

Lighting a “SPARC” and Fanning the Flames of Change at Gaston College

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Abstract

In 2009, Gaston College launched the SPARC (Student Persistence and Retention through Curriculum, Cohorts, and Centralization) initiative to improve student engagement and enhance transfer student success. The initiative sought to revamp curricula by integrating inquiry-based instruction and introducing a research methods course, centralize STEM student support services, and provide scholarships to cohort students with unmet financial needs. To implement these services and offer scholarships to low-income, academically talented U.S. citizens or permanent residents, the College secured three National Science Foundation (NSF) S-STEM grants. The SPARC model has yielded promising results, with participating students experiencing increased fall-to-fall retention rates and three-year graduation rates.

Keywords: curriculum redesign, STEM student persistence, retention and graduation rates, undergraduate research, S-STEM scholarships

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Beginning in 2009, the Arts and Sciences Division at Gaston College embarked on a major reform of the Associate of Science program with a focus on improving student engagement and enhancing transfer student success. This divisional improvement project spanned multiple years and was informed by a variety of sources, including national research, internal assessment data, and the documented needs of professional fields. Additionally, suggestions from

program advisory committees, industry partners, transfer institutions, and faculty and staff were considered. As part of these efforts, Gaston College's 2012 Community College Survey of Student Engagement (CCSSE) data was also examined.

CCSSE data from Gaston College's 2012 administration of this survey indicated that 69% of associate degree-seeking students at the College desired to transfer to a four-year college or university. State performance measures indicated that students who transferred from the College to a four-year institution were successful; however, retaining students until the point of transfer became a focused concern. Internal data from Fall 2011 to Fall 2012 showed that the retention rate of Associate of Science (A.S.) students was 45%, and the three-year graduation rate for students beginning in the fall of 2009 and graduating by Summer 2012 was only 12%. The CCSSE data also indicated that nearly 8 out of 10 students attending classes worked for pay, with over 53% of those working more than 21 hours per week. These data indicate that financial support could reduce the need for full-time work giving students additional time to focus on academic endeavors.

A review of primary literature revealed Gaston College Associate of Science students would likely benefit from centralized support services such as advising and mentoring. Advising has been shown to be vital for student persistence (Seidman, 1991) as well as for the transition from community colleges to four-year institutions (Allen, Smith, & Muehleck, 2013). Advising can assist first-year college students who are most likely to have difficulty navigating the

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higher education environment (Gilroy, 2003) and who are shown to need additional support services to achieve success (Roach, 2009). Mentoring has also been shown to produce positive student outcomes such as increases in GPA (Crisp et al., 2017) and persistence in education (Clutterbuck et al., 2017). Additionally, students who engage in a mentoring relationship are more likely to develop professional skills and confidence, possess more self-efficacy, and experience increased psychological adjustment and higher satisfaction during their educational experience (Johnson, 2016).

To improve course success rates (grades of C or higher) in foundational Associate of Science courses such as biology, chemistry, and mathematics, program faculty proposed to redesign curricula with a focus on inquiry-based active learning strategies and undergraduate student research. According to Nunami et al. (2020), inquiry-based curricula increase student performance by fostering science process skills. Inquiry-based curricula also increase exposure to primary literature (Elgren and Hensel, 2006). Early involvement in independent research has been shown to be important for performance level and persistence in the sciences, particularly for minority students (Jones, Barlow, and Villarejo, 2010; Lapatto, 2004; Nagda et al., 1998).

College leadership and program faculty worked to develop a comprehensive plan to bring these elements of financial support, social support, and curricular improvements together. This plan, known as SPARC (Student Persistence and Retention through Curriculum, Cohorts, and Centralization), was formally launched in 2010. The goal of the SPARC initiative was to (1) transform curricula through the integration of inquiry-based instruction and development of a research methods course with an undergraduate research component as a capstone experience; (2) centralize STEM student support services that included advising, mentoring, cooperative work experiences and undergraduate research experiences; and (3) reduce the unmet need of cohort students by providing scholarships. The target of these interventions was to increase the fall-to-fall retention rate and the three-year graduation rate of participating students.

To implement the SPARC model, the College has used institutional funds and sought and ultimately received three National Science Foundation (NSF) S-STEM grants to help fulfill these goals. Specifically, these grants have allowed the College to implement

services for students and to offer scholarships to students of up to \$10,000 annually based on unmet financial need. All scholarships followed the NSF guidelines requiring students to be low-income, academically talented, U.S. Citizens, or permanent residents. A private donor provided additional scholarship support for talented students who did not meet the financial need or citizenship requirements. Funds from the private donor have allowed the program to serve a greater number of highly qualified students, particularly undocumented Latino/Latina students, who are ineligible for federal student aid. Participating students, known as SPARC Scholars, are enrolled in the College's Associate in Science (A.S.) or Associate in Engineering (A.E.) programs.

Methods

To address curriculum transformation, the College initially partnered with Finger Lakes Community College as part of the Community College Undergraduate Research Initiative (CCURI) funded by the National Science Foundation (NSF TUES Type III grant, NSF ID 1118679). As a CCURI partner, Gaston College focused on the creation of curriculum strategies and materials for a capstone research course, as well as curricular improvements to foundational biology, chemistry, and mathematics courses in the Associate of Science program (General Biology I and II, Genetics, Microbiology, General Chemistry I and II, Organic Chemistry I and II, and Statistics).

The partnership with CCURI offered professional development opportunities for science faculty to either gain additional laboratory experience or begin implementation of inquiry-based instructional methods in their classrooms as a pathway toward course-based or independent undergraduate research. Faculty shared what they learned from these professional development activities at the annual SPARC Professional Development Day, started in 2013, which annually drew up to 120 educators from secondary schools, community colleges, and universities across North Carolina. As professional development allowed faculty expertise and confidence in new instructional methods to increase, faculty implemented numerous research opportunities for students.

Research projects that were implemented in science courses at Gaston ranged from water quality testing of student's home water supply and surface water testing, nitrification testing of wastewater effluent, participation in the Tiny Earth project (for-

merly Small World)—where students look for antibiotic producers in soil in Microbiology, bone density testing, a national maleate dehydrogenase (MDH) project, and student-designed independent research projects in General Biology II and Genetics. Before the pandemic, many students chose to work concurrently on independent research projects of their own design with a faculty mentor such as work with jellyfish, freshwater sponges, and microbes. Since the conclusion of the CCURI project, SPARC faculty have continued to work on curricular improvements and more widespread adoption of undergraduate research in the sciences, engineering, and psychology. While the COVID-19 pandemic did have a temporary impact on the completion of undergraduate research experiences as the College turned to online instruction only, SPARC scholars, as well as other students enrolled in the A.S. and A.E. programs, have resumed research projects. Research projects and equipment for research have been funded by institutional funds, several smaller grants and a National Institutes of Health Bridges to Baccalaureate (NIH B2B) grant (1R25GM128571-01) in partnership with the University of North Carolina-Charlotte (UNCC). This grant provides funds for equipment and supplies for research and pays a stipend as well as travel to professional conferences for students who participate in research both at Gaston College and after transfer to UNCC.

Twice annually, the College hosts the Research and Creativity Symposium where students present their research projects. This event was developed as a part of the SPARC program. Many scholars participated in local, state, and national poster presentations where they were able to share their research results on a professional level, which helped them gain experience communicating with a broader audience. These conferences included the State of North Carolina Undergraduate Research and Creativity Symposium (SNCURCS), the National Conference for Undergraduate Research (NCUR), and National Science Foundation-hosted events. All student expenses for these conferences were paid by grant funds or sponsoring agencies.

Centralization of Services

Gaston College coordinated the centralization of services to STEM students, including the appointment of a director of undergraduate research, targeted advising, mentoring, and the hiring of professional tutors for math and science. SPARC students see an advisor each semester to create and monitor an

academic plan and prepare for transfer to a four-year program after graduation from Gaston College. Students meet with their selected mentor a minimum of three times per semester, however, many meet more often. Mentors also work with students on undergraduate research or other engagement activities such as volunteer work. The SPARC director monitors student grades each week and refers students for professional tutoring services when their current course average falls below 75%. As the SPARC project progressed, feedback from scholars after transfer to a four-year institution indicated a need for continuing mentoring after transfer due to a phenomenon long known as transfer shock (Hills, 1965, Santos Laanan, 2003 and 2007). Thus, in 2018, post-graduation mentoring was incorporated into the project to help students manage transfer shock and the accompanying decline in academic performance.

Professional tutors in math and science were added to help facilitate course comprehension skills, however, since the pandemic finding such tutors has been difficult. As a result, Gaston has hired former SPARC scholars who had recently graduated from a four-year STEM program as program assistants. These assistants have been able to both serve as near-peer mentors and tutors while they are preparing to enter graduate school in the STEM fields. This practice has been in place since 2021.

As students enter their third semester in the program, a meeting with a program advisor focused on graduation and transfer is required. This meeting ensures students are on track for graduation and are being prepared for the next step in their academic career. This advisor has also worked with students on applications to four-year institutions as well as applications for transfer scholarships.

In addition to undergraduate research experiences, students were offered many different STEM educational and career experiences to help build their STEM identity. Students participated in community STEM presentations such as a National Geographic lecture series presented by the Discovery Place Museum in Charlotte, North Carolina. Students also attended Charlotte Area Science Network lectures. During the pandemic, students were encouraged to participate in virtual ‘science cafes’ and lectures presented by Discovery Place and the N.C. Natural History Museum. Students also served as volunteers at the college’s annual sciVisit event until it was put on hold during the pandemic. This event, which drew over 1000 high school students and their teachers to

campus each year will be returning in April of 2024. Students have also served as judges and volunteers at local and regional science fairs.

An important 'lesson learned' from the pandemic was that students particularly liked having local daytime on-campus options for their STEM-identity building activities. As a result, we now provide several on-campus STEM-specific opportunities beyond undergraduate research. On-campus panels of different types of engineers have been offered twice. These engineers spoke about their careers and what it took to become an engineer. Several of the engineers were former SPARC scholars who shared their experiences moving from college into a working STEM profession. A similar panel was held for students interested in life sciences and another is being planned for spring semester 2024.

SPARC leaders organize travel opportunities for scholars including four-year college visits and other events. Before the pandemic scholars had the opportunity to tour several N.C. universities including overnight trips to Appalachian State University (ASU)/Western Carolina University (WCU), and N.C. State University/ UNC-Chapel Hill. During the pandemic, we held virtual transfer sessions with former scholars who had transferred to these universities. Since resuming seated instruction in 2021, in-person visits to universities have resumed.

As an example of STEM identity-building-related travel, a highlight of the 2022-23 academic year was a trip to Florida to the Kennedy Space Center, Blue Spring State Park (to observe manatee behavior in a natural environment), and Sea World's rescue facilities. As with research presentations, all student expenses for these trips were paid by grant funds. Students also had the opportunity to attend SNCURCS in Wilmington, NC (with a tour of UNC Wilmington) and the NCUR conference in Wisconsin, even if they were not presenting at the conferences. A trip to the Florida Keys is being planned for April 2024. This trip will focus heavily on marine ecology and coastal management, but will also provide an opportunity for students to learn about the engineering of the bridges and roads that link the Keys, particularly the Seven Mile Bridge.

SPARC Learning Community and Scholarships

The third element of SPARC is a scholarship-based learning community that has supported a new cohort of 15-30 scholarship students each year since 2014. These scholarships have been funded by the three NSF S-STEM grant awards and were open

initially to students enrolled full-time in the A.S. program with priority given to members of under-represented populations. The A.S. curriculum is a 60-hour program of study including 30 hours of general education courses and 30 hours of math, science, and computer science courses. Since 2018, the SPARC program has also offered scholarships to students enrolled in the 60-hour Associate in Engineering (A.E.) program. The A.E. degree is similar in composition to the A.S. curriculum, with a greater focus on engineering and upper-level mathematics courses. Students have traditionally been enrolled in cohort classes together during the first 30 hours of the program.

Student responses to surveys showed that the cohort structure was one of the greatest strengths of the program. Students reported that the cohort structure provided them with a core peer group that held similar interests, helped them hold each other accountable, and encouraged them to participate more fully in group activities. However, the cohort structure became impossible once the onset of the pandemic as almost all academic work suddenly moved exclusively to online formats.

Student demographic changes post-pandemic have also had an impact on our SPARC scholarship program. The College enrollment is shifting to a majority of part-time students. We have also discovered that many of our full-time students work more than 30 hours per week. As such, the learning community experience post-pandemic has changed dramatically. Based on changing student needs, the required 30-hour on-campus curriculum cohort is no longer a possibility. Scholars need greater freedom to choose online courses rather than seated courses based on changes in family household structures and work requirements. Scholars also had expectations that they would be able to continue choosing online courses post-pandemic.

To provide more flexibility for students, we now provide flexibility in course scheduling of non-STEM courses. This includes student choice of on-campus or online sections. Initially, SPARC scholars completed a STEM-focused college transfer success course together as a cohort to help provide information and strategies necessary to develop clear and professional goals beyond the community college experience and to begin building community. However, one casualty of this increased flexibility is the STEM-focused section of the college transfer success course (ACA 122). Most sections of this course

are now taught online, and our students are scattered into many different sections. The topics taught in that course have been integrated as much as possible into the SPARC informational and team-building meetings. We still strongly encourage students to take as many seated STEM courses as possible, and many scholars have been required to take seated courses in their second year. Currently, physics and upper-level math courses as well as organic chemistry are only offered on campus. Those scholars returning to seated courses have tended to take the courses together, so natural cohorts are now reforming. Similar natural cohorts are also forming between students who regularly attend weekly information and team-building meetings.

SPARC Recruitment and Student Orientation

Many avenues have been used to recruit underrepresented populations, such as women and learners of color, into the SPARC program. Personalized letters were mailed to all graduating seniors from surrounding counties. News articles and advertisements appeared in local print, radio, and social media. A “SPARC of Genius” award was given annually at a regional science and engineering fair, recognizing first-year individual student projects that showed ingenuity and creativity. Regular presentations were made to local county school officials and career fairs to bring awareness to administrators, faculty, and students about the scholar’s program.

Additionally, program banners were strategically placed around campus to help make all students on campus aware of the program. SPARC program administrators also worked with academic advisors to recruit potential scholars. Referrals also came from the college’s TRiO program and the financial aid office. Once students were recruited, orientation activities were provided to share program expectations; enjoy team-building exercises; introduce students to mentors and advisors; and explore possible undergraduate research opportunities, volunteer outreach opportunities, and opportunities to participate in various STEM clubs across campus. This is done before the start of the fall semester as well as ongoing activities throughout the beginning of the semester.

Expansion of the SPARC Model

In 2017, Gaston College worked to expand the SPARC model to two additional colleges in North Carolina, the University of North Carolina-Charlotte (UNCC) and Rowan-Cabarrus Community College (RCCC). The expansion project, and accompanying

NSF grant funds, provides scholarships of up to \$10,000/year for students pursuing A.S. degrees at Gaston College or RCCC and transferring to complete bachelor’s degrees in biology at UNCC. Students are awarded support for up to two years at Gaston College and then an additional two years of support at UNCC. The partner institutions are committed to working together to increase associate and bachelor’s degree completion and reduce transfer shock. Program leaders have also worked with faculty and administration at other colleges in North Carolina and across the United States to share the SPARC model and assist with the implementation of similar projects.

Results

The SPARC program has served 191 scholars since 2014 with 44 still currently enrolled at Gaston for the 23-24 academic year with 30 expected to graduate in the spring of 2024. The average NSF award for scholars ranged from about \$4000 in the Fall 2014 Cohort (award limit \$6000) to \$8600 in the Fall 2023 Cohort (award limit \$10,000). Excluding currently enrolled students, the program has shown an overall 87% fall-to-fall retention rate and 85% of the scholars have completed an associate’s degree within two years of their program start. The average GPA of our scholars is 3.5. Our scholars have transferred to four-year colleges at a rate of 70%. As a comparison, data released in 2022 by the National Student Clearinghouse found that the fall-to-fall retention rate at community colleges is 59% (National Student Clearinghouse Research Center, 2022). Additionally, the National Center for Educational Statistics reports that the 2018 cohort of community college students nationwide showed a 36.4% graduation rate within three years of entering college (National Center for Education Statistics, nd). Before the pandemic, we saw over 80% of our scholars transfer to four-year institutions. Several of our scholars have been recognized with national and regional scholarships. Two SPARC scholars were awarded Jack Kent Cooke transfer scholarships, and one scholar was awarded the highly prestigious Goldwater Award for research. We’ve had two scholars awarded Goodnight Scholarships at N.C. State University. As of June 2023, 47 scholars have completed bachelor’s degrees in a STEM field. Seven others have completed bachelor’s degrees in non-STEM fields such as accounting, nursing, and business administration. Six scholars are currently en-

rolled in graduate school or have completed a graduate degree.

Conclusion and Lessons Learned

The SPARC project successfully met and exceeded all stated goals during the first grant period, which ended in 2019. The two additional SPARC grants are in no-cost extension years from the NSF and will end within the next 18 months. These grants have also met or exceeded all goals to date. The project team has disseminated results widely through numerous conference presentations and one publication (Ariyo, Hagler, Armstrong, & Miller Woodson, 2018). In 2016, the College and the SPARC project gained national attention when awarded the annual Community College Futures Assembly's Bellwether Award for innovative instructional programs and services. The project was one of ten finalists in the 2018 Bellwether Legacy Award competition and has again been selected as a finalist for the 2024 Legacy Award.

A number of the interventions piloted by the SPARC program have been institutionalized at Gaston College such as the expansion of the intrusive advising model, success coaching for all students, and ongoing revision to the honors program. In addition to replication at RCCC and UNCC, the project team has consulted with community college and university faculty from across the nation to discuss how the program can be replicated at their institutions.

Although our timeline illustrates the unique journey of Gaston College, some basic elements are universal and can be adapted to meet the unique needs of other communities. To implement the SPARC model at other institutions, Gaston College recommends following the steps below:

1. Define the Need (Your College's Need and Your Community's Need)

- Read the literature
- Gather information from advisory committees
- Examine job projections

2. Get the Right People Involved and in the Right Position

- Hire enthusiastic, knowledgeable people
- Promote from within
- Consider diverse perspectives
- Professional development may be required

3. Establish Your Plan (Short Term and Long Term)

- Brainstorm ideas
- Define your mission
- Be flexible
- Be willing to push the envelope
- Set short-term goals
- Set long-term goals

4. Seek Assistance and Form Collaborations

- Gain internal support
- Look for partners on and off campus
- Look for opportunities for funding
- Look for low-cost opportunities

5. Assess Progress and Learn from the Feedback

- Qualitative measures – faculty and student surveys, focus groups
- Quantitative measures – grades, persistence, graduation rates
- External assessment – accreditation, performance measures

As noted on numerous annual internal and external reviews, the SPARC project continues to meet high benchmarks set for student retention and graduation rates, as well as transfer and bachelor's degree graduation rates. Former SPARC scholars are contributing members of the STEM community in diverse fields such as education, biology, chemistry, engineering, and human and veterinary medicine, both in the service area of Gaston College and beyond. While the most significant positive impact has been seen in the scholarship recipients, the impacts of SPARC have been felt more broadly at the College. Undergraduate research is now a common practice at the College well beyond scholarship recipients. Additionally, curricular improvements have affected all students who complete these courses, and retention rates in these courses have improved since the implementation of SPARC. The total student population in the Associate of Science and Associate of Engineering programs has also grown significantly from less than 30 students at the onset of SPARC to over 700 students currently. While the project initially began with three goals—to improve curriculum, centralize services, and provide scholarships—SPARC has since grown and evolved. This transformation has been driven by changing conditions, feedback from students revealing new needs, and the lessons learned along the way. These chang-

es have allowed the project to continue to thrive despite the changing educational landscape.

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Authors' Note

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