Keeping the 'SPARK' alive - Investigating Effective Practices in the Retention of Female Undergraduates in Engineering and Computer Science

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Abstract

SPARK is the first project at Texas State University designed to recruit and retain low income, female, first year students who show an early interest in majoring in engineering and computer science (ECS). Female students who show an initial extrinsic interest in these majors can be driven away far too easily by their experiences. SPARK has two primary goals: (1) create an environment where belonging to a like-minded cohort nurtures a strong sense of self, and (2) deliver high quality, high impact practices that engender female students' success and retention in ECS.

Guided by Albert Bandura and Frank Pajares' research on self-efficacy in theory and practice, the SPARK project sheds light on self-efficacy and confidence as predictive of persistence for female students in ECS. Additionally, the effect of SPARK students' spatial visualization skills was assessed and tracked throughout the life of the project, utilizing Sheryl Sorby's research correlating spatial visualization skills to STEM success. Current research-based approaches to student engagement provide good evidence that mattering and sense of belonging are also highly correlative with persistence, particularly for first year students. This is important because the national conversation on what works to mend the gender gap in STEM is currently wedged between Sheryl Sandberg's "leaning in" and Angela Duckworth's views on "grit" as an indicator of persistence.

In this paper, we will discuss the context and history of the SPARK program, present assessment outcomes about impact to date, share lessons learned, and consider future directions. This work will contribute to the growing body of research on retaining females in ECS by developing and analyzing student motivation; recognizing factors that may contribute to aspirational deficient, attrition, and marginalization; and designing and assessing activities that strengthen self-confidence, self-efficacy, and persistence in retention programs for females in ECS.

Introduction

The SPARK Program at Texas State University is one of a growing number of research projects and educational initiatives that encourage young women to pursue careers in engineering and computer science (ECS). As a National Science Foundation S-STEM awardee (2012-2016), SPARK was created to support the college experience, degree attainment, and ECS career aspirations of talented and financially needy female students. We chose to name the program SPARK as an insignia of our mission to "spark" early interest in ECS. The overarching goal of this project is to disrupt the multiple, complex drivers of inequality that have led to – and are sustaining – underrepresentation of women in ECS. Yet the obstacles facing college age females contemplating a career in ECS are as varied as they are complex: lack of interest; perceived lack of ability; unconscious bias by teachers, counselors, students, peers, or family members; impostor syndrome; lower persistence in face of difficulty; sense of not belonging or being the "other"; explicit bias and sexual harassment. And this list is by no means exhaustive. In this paper, we will delineate and discuss the findings of three years (2013-2015) of assessments from a single SPARK undergraduate cohort. Our key research questions include examining motivation, self-perception, and social and academic practices that lead to female undergraduate persistence and degree attainment in ECS.

Background

Texas State University is a public, student-centered, Emerging Research University with almost 38,000 students. It ranks as the largest public university in the Texas State University System and one of the 50 largest in the country. With a diverse campus where ethnic minorities make up 49% of the student body and 33% are Hispanic, Texas State is a Hispanic Serving Institution. Texas State has the fifth highest retention rate and graduation rate of public universities in the state. The university has experienced regularly increasing enrollment growth (Table 1).

Texas State University Summary of Headcount/Enrollment				
	Total	Female (F)	% (F)	Male (M)
FY 2012	34,087	19,224	56.40%	14,863
FY 2013	34,225	19,254	56.26%	14,971
FY 2014	35,546	20,068	56.45%	15,478
FY 2015	36,739	20,852	56.76%	15,887
FY 2016	37,979	21,860	57.56%	16,119

Table 1. Overall Enrollment, Texas State University 2012-2016

However, overall enrollment growth at the university has not significantly increased the percentage of female students pursuing ECS undergraduate degrees (Table 2).

Engineering and Computer Science Undergraduate Female Enrollment						
	Engineering			Computer Science		
	Total	Female (F)	% (F)	Total	Female (F)	% (F)
Spring '12	489	61	12.47%	344	33	9.60%
Spring '13	480	59	12.29%	389	40	10.28%
Spring '14	556	73	13.12%	466	60	12.87%
Spring '15	706	112	15.86%	603	86	14.26%

Table 2. Undergraduate Enrollment in Engineering and Computer Science, 2012-2016

By 2011, increasing public attention to the gender imbalance in STEM encouraged us to recognize that sizeable leaps in the enrollment of female ECS majors at Texas State University was not likely to happen on its own. Our ECS female enrollment numbers showed a small but promising upward trend that we wanted to encourage. Receiving NSF S-STEM funding for SPARK enabled us to recruit 18 students from a large pool of female high school seniors in the state of Texas who had strong academic potential, expressed interest in becoming engineers or computer scientists, and who were from low socioeconomic backgrounds. Texas ranks fifth in income inequality among states, and Texas State University enrolls a large percentage of students with substantial financial need. Over 50% of our students receive financial aid with a higher average reliance upon loans over other forms of available aid. Roughly 65% of undergraduate College of Science and Engineering students receive financial aid. The SPARK scholarship ($10K) defrays about 50% of the annual cost of attendance. In our experience with SPARK students, most have FAFSA Estimated Family Contributions of $0 – which means they need considerable financial aid to afford college. Our initial cohort of 18 students was recruited between Fall 2012 and Spring 2013, and they started together as a freshman class in Fall 2013. Each student was awarded a scholarship of $10,000 per year for three years, based on maintaining academic and financial eligibility each semester. Curricular and co-curricular best practices were built into the SPARK program as added investments in these young women who showed early promise and aspired to careers in these traditionally male-dominated fields.

Recruiting the initial cohort and providing the students with a sizeable annual scholarship was an important first step. Retaining them required us to systematically evaluate the effectiveness of our program elements and see if we could distinguish characteristics of female students who persist in traditionally rigorous and male-dominated majors – engineering and computer science. Educational strategies and efforts to address gender parity are diverse, yet a basic common question persists: What is the true nature of student experience? Answer - you have to ask the students. According to Bandura (1993), "Students' beliefs in their efficacy to regulate their own learning and to master academic activities determine their aspirations, level of motivation, and academic accomplishments (p.117)".[1] What would the students' beliefs about their abilities, perceptions of their experiences as members of SPARK, and their responses to challenging situations signal to us (Pajares, 1996)?[2]

In 2013, Angela Duckworth's TED talk about her research on grit and its positive effect on persistence brought her years of research into popular public discourse. Defining grit as "the tendency to sustain interest in and effort toward very long-term goals," Duckworth developed a theoretical model with grit as a key characteristic and predictor of success (Duckworth et al., 2007).[3] The initial SPARK cohort was certainly interested in engineering or computer science while they were in high school. Their application essays in response to a "grit" related prompt attested to their willingness to take their interest to the next level and make the effort to get a college degree in those fields.

> *"I feel adequately prepared to undertake my chosen STEM major, computer science, due to the fact that I have an absolute passion for programming and technology in general, and a mind that loves to think in code and solve puzzles. Though my knowledge of computer science is only basic since high school courses can only offer so much on career specific classes, I'm ready to learn and apply myself all that I possibly can here*

at Texas State University (and then some) so that my already sizeable "database" can grow even more immensely."

"Having a strong drive for near perfection, success, and more knowledge is what has gotten me as far as I have with gaining my certifications and with helping out other students to gain theirs. My determination is what helped me insure that I got into my computer tech class and is what helped me gain acceptance into Texas State University."

"Even at a young age of 5 and 6 I liked to build my palaces and convoluted devices which I always fantasized did wondrous things. I would always draw out plans for my projects. The organizational process I did then I can compare to the engineering process which I learned recently two years ago, in a [high school] principles of engineering class. In school I prepared for college, even when I was in 8th grade. I had the forethought to get into the highest classes available. I decided I wanted to take calculus senior year, so I took geometry in summer school in the time between 9th and 10th year. I made plans which I followed through with. The facets of my personality and experience I have will be an asset to your community. This opportunity will prepare me for realizing my dream of becoming a successful engineer."

"Opportunities are open to everyone, but I learned one must take the challenge to receive them. Graduating from high school and entering college can be a tough transition. Anxiety, stress, and sleep will all be an issue I know I will face, including homesickness; however, I know I will be able to handle it because I learned I am the type of person who without caring what the challenge is, I will get it accomplished. All I expect is to have a future, because I know I have one."

At roughly the same time as Duckworth's work on grit was gaining momentum in the educational community, Facebook COO Sheryl Sandberg's published her book, "Lean In" - a rallying cry for professional women to work harder and more aggressively in order to "get a seat at the table and in the board room" (Sandberg, 2013).[4] Sandberg pressed female college students to do the same – telling them they can be the number one person in their field and giving them permission to "stand up" and "do anything that you really believe you want to do that you might not think you can" (Lean In, 2013).[5] The response to Sandberg's advice to women has not been without controversy, particularly due to its glossing over systemic gender bias experienced by women. Yet her high visibility as COO at Facebook has lent a timely and beneficial focus to moving the discussion forward about how to keep and advance women in the STEM workforce once they have arrived.

Self-efficacy, grit, and leaning in; are these the keys that distinguish female students who will thrive in ECS not only as college students but also as career professionals? Arguably, Bandura, Duckworth, and Sandberg were a perfect storm of women's empowerment theories. In our SPARK assessments, we decided to quantify the first two items and qualitatively assess how – and if – our students were "leaning in".

In addition to measuring self-efficacy, we administered surveys to assess the students' grit, perseverance, ambition, problem-solving abilities, resilience, self-confidence, and GPAs. We included questions about their satisfaction with the various SPARK activities we organized throughout the years. We also asked open ended questions about the challenges they felt they were facing each year and their social experience in the learning community.

Description of Project and Participants

Gender		Ethnicity		Major	
Female	14 (77.78%)	Hispanic/Latino	9 (50.00%)	Engineering	7 (38.89%)
Male	4 (22.22%)	African American/ Black	1 (5.56%)	Computer Science	4 (22.22%)
		Caucasian/White	8 (44.44%)	Engineering Technology or Mathematics	7 (38.89%)

Table 3. Demographics of SPARK initial cohort

The strategic elements of the SPARK program are:

$10,000 per year scholarship per student (continuing annually for three years, based on meeting academic and financial requirements each semester)
The substantial scholarship funding from this project enables low income students to enroll fulltime, reducing their need to work to pay their college expenses and as a strategy to ameliorate financial reasons for dropping out.

Residential Living Learning Community (during the first year, for freshman students)
A primary culprit in the attrition of ECS students is students' perception of a non-motivating and unwelcoming learning environment (ASEE, 2009).[6] Beginning their college experience as a living and learning cohort, this feature of the SPARK program aimed to create a sense of belonging, solidarity, and empowerment within a shared residential setting. Marginalization remains an obstacle for many women in ECS. Tackling these attitudes head-on in a supportive environment holds the promise of empowering young women who show ability in ECS. Women particularly benefit from a culture of inclusiveness, sense of belonging, peer networks and professional role modeling as the one envisioned by SPARK (Forret, 2004).[7]

Orientations and Specialized Training
To begin each semester, SPARK orientation includes lectures and guest presentations focused on strategies for succeeding in ECS studies. These orientation sessions familiarize participants with program goals, existing support systems, and scheduled enrichment activities. Specialized trainings were held to improve academic performance and enhance skills.

To launch the cohort's first year, orientation had a one-week duration and introduced students to the concept of "Your Journey's Trajectory" presented by professionals from our industry partner, Tokyo Electron America, as well as hearing from current and alumnae ECS majors, participating in community-building social events, being part of a focus group, and gaining a first-hand view into ECS careers via an industry tour. The focus group examined students' perceptions regarding barriers to women pursuing STEM majors. Focus group conversation focused on two themes: peer pressure and a lack of encouragement from teachers and family members. With regard to peer pressure, several students commented on how being perceived as clever was undesirable, especially to opposite-sex peers. While many students identified family as major sources of support and encouragement, others commented on upbringing as a factor in whether family members would support a woman in a male-dominated field. Educational costs, in general, were identified as a disincentive to pursue a college education.

As part of this first orientation, the Purdue Spatial Visualization Test (PSVT-R) was also administered to the entire SPARK cohort (18 students). Strong spatial skills correlate well with persistence and retention in STEM (Sorby, 2001).[8] Eight students scored below 60% (44.44% of the cohort). A 16-hour spatial visualization training was conducted the following semester. The goal of the training was to help to develop and improve the spatial skills of six freshman students who continued in the program and received scores below 60% in the PSVT-R.

In the second year, a one-week summer activity was held that included spatial visualization and ECS skill-building through robotics. The goal of this activity was to improve the spatial cognition and spatial computational skills of female students in simple target tracking scenarios using robots. The content covered both theoretical background and hands-on activities. Students learned how to develop a spatial abstraction of the environment and reason about its shortcuts, obstacles and borders; develop navigation algorithms that make good decisions even in absence of fresh control signals; and implemented navigation modules on robots similar to those used in target tracking and search and rescue operations. Post-activity surveys rated this activity very highly.

<u>Mentoring and Career Development</u>
Mentoring and role modelling, particularly for women in STEM, has been well studied as means to positively influence retention and ECS career choices [Dean, 2009].[9] SPARK mentoring has included monthly meetings with students throughout the project life. The mentoring team is comprised of SPARK faculty and faculty associates, College of Science and Engineering faculty mentors, learning community coordinators, peer mentors, and industry mentors. Topics for the mentoring sessions include academic counseling, familiarizing students with sites and resources for finding REU's and internships, describing ECS collegiate societies and how to become a member, informing students about opportunities for research with faculty, attending conferences, enrolling in competitions, and learning about graduate school. Appendix A is an example of the calendars we developed and shared with all SPARK faculty mentors that they could use to track students' engagement with various career opportunities. Appendix B is a questionnaire that mentors used at the end of the first year to increase students' familiarity with departmental research and career ideas. Appendix C is a mentoring guide for helping the students identify their strengths and weaknesses. These three mentoring tools have been inspired by the excellent Million Women Mentors mentoring guide designed by Kantor and Frasier; Million Women Mentors is an initiative of STEMconnector® in collaboration with over 60+ partners reaching over 30 million girls and women, 45+ corporate sponsors, and 35+ state leadership teams (Kantor et al., 2014).[10]

Our leadership team organized quite a few ECS career-related presentations, industry visits, and STEM outreach activities over the last three years. Career skills workshops included resume writing, interviewing, business etiquette, and how to work a career fair. Motivational and role modeling presentations included invited talks by female industry professionals and industry tours at global technology companies in the Austin/San Antonio region. Student surveys consistently reported high satisfaction with these latter type of activities.

Results and Summary

In order to evaluate the impact of the elements of the SPARK project, we administered assessments at the end of every semester and after some project milestones were completed. Seven students are no longer in the program. Six students were dropped due to GPA's below SPARK academic benchmarks (i.e., minimum GPA of 2.5 in their major and in their overall Texas State GPA every semester). Two students were dropped at the end of Fall '13, three students were dropped at the end of Fall '14, and one student was dropped at the end of Spring '15. One student was dropped from the program due to financial/FAFSA ineligibility at the end of Spring '15. In the following confidence, self-efficacy, and average/overall/major GPA analyses, the six students dropped due to GPA are labeled as "dropped". The eleven students that have continued in the program are labeled as "continued".

Confidence has been assessed through eight surveys administered before first year orientation, after first year orientation, end of Fall'13, end of Spring '13, start of Fall '14 (i.e., after second year orientation), end of Fall '14, end of Spring'15, and end of Fall '15. Each survey has 13 confidence-related questions. These questions are on a 1-5 scale (1 = not at all confident, 2 = not very confident, 3 = somewhat confident, 4 = quite confident, 5 = very confident). For each participant, scores on the 13 questions are averaged and, consequently, the average may range from 1-5. Figure 1 shows average confidence scores for dropped and continued students. The figure shows that after the initial summer orientation, confidence for continued students has been above 4.0. The figure also shows less variation in the confidence scores over the semesters for continued students as compared to the one for dropped students. Since the number of dropped students is very small, changes in major and consequently in confidence of these few students explains the high variations in this pool.

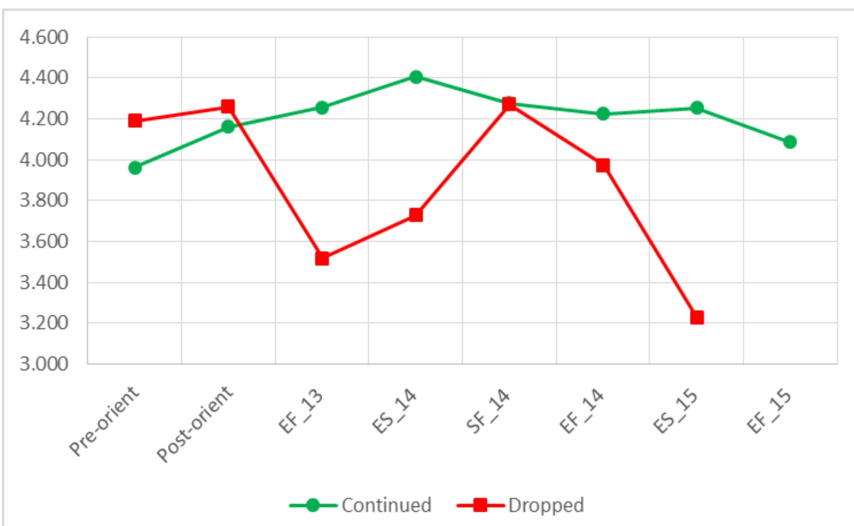

Figure 1: Confidence results

Self-efficacy has been assessed through seven surveys administered in the periods listed in the previous paragraph, except after first year orientation. Each survey has 10 self-efficacy related questions. The questions are on a 1-5 scale (1 = not at all true, 2 = hardly true, 3 = moderately true, 4 = almost always true, 5 = true). For each participant, scores on the 10 efficacy questions are added and, therefore, the results may range from 10-50. Figure 2 shows the average self-efficacy scores. Average self-efficacy before starting the Fall '13 semester was very similar for dropped and continued students, didn't improve for dropped students, and has shown a slight increase for continued students.

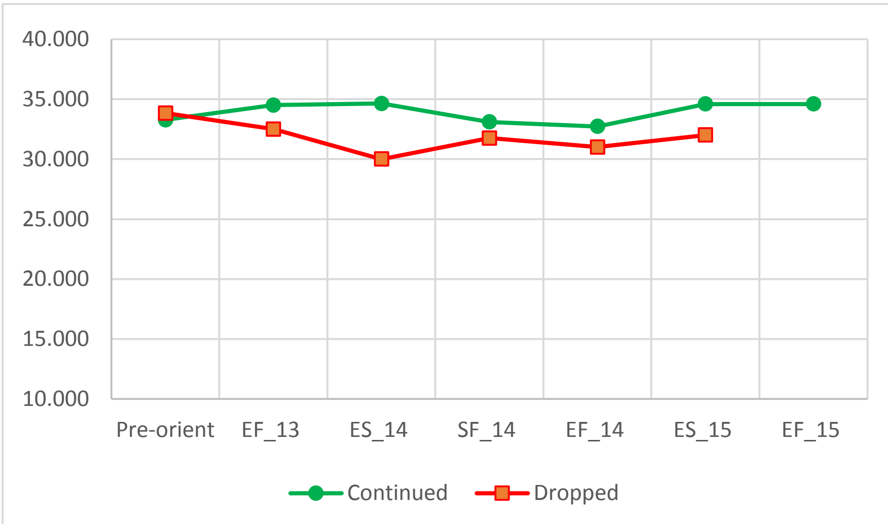

Figure 2: Self-efficacy results

Confidence and self-efficacy results of students who have remained in the program for more than one semester have proactively alerted us about students' ability to persist in the program and guided us on the interventions provided each semester.

Figures 3 and 4 show the trends in overall and major GPA for continued and dropped students. The data includes GPA scores for dropped students while they were in the program. The positive trend in overall and major GPA for continued students indicates that for most of the students (66.66%), the SPARK program elements have been very beneficial. We are very pleased to report that the current average GPA for continued SPARK students is 3.31. Texas State University Institutional Research data from Spring 2015 indicates that the average GPA for all College of Science and Engineering majors is 2.48 (including graduates and students who dropped out and excluding transfer students) and is slightly higher (2.56) if excluding graduates and students who dropped out. Comparatively, our SPARK continued students are doing very well.

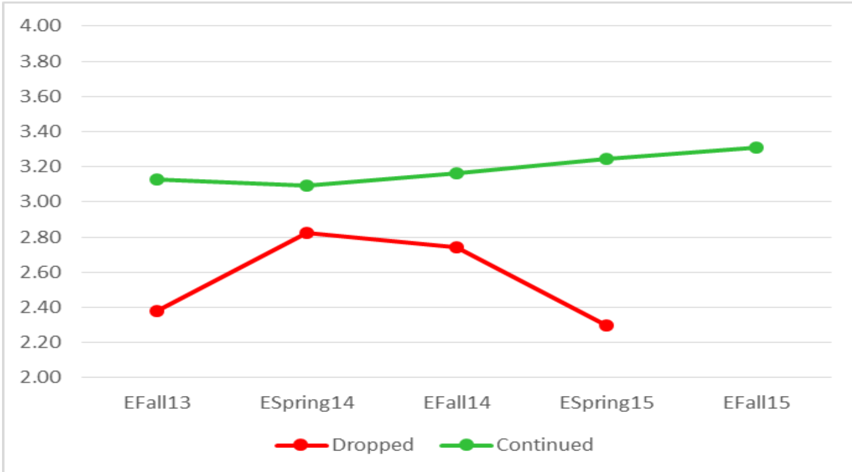

Figure 3: Overall GPA's

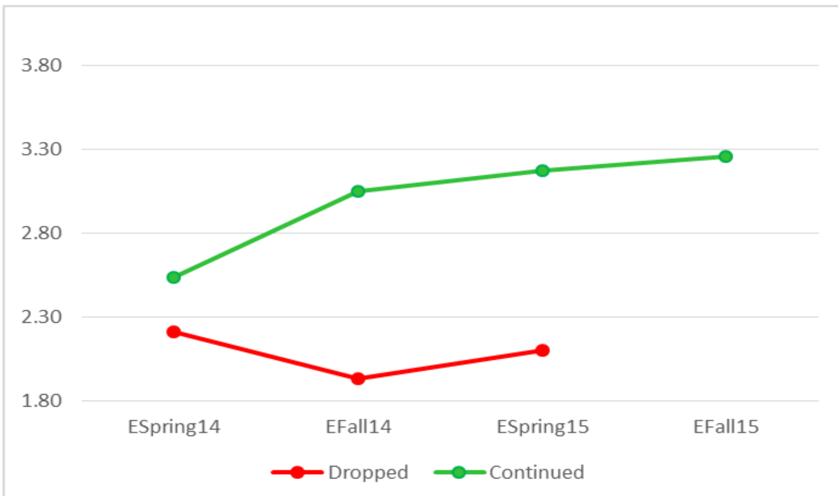

Figure 4: Major GPA's

Further analysis of the overall GPA for the eleven continued students indicates that they can be classified into two different groups according to the percentage increase in overall GPA computed as (current GPA – Fall '13 GPA)/Fall '13 GPA. The classification was validated with a discriminant analysis test. Group 1 has seven students (63.64%) who have increased their overall GPA. The statistically significant increase was tested with a paired t-test (n = 7, average increase = 0.3328, p-value = 0.0036). Group 0 has only four students (36.36%) who have decreased or kept the same GPA's. The statistically significant decrease was also validated with a paired t-test (n = 4, average decrease = -0.085, p-value = 0.1175). The p-value shows that there is no evidence to conclude that the decrease is significant. Figures 5 and 6 show the overall GPA trends for students in each of these two groups.

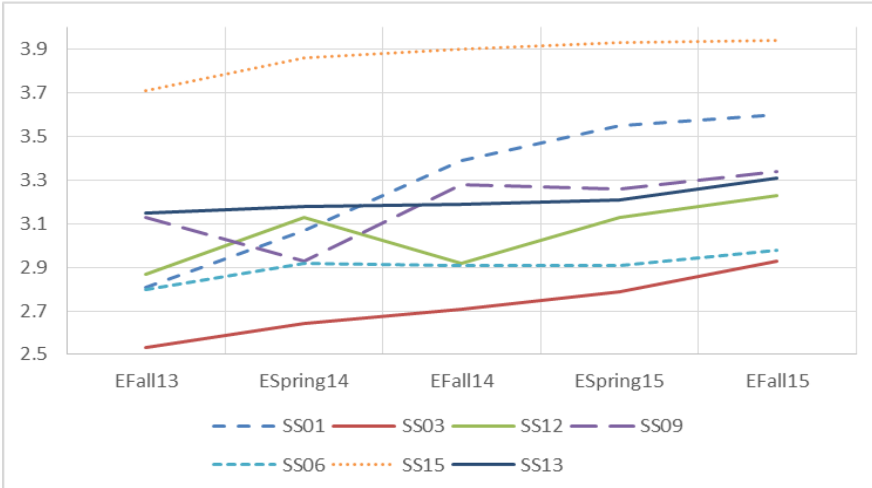

Figure 5: GPA trends for continued students in Group 1

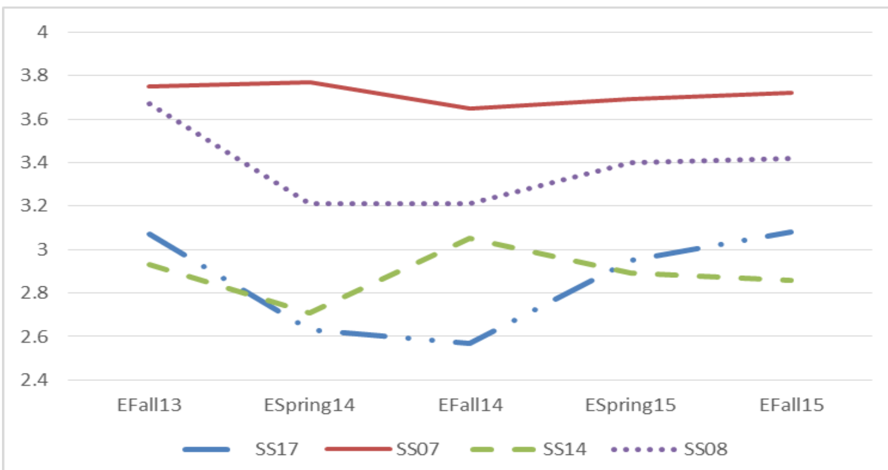

Figure 6: GPA trends for continued students in Group 0

Statistical comparison of students' scores in the Purdue Spatial Visualization Test (variable named PSVT2) and their latest GPA in the program, shows a significant correlation ($r = .61$, $p < .01$). We recall from the previous section that after taking the PVST-R eight students (44.44%) in the cohort scored below 60%, two (11.11%) left the program after the first semester, and six (33.33%) took the training in the next semester. After the training, 5 out of 6 students (83.33%) improved their scores with an average improvement of 25%. Four of the six students (66.67%) that took the training have continued in the program. A paired t-test showed that the improvement in scores for the six students taking the training was statistically significant (n=6, average increase = 25, p-value = 0.007).

An ANOVA table in which student status (dropped or continued) is used as a factor to explain the spatial visualization scores (PSVT2) is shown below. The factor student status (i.e., see row "statusFall2015") is significant in the model. However, the model R-squared is not high. It indicates that other factors not included in the model should help to explain the PSVT2 variance.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1837.13	1	1837.13	10.599	0.005
Intercept	85886.7	1	85886.7	495.491	0
statusFall2015	1837.13	1	1837.13	10.599	0.005
Error	2773.38	16	173.337		
Total	100927	18			
Corrected Total	4610.51	17			
R Squared = .398 (Adjusted R Squared = .361)					

Table 4: ANOVA Table to Explain SPARK Students PSVT2 Scores

From the statistical analyses of GPA and PSVT-R test results for this SPARK cohort, we conclude that it is crucial to provide the PSVT-R before students start their first semester in college. It is also beneficial to recommend the training to students who score below 70%. Early testing permits identification of students in need of additional training to improve their spatial skills.

These assessments show that the spatial skills training and the other supporting program elements have helped to retain SPARK students, improve students' grades in 1st and 2nd year STEM classes, and influence overall positive trends in academic performance.

Lessons Learned and Future Directions

There is no shortage of factors to consider concerning what works and does not work in supporting, retaining, and graduating female ECS majors. SPARK demonstrates how positive early path opportunities and established support structures can amplify female students' interest, engagement, and retention in engineering and computer science careers as well as combatting patterns of gender bias. The quantitative data we collected demonstrates that, even on a small scale, confidence and self-efficacy may be reasonably predictive of persistence for female students in ECS and that strong spatial skill abilities seem well correlated to ECS academic success. Qualitative and anecdotal reporting reveal a collective student sense of thriving and empowerment as well as satisfaction with the SPARK program activities designed to improve female retention in ECS.

The students were most satisfied with the social benefits of the SPARK Learning Community (e.g., social support, friendships, shared interests), and most felt that the learning community helped them with studying and improving their study habits (Schreiner et. al., 2013)[11]. In addition, most felt that having other SPARK students in their classes gave them more confidence to ask questions in class as well as providing them with support in completing homework and assignments. Our well-rated first summer session orientation week seemed to ease students' introduction to college life and laid the groundwork for a cohesive SPARK learning community. The students spent significant amounts of time together in study groups, social activities, and personal growth enrichment activities. As a result, strong community bonds were forged early and were sustained throughout the first year. SPARK students only spent one year in the learning community which resulted in some lessening of solidarity within the group after year one. When the students moved out of the learning community, many chose to continue living together either on or off campus. We propose that it may be beneficial to extend to two years the amount of time that a female ECS cohort lives together in a dedicated community. It would be interesting to evaluate whether a two year residential community makes a difference in retention and/or academic performance for those female ECS students with lower GPAs at the end of their first year. We project that by extending students' sense of ownership, belonging, and like-minded focus in a shared living community for two years, that this may serve as a safety net to prevent attrition while benefitting and mobilizing learning.

Of note, the transcripts from our focus groups revealed that lack of encouragement from teachers or their families was a common theme for these SPARK students who aspired to careers in male-dominated professions. The SPARK students are from very low income families, which is a requirement of the S-STEM program. Many live in small or rural towns and attended public high schools that gave them no or limited exposure to the business world of engineering and computer science. Providing students with early training in professionalism, business etiquette, good manners, and communication skills is important to address this gap, and we incorporated these topics into many of our activities. Despite the students' own assertions that they were excited to be part of a program that offered so many opportunities, their actual follow through in the first year was somewhat disappointing. Our SPARK leadership team overestimated the students' level of initiative and willingness to take advantage of the many opportunities offered to them, despite the students' assertions to the contrary. Moreover, NSF stipulated that S-STEM programs could not require students to participate in the ancillary activities associated with these S-STEM programs. We frequently emphasized not only the relevance of acting on opportunities but also the importance of getting involved as early as possible. It is not unreasonable to attribute some reluctance to the typical adjustments that most students experience when they begin college. Although this apathy was a source of frustration for our leadership team, each year has brought increased maturity and ambition from the students in the cohort. We have witnessed these characteristics developing at different rates for different individuals. Whether this gradual personal and professional growth constitutes Sandberg's exhortation "what would you do if you weren't afraid" is an open question and may be better understood with further study. We are pleased that this project will become part of the larger literature on gender bias in STEM and is fertile ground for studying its impact on low income, college-age women aspiring to engineering and computer science careers.

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Appendix A

Description: Calendar used by SPARK mentors to follow-up on students' career related activities (note: example shown is for use with industrial engineering majors)

		Month											
Check if done		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1. Visit https://www.nsf.gov/crssprgm/reu/ and look for REU's in Industrial Engineering. Also look at bulletin boards, faculty and staff e-mails.	x									x		
	2. Visit the link below and similar places to look for Industrial Engineering internships http://www.internmatch.com/s/engineering-internship	x								x			
	3. Become member of the Society of Women Engineers (SWE) Membership fee: $20/year. 4. Register on-line at http://societyofwomenengineers.swe.org/ on July 1st (early applications open April 15). 5. Your SWE membership gives you the possibility to register as a protégé in MentorNet https://mentornet.org free of charge. In this program, you are matched with an industry mentor. You communicate with the mentor 15-20 minutes weekly for four-months. After this period, you can continue with the same mentor or a new one.				X x	X x	X x	X x					
	6. Become member of the Institute of Industrial Engineers. Membership fee: $35/year. Register on-line at http://www.iienet2.org/details.aspx?id=560 It seems there is no preferred date to become a member.							x					
	7. Become MAES member Latinos in Science and Engineering (if you qualify) and attend its annual Symposium http://mymaes.org/student/ Membership fee: $10/year										x		
	8. Attend the SWE National Conference										x		
	9. Attend the SWE Region C Conference		x										
	10. Attend the Society of Hispanic Engineers (SHPE) Annual Conference http://www.shpe.org/											x	
	11. Attend the Great Minds in STEM (HENACC) Annual Conference http://www.greatmindsinstem.org/										x		
	12. Become involved in research and attend professional conferences such as the one offered by the Institute of Industrial Engineers						x						

Appendix B

Description: Questionnaire given to students in the second mentoring session, end of first-year

1. Sharing about achievements and obstacles - in which areas do you feel less confident?

2. Research and opportunities homework; how will you maintain your mentoring relationship with faculty?

   - Visit 3 professors in the next few weeks and write a one-page report about the kind of research the faculty does and if there are any opportunities for you to become involved. Provide details about the opportunity, number of hours per week it would demand, etc.

   - SWE Team Tech Competition
     Emphasizes the importance of teamwork and interface with industry in the engineering educational process. Read the package, e-mail me your ideas, questions, and interests.

   - Do you see possibilities for sustaining the professional dialogue with this faculty member on a periodic basis, let's say to continue talking 2-3 times during the Fall semester? Topics could be discussing a specific class where you may want to increase your knowledge, getting help on building your resume, or assisting the faculty as a grader.

3. Are you are considering graduate school? Provide details to this answer.

4. Are you in search of books for the summer?
   - http://www.engineeringdaily.net/5-mentally-engaging-books-that-engineers-would-like-as-gifts/

5. Another link, besides SWE, SME, IEEE, and IIE, that provides good information and mentoring about engineering
   - American Society of Mechanical Engineers
     https://www.asme.org/career-education/mentoring

6. Participating in extra-curricular activities organized by SPARK is very critical. Keep this in mind!

7. Do you have any other questions?

Appendix C

Description: Questionnaire given to students during mentoring sessions to help students examine self-confidence, set goals, and identify potential problem areas

A. Think about your strengths and interests as well as areas where you'd like to grow.

I am really good at:

1.
2.
3.

Areas where I'd like to grow:

1.
2.
3.

B. List your academic/professional goals (i.e., 5 short term and 5 long term goals).

Short term

Goal description	Desired outcome	Opportunities for achieving this goal	Obstacles/Threats to achieving this goal

Long term

Goal description	Desired outcome	Opportunities for achieving this goal	Obstacles/Threats to achieving this goal

C. To protect my time and focus, I am dedicating to saying….

YES to:

1.
2.
3.

NO to:

1.
2.
3.

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