A Collaborative Framework to Advance Student Degree Completion in STEM

Dr. Ali Zilouchian, Florida Atlantic University

Ali Zilouchian is currently the Associate Dean for Academic Affairs and a professor in the College of Engineering and Computer Science at Florida Atlantic University. He is also currently the Director of "CAPTURE" program which is related to increasing pipeline, graduation rate as well as future jobs in the State of Florida related to STEM graduates especially Computer Science and Engineering fields. His recent projects have been funded by DOE, Florida BOG, National Science Foundation, Florida Power and Lights (FPL), Broward County School district and several other sources. His recent research works related to alternative energy applications includes Maximum Power Point Tracking (MPPT) for Solar Systems, Proton Exchange Membrane Fuel Cell (PEMFC) and battery technology to transportation technology. In addition, he has conducted research on the applications of soft computing methodologies to industrial processes including, desalination processes, oil refineries, fuzzy control of jet engines, and fuzzy controllers for car engines. Dr. Zilouchian has published one book, and over 143 book chapters, scholarly journal papers, and refereed conference proceedings. He has supervised 20 Ph.D. and MS students to completion during his tenure at FAU. He has taught more than thirty (30) different courses related to engineering technology during his tenure at FAU. In 1996 and 2001, Dr. Zilouchian was awarded for the Excellence in Undergraduate Teaching at FAU. He has also received many awards including 1998 outstanding leadership award (IEEE, membership development), best organizer award(World Automation Congress, 2002), best paper award(WAC, 2002), 2003 and 2004 College of Engineering Dean's awards in recognition of his contributions toward achievement of the goals of College of Engineering and Computer Science at FAU. He has served as session chair and organizer of many sessions in the international conferences for the past 30 years. Professor Zilouchian is currently an associate editor of the International Journal of Electrical and Computer Engineering out of Oxford, UK. Professor Zilouchian is senior member of several professional societies including Tau Beta Pi, Sigma Xi, Phi Kappa Phi, ASEE and IEEE.

Dr. Nancy Romance , Florida Atlantic University

Dr. Romance is Professor of Science Education in the College of Education at Florida Atlantic University (FAU) and a graduate faculty member in both the College of Engineering and Computer Science and the College of Science at FAU.Her research interests address meaningful learning in complex STEM domains, applying a learning sciences lens in addressing issues ranging from building elementary teachers knowledge and skill in teaching science to coordinating learning communities addressing mathematics curriculum as a persistent barrier impacting student success and retention in undergraduate STEM programs. She is currently Co-PI for the USDOE Title III Hispanic Serving Institution, internal evaluator on FAU's NSF Advance early phase grant, a member of the Advisory Board on the NSF STEM+C in Broward Schools and the NSF MSP at the University of Toledo. She is the newly appointed Director of FAUs STEM Collaborative.

michael vitale

DR. Vitale holds the Ph.D. in Educational Research and Instructional Psychology.

Ms. Annie Laurie Myers

Annie Myers - A dynamic, forthright leader who engages her employees in partnerships for success in process and performance, she exudes positive energy and has the ability to energize others. She is extroverted and optimistic and thrives on action, she relishes change, and has the ability to execute—to get the job done.

A hybrid leader, with 22 years of supervisory, management, and leadership experience from the newspaper industry, proficient in both operations and information systems.

Associate Dean at Broward College and teaching since 2002, providing leadership and policy advice on matters related to all teaching and academic support services which include courses within Baccalaureate degrees, Associate in arts, Associate in science, and Associate in Applied Science.

Ms. Dana Hamadeh

Dana Hamadeh earned a Bachelor of Science in Computer Engineering and a Master of Education in Curriculum and Instruction with a minor in Mathematics. Some of her professional experiences include over ten years teaching college mathematics, supervising student learning center for physics and mathematics, managing million dollar STEM grant programs, and serving as Associate Dean of STEM Academic Affairs at Palm Beach State College. She continues to develop and present dynamic and interactive staff, faculty, and student workshops and seminars on various academic and professional related topics. She feels privileged and blessed to wake up every morning doing what she loves to do.

A Collaborative Framework to Advance Student Degree Completion in STEM

ABSTRACT

The session will report on the success of curriculum mapping and articulation from the two-State Colleges to a 4-year institution Florida Atlantic University (FAU) to support student degree completion in computer science and engineering programs. In addition, the session will report on a Systemic, Evidenced-Based and Student-Centered (SE-SC) framework designed to maximize the number of academically-talented, Hispanic students who complete a degree and are career-ready to enter engineering and computer science (ECS). The SE-SC framework has guided the implementation of select interventions/practices that meet the criteria of being able to be sustained, have broad impact, are based on evidence supporting their effectiveness in STEM learning environments, and that directly engage and support students as they traverse the academic pathway leading to degree completion in Engineering and Computer Science (ECS). This research project aligns with the need to boost the nation's economic growth and competitiveness by not only expanding emphasis on STEM education but systemically addressing ways to expand the impact on the education of 'Hispanic' students, thus contributing to a growing, more diverse talent pool for STEM education and careers. Data collected for the past three years (2016-2019) validate the effectiveness of the proposed initiative in increasing both the student pipeline and graduation rates. The process has also deepened our understanding of students' needs in terms of how to better align student career aspirations with industry workforce needs. The effectiveness of the collaborative model could be replicated among other institutions interested in promoting engineering degrees among Hispanic and low-income students.

ACKNOWLEDGMENT

The work was partially supported by the United States Department of Education (DOE)- Grant No. *P031C160228*. The authors wish to thank the research team members and all the students who participated in the program.

INTRODUCTION

Powerful indicators suggest that there may be more than 858,500 new jobs in STEM fields by the year 2028, and, as a group, they will grow 76% faster than the average for all occupations in the economy, according to the latest projection by the Department of Labor, Bureau of Labor Statistics [1], [2]. Equally powerful indicators suggest that Hispanics are one of the fastest-growing demographic groups in America, but one of the least represented in STEM post-secondary education and STEM careers [3],[4]. The importance of these two indicators in terms of America's global competitiveness, national security, and economic growth cannot be underestimated.

The growth in Information Technology (IT) and related computer industry is expected to increase exponentially over the next decade. Given the fact that the medical and health care industries will require innovative software packages to manage the health care, the exponential growth of 25.6 % in the IT sector is expected from 2018 to 2028[1], [2], [5]. Besides, two of the projected fastest-growing engineering occupations are related to alternative energy production. Specifically, the employment of solar photovoltaic (PV) and wind turbine are expected to grow by 56.9% over the next ten years. However, the number of the 2018 occupation levels for these two sectors is relatively small [1].

As a further indicator, the US News and World Report has ranked software development jobs as number one among the best one hundred jobs in 2020 for the third year in a row [6]. It is anticipated that cybersecurity-related jobs increase the fastest by 31.6% over the next decade. According to the new Pew Research Center analysis [7], employment in STEM occupations has increased 79% since 1990 from 9.7 million to 17.3 million, outpacing overall US job growth. Additionally, over 99 percent of STEM employment was in occupations that typically require some type of post-secondary education for entry, compared with 36 percent of overall jobs [8].

Transitioning into College and completing a STEM degree have been identified as critical factors associated with and the pathway to economic success and preparation for STEM careers. As reported [9], more than 40% of the students entering 2- and 4-year post-secondary institutions indicated their intention to study in the STEM discipline. However, the national statistical data reveal that nearly half of the students with the intention to earn a STEM degree fail to earn these degrees in 6 years after their initial enrollment [10]. Many of those who do obtain a degree take longer than the advertised length of the programs, thus raising the cost of students' education. In considering where to expand existing baccalaureate degree programs in support of computer occupations, both State Colleges surveyed their students. They found that the majority (77% BC and 86% PBSC) of students wanted to enroll in a program that guarantees them seamless admission to Florida Atlantic University. To address the student needs, the Community Colleges incorporated educational technology into the program, so students had direct access to both coursework and programs at times and locations that meet their needs—without regard to the location of the provider. Over 90% of our students are in-state students, and it's not anticipated that students already enrolled will relocate out-of-state. Given that many local industries employ more than 70% of FAU's graduates, it is obvious that many have chosen to remain in South Florida while some others were provided with assistance to relocate to other parts of Florida upon graduation.

In working to develop student career potential, this project also recognizes a complex array of barriers faced by students in progressing through the academic pipeline toward earning a CS degree. In considering these barriers as challenges to be overcome, this project aligns with evidence-based recommendations from the National Academy of Science, Engineering, and Medicine (NASEM)[9], the National Research Council (NRC)[11]-[14], and the National Academy of Engineering[15]-[17]. In contrast to what our nation needs require, universities are confronted with undergraduate students who, across the spectrum of ethnicities, struggle with gateway courses in mathematics and science ([18] – [20]) required for all STEM degrees. In this regard, the project builds upon a large body of research from a variety of disciplines such as the learning sciences[21]-[22], where comprehensive studies and parameters associated with students' learning are addressed. The project also draws upon principles and findings from related fields such as instructional design, cognitive science, and educational leadership[23]-[26], all of which serve as the basis for the SE-SC framework which guided our work with mentors, project participants as well as participating faculty across all three post-secondary institutions.

The session will highlight the progress, success, and "lessons learned" from the first three years of a $4.5 M United States Department of Education (DOE) Title III transformative project for Hispanics and low-income students. The awarded five-year (2016-2021) STEM project is based on the extensive collaboration among two state colleges and a recent Hispanic Serving Institution (HSI) university with a combined total of 140,000+ undergraduate students. Further, the present project was modeled after a previous, successfully completed initiative entitled Computer Accelerated Pipeline to Unlock Regional Excellence (CAPTURE), which was sponsored by the Florida Board of Governors (BOG) [27].

UNIVERSITY-STATE COLLEGES COLLABORATION

Below is a brief description of the partnering institutions:

Florida Atlantic University (FAU) is a large, diverse, degree-granting institution (180 undergraduate and graduate degree programs) located in south Florida. It is designated as a "High Research Activity" university by the Carnegie Foundation for the Advancement for Teaching. FAU serves over 30,000 undergraduate and graduate students and ranks as the most racially, ethnically diverse institution in Florida. The College of Engineering and Computer Science and the Department of Computer & Electrical Engineering and Computer Science (CEECS) are located on the main campus. All the undergraduate degree programs in the College are accredited by the Accreditation Board of Engineering and Technology (ABET). The College offers a flexible schedule of courses delivered through a variety of formats (e.g., e-learning, distance learning, daily-recorded live lectures, downloadable video streaming, podcasts, and interactive video courses broadcast to remote locations and featuring two-way audio and video). It also offers internships with over 30 business/industry partners and an Innovation Leadership Honors Program with training in innovation, entrepreneurship, leadership, and sustainability.

Broward College (BC) serves more than 67,000 students, of which 35% are identified as Hispanic. The percentage of enrolled students eligible for Pell grants is even higher-55%. Broward College students can choose from among 132 Bachelor's, Associate's, and certificate programs and classes offered online and on-campus. BC boasts a student body representing more than 175 countries, and 37% of BC student body was born outside of the United States. Broward College is one of the nation's largest institutions of its type and ranks fifth nationally among four-year institutions in awarding Associate degrees, according to *Community College Week*, and third in the country in awarding Associate's degrees to minority students.

Palm Beach State College (PBSC) serves more than 48,000 students, of which 27.5% are Hispanic, and 53% of the full-time students are eligible for need-based aid (as of 2014). PBSC offers 130-degree programs and 13 primary areas of study, of which two are focused on Computer Science & Information Technology and Science & Environment. PBSC is the 11th largest producer of Associate of Arts degrees in the nation (Community College Week). Its' two-year, AA degree is a requirement for students to transfer seamlessly to the university and is a requirement for the present project

AN OVERVIEW OF the DOE PROJECT

The primary goal of this Title III HSI project is to facilitate the completion of undergraduate degrees in computer science, computer engineering, and electrical engineering (referred to hereafter as "computer science") by students who first begin their undergraduate academic programs and complete their AA degree at BC and PBSC and then transfer, enroll and complete a BS degree Computer Science within the College of Engineering and Computer Science at FAU. Figure 1 overviews the major project components.

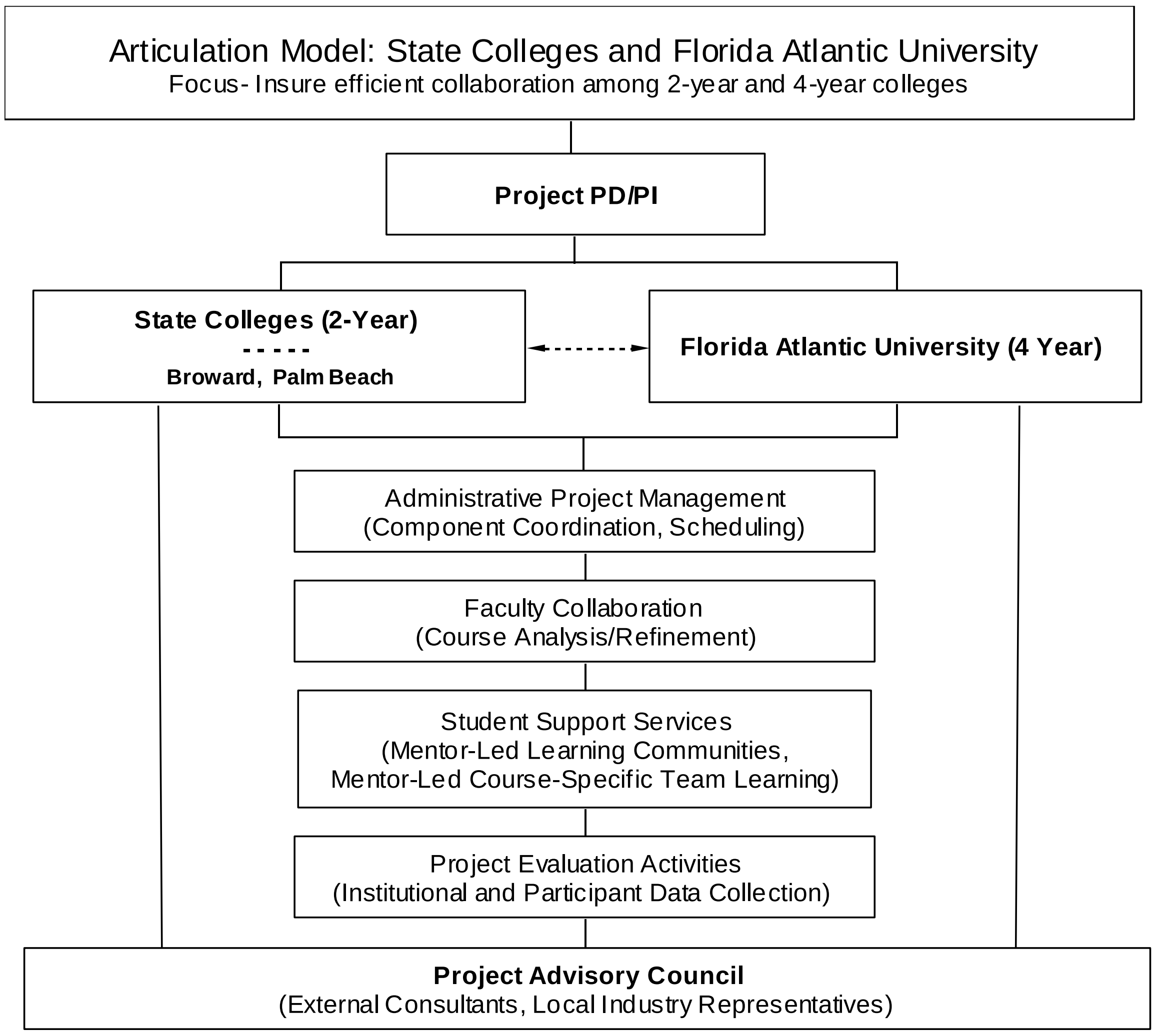

Figure 1- *Project Components*

In accomplishing project goals, the key elements were designed to provide academic and motivational support for student participants throughout their enrollment at the State Colleges and Florida Atlantic University. Although the focus of this paper is on year 1-3 of the project activities, for clarity, some activities projected into year four are also noted.

The above Articulation Model (Figure 1) provides the framework for the extensive collaboration between the State Colleges (BC, PBSC) and the upper-division CS/CE and EE degree programs at FAU. During Year 2 of the project, a series of key components were implemented. It is expected that the present Title III project will provide a national model due to the effectiveness of the project in increasing the graduation rates in CS/CE of Hispanic and low-income students. We have also expanded the scope of the program to include the Electrical Engineering program. In accomplishing the project goals, the key components were designed to provide academic and motivational support for student participants throughout their enrollment at the State Colleges and FAU.

IMPLEMENTATION OF MAJOR PROJECT COMPONENTS

In this section, the status and progress related to each of the major project components are reported.

a) Curricular refinement of gateway courses in mathematics and computer science

During years 1 and 2, a team of gateway mathematics faculty from each State College in collaboration with faculty from the FAU 's Department of Mathematical Sciences reviewed and refined three mathematics gateway courses offered at the State Colleges (Trigonometry, Pre-Calculus, Calculus I). Note: The mathematics faculty decided to leave College Algebra for a separate discussion which is currently taking place. The course refinement process consisted of a critical review of the different course syllabi used at the State Colleges followed by consensus on a common refined syllabus for each course that emphasized the core mathematical concepts and their sequencing so as to provide a well-thought-out conceptual instructional framework for each course. The general framework for the course refinement process can be found in Appendix A. Using the refined course syllabi completed in year 2, State College and FAU faculty are currently developing a plan to pilot the evaluation of the course frameworks. Additionally, FAU project staff and State College faculty initiated the refinement of the Introduction to Programming course, which was targeted and completed during year 3 of the project.

b) Development of a course-specific mentor support model

During years 1 and 2, Florida Atlantic University HSI project staff developed and iteratively refined a generic process (see Appendix B) through which project mentors, College of Engineering and Computer Science junior and senior honors' students, would provide instructional support to participating HSI students enrolled in the specific gateway mathematics sections taught by project-affiliated State College mathematics faculty. In providing instructional support, the student mentors met regularly during the 2017-2019 period with FAU Project staff and an Instructor in the FAUs Mathematics Department. The goal of this training was to develop mentor proficiency in maximally supporting HSI participants as they develop a more in-depth, concept-based approach to solving mathematics problems. Problems used in training mentors were selected from their suggestions based on interactions they had with the project participants and the problems the participants had the most difficulty with using end-of-semester data from FAU gateway mathematics classes. Such an approach enabled the FAU project staff to address mathematics concepts that are persistent challenges for most students.

In year 2, mentors were each assigned a small number of participating Cohort 1 or Cohort 2 students. The result of this modified contact process was that mentors and students reported stronger social (personal) linkage between them in year 2 in comparison to year 1. In addition, several math faculty and mentors have created math workshops for students in BC and PBSC. Table 1 shares student and mentor's testimonials pertaining to their sessions:

Participants	Students Feedback/ Comments
Student#1(BC)	*"This was a great experience. This workshop helped me understand math. The Professor was fantastic – he related Math to everyday life; therefore, I was able to understand it a little better. He made making math fun."*
Student#2(BC)	*"The Math Therapy session helped me remember certain parts of algebra that I forgot in the past few years. It also made me think critically about explaining and understand math concepts. I am glad I attended the session."*
Student#3(PBSC)	*"The workshop was an awesome addition to the learning process. All the tricks related to algebra and solving variables we registered clearly during this workshop. This session provided me with a better knowledge to the start of my fall semester."*
Student#4(PBSC)	*"I wanted to say math therapy was very helpful! I'm taking statistics in my first math class for freshman year. I learned a lot yesterday, yes it got a little confusing, but the Professor helped a lot to understand. I knew a lot of stuff about math and how to solve a problem but the stuff I didn't know it was so nice to understand and figure it out and knowing little key tips."*
Mentor (FAU)	*The math seminar was awesome. I actually learned a lot, and I enjoyed it. It was helpful, informative, and I would happily participate again."*

Table 1- *Students Testimonials of Math Workshops*

c) Project components in support of student recruitment

This section outlines facets of the project recruiting model modified for use in year 2. The original project proposal identified three mathematics gateway courses offered at the State colleges. As such, the project now recognizes and has addressed the fact that State College students, upon completion of their AA degree, must complete all (or test out of) four gateway mathematics courses (College Algebra, Trigonometry, Pre-Calculus, and Calculus I) prior to acceptance into Florida Atlantic University' s BS degree program in the College of Engineering and Computer Science at FAU and to ensure that they are maximally successful in subsequent mathematics and engineering courses within the computer science major.

In year 1, the focus of the recruiting process was on the Math Gateway Courses. However, in year 2, this process was modified to focus recruiting on the Introduction to Programming course, which is also required for acceptance to the FAU computer science programs. Overall, the revised year 2 student recruitment model consisted of the following parts:

1. All students enrolled in Introduction to Programming were invited to all Learning Community events.

2. Recruitment of students occurred primarily during the Introduction to Programming course.

3. The method of application consisted of an online, phone-accessible web-based tool developed by the project.

4. Once accepted as a participant, the project linked a specific FAU College of Engineering student mentor to each participant to provide course-specific and other forms of general support.

During the initial recruitment process, the project PI's and State College Coordinators also coordinated with each State Colleges' Associate Dean for Mathematics and Computer Science (BC - Davie, Coconut Creek, and PBSC - Boca Raton, Lake Worth). The Campus Deans notified and encouraged mathematics and computer science faculty involvement in the recruitment process as they acknowledged the importance of fostering student interest and success in completing their AA degree programs and being accepted into FAUs College of Engineering and Computer Science.

d) Student learning community development

Development of a student learning community in year 1 of the project consisted primarily of identifying and/or developing a series of computer-science oriented events for participating students to be hosted at each State College as well as FAU. In year two, the project has finalized the computer science events, and a Flyer with this information was sent to all coordinators. FAU project staff are coordinating specific engineering events that incorporate FAU engineering students (e.g., FAU open-house to include a variety of student clubs (e.g., IEEE club; Women in Engineering; Hispanic Engineers Club) as well as activities involving faculty. During year 2 of the project, FAU Staff has identified technology-based industry representatives to participate in selected student activities.

During year 2 of the project, each State College organized and hosted computer-science events for participating as well as potential new students (e.g., those enrolled in the Introduction to Programming course). These included BC Hackathon, Palm Beach State College's Fear the Claw Cyber-security event, and FAU's Engineering Mini-Projects and FAU's College of Engineering Open House Showcase including faculty presentations, student engineering clubs, and detailed tour of the College of Engineering facilities. Each Institution has also developed its project-specific promotional materials for these events. Coordinators at each State College are also working with their in-house advisors and student support services.

e) Project multi-year longitudinal database

The project multi-year database is designed to collect pertinent student data from each State College and provide accessibility for project-specific reporting functions across the 5-year project. In year 1, State College Coordinators reported student information using Excel spreadsheets on a temporary basis. Beginning Spring, 2018, the data from State Colleges and FAU have been provided in a form that has resulted in direct transfer into the project longitudinal database housed in the College of Engineering and Computer Science. This database allowed the research team for the following applications: (a) the collection, filtering, and random selection of student applications, including the identification of participants for each project cohort, (b) the tracking of the academic progress and performance of students in each project cohort, first at the

State College level, and, then, after State College student transfers to FAU, and (c) support of the multi-year project evaluation. A major focus of the project longitudinal database will be the integration of student records from the State Colleges with data on their performance in computer science courses after they enroll at FAU.

The project created a web application that enabled students at BC and PBSC to enter their student information by themselves and that was completed this year. Once an early release of the web application was completed, the web application was made available to students through the World Wide Web.

The web application employs data filtering mechanisms that allow data to be stored in a clean manner, which thwarts embedded malicious code. The data fields in the web application feature basic validation methods. This effort ensures that only requested data values are processed by the application and are subsequently stored in the database system. Once students complete their data entry efforts, their records are stored in the database system. The data in the database system is backed up in a non-public facing directory in the HSI Capture project web server managed by the IT team from the College of Engineering, FAU. The data is alternatively backed up in the HSI Capture Project Google Team Drive setup by the HSI Capture IT admin.

While data stored in the database system provides easy accessibility from a technical perspective, the data is usually not easy to use by non-technical users. This means the data needs to be transformed into a friendlier format other than Structure Query Language (SQL), the standard language of database systems. In order to accomplish this step, an extract, load, and transform (ETL) methodology effort are employed. This step is necessary for the sole purpose that it provides the ability to transform SQL to an accessible format, comma-separated-values (CSV), for the HSI Capture researchers and coordinators.

STUDENT ENROLLMENT AND GRADUATION

As the recruitment of its 3rd Cohort is now completed, the project has fine-tuned its initial comprehensive research framework for investigating the effectiveness of student enrollment, retention, graduation rate as well as its academic/ institutional/ mentoring support with the following actions:

1. *Recruitment, Retention and Graduation*: Identify and/or build upon a set of successful interventions to target, recruit and support an increasing number of students in the targeted population who, equipped with their plan of study and strategic supports, are able to actively pursue and complete a degree in ECS in a timely fashion.

2. *Implement a System of Supports to Ensure Student Retention in Engineering and CS:* Identify-and/or build upon a system of supports that address student needs from a variety of perspectives (e.g., academic, motivational/self-efficacy, socio-cultural), engage students in early/challenging engineering and career-related experiences and in faculty research.

The implementation of the above strategies demonstrated the impact of the project outcomes in terms of student pipelines, student graduation with AA degrees, and student transferring to FAU in Computer Science, Computer Engineering, and Electrical Engineering programs. Currently, a total of 167 students in the cohorts. The retention rate (fall to fall) for Cohort 1(2018) and Cohort 2(2019) was 89% and 92%, respectively. A total of 42 students graduated with an AA degree from the State Colleges across the time span ranging from Fall 2018-Summer 2019. Out of the 42 graduates, 29 graduated from PBSC, and 13 graduated from BC.

The collected data also show a relatively large increase in the number of Hispanic students who started their post-secondary education at the state colleges and finished their AA degree. Given the total number of the minority students in cohorts 1 and 2 (106), this represents an increase of 17% (18/106) in the completion rate of the minority students. Of the 24 Low Socioeconomic status (SES) students who graduated from Fall 2018- Summer 2019, 6 of the students were from PBSC, while 18 were from BC with a total of 79 SES students in Cohort. The above figure represents a 24% increase in our completion rate for the low-income students.

The project currently continues to provide key support services and assistance to State College HSI students. There were 13 students who transferred to FAU last year. At this time, there are a total of 23 additional students who have completed their AA degree and have transferred from BC and PBSC to FAU. Of this total, nine students were from PBSC, and 14 students were from BC. Among the most notable areas of assistance and support are the course-specific academic flight plans which guide student course enrollment, program-specific advising/tutoring/mentoring for the HSI participants. This on-going assistance has proven to be highly contributory to the HSI students' continued success.

PERFORMANCE EVALUATION AND ANALYSIS:

This section presents findings describing the impact of the overall GPA of HSI Project on participants at the two collaborating State Colleges. The data were drawn from the first two HSI cohort participant groups at each College. In evaluating the HSI achievement impact, demographically comparable control groups were randomly selected from each College for each of the two cohort groups.

Data consisted of N= 183 Project Participants and N=585 controls randomly selected by the State Colleges to match the demographic patterns of the Participants. Overall, 89% of participants were identified as Low Socioeconomic status (SES), and 10% as non-low SES. In terms of Participant patterns, 32% of participants were identified as Low SES Hispanics, 19% as non-low SES Hispanics, and 46% as Low SES non-Hispanics.

All data were obtained from the longitudinal project databases maintained by each State College. Controls were sampled randomly from State College student databases to ensure the demographic comparability of the HSI participants and controls for each Cohort. Data were processed using SQL software and analyzed statistically using SYSTAT. The semester-by-semester cumulative GPA was obtained from the following semesters: 2017 (Semester 3), 2018 (Semesters 1, 2, 3), 2019 (Semester 1) for Cohorts 1 and 2. This series of semesters marked the beginning of the HSI Project Implementation through the year 3 Fall Semester. These data were preprocessed for analysis by first developing an ordered sequence of codes representing the year-semester.

Table 2 shows the number and percentages of HSI participants and control students used in the evaluation. As Table 2 shows, the total number of HSI participants in Cohort 1 and Cohort 2 was N = 186.

College	Treatment	Number	Percent (Overall)
Broward	Participants	90	16%
	Controls	264	49%
Palm Beach	Participants	96	18%
	Controls	82	15%
	TOTAL	**532**	100%

Table 2. *Number and Percent of HSI and Control Students Used in Evaluation*

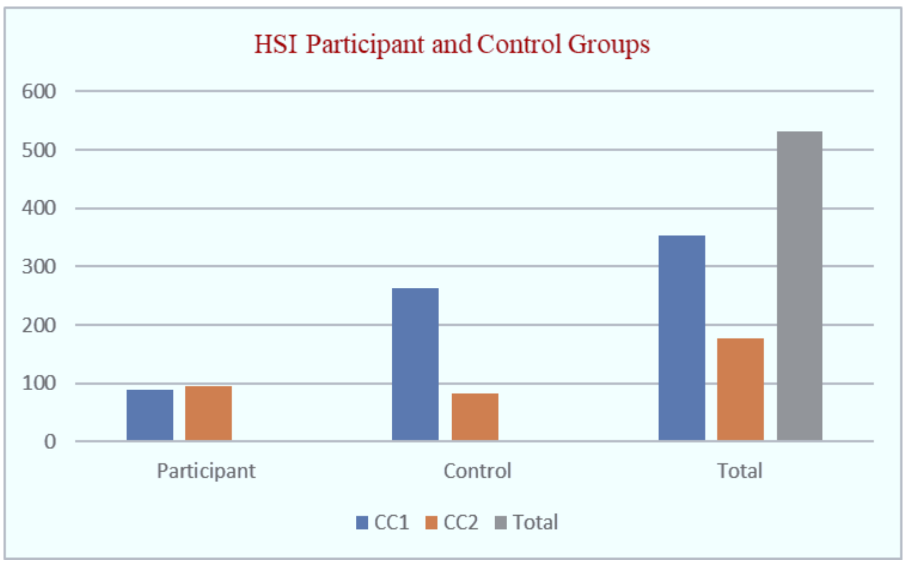

Figure 2- *Number and Percent of HSI and Control Students Used in Evaluation*

Table 3 shows the number of HSI participants in each of the two Cohorts at each State College.

College	Cohort 1	Cohort 2
Broward	42	48
Palm Beach	42	54

Table 3. *Number of HSI Participants in Each Cohort*

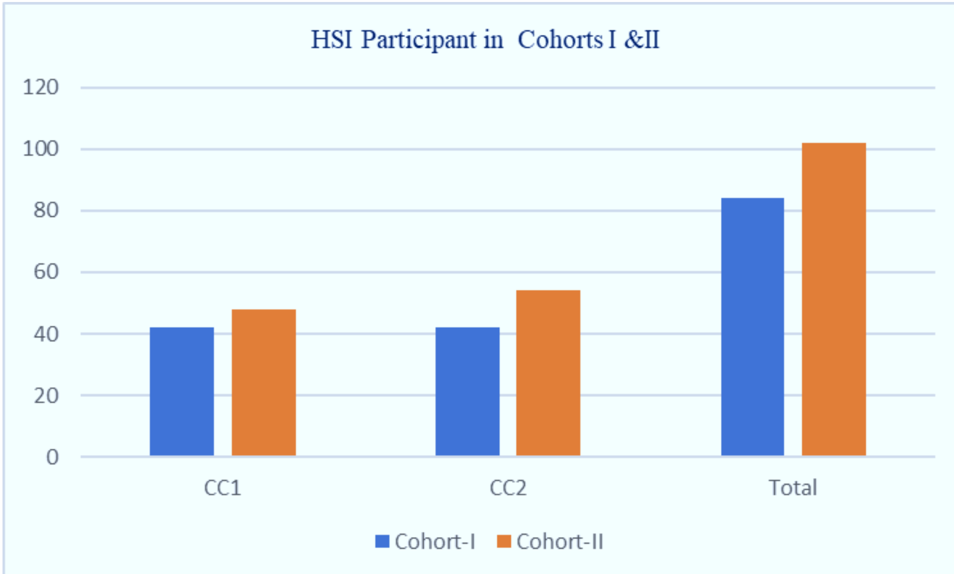

Figure 3- *Number of participants in Each Cohort from State Colleges*

Table 4 shows the demographic characteristics of the participants and controls used in the evaluation. As shown in Table 4, the pattern of demographics for the Participants and Controls were similar.

College	Treatment	Males	Hispanic	Low-SES
Broward	Participants	54%	57%	86%
	Controls	50%	54%	99%
Palm Beach	Participants	83%	51%	68%
	Controls	85%	65%	64%

Table 4. *Demographic Percentages of HSI Participants and Controls*

To assess the overall impact of the project, ANCOVA compared the grade point average (GPA) between the Participants vs. Controls (Intervention) and between Cohort 1 and Cohort 2 students. In addition, the ANCOVA investigated whether the effect of the intervention was consistent across the two Cohorts. The covariates used in the analysis were Gender (Male vs. Female), Ethnicity (Hispanic vs. Non-Hispanic), and SES Status (Low vs. Not-Low). The results of the ANCOVA found that Participants obtained a significantly higher GPA than controls (Adjusted mean difference = +.42 GPA units on a 1-2-3-4 scale), and Males obtained a significantly higher GPA than Females (Adjusted mean difference = +.52 GPA units). The non-significant interaction between the Intervention and Cohort levels confirmed that the effect of the intervention was consistent across the two cohorts. No other effects were significant. Overall the effect of the project on participant GPA was large- .42units of GPA on a 4 point scale. As a major project indicator, these results support the positive impact of the project on facilitating student progress toward State College graduation.

SUMMARY

Overall, the project successfully completed all major activities in year 2. A major initiative was the refinement of the recruiting process that ultimately led to inviting all Introduction to Computer Programming students to the Computer Learning Community events. A major project initiative was the design of the project longitudinal database as a tool for addressing the project-designed evaluation questions.

The implementation of the project for the last two years has deepened our understanding of the needs of transfer students from BC and PBSC who want to pursue Computer Science Computer Engineering, and Electrical Engineering programs. It provides us with valuable lessons on how to better help students achieve timely graduations. In addition, the students attending the State Colleges (BC and PBSC) appreciate the accessibility of a personal advisor; someone to guide them through their academic plan of study, provide student success strategies with referrals to support services. Sharing resources among the campuses has proven to be of great value to both the students and the support staff at each College. Not only do the students benefit from the additional resources, but the staff also naturally share best practices and innovative teaching technologies.

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APPENDIX A- PROJECT COURSE REFINEMENT MODEL

Course refinement is difficult because of the multiple perspectives that must be applied whenever the courses being refined are arranged in an interdependent course sequence. The present model focuses the refinement process on three ordered emphases: (a) refinement focusing on a single course, (b) refinement addressing the sequential order of the courses (i.e., the degree to which the outcomes of one course provide the entry skills for the following course, and (c) the degree to which the outcomes of the course focus on the preparation students need for computer science, computer engineering, and/or electrical engineering.

Recommended Criteria for Faculty Conducting Course Analysis

1) Regular Faculty or Instructor
2) Must Be Teaching Course (or very recent course experience)
3) Will Teach Course in Project

Gateway Course Refinement- Phase 1 (Individual Course Focus)

Refinement Focus: 1) Specify desired course student academic outcomes

2) Identify course prerequisites, including deficiencies students' exhibit

3) Identify course assignments students must engage in for course mastery, including problems students exhibit in course

4) Identify major course teaching emphases- including:

a) focus on core concepts,
b) course conceptual coherence,
c) linkage of student assignments to course core concepts,
d) cumulative review.

Refinement Actions: State and FAU faculty would work collaboratively to address 1), 2), and 3) above.

Refinement Result: Courses should have increased coherence and effectiveness in support of student learning success.

Gateway Course Refinement- Phase 2 (Sequential (Cumulative) Course Focus)

Refinement Focus: 1) Identify Gateway course sequential dependencies. In math, Algebra – Trigonometry, Pre-Calculus, Calculus 1. In computer science, Introduction to Programming in C, Logic Design (Note- computer science courses may be involved in sequence with math.)

2) Analyze outcomes of prerequisite courses to determine whether they are sufficient to provide students with the prior knowledge needed for the following course(s). Identify course prerequisites, including deficiencies students exhibit

Refinement Actions: State and FAU faculty would work collaboratively to address 1) and 2) above.

Refinement Result: Gateway courses should fit together by linking outcomes of preceding courses with prior knowledge needed for success in the following courses.

Gateway Course Refinement- Phase 3 (Relevance of Course Outcomes to Overall Program)

Refinement Focus: 1) Review Math Gateway course outcomes and Introduction to Programming course to ensure that they provide the appropriate academic focus for advanced computer science courses. This phase is essential to ensure that Math Gateway courses and Introduction to Programming are maximally relevant to the overall computer science program.

Refinement Actions: State and FAU faculty would work collaboratively to address 1) above. This may involve the application of the Phase 1 process as necessary.

Refinement Result: Courses should be optimal in building student academic preparation for advanced computer science courses.

APPENDIX B- PROJECT MENTOR MODEL