total of 238 students were awarded scholarships. The data provides an indication of program success in motivating these students to persist and graduate in the technical fields. Program guidelines are providing structure and discipline for students to graduate on time.

During the 2013-2014 school year, the college had a total number of 80 graduates in the following fields: Network Systems Management, Automotive Technology, Civil Engineering Technology, Electronics Engineering Tech, HVAC, Machine Tool Technology, Mechanical Engineering Tech, Auto Body Repair, Basic Automotive, and Machine Operator. During the 2012-2013 school year, the college had a total number of 100 graduates in the following fields: Network Systems Management, Automotive Technology, Civil Engineering Technology, Electronics Engineering Tech, HVAC, Machine Tool Technology, Mechanical Engineering Tech, Auto Body Repair, Basic Automotive, and Machine Operator. During the 2011-2012 school year, the college had a total number of 88 graduates in the following fields: Network Systems Management, Automotive Technology, Civil Engineering Technology, Electronics Engineering Tech, HVAC, Machine Tool Technology, Mechanical Engineering Tech, Auto Body Repair, Basic Automotive, and Machine Operator. Of the total 268 graduates from programs of study eligible for Tech Stars scholarships 2011-2014, 104 (38.8%) were Tech Star Scholars.

The tables below show an overview of the number of students served as Tech Star scholars from 2008 until 2015 as well as their demographic breakdown. The applicant pool consists of all students meeting eligibility criteria. All eligible students are invited to apply. To date, because the project awards scholarship funds after other financial aid and scholarships are applied, all eligible students who have applied have been awarded a scholarship. There has been no need to apply other selection criteria.

Table 2: Demographics by Race for S-STEM Scholarship Recipients (Tech Stars): Two Grant Awards (Time Periods)

Demographics by Race	2008-2012		2012-2015*	
	Number (#)	Percent (%)	Number (#)	Percent (%)
American Indian/Alaska Native	1	1.0	3	2.1
Caucasian	71	74.0	102	71.8
African American	24	25.0	32	22.5
Unknown or unreported	0	0	4	2.8
Total # Scholarship Recipients	96	100	142	99.2*

*Not 100% due to rounding.

Table 3: Demographics by Gender for S-STEM Scholarship Recipients (Tech Stars): Two Grant Awards (Time Periods)

Demographics by Gender	2008-2012		2012-2015	
	Number (#)	Percent (%)	Number (#)	Percent (%)
Male	89	93	131	93
Female	7	7	11	7

The graduation rates for community college students overall and graduation rates for the Tech Stars subset of majors provides context for understanding outcomes for this S-STEM scholarship program. Graduation rates for the college overall ranged from 9-14% in the 2002-2006 time frame when the Tech Stars scholarship intervention began, and these percentages were based on graduation within 150% of program length (vs. Tech Stars on-time graduation). With two separate NSF funding awards for S-STEM scholarships, in 2004 and 2008, a total of 258 scholarships were awarded and 211 of these Tech Stars graduated (81.8% success rate). Of these Tech Stars scholarship recipients, 39% were students from underrepresented populations for the targeted STEM majors (e.g., African Americans, females). In addition, 43% of Tech Stars benefited from paid internships lasting from one to four semesters while they completed their program of study at the college.

Some students who lost scholarships because of lower grades were retained at the college and either graduated in their original STEM major or another major at the college. Interviews with these graduates indicate that the scholarship and associated Tech Stars support got them over the initial challenges of college and played a large part in their ultimate success in attaining an associate degree.

Stimulating on-time graduation increases student retention. 52% of the college's students were enrolled full-time, but all Tech Stars were enrolled full-time. Providing students with the tools and technology they need to be productive anywhere at any time saved both time and money and supported scholarship. Graduates in targeted high-demand majors (engineering, industrial, and computer technologies) entered the workforce or transferred sooner.

Scholarship recipients confirm the benefit of the combination of technology support and student services that accompany a Tech Stars scholarship award:

“The scholarship was a great assistance in my schooling. It enabled me to operate easily anywhere via the Verizon mifi and laptop issued. It also greatly assisted me financially by covering book and supply costs. The Tech Star program greatly improved my success and ability to continue my education with less stress and the proper tools...and employment resources.”

“I appreciate the program and it was a great benefit that I don't take lightly.”

“Having a laptop has made me able to work after school.”

Another student commented on whether or not the laptop provided an incentive to improve or maintain a high GPA: “Definitely, Before I stayed after school until 5:00 every day to do homework. Now, I have much more convenience at home.”

“I am extremely thankful for TECH Stars making my college experience much more manageable and successful! “

Tech Stars graduate on time from 5-semester STEM programs of study and are typically the first to be selected for full-time employment as graduates. Tech Star graduates demonstrate scholarship by retaining a 3.0 GPA or higher throughout their associate degree program of study. As a result of the way the Tech Stars scholarship program is implemented, graduates typically graduate with no debt, and they find immediate employment or successfully transfer to a senior institution.

Conclusion and areas for future study

The financial support provided by a Tech Stars scholarship is enabling many student to complete associate degrees in engineering technology, industrial technology or computer technology well prepared for work or college transfer and college-loan (debt) free. By paying after other financial aid sources, S-STEM scholarship funds fill any unmet need for tuition, fees, and books for five consecutive semesters and makes attendance in the summer possible for many who otherwise would be unable to graduate on time. The powerful technology tools have prompted and facilitate more off-campus study and reduced out-of-pocket expenses for transportation and childcare for students who otherwise would be required to return to the college to use computers and/or access the internet. More than the anticipated number of scholars have been supported as a result of applying S-STEM scholarship money to a student’s financial aid package after other scholarships and financial aid have been applied and by careful management of the program. The success rate for Tech Stars completing on-time associate degrees in targeted STEM majors was 81.8% for the first two scholarship grant awards, and a third scholarship grant award began in 2013.

Areas for additional research include the number and success rates among Tech Star scholarship recipients who began their college studies with pre-curriculum or developmental coursework. Also of interest is the relative impact of different college services on Tech Star success. Which college services are utilized, by whom, and with what impact or contribution to the overall success of S-STEM Tech Star scholarship recipients?

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