Working with the Wesley College Cannon Scholar Program: Improving Retention, Persistence, and Success

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Abstract

Wesley College secured a five-year National Science Foundation (NSF) S-STEM (scholarships in science, technology, engineering, and mathematics) grant (1355554) to provide affordability and access to its robust STEM programs. With these funds, the college initiated a freshman to senior level, mixed-cohort, Cannon Scholar (CS) learning community (LC). Around the proven high-impact practice of multi-tiered mentoring, this LC is designed for greater commitment to participating STEM undergraduates. It truly is a collaborative effort between faculty and administrators. For Scholars interested in mentored research, existing NSF Experimental Program to Stimulate Competitive Research, and National Institutes of Health, National Institute of General Medical Sciences - IDeA Networks of Biomedical Research Excellence funding, complement the innovation and cross-disciplinary collaborations in the CS programming. This enriches and further supports the CS LC.

Throughout the 2014-2016 program duration, there were 66 *unique* scholarship recipients and 82% participated in directed research. Fifty-nine percent were from underrepresented minority populations and 65% were female. Ninety-five percent of these Scholars were retained and 100% of the graduates ($n = 21$) entered STEM fields. Analyses controlled for population similarity proves that with an intensive focus on academic support, high-impact uplifting practices were implemented through a framework of comprehensive student engagement activities. Such strategic interactions resulted in higher overall GPAs and significantly improved Scholar retention rates.

Keywords: S-STEM, Cannon Scholar, Wesley College, EPSCoR, INBRE

1. Introduction

To increase proficiency for global leadership in industrial productivity, the United States (US) is continually probing for definitive methods to increase persistence in STEM (science, technology, engineering, and mathematics) fields by maintaining a pipeline of trained undergraduates (Arcidiacono, Aucejo, & Hotz, 2016; Carnevale & Smith, 2012; Connors-Kellgren, Parker, Blustein, & Barnett, 2016; D'Souza, 2016; D'Souza, Curran, Olsen, Nwogbaga, & Stotts, 2016; D'Souza, Curran, & Stotts, 2014; D'Souza, Shuman, Curran, Wentzien, & Nwogbaga, 2017; D'Souza & Wang, 2012; Fiore, Rodriguez, & Carstens, 2012, Gayles & Ampaw, 2016; Goonatilake, Ni, & Moran-Lopez, 2009; Kuh, 2008; Laura, 2013; Quaye & Harper, 2014; Shadle, Marker, & Earl, 2017; Sithole, Chiyaka, McCarthy, Mupinga, Bucklein, & Kibirige, 2017; Tinto, 2012). For equity for its growing underrepresented populations (URMs), the US education policy encourages transparency to improve STEM program persistence rates and academic achievement (Crippen, Brown, Apraiz, Busi, Evran, McLaughlin, Peace, & Temurtas, 2016; D'Souza, Kroen, Stephens, & Kashmar, 2015; Glater, 2016; Laura, 2013; Mau, 2016; Page, Scott-Clayton, 2016).

Several studies show that an infusion of need-based financial awards (Bianchini, 2013; Denning & Turley, 2017; Edwards, 2015; Medsker, Allard, Tucker, O'Donnell, Quaye & Harper, 2014; Sterne-Marr, Bannon, Finn, Weatherwax, 2016; Whittaker & Montgomery, 2012), when coupled with the use of appropriate general requirement assessment tools for freshman math and science course placements (D'Souza, Kroen et al., 2015; D'Souza, Shuman et al., 2017; Gilmer, 2007; Quaye & Harper, 2014; Whalen & Shelly, 2010), structured academic support and collaborative academic advising services (D'Souza, Kroen et al., 2015; D'Souza, Shuman et al., 2017; D'Souza & Wang, 2012; Dwyer, 2017; Gilmer, 2007; Kuh, 2008; Perna, Lundy-Wagner, Drezner, Gasman, Yoon, Bose, & Gary, S., 2009; Palmer, Maramba, Dancy, 2011; Quaye & Harper, 2014; Sithole et al., 2017; Tinto, 2012; Whalen & Shelly, 2010), course-embedded or independent mentored undergraduate research experiences (Crisp, Baker, Griffin, Lunsford, & Pifer, 2017; D'Souza, Brandenburg, Wentzien, Bautista, Nwogbaga, Miller, & Olsen, 2017; D'Souza, Dwyer, Allison, Miller, & Drohan, 2011; D'Souza, Kashmar, Hurst, Fiedler, Gross, Deol, & Wilson, 2015; D'Souza, Shuman et al., 2017; Dwyer, 2017; Graham, McIntee, Raigoza, Fazal, & Jakubowski, 2017; Kuh, 2008; Linn, Palmer, Baranger, Gerard, & Stone, 2015; Powell, Harmon, 2016; Quaye & Harper, 2014), and the incorporation of faculty and peer-support within living learning communities (LLCs) (D'Souza, Curran et al., 2016; D'Souza, Kroen et al., 2015; D'Souza, Shuman et al., 2017; Haydel, & Escalera, 2016; Museus, Yi, Saelua, 2017; Kuh, 2008; Quaye & Harper, 2014; Sriram, Diaz, 2016) are critical to student preparation and STEM degree attainment. At liberal-arts institutions, inquiry-based capacity building initiatives that foster long-term student-learning, persistence and success in the STEM areas are achieved through interdisciplinary project-based courses that develop critical thinking skills, integrity, and oral/written communication training (Adams Becker, Cummins, Davis, D'Souza, Brandenburg et al., 2017; D'Souza, Curran & Stotts, 2014; D'Souza, Shuman et al., 2017; Dwyer, 2017; Gibson, Dwyer,, & Barnhardt, 2015; Freeman, Hall Giesinger, & Ananthanarayanan, 2017; Harrison & Parks, 2017; Haydel, & Escalera, 2016; Klein, 2009; Kuh 2008; Quaye & Harper, 2014; Shadle et al., 2017; Tinto, 2012).

The National Science Foundation (NSF) promotes STEM student success by offering programs that specifically target academically talented, URMs and low-income students (August, 2017; Crisp et al., 2017; James & Singer, 2016; Tsui, 2007). The NSF Scholarships in STEM (S-STEM) program has shown real progress for students with definable financial need (August 2017; Baker & Slunt, 2017; D'Souza, 2016; D'Souza, Shuman et al., 2017; Edwards, 2015; James & Singer, 2016; Medsker, 2016; Shuman, 2017). The National Institutes of Health (NIH) and other federal agencies also have diversity initiatives that seek achievable STEM academic pathways for underrepresented groups (Olszewski-Kubilius, Steenbergen-Hu, Thomson, & Rosen, 2017; Rincon & George-Jackson, 2016).

1.1 Institutional Engagement in High-impact Educational Practices

Wesley College (Wesley) is a private liberal-arts college in Delaware. This minority-serving primarily undergraduate institution (MSI-PUI) is fully accredited through the Middle States Commission on Higher Education. In academic year (AY) 2016-2017, out of a 1414 total undergraduate student body, Caucasians were 39%, while at 41% African-Americans were the majority minority population. According to the federal poverty thresholds and guidelines, 56% of Wesley's undergraduate population are classified as coming from low-income households, and over 40% of the student-body are the first-in-their-

families to go to college.

In the STEM fields, Wesley offers undergraduate degrees in biological chemistry, biology, environmental science, environmental policy, mathematics, and medical technology. Environmental science also has a masters-level graduate degree program. The STEM programs are housed in Cannon Hall, named after Wesley's famed alumna and Harvard astronomer, Annie Jump Cannon.

Through federal NIH, National Institute of General Medical Sciences, IDeA Networks of Biomedical Research Excellence (INBRE), and NSF Experimental Program to Stimulate Competitive Research (EPSCoR) grant support, the STEM areas developed a vigorous, nationally recognized, directed research program for its undergraduates (D'Souza, 2016; D'Souza, Brandenburg et al., 2017; D'Souza, Curran et al. 2016; D'Souza, Curran et al., 2014; D'Souza, Dwyer et al., 2011; D'Souza, Kashmar et al., 2015; D'Souza, Kroen et al., 2015; D'Souza, Shuman et al., 2017; D'Souza & Wang, 2012). Students participate in individualized paid/unpaid undergraduate research (UR) experiences during which they work one-on-one with a research mentor throughout the academic year and an intense 10-week summer session. The high level of commitment required allows the undergraduates to receive one or two-directed research course credits directly from their participation in the program. Since 2003, participants earned 104 national and regional award recognitions and 65 UR scholars are co-authors on peer-reviewed publications, which demonstrates the successful nature and application of the Wesley UR program.

In 2005, for intellectually driven high school (HS) graduates and for those with proven college credentials, Wesley created an Honors program (D'Souza, Kroen et al., 2015; D'Souza, Curran et al. 2015; D'Souza, Kashmar et al., 2015). Entering freshman with a mean HS GPA of 3.3 (on a 4.0 scale) and existing Wesley students with a 3.0 or higher mean GPA, are encouraged to enroll in honors courses and to participate in the Honors LLC program.

EPSCoR and INBRE faculty development reform initiatives (that commenced in AY 2009-2010) led to a complete restructuring of the College's liberal-arts core curriculum (D'Souza, 2016; D'Souza, Brandenburg et al., 2017; D'Souza, Curran et al. 2016; D'Souza, Curran et al., 2014; D'Souza, Kashmar et al., 2015; D'Souza, Kroen et al., 2015; D'Souza, Shuman et al., 2017; Dwyer, 2017; Gibson, Dwyer et al., 2015). STEM faculty revised their lab-based courses to integrate authentic and creative research engagement activities (D'Souza, Curran et al. 2016; D'Souza, Curran et al., 2014; D'Souza, Kashmar et al., 2015; D'Souza, Kroen et al., 2015). Beginning in the first semester of their freshman year, Wesley undergraduates are immersed in 39-credits of liberal-arts core-courses (D'Souza, Curran et al. 2016; D'Souza, Shuman et al., 2017) that emphasize collaboration, critical thinking, constructive oral/written communication, the understanding of multiple perspectives, ethical /personal integrity training, persistence, and organizational skills.

Entering STEM majors enroll in a one-credit Scientific Process course (D'Souza, Curran et al., 2016; D'Souza, Kroen at al., 2015). This introductory freshman STEM course emphasizes hypothesis testing and deductive reasoning to explain the generality of observations. As seniors, students complete a capstone thesis that encompasses an investigative project, or carry out a culminating cross-curricular project demonstration of higher-order thinking skills through research and analysis (D'Souza, Shuman et al., 2017).

In AY 2015-2016 through EPSCoR and INBRE grant funds, the STEM areas began rigorous informatics minor and certificate programs. Coursework includes applied statistics to solve problems associated with making decisions and testing hypotheses, data-mining using SAS® programming tools, and geospatial analysis that analyze patterns and relationships using ArcGIS® (D'Souza, Brandenburg et al., 2017; D'Souza, Kashmar et al., 2015; D'Souza, Shuman et al., 2017). As the two data-mining and geospatial analysis courses are embedded in level-3 (junior year) of the college core, they afford a competitive edge to all Wesley majors in the workforce openings that require 21st century skills (D'Souza, Brandenburg et al., 2017; D'Souza, Curran et al. 2016; D'Souza, Shuman et al., 2017).

Additionally, EPSCoR and INBRE support focused on the reorganization of the Wesley academic support structures (D'Souza, Kroen et al., 2015; D'Souza, Shuman et al., 2017; Dwyer, 2017). The reorganization of the Student Success & Retention department centralized academic student support services within the Academic Success Center (ASC) to offer well-coordinated student learning, persistence, and success programs.

In 2017, to provide empowering STEM opportunities for its majority URM population, Wesley initiated an interdisciplinary Undergraduate Research Center for Analytics, Talent, and Success (UR-CATS). Through UR-CATS programming (D'Souza, Shuman et al., 2017), Wesley can expand undergraduate research experiences, create a framework of mentoring for its standing faculty, strengthen student support services, provide STEM innovation programing for high-school seniors, and initiate a variety of STEM outreach/volunteer opportunities. UR-CATS will also continue to encourage more faculty to pursue research and to seek outside funding.

1.2 Regional STEM Workforce Employment Needs

According to a 2012 Georgetown University (GU) report (Carnevale & Smith, 2012), when compared to the national average, the Delaware job-skills and credentials places its workers at a significant disadvantage. The same GU report projected a decade-long 16% annual job-growth for Delaware. This growth was shown to favor post-secondary education, as many of the job openings came from the healthcare and the scientific fields. Such new employment demands and Delaware's aging workforce create a critical need for college graduates that are fully trained in science and technology (by 2030 almost 27% of the state population is projected to be over 65 compared with 14% in 2008). According to the US Bureau of Labor Statistics, the 2014 Delaware median annual earnings for full-time wage and salary workers with a STEM bachelor's degree is reported to be $57,252.

Delaware is also a coastal state with substantial acreage devoted to agriculture and the poultry industry. Hence there is a constant need for STEM-majors to monitor and protect activities that relate to human health, agriculture, and the environment (D'Souza, 2016). These occupations, for the most part, are also technical areas of national need.

1.3 Rationale for the 2013 Wesley College Application to the NSF S-STEM Program

An exhaustive independent AY 2011-2012 study of Wesley's academic support services, student affairs, residence life, financial aid, student accounts, athletics, and other campus offices, provided evidence that in comparison to the returning students, the non-returning students had much higher unmet financial needs (D'Souza, Curran et al., 2016; D'Souza, Kroen et al., 2015). The study demonstrated that 60% of non-returners were impacted by financial challenges, 20% lacked academic ability, and 16% were deficient in the knowledge, skills, and attitudes essential for freshman year success (D'Souza, Curran et al., 2016; D'Souza, Kroen et al., 2015; D'Souza, Shuman et al., 2017).

Many students admitted to our STEM programs that they have poor HS GPAs and ACT/SAT scores (D'Souza, Kroen et al., 2015; D'Souza, Shuman et al., 2017). This data signifies that Wesley affords more students the opportunity to go to college, as their HS academic records are not sufficient for STEM program admission at other local and regional state universities.

Low HS performance scores of incoming freshmen coupled with major financial issues are sufficient predictors of a Wesley STEM student's disadvantage for overall first-year college success. For AYs 2010-2014, the average STEM first-time-full-time (FTFT) freshman to sophomore retention rate was 44% which was marginally below the overall college FTFT retention rate of 46% (D'Souza, Curran et al., 2016; D'Souza, Kroen et al., 2015).

Wesley believed that mitigating any overriding financial barriers by using accountable and uplifting high-impact intervention and educational strategies would increase STEM program retention, persistence, and success, at this Delaware MSI-PUI. To ease the predominant financial burden on its STEM population, Wesley applied for and received a $600,000 NSF S-STEM award (135554, 2014-2019).

2. Methods

To enhance their academic success and their identification with their STEM discipline, Wesley utilized its S-STEM funds to award scholarships within a Cannon Scholar (CS) program (D'Souza, Curran et al., 2016; D'Souza, Kroen et al., 2015, D'Souza, Shuman et al., 2017; Shuman, 2017). The CS scholarships are renewable one-year scholarships with NSF Division of Undergraduate Education (DUE) stipulations and guidelines that must be followed for continuous funding.

Incoming freshmen who have a keen interest in STEM, or current Wesley STEM majors with a 2.7 GPA, can apply to the CS program and are required to reapply each year. The program focuses on engaging a mixed-enrollment cohort (freshmen to senior levels) in a vibrant student-centered learning community (LC), where students of all backgrounds come, learn, and live together (D'Souza, Curran et al., 2016; D'Souza, Shuman et al., 2017). To encourage CS students (Scholars) to graduate within five years, a maximum of four scholarship renewals are allowed. Scholars are *encouraged but not required* to participate in mentored UR activities.

Proper planning and effort is required for successful program implementation, effectiveness, and consistency. Governance decisions for managing processes are shaped by the principal investigator (PI), the co-investigator (co-I), the Academic Research Grants Administrator, and the STEM Programs Assistant. Furthermore, project oversight, management, and guidance, are provided by an Advisory Committee and a Scholarships Selection Committee. Both committees are composed of voting members from the STEM faculty, Student Success & Retention (SSR), Financial Aid, Student Affairs, Enrollment, Communications and Marketing, and the Office of Academic Affairs.

To receive a CS S-STEM scholarship, students *must*:

- Write a one-page essay to justify the award and indicate their future STEM goals.
- Have financial need as defined by the US Department of Education rules.
- Be a US citizen or permanent resident.
- Have a HS GPA of at least 3.0 (or a Wesley student with a 2.7 GPA).
- Have an SAT score of at least 1006 out of 1600.
- Have completed three years of HS English, three units of Math (Algebra I, Geometry, and Algebra II) or equivalent, and preferably three years of laboratory science courses.
- Have an interest in math or science as demonstrated by participation in STEM-focused activities such as Science Olympiad or Math League.
- Be enrolled (full-time) in a Wesley STEM program (other than Medical Technology).

Applicants are assessed with diligence and attention to detail. Scholarship award amounts are based on an analytical scoring scale. The weighting of the scale-components was determined and developed in accordance to the NSF S-STEM guidelines and requirements.

Wesley STEM majors who do not qualify for the CS program but have a 2.7 GPA and have an expressed interest in UR, are afforded the opportunity to participate as Scholars with academic scholarships awarded through Wesley's EPSCoR and INBRE programs.

Our long-term CS program goals are: (a) increase the number of academically-talented, financially-disadvantaged URM students graduate from the Wesley STEM areas, (b) strengthen their preparation and interest in future graduate/professional programs, and (c) increase the number of well-educated and skilled employees in technical areas of national need.

The Wesley (2014-2019) Cannon Scholars (CS) Program has four major objectives:

- Increase the number of CS program applicants by at least 20%.
- At least 75% of the Cannon Scholars will be retained until their senior year.
- At least 75% of the Cannon Scholars graduate.
- On graduation, 90% will progress into STEM fields.

To achieve these objectives, we use a three-pronged strategy, focused on recruitment, retention, and academic leadership.

Recruitment: Recruitment efforts are collaborative. The CS teams work with Admissions, SSR, Financial Aid, Student Affairs, and Communications and Marketing, to promote the program at the institutional and program webpages, in print, and on social media.

The Office of Admissions helps identify and recruit academically talented HS STEM applicants from URM populations to Wesley. Admissions invites them to Cannon Hall to develop a connection with the STEM faculty, staff, and students. Additionally, tenured STEM faculty teach the science-based first-year seminar (FYS) courses and serve as faculty-leads on interactive LLCs (D'Souza, Curran et al., 2016; D'Souza, Shuman et al., 2017). The FYS and LLC programs are intimate: they connect the world to STEM fields, help URMs navigate academia, encourage academic development, and are available to undeclared majors. This approach fosters the development of familial attitudes and impressions of the STEM-related job market, and as a result some participating undeclared students choose to major in a STEM area. Applicants who qualify academically and who demonstrate financial need are offered S-STEM scholarships to pursue a STEM major at Wesley.

Retention: Each Cannon Scholar is part of a Learning Community (LC) (D'Souza, Shuman et al., 2017). UR-CATS organizes monthly CS orientation events and town-halls that offer avenues to meet peers, STEM faculty, and CS program staff. The faculty and staff provide an overview of their respective STEM programs, and the students are informed/reminded of the expectations of the CS program as well as other Wesley student-programs which are available to assist in accessing services applicable to their individual needs. The monthly events also serve as a forum through which former STEM graduates, regional graduate/professional school representatives, as well as state government and industrial partners, come to discuss technical information and supplemental training that are important for future academic and non-academic STEM career pathways.

In collaboration with the UR-CATS team and with EPSCoR/INBRE funding, the Office of Academic Affairs organizes mandatory biannual faculty workshops to routinely provide training to build dynamic faculty-student partnerships (D'Souza, Curran et al., 2016; D'Souza, Kroen et al., 2015; D'Souza, Shuman et al., 2017). Workshop activities and discussions typically focus on the implementation of best practices for mentoring, interactive teaching, assessment, advising, grantsmanship, and for relevant effective and culturally responsive interventions and scholarship. At these events, workshop presenters provide constructive feedback in the form of suggestions for improvements in order to assist the Wesley faculty to develop techniques to adapt to the role of being a student's advocate, evaluator, and coach.

The PI and co-I serve as *official* Scholar mentors and each Scholar has an academic advisor from the Wesley-STEM faculty body. In addition to mobile/online communications, the mentors and the advisors meet regularly with the Scholar in person to discuss student progress and troubleshoot potential barriers (including finances) to academic success. Cannon Scholars are provided significant financial assistance to reduce their reliance on outside employment which allows them to progress more rapidly toward a degree.

The PI, the co-I, STEM faculty, and Scholars (also) participate in other on-campus mentored student organizations that sponsor activities and field trips where members come together to share a common interest. Through EPSCoR and INBRE support, the Department of Student Success & Retention (SSR) provides a plethora of enhanced mentoring, tutoring, career-advising, and student advocacy resources (D'Souza, Kroen et al., 2015; D'Souza, Shuman et al., 2017). In addition, a comprehensive online case and early-alert management system (called Lantern) provides the infrastructure that allows the PI, the co-I, STEM faculty, project relevant campus staff and the SSR staff, to share information that is focused on the student's success and well-being. Input into Lantern creates data predictors for suitable interventions that assist student progress. This efficient intranet forum improves inter-campus communications, breaks down barriers, and provides timely resources to students in need.

Tutoring sessions, programs concerning time management, study skills, test anxiety, exam preparations, writing, and personal and relationship issues, are available in the ASC and in the designated EPSCoR and INBRE designed LLC space. Extended STEM-subject study ses-

sions within a peer-group or in an individualized tutoring session are required for all Scholars. When struggling, or to improve their knowledge in their STEM subject matter, Scholars can schedule, modify, and cancel, one-on-one or group tutor requests through an online tracking portal, referred to as TutorTrac. The CS program also requires the Scholars to track completed sessions and study hours through the same TutorTrac portal. Documentation of logged hours is used as input to improve the STEM Mentor/Advisor's understanding of the Scholars' challenges, abilities, and skills in the academic arena, as well as academically unrelated life situations which may interfere with academic success and retention if not addressed in a timely manner.

Academic Leadership Training: To address issues along their STEM educational continuum and to foster an equitable distribution of encouragement, Scholars attend EPSCoR/INBRE sponsored workshops at Wesley and at our regional partner institutions (D'Souza, Shuman et al., 2017). These workshops focus on personal growth, technology competitiveness, and other high-quality STEM hands-on learning opportunities. The CS program also organizes visits to neighboring graduate STEM institutions, national museums, scientific laboratories, and industries. In addition, educational and career development initiatives and training occur during the monthly STEM town-halls.

In their first freshman-semester Scientific Process course (D'Souza, Kroen et al. 2015), the CS program participants develop the use of inferential processing methodologies to reach logical conclusions through deductive reasoning. Then beginning in the second semester of their freshman year, Scholars are *encouraged* to participate in independent UR, summer internship activities, and cooperative work experience opportunities (D'Souza, 2016; D'Souza, Brandenburg et al., 2017; D'Souza, Curran et al. 2016; D'Souza, Curran et al., 2014; D'Souza, Dwyer et al., 2011; D'Souza, Kashmar et al., 2015; D'Souza, Kroen et al., 2015; D'Souza, Shuman et al., 2017; D'Souza & Wang, 2012). To comprehend proper logic within their experiential learning experiences and within some of the project-based level-2 and level-3 core-curriculum courses, Cannon Scholars learn to use the cautious language of inductive and abductive reasoning to develop the likeliest possible explanations for their experimental observations. In this high-impact educational networking environment, Scholars, by their own ethos, begin to identify themselves primarily as members of their STEM discipline rather than just a student. Culminating project outcomes are celebrated with presentations at the annual Wesley College Scholars Day event, and at local, regional, and national scientific conferences, and are documented at the Cannon Scholars web and social media pages.

A commitment to, and understanding of social responsibility, research ethics, and personal integrity are integral traits of the CS program which are instilled in the applicants from their initial introduction to the program. Together with promoting contextual and global adaptation, Wesley's revised project-based liberal-arts core-curriculum includes faculty approved learning outcomes (D'Souza, Curran et al., 2016; D'Souza, Shuman et al., 2017). In addition to verbal and written technical communication, a commitment to social justice and STEM-related modern-day issues are developed, analyzed, and emphasized in day-long co-curricular workshops and in required core-courses (D'Souza, Brandenburg et al., 2017; D'Souza, Curran et al. 2016; D'Souza, Kashmar et al., 2015; D'Souza, Shuman et al., 2017). Furthermore, UR participants sponsored through the EPSCoR/INBRE programs must participate in a series of webinars and facilitated-workshops that cover instruction and training on conduct in research, human and animal subject protection, as well as compliance and federal regulations (D'Souza, 2016; D'Souza, Brandenburg et al., 2017; D'Souza, Curran et al. 2016; D'Souza, Curran et al., 2014; D'Souza, Dwyer et al., 2011).

In pursuit of obtaining a College Reading and Learning Association (CRLA) Level I certification through the Tutoring Coordinator, Cannon Scholars participate as tutors (or if needed, tutees) in the STEM-subject peer-tutoring program (D'Souza, Kroen et al., 2015). Also within the CS program, harnessing the power of peers is important to build collaborative support networks, especially for those Scholars participating in UR. The more senior academically experienced Scholars provide intellectual support, coursework assistance, and interpersonal needs. In such situations, Scholars learn to promote mastery of material by both giving and receiving help.

To build social friendships that engage and foster a sense of community, Scholars design a series of targeted service-learning projects and actively participate in STEM-outreach activities (D'Souza, Shuman et al., 2017). The community-based service-learning projects are integrated within academic credit-bearing first-year seminar core-courses (D'Souza, Curran et al., 2016) and many of the projects are designed to be effective and meaningful around social justice, the environment, and other public health themes (D'Souza, Shuman et al., 2017). To inspire and stimulate future interests in science, the CS program participants design fun, hands-on activities with an emphasis on chemistry, biology, and physics principles during the annual Delaware-Section American Chemical Society *Kids n Chemistry* program and the Dover Public Library *STEM Maker-fest* K-8 student events (D'Souza, Shuman et al., 2017).

A 5-point response scale of carefully constructed student satisfaction surveys are used to gain valid and useful feedback: to understand program effectiveness and efficiency, the learning environment, and student engagement and perceptions. To specifically determine CS programing impacts, the online surveys are given to all Wesley STEM majors.

3. Results and Discussions

In AYs 2014-2016, there were 66 unique CS scholar-

Groups	Enrollment	Graduated	Retained	Retention Rate[b]	Cumulative GPA[c]
AY2016-2017					
Cannon Scholars	35	7	28	100%	3.17 ± 0.45
STEM Majors[a]	69	3	45	69.6%	2.48 ± 0.74
Non-STEM Majors	1310	141	778	70.2%	2.74 ± 0.76
AY2015-2016					
Cannon Scholars	35	7	25	91.4%	3.17 ± 0.49
STEM Majors[a]	88	10	45	62.5%	2.60 ± 0.77
Non-STEM Majors	1380	127	831	69.4%	2.85 ± 0.59
AY2014-2015					
Cannon Scholars	31	7	22	93.5%	3.30 ± 0.49
STEM Majors[a]	95	8	60	71.6%	2.63 ± 0.73
Non-STEM Majors	1273	124	789	71.7%	2.87 ± 0.57

[a]Excludes Cannon Scholars

[b]Includes the students that graduated and the retained students

[c]Includes standard deviation

Table 1. The CS program comparison to the Wesley STEM and non-STEM majors.

ship recipients with 59% URMs and 65% female. In addition, 82% percent of Scholars chose to participate in mentored UR. Fifty-two Scholars received direct S-STEM support and 14 received scholarships from the Wesley EPSCoR or INBRE programs. The CS annual award amounts ranged from $1,109 to $6,256.

To compare institutional and S-STEM student-level characteristics, experiences, and indicators of academic achievement, Table 1 lists the AYs 2014-2016 mixed-enrollment cohort (freshman to senior level) numbers of the CS program participants, the Wesley STEM program numbers (excluding the CS students), and the non-STEM majors. Also listed are the corresponding graduation numbers, retention rate data (enrollment from one academic year to the next), and cumulative GPAs.

In each of the three S-STEM years, the Scholars made up (Table 1) 25%, 29%, and 34%, of the overall STEM population. To determine if the CS program (really) impacted participant success, a two-sample z-test is used to test the difference between the two population proportions (CS program versus non-CS STEM majors, and versus non-STEM majors).

Table 1 shows significantly higher retention rates for the CS STEM majors in all three academic years (2014-2016). In Years 1-3, the CS STEM retention rates were statistically greater than the traditional non-CS STEM majors ($z = 2.523$, $p = 0.005814$; $z = 3.182$, $p = 0.00073$; $z = 3.653$, $p = 0.00013$), and the general non-STEM undergraduate population ($z = 2.681$, $p = 0.00367$; $z = 3.805$, $p = 0.00252$; $z = 3.838$, $p = 0.00006$).

The 2014-2016 Wesley College enrollment numbers did not fluctuate significantly nor did the academic ability of the incoming freshmen cohorts. However, the number of CS program applicants increased by 20% in Year 3 (2016) and the corresponding annual 2014-2016 S-STEM award rates were 79%, 77%, and 59% respectively. One possible cause for this CS award rate decline was that in the first two years, $131,000 per-year was budgeted for S-STEM scholarships and in Years 3-5, the annual budgeted S-STEM amount was $76,000. A second compelling reason is attributed to the effective CS programming practices that has led to significant ($p > 0.05$) 2014-2016 increases in CS retention rates (Table 1). Hence, we can remain diligent and steadfast in our current efforts to implement what we know is working, as we are clearly meeting the Scholars needs and priorities that define their college experience.

In the first year, many incoming Scholars showed favorable STEM potential but barely met the entering academic requirements. Nevertheless, Table 1 lists the year-end academic achievements as measured by the mean cumulative GPA. In Years 1-3, Scholars earned B average GPAs which are 0.6-0.7 points (~two-thirds of a letter grade) higher than the non-CS STEM students, and 0.3-0.4 points (~two-sixths) higher than the non-STEM majors.

Entering Year 3, Table 1 substantiates the significant academic CS programing traction (at $p < 0.05$). The mean GPA (3.17) of the Scholars is greater than the mean GPA (2.48) of the non-CS STEM majors ($t = 5.946$, $p = 2.07 \times 10^{-8}$), and is also greater than the mean GPA (2.74) of the Wesley College non-STEM majors ($t = 5.483$, $p = 5.48 \times 10^{-6}$). However, such results may not be unexpected as there is a minimum CS program GPA requirement of 2.70. To help reduce (any) potential bias, GPA and retention rates for the CS students were later compared to the students in the Honors program (with a higher GPA requirement of 3.0) and to a randomly generated sample of 80 non-STEM majors who fit the CS program profile and have a minimum Wesley GPA of 2.70. The sample populations were determined using a similarity index generated by Excel.

Analogous to Table 1, Table 2 provides the graduation, mixed-enrollment retention, and cumulative mean GPA information of the URMs in the CS, STEM, and non-STEM populace. In Years 1-3, the CS URM retention rates were greater than the URM non-CS STEM majors ($z = 1.605$, $p = 0.05420$; $z = 1.393$, $p = 0.08179$; $z = 2.959$, $p = 0.00154$) and the URM non-STEM majors ($z = 1.964$, $p = 0.02479$; $z = 1.259$, $p = 0.10398$; $z = 3.498$, $p = 0.00023$).

This (Table 2) data, albeit (in Years 1 and 2) at a lower statistically significant association, is critical, as it proves that the URM population in the CS program greatly benefited from the programming content, and as a result had much higher retention rates and cumulative GPAs than the comparative traditional URM non-CS STEM and non-STEM populations. In Year 3, there was a significant academic difference ($p < 0.05$), as the mean GPA (3.06) of the URM Scholars was found to be greater than the mean GPA (2.46) of the non-CS URM STEM majors ($t = 4.192$, $p = 3.66 \times 10^{-5}$), and were also greater than the mean GPA (2.63) of the URM non-STEM majors ($t = 4.304$, $p = 1.05 \times 10^{-4}$). To minimize bias, GPA and retention rates for the URM CS students were later compared to the URM students in the Honors program and using an Excel similarity index, to a randomly generated sample of URMs with similar CS program profiles and a minimum Wesley GPA of 2.70.

To gain valuable insight and to independently verify CS STEM engagement and any other positive linkages gained from the CS programming, we invited all Wesley STEM majors to complete an annual online survey, which is kept available for a month on the college's intranet system. Table 3 lists the survey statements, mean responses, and significant differences (P) observed using a Wilcoxon Rank Sum Test.

Analyses of the Table 3 survey responses elucidates that the CS program encompasses a student body that is encouraged and incentivized to promote the mastery of STEM-related issues and content. This knowledge and newly developed skillset allows participants to make and act upon informed decisions in their daily lives, as well as in their academic and work-related pursuits. Some of the

Groups	Enrollment	Graduated	Retained	Retention Rate[b]	Cumulative GPA[c]
AY2016-2017					
Cannon Scholars	24	4	20	100%	3.06 ± 0.47
STEM Majors[a]	55	1	38	70.9%	2.46 ± 0.62
Non-STEM Majors	925	86	524	65.9%	2.63 ± 0.75
AY2015-2016					
Cannon Scholars	19	4	11	78.9%	3.07 ± 0.55
STEM Majors[a]	68	4	38	61.8%	2.53 ± 0.78
Non-STEM Majors	979	77	560	65.1%	2.76 ± 0.58
AY2014-2015					
Cannon Scholars	15	3	11	93.3%	3.27 ± 0.48
STEM Majors[a]	66	4	45	74.2%	2.58 ± 0.62
Non-STEM Majors	873	81	530	70.0%	2.80 ± 0.56

[a]Excludes Cannon Scholars

[b]Includes the students that graduated and the retained students

[c]Includes standard deviation

Table 2. Comparison of URMs in the CS program, STEM, and non-STEM fields.

Survey Questions	CS program	Non-CS STEM majors	p <0.05
I enjoy talking about science with other students.	4.47	3.95	P
Due to available research opportunities, I am more likely to choose a career in STEM.	4.41	3.91	P
I am aware of scientific career paths in STEM besides Academia and Industry.	3.94	3.68	
I am interested in taking non-required elective STEM courses.	4.12	3.58	P
My friends and family enjoy talking about STEM topics with me.	3.65	2.86	P
My professors clearly explain the requirements of scientific writing.	4.03	3.41	P
I feel confident that my training will result in a career in STEM.	4.29	3.75	P
I can use the scientific method to develop and test hypotheses.	4.38	4.24	
My ability to individually troubleshoot has increased as a result of my research experience.	4.15	3.23	P
I recognize the difference between primary and secondary literature and know when it is appropriate to reference them.	3.85	3.17	P
I am interested in attending a professional or graduate school.	4.32	4.11	

Table 3. Results of responses from the annual academic experience survey questionnaire given to all STEM majors. Significant predictors (p <0.05) are denoted by a "P".

Groups	Enrollment	Graduated	Retained	Retention Rate[c]	Cumulative GPA[d]
AY2016-2017					
Cannon Scholars	35	7	28	100%	3.17 ± 0.45
Honors Program[a]	74	17	43	81.1%	3.24 ± 0.47
Non-STEM[b]	80	13	52	81.3%	2.96 ± 0.78
AY2015-2016					
Cannon Scholars	35	7	25	91.4%	3.09 ± 0.47
Honors Program[a]	77	11	57	88.3%	3.39 ± 0.43
Non-STEM[b]	80	12	41	66.2%	3.03 ± 0.64
AY2014-2015					
Cannon Scholars	31	7	22	93.5%	3.28 ± 0.49
Honors Program[a]	59	9	43	88.1%	3.48 ± 0.36
Non-STEM[b]	80	23	33	70.0%	3.01 ± 0.64

[a]Excludes Cannon Scholars in the Honors Program

[b]Randomly selected non-STEM Majors with an initial GPA ≥ 2.70

[c]Includes the students who graduated and the retained students

[d]Includes standard deviation

Table 4. Comparison of the Wesley CS program and the Wesley Honors program.

significant Table 3 predictors imply that the strategic CS mentoring efforts coupled with its targeted communication has resulted in a much greater STEM-field interest and, the CS students have effectively used the scientific literature and developed a focused analytical approach to problem solving. Furthermore, the Table 3 feedback demonstrates that the broad range of course-embedded experiential learning and service-learning extracurricular opportunities has motivated Scholars to readily lead themselves to conversations that have substantially improved their self-efficacy, confidence, and attitudes towards STEM.

Although the Wesley College Honors LLC has a 10% higher entering HS GPA and/or Wesley GPA requirements, it is commensurate to the Cannon Scholar LC. Most of the Honors students major in non-STEM fields. Table 4 presents the mixed-enrollment numbers, graduation numbers, information about the retention rates, and cumulative average GPAs, of the AYs 2014-2016 Honors program, the S-STEM students, and a random sample of 80 non-STEM majors with a minimum Wesley GPA of 2.70 (the same minimum Wesley GPA to qualify for the CS program).

In Years 1-3, even though the Honors students had higher incoming academic credentials, the CS program retention rates surpassed those observed in the Honors program by 5% ($z = 0.81337$, $p = 0.20800$), 3% ($z = 0.4943$, $p = 0.31054$), and 19% ($z = 2.756$, $p = 0.00292$) respectively, and the CS program retention rates exceeded those in the random sample of 80 non-STEM majors with a minimum Wesley GPA of 2.70 by 24% ($z = 2.628$, $p = 0.0043$), 25% ($z = 2.829$, $p = 0.0023$), and 19% ($z = 2.747$, $p = 0.0030$). Nonetheless, in the same three academic years, the average GPAs for the Honors students are ~6% higher than the average GPAs of the Cannon Scholars, but the GPA's of the Cannon Scholars were statistically significantly higher than the random sample of 80 non-STEM majors with a minimum GPA of 2.70 in years 1 and 3 ($t = 2.557$, $p = 0.0064$; $t = 1.279$, $p = 0.1022$; and $t = 1.815$, $p = 0.0362$).

Parallel results are seen in Table 5 for the URM Honors students, the URM Cannon Scholars, and the URM non-STEM majors with a minimum Wesley GPA of 2.70. In AYs 2014-2016, the URM Cannon Scholar mixed-enrollment retention rate was 9% ($z = 0.82168$, $p = 0.20563$), 0.1% ($z = -0.04237$, $p = 0.51690$), and 12% ($z = 1.7688$, $p = 0.03846$) higher than the URM Honors students, and the URM Cannon Scholar mixed-enrollment retention rate was 21% ($z = 1.689$, $p = 0.0457$), 17% ($z = 1.334$, $p = 0.09110$), and 21% ($z = 2.411$, $p = 0.0080$) higher than the URM non-STEM majors with a minimum Wesley GPA of 2.70. The average GPAs of the URM Honors students are ~5% higher than those of the URM Cannon Scholars. The average GPAs of the URM Cannon Scholars were higher than the URM non-STEM majors with a minimum Wesley GPA of 2.70 for all three years, but only statistically signifi-

Groups	Enrollment	Graduated	Retained	Retention Rate[c]	Cumulative GPA[d]
AY2016-2017					
Cannon Scholars	24	4	20	100%	3.06 ± 0.47
Honors Program[a]	33	6	23	87.9%	3.24 ± 0.50
Non-STEM[b]	53	9	33	79.2%	2.85 ± 0.85
AY2015-2016					
Cannon Scholars	18	4	11	83.3%	3.08 ± 0.57
Honors Program*	37	4	27	83.8%	3.26 ± 0.47
Non-STEM[b]	50	7	24	62.0%	2.86 ± 0.65
AY2014-2015					
Cannon Scholars	15	3	11	93.3%	3.27 ± 0.48
Honors Program*	26	3	19	84.6%	3.38 ± 0.43
Non-STEM[b]	51	13	24	72.5%	2.97 ± 0.68

[a]Excludes Cannon Scholars in the Honors Program

[b]Randomly selected non-STEM Majors with an initial GPA ≥ 2.70

[c]Includes the students who graduated and the retained students

[d]Includes standard deviation

Table 5. Comparison of URMs in the Wesley CS program and the Wesley Honors program.

cantly higher in Year 1 ($t = 1.920$, $p = 0.0319$; $t = 1.345$, $p = 0.0932$; and $t = 1.390$, $p = 0.0845$).

In general, when compared to the high-achieving Honors students and the randomly selected control group, the AY 2016-2017 Table 4 and Table 5 findings, at a 5% level of significance, further supports the notion that the CS mentoring supportive environment is proving to be a strong predictor of URM STEM-program persistence and success at Wesley College.

In AYs 2014-2016, an equal number of CS and non-CS STEM majors graduated. On graduation, all of the Wesley College STEM graduates stayed in STEM fields. Among the Cannon Scholars, 57% entered graduate/professional programs, 29% joined STEM occupations, 10% work in a hospital laboratory setting, and 4% work in education. In comparison, for the non-CS STEM graduates, 81% were directly absorbed in STEM industry, 13% sought educational professions, and 6% work in medical laboratories. This employment data demonstrates that the STEM attributes and competencies gained through the Wesley STEM programs are very transferable and are in demand.

4. Program Sustainability

The CS program leaderships continuous monitoring of the cyclical processes that refine the use of data to inform decisions for response actions and for the development of outcome-driven forward-looking goals, will result in longer-term programming sustainability. To foster and maintain constructive relationships and to increase programming effectiveness that meet CS student needs, programmatic changes are based on inputs received from all relevant stakeholders. To achieve lasting improvements, prioritized needs that identify meaningful key performance indicators are received from enrollment management, financial aid, student support services, faculty and advisor observations, student affairs, CS participant self-evaluations, online surveys, exit surveys, anecdotal evidence from social media networking sites, and the inclusion of comparison groups. Furthermore, agency mandated biannual EPSCoR/INBRE external evaluations that benchmark peer-institutional data, provide invaluable feedback that further supports CS programing sustainability.

5. Conclusions

Prior steps by the Office of Academic Affairs to institute mandatory biannual faculty-training workshops and its reorganization push of the academic student support services within a centralized Academic Success Center, have now provided the critical components to help ensure success and community support for the Wesley students in difficult situations. The annual scholarships provided through S-STEM (and through our EPSCoR/INBRE programs) when coupled with the collaborative efforts amongst the various participating academic entities, has fostered proven practices for nurturing a multi-tiered mentoring environment that helps support, retain, and graduate our Scholars. Through cohort community-building, intrusive coaching and mentoring, and programmatic elements that align with student support structures, the CS program has helped empower Scholars (who were not necessarily stellar students) to change their academic experience and shatter through many of the socioeconomic constraints these students typically encounter. Even though it is only in Year 3 of this five-year (2014-2019) NSF DUE grant (1355554), the four proposed programming objectives have been met and exceeded in producing significant increases in retention rates that will be sustainable long-term. In Years 4 and 5, this project will maintain its productive work and will continue to shape and benefit STEM students, their careers, and their future impacts on society.

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