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Absolute & Competitive Preference Priorities

The needs identified and the strategies proposed to address them are closely correlated to the absolute and competitive preference priorities established by the 2016 HSI STEM and Articulation Program. It incorporates strategies from CUNY's Accelerated Study in Associate Programs (ASAP), as well as additional best practices, to form a sustainable approach as follows:

Absolute Priority 1. A major initiative of this project will be to provide greater access to student support services. The Supplemental Instruction (SI) program will be doubled in size from 5 to 7 course sections per year to 18 sections and will be run as ***a randomized controlled trial to assess the causal validity of the impacts of SI on learning and completion outcomes.*** It is expected to meet the standards without reservations; however, at a minimum, the study design will meet What Works Clearinghouse standards with reservations. This priority will also be met through academic, transfer, financial, and career counseling, as well as culturally sensitive teaching, curriculum enhancements, online tutoring services, open educational resources, and, the summer bridge and bootcamp programs.

Absolute Priority 2. A prominent component of this project will be the development of the STEM Student Scholars Program with a major goal of recruiting and retaining Hispanic students in STEM transfer programs. This program is being developed in partnership with the Statewide Hispanic Chamber of Commerce of New Jersey, 4-year institutions and private industry with which BCC has entered partnerships; it will encourage students to engage in research projects by joining a student research team during the academic year and participate in corporate-sponsored summer research internships. Students will present their work at the College's new multistate research conference, the STEM C² Research Summit, Bergen's first scientific conference that

brings together high school, two-year, four-year, and industry partners. In addition, this project will build upon its pursuit of articulation agreements by developing Dual Admissions Agreements with those partners with whom the College has existing articulations as well as seeking out new partners. Furthermore, as a result of previous articulations, this project will address a transfer gap by offering students a design course required during the first two years at four-year engineering programs that are currently not offered at the College.

Competitive Priority 2. This program uses the CUNY ASAP program as a conceptual framework for student success. CUNY ASAP is a multi-institutional randomized controlled trial that tests the causal validity of its interventions on student retention, completion/graduation and transfer¹. The CUNY ASAP report meets the conditions set out in the definition of “moderate evidence of effectiveness.”

QUALITY OF PROJECT DESIGN

(1) Needs of the Target Population

Introduction

Five years ago, the STEM programs at Bergen Community College were traditional lecture and textbook-based courses driven by the standard curricula of the four-year institutions to which students transferred. Few STEM-specific programs existed outside the classroom. STEM enrollments, retention rates, and graduation rates were all in decline. Since 2011, the STEM Graduation Pathway to Success (*STEM GPS*) Project at Bergen Community College has made significant strides in reversing some of these trends through initiatives that actively engage

¹ Scrivener, S., Weiss, M. J., Ratledge, A., Rudd, T., Sommo, C., & Fresques, H. (2015). Doubling Graduation Rates: Three-Year Effects of CUNY's Accelerated Study in Associate Programs (ASAP) for Developmental Education Students. *Scrivener, Susan, Michael J. Weiss, Alyssa Ratledge, Timothy Rudd, Colleen Sommo, and Hannah Fresques.*

students in STEM activities inside and outside the classroom and provide basic counseling and academic support to students, especially Hispanic and at-risk students. As a result, the college has experienced a 67% increase in the enrollment of STEM transfer majors from the 2009 baseline cohort to the Fall 2015 cohort. As a result, the retention and transfer numbers increased slightly, with rates trending better than the general BCC student population, however, STEM retention and transfer rates did not see any improvement. The graduation rates of STEM students at BCC increased by 2 percentage points (13% for 2009 cohort to 15% for 2011 cohort), with the 2012 cohort being an outlier due to *Project Graduation*, an initiative that awarded degrees to students who either never applied for graduation but had completed all graduation requirements, or were close to graduation and completed final requirements at their current institution. *STEMatics* will expand on the successes of *STEM GPS* and introduce new, evidence-based strategies to fill its gaps.

Demographics

Bergen Community College is the largest Hispanic-Serving Institution in the state of New Jersey. Student enrollment at Bergen Community College is approximately 14,600 students with 57% being full-time students. The student population is diverse with 32% Caucasian, 25% Hispanic, 7.2% Asian, 6.0% Black, and 0.2% American Indian. In Fall 2015, 50.3% of the students were male and 49.7% female. Day and evening classes are offered with 59.5% enrolled in day classes, 13.6% enrolled in evening classes, and 27.0% enrolled in a combination of day/evening classes.

The proportion of degree/certificate-seeking students has steadily increased over the past 10 years, to a high of 93.1% in Fall 2015. As of that time, 78.1% of all students were enrolled in transfer programs. The STEM component of these programs consists of students enrolled in

Associate in Science programs in the Natural Sciences, Math, and Engineering Science, a total of 2,499 students (17.1% of the student population). This is part of a slow, but consistent percentage increase in the total STEM population from 13.7% of the student population in 2011 to 17.1% in 2015. Table 1 below describes the changes in STEM enrollment by program.

Table 1: STEM Enrollment 2011-2015						
	STEM Programs	2011	2012	2013	2014	2015
A.S. Degree Programs	Aircraft Operations	0	0	10	29	29
	Aviation Administration	0	1	6	9	8
	Biology	388	435	388	417	408
	Biotechnology	33	34	24	22	23
	Chemistry	69	66	69	72	87
	Computer Science	226	244	276	323	345
	Engineering Science	295	323	356	354	367
	Gen. Natural Science & Math	422	465	513	514	475
	Information Technology	78	99	94	111	125
	Mathematics	87	80	78	70	51
	Physics	24	34	28	26	33
	Total A.S.	1622	1781	1842	1947	1951
A.A.S. Degree Programs	Avionics	0	0	0	1	3
	Computer Animation	61	61	53	53	61
	Database Programming & Admin	25	23	23	22	25
	Drafting & Design	81	79	62	59	49
	Electronics Technology	66	39	38	30	39
	Environmental Technology	11	9	7	0	0
	Game Programming	22	25	49	50	57
	Game Testing	10	14	12	11	16
	General Engineering Technology	92	79	69	77	52
	Computer Graphics	218	203	161	144	125
	Horticulture	21	17	16	16	18
	Information Technology	38	24	13	6	2
	Manufacturing Technology	21	21	16	28	24
	Networking Administration	159	149	133	110	107
	Office Technology	25	24	24	19	20
	Science Lab Technology	15	20	7	3	2
	Technical Studies	2	2	1	1	1
Web Development & Management	32	30	21	31	32	
	Total A.A.S.	899	819	705	661	633
	TOTAL	2,521	2,600	2,547	2,608	2,584

Table 2: STEM Student Enrollment, Retention, Graduation, Transfer 2011-2015 (First Time Full Time Degree Seeking Fall Cohorts) (*indicates Hispanic students)				
Cohort	Enrollment (*)	Retention (*)	Graduation (*)	Transfer (*)
Fall 2009	225 (30.7%)	73.3% (68.1%)	21.3% (13.0%)	10.7% (15.9%)
Fall 2010	264 (33.0%)	72.3% (70.1%)	20.1% (16.1%)	13.3% (12.6%)
Fall 2011	306 (26.1%)	76.1% (77.5%)	20.6% (15.0%)	8.8% (5.0%)
Fall 2012	336 (28.6%)	72.3% (69.8%)	26.8% (27.1%)	8.3% (7.3%)
Fall 2013	333 (26.1%)	75.4% (72.4%)	n/a	n/a
Fall 2014	396 (29.8%)	65.7% (62.7%)	n/a	n/a
Fall 2015	377 (30.0%)	n/a	n/a	n/a

Lack of Access to Support Services. Another factor that negatively impacts retention rates is the difficulty that many students experience in accessing the many support services available to them. The College is extremely proud that the Cerullo Learning Assistance Center's (Bergen's tutoring center) Community College Program of the Year Award by the National Tutoring Association in 2016, and the Frank J. Christ Outstanding Learning Center Award by the National College Learning Center Association in 2014; however, there remains a gap in students' ability to access these services. Since the initiation of the STEM GPS Project, the Cerullo Learning Assistance Center (CLAC) has greatly expanded its services to STEM students. In the past year alone, this Center has hosted over 13,000 1-on-1 STEM appointments with peer (student) and professional (degree holder) tutors. As the STEM GPS Project has developed, however, it has become evident that the personal and professional responsibilities of students often interfere with their ability to avail themselves of the many on-campus support services offered them through the project. An overwhelming majority (74.6%) of BCC students are employed outside of school in either part-time or full-time jobs. It has been shown that within the Hispanic and low-income communities, such employment is positively correlated to lower persistence rates in STEM fields; it is a considerable problem for the Hispanic students at BCC and is likely the major reason why the expected increases in student retention rates were not realized. A major

component of this proposal will therefore address the pathways through which support services are delivered. Specifically, it will provide tutorial support pathways for students who are often off campus due to professional and personal responsibilities.

While participating in STEM Research has had a strong impact, few students benefit. The effectiveness of student research projects in improving STEM recruitment and persistence has been documented in the literature (engaging in such "pre-professional" activities has been shown to increase persistence by 150%) and has contributed greatly to the success of the STEM GPS Project at Bergen Community College. This project has given rise to over 25 independent research projects engaging an average of 40 students per year. While the success and visibility these projects have contributed much to the BCC STEM Community, they have engaged only a small proportion of the total STEM population. This is largely due to the lack of adequate space for research and design activities; some BCC student projects require large open spaces, such as the building of an electric car or the development of a large wind turbine. Other large-scale projects, such as the Object Simulation and Gaming Lab, will require renovation of space recently made available in the science wing (rooms S134-S138).

Further Curriculum Alignment is Needed. The STEM GPS Project has also increased the number of articulation agreements with 4-year colleges and universities. The number of such institutions with which BCC has agreements has grown from 1 to 10. In the course of implementing these agreements, an unforeseen challenge surfaced. Four-year institutions require students to take a Design course during each of their four years; thus, upon a successful transfer to four-year colleges, STEM BCC graduates need to make up 4 semesters of Design courses before they can fully align with their peers, adding a year to their education timeline. It is evident, therefore, that curriculum alignment beyond the scope of the current articulation

agreements is needed to better facilitate the transfer of STEM students to four-year institutions and reduce time to degree completion.

Financial Concerns Remain a Major Barrier to Retention. There remains a critical need to improve the STEM retention rate as well as the STEM enrollment rate for Hispanic students, of which 30% are now enrolled in STEM transfer programs. The 2015 Stop-Out survey was administered to students who had previously enrolled at BCC in Spring 2015, but had not re-enrolled in Fall 2015. When asked why they left BCC, a substantial proportion of those students cited financial reasons as a reason for their stop-out.

- ❖ The cost of textbooks is an inhibiting factor in degree attainment. Students often avoid buying the course textbooks and hope to ‘get by’ without them. The cost of textbooks for the Associate in Science in Natural Sciences and Mathematics – General Curriculum (AS.NSM.GEN), the most highly enrolled STEM degree program at the College, totals \$2,960. A cost breakdown follows in the table below.

	Course	Credits	Course	Textbook Cost (non-OER)
Semester 1	Mathematics Elective	4	MAT180	\$197
	Natural Sciences Elective	4	BIO101	\$223
	Humanities Elective	3	MUS101	\$124
	Speech Communication	3	COM100	\$103
	English Composition I	3	WRT101	\$142
Semester 2	Mathematics Elective	4	MAT280	\$302
	Natural Science Elective	4	CHM100	\$252
	Humanities Elective	3	PHR101	\$198
	Social Science Elective	3	ECO101	\$254
	English Composition II	3	WRT201	\$107
Semester 3	Natural Science Elective	4	CHM140/141	\$207
	Natural Science Electives	4	PHY186	\$281
	Humanities Elective	3	HIS105	\$89
	Social Science Elective	3	PSY101	\$209
Semester 4	Natural Science Electives	4	CHM240/241	CHM140/141 text
	Natural Science Elective	4	BIO203	\$205
	Humanities Elective	3	LIT201	\$67

	Free Elective	4	PHY286	PHY186 text
TOTAL				\$2,960

Developmental Education, Intermediate Algebra and Pre-Calculus are Major Gateway

Courses for STEM Students. An analysis of all courses offered at the College has identified Intermediate Algebra (MAT160), Pre-Calculus (MAT180) and a wide range of STEM courses as gateway courses; i.e. a combination of high enrollment and high failure (D, F, Withdrawal, and Incomplete) rates. Supportive interventions are required to address these.

Table 4: Gateway Courses: High Enrollment STEM Degree Courses with the Highest Failure Rates

COURSE	TITLE	SECTIONS	ENROLLMENT	D,F,W,I, RATE
MAT 160	Intermediate Algebra	52	1,226	49.3 %
MAT 180	Pre-calculus	25	652	47.1 %
BIO 109	Anatomy & Physiology I	85	1,703	33.2 %
CIS 158	Intro Computer Science	31	628	32.0 %
BIO 101	General Biology I	62	1,258	29.0 %
INF 101	Intro Info Tech	27	544	28.7 %
BIO 104	Microbiology	60	869	28.0 %
CHM 100	Intro to Chemistry	63	1,234	24.1 %
BIO 108	Intro Environ. Biology	27	587	21.6 %
BIO 103	The Human Body	31	669	19.0 %
BIO 209	Anatomy & Physiology II	47	845	12.0 %

(2) Literature Review, Plan for Implementation, and Methodological Tools

In recent years, more research results are available that indicate the need for a more systemic approach to improve graduation and retention rates in STEM. Academic support services that include tutoring, counseling and developmental courses are critical for the success of at-risk students.² Laskey & Hetzel (2011) and Hodges (2001) show that such services are

² Tinto, V. (1999), *Taking Student Retention Seriously: Rethinking the First Year of College*. National Academic Advising Association Journal, 19(2)

effective in helping at-risk students catch up and even surpass their peers academically.³⁴

Amenkianan and Kogan (2004) have further shown that student support services positively impact the academic performance of engineering students.⁵ Pascarella & Terenzini (1991, 2005) have also argued that a combination of the interventions discussed here play an important role in persistence, retention, and graduation and must be treated together.

The CUNY Accelerated Study in Associate Programs (ASAP) provides a strong conceptual framework for *STEMatics* to dramatically improve the retention, graduation and transfer rates of community college students.⁶ As Hispanic Serving Institutions, all three community colleges included in the evaluation report for ASAP share similar student demographics, including a high proportion of Hispanic and low-income students.

Table 5: Conceptual Framework		
	CUNY ASAP	STEMATICS
<i>Requirements/Messages:</i>		
Enrollment	Full-time	Full-time and Part-time
Take developmental courses early; Graduate within 3 yrs	Encouraged consistently and strongly	Encouraged consistently and strongly
Dual Admissions	Not Offered	Students strongly encouraged to apply to dual admissions programs
<i>Student Services:</i>		
Advising	Student to advisor ratio between 60:1 and 80:1	Student to advisor ratio 85:1 Yr 1; faculty advising yrs 2-3
Career Services	Students meet with career and employment services staff	Student to advisor ratio 85:1; advisors also provide career services support
Tutoring	Students encouraged to meet with tutors	Students encouraged to meet with tutors; MAT 160 students are

³ Hodges, R.,(2001), Encouraging High-Risk Student Participation in Tutoring and Supplemental Instruction, Journal of Developmental Education. 24(3)

⁴ Laskey, M.L., and Hetzel, C. J., (2011), Investigating Factors Related to Retention of At-Risk College Students. The Learning Assistance Review, Vol 16, No 1.

⁵ Amenkianan, C.A., & Kogan, L.R., (2004), *Engineering Students' Perceptions of Academic Activities and Support Services: Factors That Influence Their Academic Performance*. College Student Journal, 38

⁶ Scrivener, S., Weiss, M. J., Ratledge, A., Rudd, T., Sommo, C., & Fresques, H. (2015). Doubling Graduation Rates: Three-Year Effects of CUNY's Accelerated Study in Associate Programs (ASAP) for Developmental Education Students. Scrivener, Susan, Michael J. Weiss, Alyssa Ratledge, Timothy Rudd, Colleen Sommo, and Hannah Fresques.

		randomly assigned to sections with (treatment)and without (control) Supplemental Instruction
<i>Extracurricular Activities:</i>		
Research/Internships	Not offered	Offered to 100 students through the STEM Student Scholars Program
<i>Course/Seminar Enrollment:</i>		
Summer Bridge and Bootcamp Programs	Not offered	Computer-based bridge program and face to face bootcamps offered
Blocked or Linked Courses	Available for first year	Not offered
Seminar	ASAP Seminar offered for 3 semesters	Students placing into developmental courses are required to take a student success course
Engineering Design Sequence	Not offered	Offered to Engineering students for seamless transfer
<i>Financial Supports:</i>		
Tuition waiver	Offered	Not offered
Incentive to Attend Advising Sessions	Offered free Metrocard (monthly train/bus pass)	Offer Book voucher
Financial Literacy	Not Offered	One-on-one meetings with Certified Financial Counselors once per semester for assistance with financial aid and financial literacy

**items highlighted in green represent interventions not offered in CUNY ASAP*

In addition to the cluster of interventions implemented in ASAP, STEMATICS will offer additional supportive strategies for student success:

Supplemental Instruction. The research has consistently shown that tutoring is an effective tool to improve the persistence and academic performance of students. Laskey and Hetzel (2011) demonstrate the positive effects of tutoring on at-risk students⁷ and Hodges (2001) further shows that for tutoring to be effective, students must begin early in the semester and attend regularly.⁸ Reinheimer & McKenzie (2011) report that students who regularly attend tutoring have a

⁷ Laskey, M.L., and Hetzel, C. J., (2011), *Investigating Factors Related to Retention of At-Risk College Students*. The Learning Assistance Review, Vol 16, No 1.

⁸ Hodges, R.,(2001), *Encouraging High-Risk Student Participation in Tutoring and Supplemental Instruction*, Journal of Developmental Education. 24(3)

retention rate that is 2.7 times higher than those who do not.⁹ Jimenez et al. (2015) has also shown tutoring to be effective for STEM students.¹⁰ Moreover, reciprocal peer tutoring (RPT), actually a cooperative learning variant, has been shown to have a significant positive effect on the academic performance of students in calculus-based Physics 1.¹¹

One of the benefits of tutoring is that it provides opportunities for students to feel socially connected to the school.¹² Potts & Schultz (2008) illustrate the importance of developing relationships between peers, tutors, and faculty in improving student retention.¹³

Research/Internships. Research has also shown that pedagogies that actively involve STEM students, especially Hispanic and underrepresented minority students affect learning and persistence. Freeman, et al, (2014) has shown that failure rates in freshman science courses can be positively correlated to pedagogies characterized by student passivity.¹⁴ Other studies have demonstrated the positive effects of integrating active learning techniques into lectures.

A particular subset of active learning pedagogies, namely, student research projects/internships, have been shown to improve STEM student persistence. Seymour & Hewitt (1997) note the effectiveness of early experiences with student research.¹⁵ Knight et al. (2003) show that low

⁹ Reinheimer, D., McKenzie, K., (2011) *The Impact of Tutoring on the Academic Success of Undeclared Students*, Journal of College Reading and Learning, 41(2)

¹⁰ Jimenez, V.A., Acuna, F.C., Quiero, F.J., Lopez, M., Zahn, C.I., (2015), *Evaluation of a Voluntary Tutoring Program In Chemistry, Physics, and Mathematics for First-Year Undergraduates at Universidad Andres Bello, Chile*, International Journal of Higher Education, 4(3)

¹¹ Dioso-Henson, L., (2012), *The Effect of Reciprocal Peer Tutoring on the Performance of Students in College Physics*, Research in Education, No 87

¹² Thomas, L. & Hixenbaugh, P.,(2006), *Personal Tutoring in Higher Education*(pp. (21--31), Stoke on Trent: Trentham Books.

¹³ Potts, G., & Schultz, B., (2008), *The Freshman Seminar and Academic Success of At-Risk Students*. College Student Journal. 42

¹⁴ Freeman, S., Eddy, S., et al, (2014), *Active Learning Increases Student Performance In Science, Engineering, and Mathematics*, Proceeding of the National Academy of Sciences, 111(23)

¹⁵ Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences*. Boulder, CO: Westview Press.

retention rates are positively correlated to the lack of hands-on projects.¹⁶ Xu reports that faculty teaching skill, class size, active learning pedagogies, and opportunities to engage in research influenced retention for STEM students more so than financial pressures or social engagement.¹⁷

Bridge/Bootcamp Programs. The project incorporates an online summer bridge program, designed to reduce the need for developmental education in college by providing students with accelerated instruction in areas where additional knowledge and skills are needed to help them succeed in higher education¹⁸.

Design Course. To better align the first two years of a four-year engineering degree, Bergen will develop and offer four semesters of design courses to students who wish to transfer to four-year colleges as an engineering major. This strategy will reduce their time to completion of a baccalaureate degree as the gap typically adds a year to their education timeline.

Financial Aid and Literacy Counseling. With students self-reporting that one of the top reasons for taking a “break” from college is due to financial reasons, it is apparent that the College needs to work with these students to better plan their finances for the next semester and assist in seeking support wherever appropriate.

STEMatics GOALS:

Goal 1: Strengthen the Learning Engagement of 2,500+ STEM students (cohorts and beneficiaries) annually; 20% or 2,000 first-time full-time degree seeking STEM students, especially at-risk low-income and/or Hispanic students (30% or 600) during the five-year grant.

¹⁶ Knight, Daniel W., Lawrence E. Carlson, and Jacquelyn F. Sullivan. "Staying in engineering: Impact of a hands-on, team-based, first-year projects course on student retention." age 8 (2003): 1.

¹⁷ Xu, Y.J., (2016), *Attention to Retention: Exploring and Addressing the Needs of College Students in STEM Majors*, Journal of Education and Training Studies, Vol 4, No 2.

¹⁸ Barnett, Elisabeth A., et al. "Bridging the Gap: An Impact Study of Eight Developmental Summer Bridge Programs in Texas." National Center for Postsecondary Research (2012).

Goal 2: Broaden the role of 20 four-year and industry partners, as well as government agencies, to become joint stewards of student success.

Goal 3: Equip STEM students with the financial empowerment necessary to persist through degree completion.

The goals of this proposal will be achieved through three strategies depicted below:



Strategy 1: To Engage Students through Active Advising, Learning & Culturally Sensitive Teaching

This strategy will focus on the following activities:

- (1) Testing Supplemental Instruction in Gatekeeper Courses (Randomized Controlled Trial)**
- (2) Implement Intensive Academic, Transfer & Career Advising**
- (3) Professional Development for Culturally Sensitive Teaching/ Enhancements of the STEM curriculum to target the needs of a culturally diverse student population**
- (4) Offering Online STEM tutoring**

The first strategy will address the academic experiences of the diverse BCC student population which as described in the Demographics Section of this proposal, is comprised of 32% Caucasian, 25% Hispanic, 7.2% Asian, 6.0% Black, and 0.2% Native American. Many of these are low income students who experience significant financial difficulty that negatively impacts on the STEM student success.

(1) Supplemental Instruction (Randomized Controlled Trial). Supplemental Instruction (SI) was first introduced to the College with the 2011 HSI STEM grant, Graduation Pathways to Success (STEM GPS), with 5-7 sections of SI being offered each year. Supplemental Instruction (SI) is an international academic support program whose benefits are recorded throughout numerous educational institutions and published in higher education journals. SI is also designated by the U.S. Department of Education (USDOE) as an Exemplary Educational Program; one of only two programs validated by the USDOE. It is crucial, however, that all SI initiatives are streamlined and systematically coordinated to abide by the guidelines set forth by the University of Missouri, Kansas City. An extensive range of collaborative learning techniques has been developed and utilized by trained SI personnel with the intent to foster holistic learning opportunities for SI Leaders and participants alike (Supplemental instruction: Supervisor manual, 2014). Roidi (2015) mentions that SI incorporates elements of the schema theory in activating

prior learning and enhancing participants' understanding of core course objectives through individual and group pedagogical strategies. The research has consistently shown that peer learning through tutoring is an effective tool to improve the persistence and academic performance of at-risk students (Laskey & Hetzel, 2011). As noted by Hodges (2001), tutorial academic support is most effective when students begin early in the semester and attend regularly. Thus, the collaborative learning experiences that SI fosters lie in the value of offering purposeful instructional methodology to learners.

As those familiar with the SI model know, it is a very time-consuming, hands-on intervention that, as per the official SI guidelines, allows SI supervisors to oversee no more than 5-7 sections in a given semester. The College has undergone a lengthy process in becoming certified by the University of Missouri, Kansas City International Center for SI and is now ready to ramp up its expansion of the SI program and test it specifically on its effectiveness in Intermediate algebra (MAT160) and Pre-calculus (MAT180) courses. Design is discussed in the evaluation section.

(2) *Implement Intensive Academic, Transfer & Career Advising.* Using the CUNY ASAP model as a guide, it is apparent that community colleges need to acknowledge the unique barriers to success many of its students face. There will be 5 advisors dedicated to academic and career counseling to serve first time students. The student to advisor ratio will be 85:1, a ratio similar to that in ASAP (60:1 to 80:1). Advisors will provide counseling in academic areas (choosing classes, acclimating to college, etc.), soft skills (study habits, time management, work/family/school balance, extracurricular activities) as well as personal issues within the context of advising as it related to their education. Advisors will be available during the week as well as nights and weekends and will document each interaction in detail.

(3) *The Development of Culturally Sensitive Curriculum and Pedagogies.* Language difficulties are among the largest obstacles for Hispanic and minority STEM students at BCC.

Building on success of BCC's American Language Program, the following activities are planned:

- a. Professional development will be held for all STEM faculty (full-time and adjunct) to address the unique academic learning styles and struggles encountered by Hispanic and other minority cultures.
- b. Science and Language Arts professors will collaborate through the Science Infusion Program to improve the communication skills of science students.

(4) *Online STEM Tutoring.* With a rise in the number of fully online courses being delivered at the College and more than 70% of students working full- or part-time, it is increasingly difficult for students to spend additional time on campus. Therefore, expanding the reach of the tutoring center's current online tutorial efforts to allow for Supplemental Instruction (SI) and one-on-one sessions to be conducted virtually using online delivery methodologies through Adobe Connect would provide the support these students need with the ability to be accessed from any location.

Strategy 2: To Expand the Campus' Reach Into the Hispanic, Corporate, and Higher Education Communities

This strategy will focus on the following activities:

- (5)** Development of a STEM Student Scholars Program in partnership with 4-year colleges and industry through the Statewide Hispanic Chamber of Commerce of New Jersey
- (6)** Introduction of Engineering Design courses to streamline Engineering student transfer
- (7)** Utilize the STEM C² Research Summit as a platform to showcase Hispanic STEM student talent and Successful Industry Representatives

This strategy addresses the gaps that arose as a result of some of the successes of the 2011 STEM GPS initiative. During that time, several things were introduced to the College, including, but not limited to, articulation agreements with four-year colleges and faculty-led student research projects. One gap that was discovered through the development of articulation agreements was

that Bergen students transferring to pursue engineering degrees at four-year colleges were missing the critical series of design courses required at those colleges. Additionally, the success and popularity of the research projects made it apparent that showcasing their hands-on work drew more students to the STEM areas. By expanding this program in a meaningful way, more students can be included in hands-on research.

(5) *STEM Student Scholars Program.* The STEM Student Research Scholars Program (SSSP) will promote excellence in knowledge, skills and ability of a select group of STEM students to mentor those who are less successful and ensure their success in securing research internships and successful transfer to their targeted 4-year institution. Students who successfully complete the program will have their achievement recorded on their official transcript.

To enhance their knowledge and skills beyond what is currently offered in the STEM curriculum at Bergen Community College, formal mini-courses/workshops will be offered on topics including, but not limited to, software (SolidWorks, PTC Creo, LabView), equipment use and instrumentation (3-D Printing), machining (basic tool use, welding, plasma cutting) and communication/writing (speech coaching, project planning and budgeting, writing a business plan, technical writing in the CSE format). Students in the program must complete one workshop topic from each of the above categories.

Students who fulfill program requirements will have an opportunity to participate in an internship off campus in their target 4-year college or industry in their second summer.

Scholars must meet the following requirements: declared STEM major; full-time student; minimum cumulative GPA of 3.2 at the completion of their first semester at Bergen; completed all required remediation courses.

The program will be administered by the STEM Student Scholars Program Coordinator working in conjunction with a team of faculty research mentors. Meetings will take place on a monthly basis to: review applications to SSSP, review progress of participants, and internship placement.

(6) Engineering Design courses. During the current STEM GPS program, it became apparent through the development of articulation agreements that colleges require at least a fundamentals of engineering design course, and in some cases, multi-semester sequence of design courses; these courses are not offered at Bergen. A Design course sequence will be introduced to Bergen to fill this gap. The courses will be developed by a course designer in consultation with faculty representatives of New Jersey Institute of Technology and Stevens Institute of Technology.

(7) STEM C² Research Summit as a platform to showcase Hispanic success in STEM. The faculty-led research projects brought about the College's first annual STEM research conference, the STEM C² Research Summit, beginning in 2014. Despite the C² standing for "Community College," the conference has shown the importance of four-year and two-year college partnerships with community colleges. The conference's scope will now be expanded to include presentations from industry, especially those with Hispanic leaders, facilitated by the Statewide Hispanic Chamber of Commerce of New Jersey. Keynote speakers will be of Hispanic origin to further the message of professional success to our STEM students.

Finally, Strategy 3 will address the financially-related needs of community college students.

Strategy 3: To Mitigate Financial Burdens

This strategy will focus on the following activities:

- (8)** Development of Dual Admissions Agreements with four-year colleges and universities
- (9)** Utilization of Open Education Resources (OER) to adopt *free* vetted on-line textbooks
- (10)** Introduction of financial aid and literacy counseling
- (11)** Free Accuplacer preparation (EdReady) and Gateway course boot-camps

CUNY ASAP addressed some of the financial needs of participating students through direct financial support (monthly bus/train passes, free textbooks and tuition). This program builds on this concept by providing indirect financial support through the development and adoption of open educational resources, financial aid and literacy counseling, free summer bridge Accuplacer placement test prep and gateway course preparation, as well as the opportunity to directly earn credits towards a four-year degree while taking the first two years of course requirements at the community college rate.

(8) Dual Admissions Agreements with four-year colleges and universities. Dual admissions agreements will be developed with four-year partners with whom the College currently has articulation agreements. This brings about a more streamlined transfer process that would enable a student to transfer to a four-year school as a true junior. Advisors will strongly encourage students who know which college they wish to transfer to, to apply to the dual admissions programs with those colleges with whom Bergen has established agreements. The College currently has a dual admissions program with Fairleigh Dickenson University; at least five additional dual admissions agreements will be finalized by the end of the 5 year period. Some of the participating colleges include: New Jersey Institute of Technology, Stevens Institute of Technology, Vaughn College of Aeronautic Engineering, Aviation and Technology, Ramapo College, Montclair State University, William Paterson University, The City College of New York, New Jersey City University, and Rutgers University (Newark campus).

(9) Open Education Resources (OER). The first OER degree program to be fully developed is the Associate in Science, Natural Science and Math (AS.NSM.GEN), the most highly enrolled STEM major at the College. The table below indicates the specific associated courses, science as well as general education and electives, the faculty members leading development of the OER

component, timeframe, the number of course sections, capacity, and projected number of student participants. The goal of this initiative is to provide a major option with free textbooks that have undergone a rigorous vetting process.

Table 6: Associate in Science, Natural Science and Math (AS.NSM.GEN) OER Plan						
	Course	Credits	Course	Faculty	# of sections	Students/section
Fall 2017	Mathematics Elective	4	MAT180	Feigenbaum	2	35
	Natural Sciences Elective	4	BIO101	Tartaglia	2	24
	Humanities Elective	3	MUS101	Krikun	2	24
	Speech Communication	3	COM100	Jewell	5	24
	English Composition I	3	WRT101	Gibbons, Feig, Cordell, Crosby	3	24
Spring 2018	Mathematics Elective	4	MAT280	Feigenbaum	2	35
	Natural Science Elective	4	CHM100	Comai	2	24
	Humanities Elective	3	PHR101	Dlugos	2	35
	Social Science Elective	3	ECO101	Mutafoglu	5	35
	English Composition II	3	WRT201	Gibbons, Feig, Cordell, Crosby	4	24
Fall 2018	Natural Science Elective	4	CHM140 CHM141	Ricatto	2	35
	Natural Science Electives	4	PHY186	Marton	2	24
	Humanities Elective	3	HIS105	Eubank	3	35
	Social Science Elective	3	PSY101	Ochoa	2	35
Spring 2019	Natural Science Electives	4	CHM240/241	Ricatto	2	24
	Natural Science Elective	4	BIO203	Tartaglia	2	24
	Humanities Elective	3	LIT201	Cordell	2	24
	Free Elective	4	PHY286	Marton	2	24

(10) Introduction of financial aid and literacy counseling. Students who are attending college for the first time may not have the financial literacy to manage the debt that post-secondary education can create. Even students who come from families in which college education has been a tradition, may lack these skills. Financial counselors will educate students about the

important decisions they will have to make in order to pay for their college education. In an era when college graduates are saddled with debt, a financial literacy program like this is essential. During one-on-one meetings, the nuances of a student's personal situation can be discussed privately. To achieve this, staff in the Financial Aid Office will be trained as certified financial counselors through an online program called Personal Financial Management Certification or the CPFM program. Topics covered will include, but are not limited to credit card use, credit reports, financial planning, and default prevention.

(11) *Free Accuplacer preparation (EdReady) and Gateway course boot-camps.*

The College has recently acquired the Accuplacer placement test prep software, EdReady. While college funds have been utilized to purchase this software and place it on the College's homepage, it is critical that there be significant outreach to students, especially STEM students to utilize this program. Students who spend time completing this placement test prep software can typically place out of one additional developmental course, compared with their counterparts who do not utilize the software. A strong campaign will be carried out to inform STEM students of this software and promote its use prior to Accuplacer testing.

The logic model below outlines the process through which these goals are supported by the three strategies. These strategies, aligned with the four categories of Robert Reason's conceptual framework for retention and persistence, work synergistically to support the goals of this project

(3) Strong Theory

The logic model below demonstrates *STEMatics'* use of strong theory.

Table 7: Logic Model				
Context and Work		Intended Results		
Resources/Inputs	Activities/Processes(Goal #)	Outputs	Outcomes(Priority #)	Impact
Articulation Agreements currently in place with 10 four year colleges	Agreement with 10 four year colleges to develop Dual Admissions programs (1)	5 Dual Admissions programs implemented	STEM students mitigate tuition costs by attending BCC for the first 2 years of a 4-yr program (2)	The recruitment, retention and transfer rates of STEM students will increase
Collaboration with the Statewide Hispanic Chamber of Commerce of NJ (SHCCNJ) and local STEM companies	Engineering Design courses developed by BCC faculty w/STEM companies; courses promoted by STEM counselor/advisors (1,2,3)	Design courses will be taught by qualified BCC faculty	Streamlined acceptance to 4 year program (2)	The retention and transfer rates of Engineering students in STEM will improve.
Expanded pool of faculty and staff committed to student research and projects; 125 student researchers	Design courses added to articulation agreements Renovate and outfit space for student research/ project use	The number of student STEM research projects will be doubled STEM Scholars Program	BCC STEM/ Engineering students will transfer to four year college as true Juniors The number of STEM students engaged in research projects will double	
Space identified for expanded STEM Learning Center	Student projects & teams are designed with input from local businesses and Design courses. Faculty will identify OER curriculum materials for STEM degree courses	Textbook materials for STEM courses and on-line tutoring materials will be adopted. SI Center for Excellence offers 44 SI STEM sections /year	The cost of curriculum materials for STEM students will be reduced. Increase in the amount of high-impact SI tutoring dramatically increases; analysis for causal validity	Students will have improved access to the local job market & be better prepared for 4-year programs
Access to Open Education Resources	SI program expands to serve 44 sections; Randomized Controlled Trial is conducted; online SI is set up	Intensive academic, career, transfer and financial advising	Stronger personal connection - Mandatory personalized advising, FAFSA application assistance, personal budget development	Retention rates of STEM students will be increased.
STEM Tutorial Supervisor oversees 8 SI sections/year	3 additional dedicated counselors; certify 2 financial aid staff as financial counselors	Online SI implemented	Increased access to tutoring services	
2 dedicated STEM Counselors; 2 financial aid staff	Professional development in culturally sensitive teaching	Improved awareness of unique learning styles of a diverse student population	Teaching pedagogies are more aligned with student learning styles	Grade in course is increased by ½ to 1 letter grade; increased graduation rates
All STEM faculty				

(4) An Exceptional Approach

The project represents an exceptional approach providing implementation of more effective practices for engaging students who are at risk for lack of retention and completion of their educational goals through the implementation of student support services, extracurricular activities, course/seminar enrollment, and financial supports.

It has been found that students who attend Supplemental Instruction (SI) sessions at Bergen improve their grade by $\frac{1}{2}$ to 1 letter grade, on average^{19 20}. For the STEM student, this support can make a dramatic improvement in retention, degree completion, and transfer. There is a less than 1 in 4 chance of a student progressing through the first two college math courses required for STEM majors (see Table 4). This has been identified as a major barrier to completion; the demonstrated success of the SI program has promising implications for STEM student retention, completion, and transfer at Bergen.

The conceptual framework upon which this program is based, CUNY's Accelerated Study in Associate Programs (ASAP), is the most effective strategy for student success that we have been able to identify in the literature. The closest study demonstrated an increase in graduation rates by 4 percentage point versus ASAP's 18 percentage points²¹. ASAP was implemented successfully as a randomized controlled trial that produced causally valid results. As such, the project design also supports **Competitive Preference Priority 2** as an approach supported by evidence of effectiveness that meets the conditions set out in the definition of "moderate evidence of effectiveness." ASAP made significant strides in accelerating credit

¹⁹ Barksdale, Keri A., and Robert A. Mans. "Transition to an Active Learning Model of Supplemental Instruction at Armstrong State University." (2016).

²⁰ Balzer Carr, Brandon, and Rebecca London. "The Role of Learning Support Services in University Students' Educational Outcomes." Available at SSRN 2743037 (2016).

²¹ Patel, Reshma, et al. "Performance-Based Scholarships: What Have We Learned? Interim Findings from the PBS Demonstration." Interim Findings from the PBS Demonstration (August 2013). Patel, Reshma, Lashawn Richburg-Hayes, Elijah de la Campa, and Timothy Rudd. "Performance-Based Scholarships: What Have We Learned (2013).

accumulation (39 credits vs. 48 credits over 3 years) and dramatically increasing three-year graduation rates from 22% (control) to 40% (ASAP recipients) as well as improvements in persistence among educationally and economically disadvantaged community college students in need of developmental education, students with characteristics quite similar to those at Bergen.

The implications of a program that utilizes CUNY ASAP's conceptual framework is tremendous. Graduation rates among community college students, especially those placing into developmental coursework, are exceptionally low with 15% earning a two-year degree or certificate within three years. At Bergen it is not much different with 16% of Hispanic students and 20% of all students graduating within three years. Considering the high cost of duplicating ASAP, as well as the need to address some gaps in the program, such as improving recruitment rates, we have adopted a variation of the program to fit our needs at the College.

Finally, there has been a dramatic increase in STEM student enrollment since the implementation of the College's first HSI STEM Grant, *STEM Graduation Pathway to Success*, despite a decrease in enrollment levels at the College overall. While we do not have causally valid data, anecdotal evidence suggests that the top reason for students' engagement in the STEM areas is due to the highly visible student projects on the campus.

QUALITY OF PROJECT SERVICES

Table 8 below outlines the goals, strategies, activities, impact and research support outlined in the *STEMatics* program.

Table 8: Goals, Strategies, Activities, Impact and Research Support			
Goal 1: Strengthen the Learning Engagement of 2,500+ STEM students (cohorts and beneficiaries) annually; 20% or 2,000 first-time full-time degree seeking STEM students, particularly among at-risk low-income and/or Hispanic students (30% or 600) during the 5-year period.			
Strategy1: To Engage Students through Active Advising, Learning & Culturally Sensitive Teaching			
ACTIVITY	POPULATION SERVED	IMPACT	RESEARCH SUPPORT
Activity 1: Testing Supplemental Instruction in Gatekeeper Courses (Randomized Controlled Trial)	The BCC student population is 25% Hispanic, 7.4% Asian, and 6.1% African American. Over 50% of all BCC students are classified low-income.	Tutoring services and workshops will be accessible to students whose access to on-campus services is limited.	Many research studies have confirmed the effectiveness of tutoring, especially for at-risk students. (Laskey and Hetzel, 2011); (Reinheimer & McKenzie, 2011); (Dioso-Henson, 2012)
Activity 2: Implement Intensive Academic, Transfer & Career Advising	The BCC student population is 25% Hispanic, 7.4% Asian, and 6.1% African American. Over 50% of all BCC students are classified low-income.	The transfer process will be facilitated and STEM retention and persistence will improve.	Research evidence exists that first-generation URM students lack access to information concerning the college experience and STEM career pathways. (Museus and Quaye, 2009) ²² ; (Nunez, A.M., 2009) ²³ ; (Hurtado-Ortiz, 2007) ²⁴
Activity 3: Professional Development for Culturally Sensitive Teaching/ Enhancements of the STEM curriculum to target the needs of a culturally diverse student population	The BCC student population is 25% Hispanic, 7.4% Asian, and 6.1% African American. Over 50% of all BCC students are low-income.	The communications skills between faculty/staff and Hispanic and other URM students will be improved.	Latino students lack skills that are pre-requisites for success in STEM programs.. (Tornatzky, et al, 2006. Seymore & Hewitt, 1997) Studiess show that students in courses with active-learning are significantly more likely to succeed than those in traditional lecture courses. (Freeman, et.al., 2014) ²⁵ ; (Colbeck, C.L., 2004)
Activity 4: SI will be expanded to include the online platform, allowing access to students with limited on-campus interaction.	The BCC student population is 25% Hispanic, 7.4% Asian, and 6.1% African American. Over 50% of all BCC students are classified low-income.	Tutoring services and workshops will be accessible to students whose access to on-campus services is limited.	Many research studies have confirmed the effectiveness of tutoring, especially for at-risk students. (Laskey and Hetzel, 2011); (Reinheimer & McKenzie, 2011); (Dioso-Henson, 2012)

²² Museus, S.D., and Quaye, S.J., *Toward an Intercultural Perspective of Racial and Ethnic Minority College Student Persistence*, Review of Higher Education, 33(1), 2009

²³ Nunez, A.M, *Latino Students' Transitions to College: A Social and Intercultural Capital Perspective*, Harvard Educational Review, 79(1), 2009

²⁴ Hurtado-Ortiz, M.T., and Gauvain, M., *Postsecondary Education Among Mexican-American Youth: Contributions Of Parents, Siblings, Acculturation, and Generational Status*, Hispanic Journal of Behavioral Sciences, 29(2), 2007

²⁵ Freeman, S., Eddy, Sarah, S.L., McDonough, M., Smith, M.K., Okoroafor, N., Jordt, H., & Wenderoth, M.P., *Active Learning Increases Student Performance in Science, Engineering, and Mathematics*, Proceedings of the 2014 National Academy of Science, vol. 111, No 23, 2014

Goal 2: Broaden the role of 20 four-year and industry partners, as well as government agencies, to become joint stewards of student success.			
Strategy 2: To Expand the Campus' Reach Into the Hispanic, Corporate, and Higher Education Communities			
ACTIVITY	POPULATION SERVED	IMPACT	RESEARCH SUPPORT
Activity 5: Development of a STEM Student Scholars Program in partnership with 4-year colleges and industry through the Statewide Hispanic Chamber of Commerce of New Jersey	The BCC student population is 25% Hispanic, 7.4% Asian, and 6.1% African American. Over 50% of all BCC students are classified low-income.	Students will become more actively engaged and will have greater access to career pathways.	Research studies have established the effectiveness of students research projects in motivating and retaining STEM students. (Hirst, et al, 2914) ²⁶
Activity 6: Introduction of Engineering Design courses to streamline Engineering student transfer	The BCC student population is 25% Hispanic, 7.4% Asian, and 6.1% African American. Over 50% of all BCC students are classified low-income.	Through the addition of these courses, BCC STEM curricula will be made more engaging and relevant.	Research shows that curriculum that actively engages students in their career choices increases persistence and retention, especially for Hispanic and underrepresented groups. (Freeman, S., Eddy, S., et al, 2014) ²⁷ (Ortiz, A.M., Sriraman, V.D.,2015) ²⁸
Activity 7: Utilize the STEM C ² Research Summit as a platform to showcase Hispanic STEM student talent and Industry Representatives	The BCC student population is 25% Hispanic, 7.4% Asian, and 6.1% African American. Over 50% of all BCC students are low-income.	The communications skills between faculty/staff and Hispanic students will be improved.	A study of Black and Hispanic students showed that scientific self-identity exhibited a strong positive effect on growth in task and performance-approach goals over time. (Hernandez, Paul R., et al., 2013) ²⁹
Goal 3: Equip STEM students with the financial empowerment necessary to persist through degree completion.			
Strategy 3: To Mitigate Financial Burdens			
ACTIVITY	POPULATION SERVED	IMPACT	RESEARCH SUPPORT
Activity 8: Development of Dual Admissions Agreements with four-	The BCC student population is 25% Hispanic, 7.4% Asian, and 6.1% African American.	The financial burden on students pursuing 4-yr	Studies consistently cite financial barriers as a major reason for the high attrition of Hispanic STEM students.(Sanuel and Scott, 2014) ³⁰ ,

²⁶ Hirst, R.A., Bolduc, G., Liotta, L., Packard, B.W., *Two-Year Community: Cultivating The STEM Transfer Pathway and Capacity for Research: A Partnership Between a Community College and a 4-Year College*, Journal of College Science Teaching, 43(4), 2914

²⁷ Freeman, S., Eddy, S., *Active Learning Increases Student Performance in Science, Engineering, and Mathematics*, Proceeding of the National Academy of Sciences. 111(23), 2014

²⁸ Ortiz, A.M., Sriraman, V.D., *Exploring Faculty Insights Into Why Undergraduate College Students Leave STEM Fields of Study-A Three-Part Organizational Self-Study*, American Journal of Engineering Education, Vol 6, No 1, 2015

²⁹ Hernandez, Paul R., et al. "Sustaining optimal motivation: A longitudinal analysis of interventions to broaden participation of underrepresented students in STEM." Journal of educational psychology 105.1 (2013): 89.

³⁰ Samuel, K.R., Scott, J.A., *Promoting Hispanic Student Retention in Two Texas Community Colleges*, Research in Higher Education Journal, Vol. 25, 2014

year colleges and universities.	Over 50% of all BCC students are classified low-income.	STEM degrees will be mitigated.	(Santiago, D.A., 2010) ³¹ , (Castleman, B.L., Long, B.T., and Mabel, Z.A., 2014) ³²
Activity 9: Utilization of Open Education Resources (OER) to adopt free vetted on-line textbooks.	The BCC student population is 25% Hispanic, 7.4% Asian, and 6.1% African American. Over 50% of all BCC students are classified low-income.	A significant financial burden will be lifted from STEM students which will positively impact retention rates.	Studies consistently cite financial barriers as a major reason for the high attrition of Hispanic and URM STEM students.(Sanuel and Scott, 2014) ³³ , (Santiago, D.A., 2010) ³⁴ , (Castleman, B.L., Long, B.T., and Mabel, Z.A., 2014) ³⁵
Activity 10: Introduction of financial aid and literacy counseling.	The BCC student population is 25% Hispanic, 7.4% Asian, and 6.1% African American. Over 50% of all BCC students are low-income.	Students will better plan and manage their finances to improve persistence and degree completion.	Research cites the importance of financial education opportunities for students while in college. (Cude, Brenda, et al., 2006) ³⁶ Latino students lack skills that are pre-requisites for success in STEM programs.. (Tornatzky, et al, 2006. Seymore & Hewitt, 1997)
Activity 11: Free Accuplacer preparation (EdReady) and Gateway course boot-camps.	The BCC student population is 25% Hispanic, 7.4% Asian, and 6.1% African American. Over 50% of all BCC students are classified low-income.	Tutoring services and workshops will be accessible to students whose access to on-campus services is limited.	Martin, Deanna C., and David R. Arendale. "Supplemental Instruction: Improving First-Year Student Success in High-Risk Courses. The Freshman Year Experience: Monograph Series Number 7." (1992). Many research studies have confirmed the effectiveness of Supplemental Instruction tutoring, especially for at-risk students. (Martin, D. C., David R. A., 1992) ³⁷ ; (Laskey & Hetzel, 2011); (Reinheimer & McKenzie, 2011); (Dioso-Henson, 2012)

³¹ Santiago, D.A., *Reality Check: Hispanic Serving Institutions on the Texas Border Strategizing Federal Aid*, Excelencia in Education, 2010

³² Castleman, B.L., Long, B.T., Mabel, Z.A., *Financial Barriers to STEM Study in College: Causal Effect Estimates of Need-Based Grants on the Pursuit and Completion of Courses and Degrees in STEM Fields*, Society for Research on Educational Effectiveness, 2014

³³ Samuel, K.R., Scott, J.A., *Promoting Hispanic Student Retention in Two Texas Community Colleges*, Research in Higher Education Journal, Vol. 25, 2014

³⁴ Santiago, D.A., *Reality Check: Hispanic Serving Institutions on the Texas Border Strategizing Federal Aid*, Excelencia in Education, 2010

³⁵ Castleman, B.L., Long, B.T., Mabel, Z.A., *Financial Barriers to STEM Study in College: Causal Effect Estimates of Need-Based Grants on the Pursuit and Completion of Courses and Degrees in STEM Fields*, Society for Research on Educational Effectiveness, 2014

³⁶ Cude, Brenda, et al. "College students and financial literacy: What they know and what we need to learn." Proceedings of the Eastern Family Economics and Resource Management Association (2006): 102-109.

³⁷ Martin, Deanna C., and David R. Arendale. "Supplemental Instruction: Improving First-Year Student Success in High-Risk Courses. The Freshman Year Experience: Monograph Series Number 7." (1992).

SIGNIFICANCE

(1) Contribution of Project

The current state of STEM student success is of national concern. With a dramatic increase in STEM-related jobs needing to be filled within the next two decades, it is essential that today's youth be properly trained to fill those positions. An overwhelming number of students do not complete their degree or transfer to four-year colleges, resulting in higher costs of education. The proposed program, *STEMatics*, is a combination of an implementation of an externally validated exceptional approach (ASAP) as well as a rigorous research study that will test the causal validity of scalable innovative approaches that utilize low-cost, effective methods for college level math course support with Supplemental Instruction. While the immediate goals of *STEMatics* are to improve retention, graduation and transfer rates of study participants, the potential benefits to society of this lower-cost, scalable approach are significant, including reduced crime rates, higher federal tax earnings, and increased quality of civic life, to name a few³⁸.

Bergen Community College proposes a multi-pronged “game changer” strategy implementing a more cost-efficient variation on CUNY ASAP as well as strong study to test the effects of tutorial support to augment its present traditional lecture structure. With a failure rate of almost 50% in Intermediate Algebra and Pre-calculus, its current teaching structure has not demonstrated effectiveness.

The project will utilize a test group: Supplemental Instruction for Intermediate Algebra and Pre-calculus as designed by the University of Missouri, Kansas City. The test group will

³⁸ Merisotis, Jamie P., and Ronald A. Phipps. "Remedial education in colleges and universities: What's really going on?." *The Review of Higher Education* 24.1 (2000): 67-85.

register for the respective courses, with both treatment and control groups having access to support services through *STEMatics*, the alternative ASAP model.

The project will increase knowledge of the effectiveness of its test group (SI) to determine the effectiveness of SI introduced in two college-level math courses versus “business-as-usual” course delivery to determine increases in persistence, academic progress, and time to degree and/or completion and transfer. All participants will complete an externally validated non-cognitive assessment to provide increased information about non-cognitive factors.

(2) System Change or Improvement

In Fall 2012, 45% of all undergraduate students in the United States were enrolled in public two-year colleges, or approximately 8.3 million students³⁹. Community colleges are the institutions of choice for a majority of Hispanic students in the US as well as low-income students. Thirty six percent of community college students in the US are the first generation in their family to attend college (AACC Fast Facts, 2014).

Completion rates have recently declined for students who started at community colleges. As community college becomes an increasingly popular point of entry for baccalaureate degree completion, improving partnerships between two- and four-year colleges is more important than before. A 2014 report from the National Student Clearinghouse indicates a decrease in completion rates for students who begin their college degree at two-year institutions. Because most of those who earn a baccalaureate degree do not first complete their two-year degree, it becomes increasingly important to create strategies for streamlining the transfer process as efficiently as possible.

” This demonstrates that one in 10 students who started in two-year public institutions transferred and graduated from a four-year institution without receiving any credential from their starting institution. Traditional graduation rate measures that focus only on completions at the starting

³⁹ IPEDS Fall 2012 Enrollment Survey

institution do not account for this type of outcome, even though it is a well-worn pathway receiving increasing attention in today's resource-constrained policy environment.⁴⁰

College completion is a major contributor to the local, regional, and state economy. As an example, Lone Star College (LSC), a community college located right outside Houston, TX, has had a tremendous impact on the economy. It has added \$3.1 billion to the Houston economy with higher student incomes and increased business productivity; the Texas tax base has increased by about \$627.8 million each year by increasing state income and business productivity; LSC students generate \$87.1 million a year in social savings to the Texas public because an educated workforce has improved lifestyle behaviors, with fewer welfare and unemployment claims; finally, LSC associate degree graduates earn an average of \$15,400 more per year than a person with a high school diploma⁴¹. The national implications of a community college program that can support students to complete their degrees are tremendous.

Supplemental Instruction has the potential to increase timely graduation. The causal validity of Supplemental Instruction on decreased time to completion would confirm the value of SI for reducing the cost of college degree attainment. According to the National Center for Education Statistics:

“for the 2012–13 academic year, annual current dollar prices for undergraduate tuition, room, and board were estimated to be \$15,022 at public institutions, \$39,173 at private nonprofit institutions, and \$23,158 at private for-profit institutions. Between 2002–03 and 2012–13, prices for undergraduate tuition, room, and board at public institutions rose 39 percent, and prices at private nonprofit institutions rose 27 percent, after adjustment for inflation. The price for undergraduate tuition, room, and board at private for-profit institutions decreased 7 percent between 2002–03 and 2012–13, after adjustment for inflation.⁴²”

⁴⁰ Shapiro, Doug, et al. "Completing College: A National View of Student Attainment Rates--Fall 2008 Cohort (Signature Report No. 8)." National Student Clearinghouse (2014).

⁴¹ <http://www.lonestar.edu/economic-impact.htm>

⁴² U.S. Department of Education, National Center for Education Statistics. (2015). Digest of Education Statistics, 2013 (NCES 2015-011), Chapter 3.

Reducing time to completion will mitigate the rise in tuition costs nationally. The steep rise in tuition costs are attributed to increased student aid support. A 2015 study attributes a portion of the rise in college tuition to the increase in Federal Student Loan Program (FSLP) support:

“All these changes combined generate a 106% rise in net tuition between 1987 and 2010, which more than accounts for the 78% increase seen in the data. Changes in the FSLP alone generate a 102% tuition increase, and changes in the college premium generate a 24% increase.⁴³”

Sustainability. Bergen Community College is fully committed to sustaining student success initiatives. This was clearly demonstrated by Bergen’s integration of the 2011 HSI *STEM GPS* grant student support activities and key personnel. Similarly, curricular and instructional design improvements initiated in the first HSI STEM project have become essential elements of the academic repertoire. In the same way, the 5-year budget plan for this proposed *STEMatics* project underscores the College’s ongoing commitment by integrating into the college – not the grant -- budget key personnel at 20% in Year 3, 40% in Year 4, and 70% in Year 5, with full commitment thereafter. This includes the STEM Student Scholars Program Center Coordinator, STEM SI Coordinator, three (3) grant-funded STEM Counselors, SI Leaders and SI Assistants. Furthermore, if the SI study indicates a significant improvement index and positive effectiveness rating for academic success and/or completion, the College is prepared to expand the SI program and continue to investigate its impact on an expanded menu of gateway courses.

QUALITY OF MANAGEMENT PLAN

The detailed Management Plan (Table 9) breaks down the steps needed to be taken to carry out each of the activities, including responsible parties, planned milestones and the timeframe within which each would occur to ensure the project objectives are achieved on time and within budget.

(1) Adequacy to Achieve Objectives

⁴³ Gordon, Grey, and Aaron Hedlund. "Accounting for the Rise in College Tuition." Education, Skills, and Technical Change: Implications for Future US GDP Growth. University of Chicago Press, 2015.

Table 9: Management Plan			
Task & Allocation	Personnel	Milestone	Timeframe
Year 1 (October 1, 2016 – September 30, 2017)			
Organize Search Committee	Managing Director of Learning Assistance Service & CLAC Manager	Appoint FT SI STEM Coordinator	9/16 – 10/16
Hiring Process for FT SI STEM Coordinator & two PT SI Assistants	Search Committee & Human Resources	Full Implementation of SI Program with SI STEM Coordinator & PT SI Assistants	10/16 - 12/16
Board Approval	Board of Trustees	Full college support	12/16 – 2/17
STEM Student Services Meeting	SI Coordinator, SI Assistants, Grant Director, STEM Tutorial Supervisor, Project Director, faculty involved with SI & JOLT	Fully understand goals and mission of SI Program and JOLT	Once per academic semester
Supervisor Certification at UMKC	SI STEM Coordinator	Acquire certification necessary to co-coordinate and oversee the SI Program at BCC as per UMKC standards	2/17 – 3/17
Onboarding training	CLAC Manager, SI STEM Coordinator, SI Assistants, STEM Tutorial Supervisor, Tutorial Supervisors	Train new and returning SI Leaders, introduce new SI Program expectations	1/17 – 8/17
Outreach	SI STEM Coordinator, SI Assistants, STEM Tutorial Supervisor	Classroom visits, faculty meetings, promotion (flyers, TV promos, clubs, signs, mass e-mails)	Duration of Grant
Research for JOLT Program and Planning (timeline, pilot launch)	CLAC Manager, SI STEM Coordinator, SI Assistants, STEM Tutorial Supervisor	Discovering needs of students, outreach, student surveys, create student focus group, reach out to faculty for video creation, creation of JOLT Team	10/16 – 9/17
Research for SI Program (best practices, best outreach techniques, etc.)	CLAC Manager, SI STEM Coordinator, SI Assistants, STEM Tutorial Supervisor, Tutorial Supervisors	Gain insight on SI practices, implementation of researched techniques	Duration of Grant
Run 5 sections SI, fall 2016 Run 6 sections SI, spring 2017 Run 2-5 sections SI, summer 2017	CLAC Manager, SI STEM Coordinator, SI Assistants, STEM Tutorial Supervisor, Tutorial Supervisors	Gradual increase of SI sections, data collection, increase faculty and adjunct support	10/16 – 9/17
Data collection and reporting	CLAC Manager, SI STEM Coordinator, SI Assistants	Supporting data for future reference	Duration of Grant
Create rationale for increased space	Managing Director of Learning Assistance Services, CLAC Manger, SI STEM Coordinator	Collect data on demand for space, address issues with study groups/workshops time conflicts	5/17 – 9/17
Update current articulation agreements in STEM	SC, DAA, DMST, GD, VPAA	Update all current articulation agreements in STEM	10/16-3/17

Extend Articulation agreement to include Dual Admission option for incoming students	SC, DMST, GD, VPAA	Complete at least one Dual Admission MOU in STEM with a partner College or University	10/16-9/17
Initiate Articulation discussions with new Partner Institutions	SC, DAA, DMST, GD, VPAA	Initiate Articulation discussions with at least two new Colleges or Universities	4/17-9/17
Enter into new Dual Admission discussions with current Articulation Partner Institutions	SC, DAA, DMST, GD, VPAA	Start serious discussions with a least one current partner school with an eye toward completing the DA agreement the following fall	4/17-9/17
Review the format and presentation of transfer information available to BCC STEM students	SC, TC, DAA, DMST, WM	Complete frame work of transfer webpages for STEM students	10/16 – 4/17
Elaborate a plan of different workshops for STEM Students a least once a month. Develop these series of workshops on topics important to Hispanic and low income students such as scholarship opportunities for URM's at partner institution	SC, STS, GC	Complete at least two workshops per semester to educate STEM students in their respective fields.	10/16 – 9-/17
Partner with the transfer counselors of the college to promote/improve the Transfer Information Sessions	SC, TC, DMST	Each semester, counselors from different colleges and universities in NJ and NY will attend Transfer Information Sessions in order to allow for more interfacing with STEM Students.	10/16-9/17
Improve the STEM website	SC, DMST, PC's, STS, WM, IT	Provide more resources for students interested in exploring careers in STEM	10/16-9/17
Improve the STEM Advising so that students meet regularly with STEM advisors throughout their first year	SC, STS, Cadres, DAA	Students will meet at least once every two weeks with their advisor	10/16-9/17
Invite Students to the different STEM Conferences available for minorities (e.g. The Society of Hispanic Professional Engineers, SHPE)	SC, DMST, GC, GD, STS	This will help student have a strong network, and to have possible internships and/or future jobs	10/16-9/17
Formation of Needs Assessment Team	SC, DAA, DMST, PC's, STS, Cadres, LA Professors, Student Representatives	STEM curriculum needs re Hispanic and URM students will be identified	10/16-3/17
Implement Professional Development on Culturally Sensitive STEM Curriculum & Pedagogies	SC, DMST, VPAA, Needs Assessment Team	Two Professional Development Programs will be implemented	10/16-9/17

Develop Action Plan for Curriculum Revision and Professional Development	SC, DAA, DMST, GD, VPAA, Needs Assessment Team	An Action Plan will be Developed and Adopted	4/17-9/17
Conduct Research on STEM Dictionary	SC, DMST, Needs Assessment Team	Problematic vocabulary, grammar, and idioms will be identified.	4/17-9/17
Year 2 (October 1, 2017 – September 30, 2018)			
STEM Student Services Meeting	CLAC Manger, SI STEM Coordinator, Grant Director, STEM Tutorial Supervisor, Project Director, faculty involved with SI & JOLT	Revisit goals and mission for JOLT and SI, review data collected from FY 2016	Once per academic semester
Pilot JOLT Program	SI STEM Coordinator, SI Assistants, student focus group, Project Director, faculty involved in SI and JOLT	Data collection for success of program, research potential troubleshooting issues, college-wide promotion; establish timeframe for filming and video editing; data relevance and quality editing of videos	Duration of Grant Year
Run 7 sections SI, fall 2017 Run 8 sections SI, spring 2018 Run 3-5 sections SI, summer 2018	CLAC Manager, SI STEM Coordinator, SI Assistants, STEM Tutorial Supervisor, Tutorial Supervisors	Gradual increase of SI sections, data collection, increase faculty and adjunct support	10/17 – 9/18
Follow up on rationale for increased space	SI STEM Coordinator, SI Assistants	Additional space granted	5/18 – 9/18
Analyze the current ways in which Articulation and Dual Admission is communicated to the students	SC, GD, DMST, WM	Write a summary report with recommendations	10/17-12/17
Extend Articulation agreements to include Dual Admission option for incoming students	SC, DMST, GD, VPAA	Complete the Dual Admission MOU initiated the previous spring	10/17-4/18
Formalize actuation agreements	SC, DMST, GD, VPAA	Complete at least one new actuation agreement initiated the previous spring	10/17-4/18
Initiate Articulation discussions with new Partner Institutions	SC, DAA, DMST, GD, VPAA	Initiate Articulation discussions with at least two new Colleges or Universities	4/18-9/18
Enter into new Dual Admission discussions with current Articulation Partner Institutions	SC, DAA, DMST, GD, VPAA	Start serious discussions with a least one current partner school with an eye toward completing the DA agreement the following fall	4/18-9/18
Have the Specific STEM articulations in the STEM website Have a direct link from to NJTRANSFER.ORG to obtain specific	SC, DAA, STS,TC, IT	To have a better understanding of the classes that would transfer to the specific 4 year institution from NJ	10/17-9/18

information about specific classes that would transfer to the different schools in NJ/NY.			
The continuation of the Transfer Informational sessions with the different Universities from NJ/NY area.	SC, TC,	To understand better the requirements of the different admissions process from the different universities from the area	10/17-9/18
When student reach 30+ credits in their program, have to make an appointment to see the SC to discuss plan toward graduation. When student reach 40+ credits in their program, they have to make appointment to see the SC or a TC to discuss transfer transition to a 4 year university. When Student reach 30+ credits in their program, have them making an appointment with a Career counselor to build up his/her Resume (Student have the option to go before)	SC, TC	When 30+ credits are reached a plan for graduation should be elaborate with student (Student have the option to come to counselor before the 30+) When 40+, student have to see SC or TC to discuss his/her transition to a 4 year college. When 30+, student will be highly recommended to build up his/her resume.	10/17-9/18
Explore what will be needed to create a student transfer academy app from the now improved transfer academy webpage.	SC, DMST, GD, WM, Cadre	Talk IT students on the program with designing the app as a summer research project.	4/18 – 9/18
Implement Phase 1 of Action Plan: Revise STEM Curriculum	DMST, Cadre	At least 2 gateway STEM courses will be revised to improve cultural sensitivity A Section of Introductory Physics will be designed to incorporate strategies from the American Language Program	10/17-9/18
Implement Phase 1 of Action Plan: Implement professional development on Culturally Sensitive Pedagogies	DMST, PC's, Needs Assessment Team	A workshop will be devoted to using the STEM Dictionary A workshop will be devoted to applying strategies from the Amer. Lang. Program	10/17-12/17 1/18 - 2/18
Design and publish STEM Dictionary	SC, DMST, Needs Assessment Team	Stem Dictionary will be made available to all STEM students.	10/17-4/18
Evaluate Action Plan and Revise for Year 3	SC, DAA, DMST, GD, VPAA	Action Plan will be Revised	4/18-9/18
Year 3 (October 1, 2018 – September 30, 2019)			
STEM Student Services Meeting	CLAC Manager, SI STEM Coordinator, STEM Tutorial Supervisor, Grant Director, STEM Tutorial Supervisor, Project Director, faculty involved with SI & JOLT	Revisit goals and mission, review data collected from FY 2017, address troubleshooting issues and create timeline for improvement	Once per academic semester

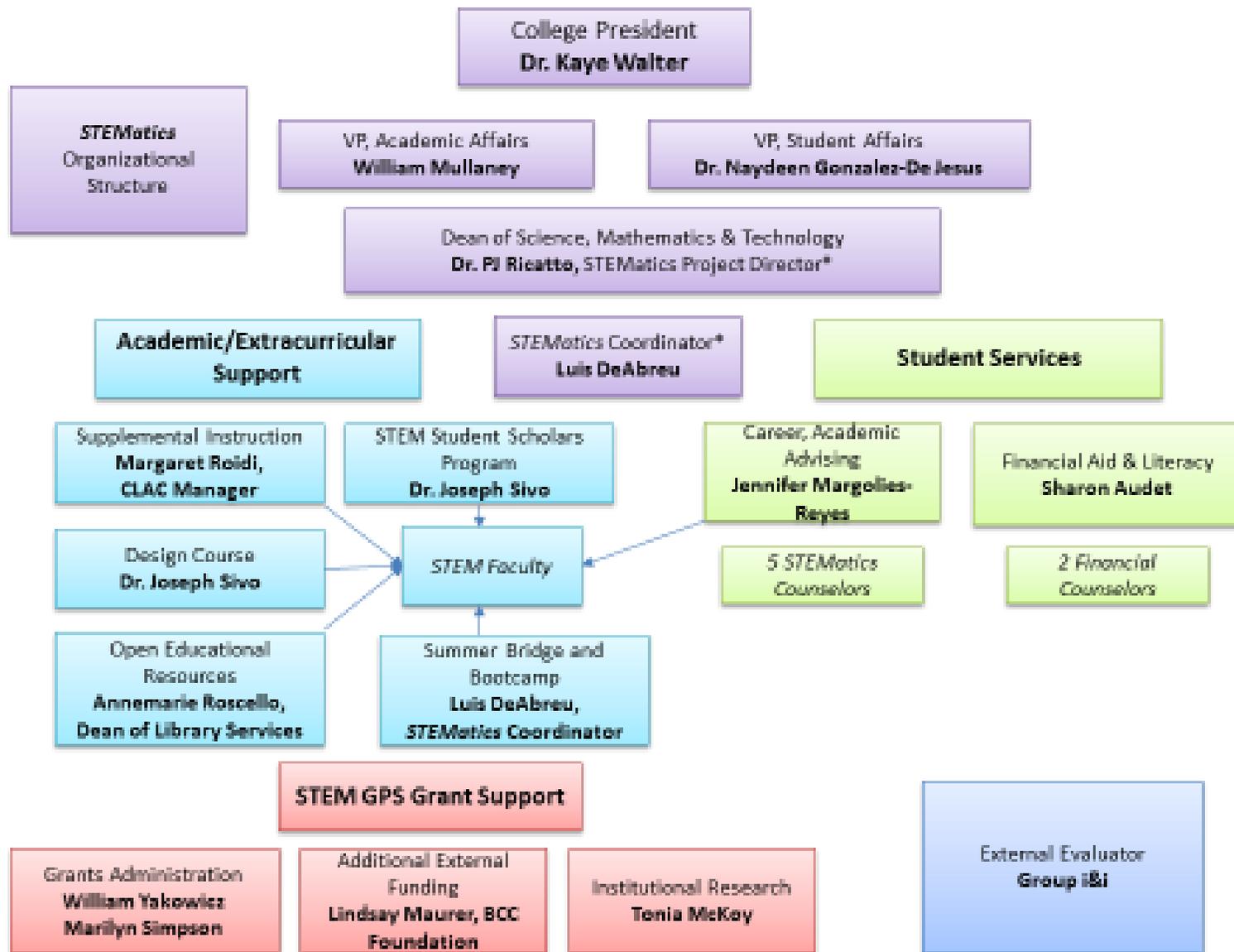
Run 9 sections SI, fall 2018 Run 10 sections SI, spring 2019 Run 3-5 sections SI, summer 2019	CLAC Manager, SI STEM Coordinator, SI Assistants, STEM Tutorial Supervisor, Tutorial Supervisors	Gradual increase of SI sections, data collection, increase faculty and adjunct support	10/18 – 9/19
Implement recommendations for better communicating Articulation and Dual Admission activities to the students	SC, GD, DMST, DAA	Implement changes and activities recommended in the previous year’s report and collect feedback on their effect	10/18-9/19
Update current articulation agreements	SC, DAA, DMST, GD, VPAA	Update all current articulation agreements	10/18-3/19
Extend Articulation agreements to include Dual Admission option for incoming students	SC, DMST, GD, VPAA	Complete the Dual Admission MOU initiated the previous spring	10/18-4/18
Formalize actuation agreements	SC, DMST, GD, VPAA	Complete at least one new actuation agreement initiated the previous spring	10/18-4/18
Initiate Articulation discussions with new Partner Institutions	SC, DAA, DMST, GD, VPAA	Initiate Articulation discussions with at least two new Colleges or Universities	4/19-9/19
Enter into new Dual Admission discussions with current Articulation Partner Institutions	SC, DAA, DMST, GD, VPAA	Start serious discussions with a least one current partner school with an eye toward completing the DA agreement the following fall	4/19-9/19
Continuation of the APP development. Develop a forum in the Transfer Academy webpage and App that is searchable by partner institution. This forum will allow current and former BCC students can share their transfer experiences so that the next student may learn the do’s and dont’s of courses and program selection in order maximize the number of program requirements that transfer	SC, IT, GD, WM	Have the forum operational by the end of the fall 2018 and then fine tune it in the spring.	10/18 – 9/19
Develop STEM notification about the different STEM event and activities on campus to the students on their phone (optional feature)	SC, WM, GD	Task IT students in the developing mobile notifications for the STEM students.	10/18-9/18
The continuation of the Transfer Informational sessions with the different Universities from NJ/NY area.	SC, TC,	Keep promoting and improving the transfer informational sessions	10/18-9/20
Implement Phase II of Action Plan: Continue Revision of STEM Curriculum	DMST, Cadre	All STEM Gateway Courses will be revised to improve Cultural Sensitivity	10/18-9/19

STEM and Lang. Arts Professors Collaborate through the Science Infusion Program	DMST, Cadre, Language Arts Professors	STEM Lab Reports will be Re-designed	10/18-9/19
Implement Phase II of Action Plan: Implement professional development on Culturally Sensitive Pedagogies	DMST, PC's, Needs Assessment Team	At least one STEM workshop will be devoted to culturally sensitive pedagogies.	10/18-12/18
Evaluate Action Plan and Revise for Year 4	SC, DAA, DMST, GD, VPAA	Action Plan will be Revised	4/19-9/19
Year 4 (October 1, 2019 – September 30, 2020)			
STEM Student Services Meeting	CLAC Manager, SI STEM Coordinator, STEM Tutorial Supervisor, Grant Director, STEM Tutorial Supervisor, Project Director, faculty involved with SI & JOLT	Revisit goals and mission, review data collected from FY 2018	Once per academic semester
JOLT Program Expansion & Improvement	CLAC Manager, SI STEM Coordinator, SI Assistants, STEM Tutorial Supervisor, Project Director, faculty involved in SI and JOLT	Work with administrators, vice presidents, and Project Director to institutionalize	Duration of Grant Year
Run 12 sections SI, fall 2019 Run 14 sections SI, spring 2020 Run 3-5 sections SI, summer 2020	CLAC Manager, SI STEM Coordinator, SI Assistants, STEM Tutorial Supervisor, Tutorial Supervisors	Gradual increase of SI sections, data collection, increase faculty and adjunct support	10/19 – 9/20
Extend Articulation agreements to include Dual Admission option for incoming students	SC, DMST, GD, VPAA	Complete the Dual Admission MOU initiated the previous spring	10/19-4/20
Formalize actuation agreements	SC, DMST, GD, VPAA	Complete at least one new actuation agreement initiated the previous spring	10/19-4/20
Initiate Articulation discussions with new Partner Institutions	SC, DAA, DMST, GD, VPAA	Initiate Articulation discussions with at least two new Colleges or Universities	4/20-9/20
Enter into new Dual Admission discussions with current Articulation Partner Institutions	SC, DAA, DMST, GD, VPAA	Start serious discussions with a least one current partner school with an eye toward completing the DA agreement the following fall	4/20-9/20
The continuation of the Transfer Informational sessions with the different Universities from NJ/NY area.	SC, TC,	Keep promoting and improving the transfer informational sessions	10/10-9/20
Development of the website & APP	SC, WM, IT, GD, GC, Cadre, STS, DMST	Keep updating both as new features are develop. Task IT students in the development of the Website and APP.	10/19-9/20

Implement Phase III of Action Plan: Continue Revision of STEM Curriculum	DMST, Cadre	Curricula of three additional STEM courses will be revised.	10/19-4/20
Implement Phase III of Action Plan: Implement professional development on Culturally Sensitive Pedagogies	DMST, PC's, Needs Assessment Team	At least one workshop will be devoted to the application of math to science in Developmental Math.	10/19-12/19
STEM and Lang. Arts Professors Collaborate through the Science Infusion Program	DMST, Cadre, Language Arts Professors	STEM Lab Reports will be Re-designed for All gateway Science courses	10/19-9/20
Evaluate Action Plan and Revise for Year 5	SC, DAA, DMST, GD, VPAA	Action Plan will be Revised	4/20-9/20
Year 5 (October 1, 2020 – September 30, 2021)			
STEM Student Services Meeting	CLAC Manager, SI STEM Coordinator, SI Assistants, Grant Director, STEM Tutorial Supervisor, Project Director, faculty involved with SI & JOLT	Revisit goals and mission, review data collected from FY 2019	Once per academic semester
Run 17 sections SI, fall 2020 Run 20 sections SI, spring 2021 Run 3-5 sections SI, summer 2021	CLAC Manager, SI STEM Coordinator, SI Assistants, STEM Tutorial Supervisor, Tutorial Supervisors	Gradual increase of SI sections, data collection, increase faculty and adjunct support	10/20 – 9/21
Institutionalization of services	President, AVP, Project Director, DSTM, Grant Director	College absorbs position of SI Coordinator	10/20 – 5/21
Extend Articulation agreements to include Dual Admission option for incoming students	SC, DMST, GD, VPAA	Complete the Dual Admission MOU initiated the previous spring	10/20-4/21
Formalize actuation agreements	SC, DMST, GD, VPAA	Complete at least one new actuation agreement initiated the previous spring	10/20-4/21
Initiate Articulation discussions with new Partner Institutions	SC, DAA, DMST, GD, VPAA	Initiate Articulation discussions with at least two new Colleges or Universities	4/21-9/21
Enter into new Dual Admission discussions with current Articulation Partner Institutions	SC, DAA, DMST, GD, VPAA	Start serious discussions with a least one current partner school with an eye toward completing the DA agreement the following fall	4/21-9/21
Integrate the transfer academy workshops into the colleges overall advising activities.	SC, GD, DAA, DMST	Continue with at least three transfer workshops a semester on key topics beyond the time period of the grant	10/21-9/22
Continue to make improvement to the colleges now interactive webpage	SC, DMST, GD, WM, DAA	Integrate five year student and faculty feedback to make final format and content changes to the platform	10/21-9/22

Disseminate the Universal aspects of the STEM Transfer Academy to other HIS Institutions	SC, DMST, GD,WM, DAA	Induce at least one partner institution to adopt the transfer academy app as a tool to help their students stay on top of potential transfer issues that they may run in.	
Implement Phase IV of Action Plan: Continue Revision of STEM Curriculum	DMST, Cadre	Curricula of three additional STEM courses will be revised.	10/20-4/21
Implement Phase IV of Action Plan: Implement professional development on Culturally Sensitive Pedagogies	DMST, PC's, Needs Assessment Team	At least one STEM workshop will be devoted to Culturally Sensitive Pedagogies	10/20-12/20
STEM and Lang. Arts Professors Collaborate through the Science Infusion Program	DMST, Cadre, Language Arts Professors	STEM Lab Reports will be Re-designed three additional Science Courses.	10/20-9/21
Evaluate Action Plan and Revise for Year 5	SC, DAA, DMST, GD, VPAA	Action Plan will be Revised	4/21-9/21
Year 6 (October 1, 2021 – September 30, 2022): First Year Post-Grant⁴⁴			
Update current articulation agreements	SC, DAA, DMST, GD, VPAA	Update all current articulation agreements	10/21-3/22
Build the Articulation Agreements process that has been modeled over the first five years of the grant into the day to day operations of Academic Affairs	SC, DAA, DMST, GD, VPAA	Complete at new actuation agreements based on an open and continuous dialogue with institutions in the region	4/22-10/22
Continue to extend the most successful articulation agreements in working Dual Admission programs between the schools	SC, DAA, DMST, GD, VPAA	Continue to complete Dual Admissions agreements with institutions in the region at a rate of one per year	12/21-10/22
Implement Phase V of Action Plan: Continue Revision of STEM Curriculum	DMST, Cadre	Curricula of three additional STEM courses will be revised.	10/20-4/21
Implement Phase IV of Action Plan: Implement professional development on Culturally Sensitive Pedagogies	DMST, PC's, Needs Assessment Team	At least one STEM workshop will be devoted to Culturally Sensitive Pedagogies	10/20-12/20
STEM and Lang. Arts Professors Collaborate through the Science Infusion Program	DMST, Cadre, Language Arts Professors	STEM Lab Reports will be Re-designed three additional Science Courses.	10/20-9/21
Evaluate Action Plan and Revise for Year 5	SC, DAA, DMST, GD, VPAA	Action Plan will be Revised	4/20-9/20

⁴⁴ Bergen Community College assumes all costs during Year 6.



The Project Director will have authority to administer all activities relevant to the grant.

Personnel Management: The Principal Investigator, will be charged with the authority of grant administration. Mr. Luis DeAbreu, the Project Director, will oversee grant management. Mr. DeAbreu will report directly to Dean PJ Ricatto (Dean of the Division of Science, Mathematics and Technology), the Principal Investigator, who will report to Dr. B. Kaye Walter, the College President, thereby ensuring support for the project from the highest levels of the organization. Mr. DeAbreu will seamlessly transition from serving as Project Coordinator of the 2011 HSI STEM grant to Project Director of *STEMatics*.

Luis De Abreu (B.S. in Finance and Accounting, Rutgers University, Newark, NJ) has been involved with the STEM “GPS” Grant initiative at Bergen since September 2012. At that time, Mr. De Abreu was appointed as the STEM Tutorial Supervisor at the Cerullo Learning Assistance Center, leading a very successful STEM tutoring operation that helped the learning center gain national recognition by the National College Learning Center Association as the 2014 *Frank L. Christ Outstanding Learning Center Award* for two year institutions and the 2016 *Program of the Year Award* by the National Tutoring Association. In September 2014, Mr. De Abreu assumed the role of the STEM GPS Grant Coordinator, helping this project reach a new high. His leadership as well as people skills are key factors that allowed the project to be recognized campus-wide. His hiring will be contingent upon following the appropriate processes and procedures at the College.

The Project Coordinator will work in collaboration with faculty and staff to ensure that project timelines and budgets are being adhered to and that outcomes are being met. Through bi-weekly meetings with the STEM Student Scholars Program Coordinator, Supplemental Instruction Supervisor and STEM Counselors, the Project Director will keep them informed of

project activities and related budget expenditures, and progress being made towards the achievement of project outcomes. The Project Director will coordinate all project activities with the management team, project staff, External Evaluator, and administrative assistant.

A STEM Advisory Committee will collaborate with Dean Ricatto and Mr. DeAbreu to ensure activities are effectively implemented and consistent with project goals.

Responsibilities, reporting lines and qualifications appear in Tables 10 to 11 below.

Table 10 –FULL TIME PERSONNEL

<p>PRINCIPAL INVESTIGATOR (20% time commitment) <i>Responsibility:</i> Implementing/institutionalizing <i>STEMatics</i>. <i>Reporting & Supervision:</i> Reports to the Vice President of Academic Affairs. Supervise Program Manager. <i>Specific Functions:</i> Serve as liaison to the U.S. Department of Education. Manage execution of the 5-year plan and budget and is accountable to proposed <i>STEMatics</i> goals & outcomes. Oversees evaluation, interfaces with External Evaluation Team and Office of Institutional Research.</p> <p>PROGRAM DIRECTOR (Full-Time) <i>Reporting & Supervision:</i> Reports to the Principal Investigator. Serves as Ex-Officio on the STEM Advisory Committee, the Project's oversight board. Supervises Campaign Staff. <i>Specific Functions:</i> Manages execution of Five-Year Plan and budget and is accountable to Project goals & outcomes. Oversees evaluation, interfacing with External Evaluation and Center for Institutional Effectiveness. Manages the day-to-day operation and coordinates all aspects of the activities, from staff to recruitment, interfacing with faculty and departments, monitoring progress, convening stakeholders, and supporting the Principal Investigator in promoting the Program. <i>Reporting & Supervision:</i> Reports to the Dean of Science, Mathematics and Technology above (Academic Affairs in the formal sense). Has dashed-line supervision over Counselors and other Coordinators, who formally report to managers within their division. <i>Qualifications:</i> Bachelor's degree; experience in higher education; experience in managing large projects.</p> <p>STEM COUNSELORS – Total of 5 full-time (2 In-kind; 3 Grant-funded); (100% time commitment) <i>Responsibility & Functions:</i> Meet with all first time STEM students at least once every 2 weeks for academic, transfer and career advising. <i>Reporting & Supervision:</i> Reporting to the Dean for Student Success with a dashed line to Program Director. <i>Qualifications:</i> Masters in Social Work or related field.</p> <p>SUPPLEMENTAL INSTRUCTION COORDINATOR (Full-time) <i>Responsibility & Functions:</i> Guide and support SI Leaders as they learn to navigate the procedures pertaining to the SI model. Schedules SI program sections, observes SI leaders, and collects SI program data. <i>Reporting & Supervision:</i> Reports to the CLAC Manager. Supervises SI Leaders. <i>Qualifications:</i> Bachelor's degree.</p> <p>DUAL ADMISSION COORDINATOR (0.25 FTE) <i>Responsibility:</i> Interfaces with 4-year partners to develop dual admission agreements. Ensures proper alignment of programs. <i>Reporting & Supervision:</i> Reports to the Project Director. <i>Qualifications:</i> Bachelor's degree.</p> <p>STEM DATA ANALYST/RESERACHER (0.25 FTE) <i>Responsibility:</i> Supports Project Director in student tracking, data management and reporting. <i>Reporting & Supervision:</i> Reports to the Managing Director of Institutional Research. <i>Qualifications:</i> Bachelors in related field.</p> <p>GRANT PURCHASING SPECIALIST (0.25 FTE) <i>Responsibility:</i> Carries out purchases for <i>STEMatics</i> in adherence with federal, state, grant and college policies and procedures. <i>Reporting & Supervision:</i> Reports to the Managing Director of Purchasing. <i>Qualifications:</i> Associates degree; certified purchasing agent.</p>

S3P CENTER COORDINATOR – (0.5 FTE) Responsibility: Coordinates day to day management of STEM Student Scholars Program, reviews applications for S3P acceptance; maintains student participation records and reports. **Reporting & Supervision:** Reports to the Project Director. **Qualifications:** Associates degree.

GRANT MANAGER (0.3 FTE) Responsibility: Financial management of *STEMatics* program in adherence with grant guidelines. **Reporting & Supervision:** Reports to the Director of Grants Administration. **Qualifications:** Bachelor’s degree.

Table 11 – PART TIME PERSONNEL

All operate under the supervision of the Project Director with appropriate input from, and in communication with, respective managers in their own areas.

SI LEADERS Responsibility & Functions: Provide prescribed tutorial support in identified SI sections. Participates in training on learning to navigate the procedures pertaining to the SI model. **Reporting & Supervision:** Reports to the SI Coordinator. **Qualifications:** Must have received a grade of B or higher in assigned course.

SI STEM ASSISTANTS Responsibility & Functions: Provide support in the areas of scheduling and data collection for the SI Coordinator. Maintains time sheets for SI Leaders. **Reporting & Supervision:** Reports to the SI Coordinator. **Qualifications:** Associates degree.

FACULTY RELEASE TIME Responsibility & Functions: Participates in one of many activities requiring faculty participation: curriculum enhancements, engineering design course, dual admissions, open educational resources and summer bridge/bootcamps. **Reporting & Supervision:** Reports to department chairs with collaboration with Principal Investigator. **Qualifications:** Current full-time or part-time professor.

STUDENT INTERNS Responsibility & Functions: S3P participant with project leadership responsibilities or general project collaboration. **Reporting & Supervision:** Reports to the S3P Coordinator. **Qualifications:** Must maintain a 3.2 GPA or higher in STEM discipline.

FINANCIAL LITERACY ASSISTANT Responsibility & Functions: Provide support in the areas of scheduling and data collection for financial counseling. **Reporting & Supervision:** Reports to the Executive Director of Financial Aid. **Qualifications:** Associates degree.

QUALITY OF EVALUATION PLAN

(1) Goals, Objectives, Outcomes

The *STEMatics* Project goals, objectives, and outcomes are consistent with the purposes of the HSI STEM and Articulation Program. The project outcomes provide specific and measurable indicators and benchmarks linked with the identified problems, gaps, and weaknesses at BCC as described in the “Quality of Project Design” section. More than 2,500 STEM students will be affected by the project services annually, with 50% increases being achieved in both program completion and transfer rates, compared to baseline data. Most significantly, substantial

increases in STEM achievement will be realized by the targeted population, low income and/or Hispanic STEM students. The goals of our project address the Absolute and Competitive Preference (#2) Priorities of the HSI STEM and Articulation Program. They are:

Goal 1: Strengthen Learning Engagement of 2,500+ STEM students (cohorts and beneficiaries) annually; 20% or 2,000 first-time full-time degree seeking STEM students, especially at-risk low-income and/or Hispanic students (30% or 600) during the five year grant period.

Goal 2: Broaden the role of 20 four-year and industry partners, as well as government agencies, to become joint stewards of student success.

Goal 3: Equip STEM students with the financial empowerment necessary to persist through degree completion.

Table 12: Goals, Objectives, Performance Measures		
<p>Goal 1: <i>Strengthen the Learning Engagement of 2,500+ STEM students (cohorts & beneficiaries) annually; 20% or 2,000 first-time full-time degree seeking STEM students, especially at-risk low-income and/or Hispanic students (30% or 600) for the 5-year period.</i></p> <p>Outcomes:</p> <ul style="list-style-type: none"> * <i>Improved Academic Performance (Decrease failure rates by 30% in gateway courses)</i> * <i>Enhanced Academic Skills & Motivation</i> * <i>Raised Faculty/Staff Sensitivities & Piqued Involvement</i> 		
ACTIVITY	OBJECTIVE	PERFORMANCE MEASURE (#3 is not applicable)
Activity 1: Testing Supplemental Instruction in Gatekeeper Courses (Randomized Controlled Trial)	Objective 1a: The failure rates for students enrolled in gateway STEM courses (MAT160 & MAT180) will decrease by 30%. Objective 1b: By the completion of the project, a causally valid relationship between SI and increased academic performance will be established, with an improvement of 1.0 GPA points in the treatment group course compared with the pre-requisite requirement	#7 The percent of Hispanic and low-income students who participated in grant-supported services or programs who successfully completed gateway courses. #4 The percentage of Hispanic and low-income first-time, full-time degree-seeking undergraduate students enrolled at two-year HSIs graduating within three years of enrollment with a STEM field degree/credential.
Activity 2: Implement Intensive Academic, Transfer & Career Advising	Objective 2: By the end of the 5 year project period, 100% of incoming STEM majors will have consulted with an advisor at least twice per month during their first year.	#6 The number of Hispanic and low-income students participating in grant-funded student support programs or services will . #8 The percent of Hispanic and low-income students who participated in grant-supported services or programs in good academic standing. #10 The percent of Hispanic and low-income students who participated in grant-supported services or programs and completed a degree or credential
Activity 3: Professional Development for Culturally Sensitive Teaching/Enhancements of the STEM curriculum to target the needs of a culturally diverse student population	Objective 3: By the end of the 5 year project period, 100% of full-time STEM faculty and at least 50% of part-time faculty will have received professional development relating to culturally-sensitive teaching.	#8 (see above)
Activity 4: Offering Online STEM tutoring	Objective 4: By the end of the 5 year project period, 100% of STEM majors will have access to online tutoring.	#8 (see above)
<p>Goal 2: <i>Broaden the role of 20 partners from four-year colleges, industry and government agencies, to become joint stewards of student success.</i></p> <p>Outcomes:</p> <ul style="list-style-type: none"> * <i>Active involvement of academic, industry and government partners in promoting student success</i> 		

ACTIVITY	OBJECTIVE	PERFORMANCE MEASURE
Activity 5: STEM Student Scholars Program with 4-year college and industry partners via Statewide Hispanic Chamber of Commerce of New Jersey	Objective 5: By the end of the 5-year project period, 400 internships with at least 10 institutions of higher education and 10 industry partners will have been completed.	#1 The percentage change, over the five-year grant period, of the number of Hispanic and low-income full-time STEM field degree-seeking undergraduate students enrolled.
Activity 6: Introduction of Engineering Design sequence to streamline Engineering student transfer	Objective 6: By the end of the 5 year project period, 100% of STEM majors planning on transferring to a four-year Engineering program will have completed at least 2 Design courses.	#9 The percent of Hispanic and low-income STEM field major transfer students on track to complete a STEM field degree within three years from their transfer date.
Activity 7: Utilize the STEM C ² Research Summit as a platform to showcase Hispanic STEM student talent and successful industry representatives	Objective 7: By the end of the 5-year project period, the STEM C ² Research Summit will become a nationally recognized platform for promoting Hispanic student representation in STEM, with a 50% increase in the number of participants from Hispanic-Serving Institutions	#1 (see above)
<p>Goal 3: Equip STEM students with the financial tools necessary to persist through degree completion.</p> <p>Outcomes:</p> <ul style="list-style-type: none"> * Heightened commitment to academic success * Gained resourcefulness and ability to cope with financial challenges 		
ACTIVITY	OBJECTIVE	PERFORMANCE MEASURE
Activity 8: Development of Dual Admissions Agreements with four-year colleges and universities.	Objective 8: By the end of the 5-year project period, at least 5 Dual Admissions agreements will have been established.	#5 The percentage of Hispanic and low-income students transferring successfully to a four-year institution from a two-year institution and retained in a STEM field major. #9 (see above)
Activity 9: Utilization of Open Education Resources (OER) to adopt free vetted on-line textbooks.	Objective 9: By the end of the 5-year project period, 100% of the 18 courses that comprise the Associate in Science, Natural Science and Math (AS.NSM.GEN) degree will utilize OER's.	#1 (see above) #2 The percentage of Hispanic and low-income first-time, full-time STEM field degree-seeking undergraduate students who were in their first year of postsecondary enrollment in the previous year and are enrolled in the current year who remain in a STEM field degree/credential program.
Activity 10: Introduction of financial aid and literacy counseling.	Objective 10: By the end of the 5 year project period, 75% of incoming STEM majors will have met with a financial counselor at least once per semester.	#1 (see above) #2 (see above)
Activity 11: Free Accuplacer placement test preparation and Gateway course boot-camps.	Objective 11: By the end of the 5-year project period, a) there will be an increase in the # of STEM majors placing into college-level math by 20%; b) 80% of students attending bootcamps will be in good academic standing	#4 (see above) #7 (see above) #8 (see above)

(2) Methods of Evaluation

The evaluation of *STEMatics* is designed to (a) deliver a rigorous set of data to meet the What Works Clearinghouse criteria for strong theory; (b) offer timely and ongoing guidance for program adjustment and delivery; and (c) provide an assessment of *STEMatics*' impact on program participants. Specifically, through the use of a combination of qualitative and quantitative techniques, the evaluation will address a series of questions regarding structure, process, outputs, outcomes, and effects of *STEMatics* (Table 13).

Table 13: Evaluation Questions
<p>STRUCTURE: (1) Is <i>STEMatics</i> being delivered to the appropriate target individuals? (2) Is <i>STEMatics</i> being administered with the appropriate effort and resources—e.g., personnel, equipment, and outreach- in order to minimize participant attrition and confounding factors?</p> <p>PROCESS/INTERVENTION: (3) Is <i>STEMatics</i> being delivered according to intended specifications; e.g., appropriate type, amount, duration, and quality of services?</p> <p>OUTPUT: (4) Is <i>STEMatics</i> serving the stated number of individuals—2,500 students in Years 2-5? (5) Is <i>STEMatics</i> offering the appropriate number of class sections in the SI treatment and control groups? (6) Is <i>STEMatics</i> engaging the appropriate number of faculty/tutors /program coordinators?</p> <p>OUTCOMES: (7) Improvements in participants' academic performance—higher grade point average, longer retention in program, decreased ratio of credits attempted to credits earned, and shorter time to completion, degree attainment and transfer to 4-year colleges. (8) Enhancement of soft skills—improved confidence, higher academic motivation. (9) Enrichment of institutional commitment to student success and enhanced professional development of faculty involved in <i>STEMatics</i>. (10) Involvement of academic, industry and government partners-commitment to actively partner on hands-on projects, conferences, and student engagement (11) Heightened commitment to college success, improved coping skills, clarity about future plans and career choices, and stronger sense of community and belonging. (12) Resourcefulness and ability to cope with financial challenges-development of OER degree, budget planning, credit rating, default prevention</p>

The project's effectiveness will be assured through data-driven decision making. A number of entities and individuals will be involved in the evaluation plan, which will be launched at the start of the project and will span its full duration. Lead among them are: The STEM Advisory Committee, the Project Coordinator, the Dean of Science, Mathematics, and Technology, the

College's Center for Institutional Effectiveness (CIE), which administers institutional research and reports to a vice president for research and assessment, the Office of Institutional Research (IR), and the External Evaluator (EE). IR staff will support and collaborate with the External Evaluator in data gathering and analysis efforts, and communicate periodic reviews with the leadership of the project and College on all aspects of the initiative.

—*Internal Perspective.* The Project Coordinator will present analysis briefings on a quarterly basis to the STEM Advisory Committee that will include relevant course enrollment and performance data; the status of Dual Admission agreements with 4-year institutions; the status of the professional development effort; the implementation of *STEMatics*; and observations from Advisors/Counselors, tutors, peers, and faculty. Researchers at the Center for Institutional Effectiveness, which has full access to a broad array of institutional and student data, will be key players in the evaluation process. They will administer a set survey schedule and fulfill as needed requests from the project for additional studies and analyses.

—*External Perspective.* The External Evaluator will serve as an independent reviewer and be retained from the start of the project. His/her charge is threefold: (1) review operational effectiveness and quality of courses, programs and events, including extent of participation, collaboration, and communication; (2) measure progress vis-à-vis stated objectives and outcomes by monitoring indicators at pre-established dates, including student performance and attitudes, faculty and peer reactions, and conducting cumulative annual reviews; and (3) assess the project's success in recruiting STEM students, in enhancing their persistence and graduation rates, and in easing their transitions to college and careers. As independent counsel, the Evaluator will suggest continued adjustments toward improvement and sustainability (formative) and render in Year 5 an objective judgment regarding the overall goal attainment and lessons

learned (summative). There will be ongoing communication and meetings with the Project Director, Director of Grants Administration, and STEM Advisory Committee, semi-annual written formative reports (February/July) and a final summative report at the end of Year 5. —*Evaluation Team*. The College intends to retain the services of Toufic M. Hakim, Ph.D., Principal Grants Advisor at Group i&i, to conduct the external evaluation as described, pending approval in accordance with procedures and regulations set forth by the College. A former university professor and director of numerous large grant projects, Dr. Hakim served as Senior Research Officer at Kean University, a New Jersey public university with a large Hispanic student body, where he oversaw all externally-funded programs including a dozen from the U.S. Department of Education. He has been involved in multiple grant-related projects at community colleges, including Bergen Community College, and led the evaluations of institutional Title III and Title V initiatives and a large U.S. Departmental of Labor grant project. He served as Review Panelist for the National Science Foundation and advised on a NSF-funded national evaluation project.

(3) What Works Clearinghouse with or without reservations

What Works Clearinghouse (WWC) without reservations

Evaluation Design. The design that experts agree is the ‘gold standard,’ to help establish causal relationships between programs and outcomes unambiguously, is the classical experimental design, where participants within each institution are randomly assigned to a treatment group or a control group that does not receive interventions. The metric of ‘gold standard’ is justified inasmuch as this guarantees satisfaction of the three primary conditions for causal relationships, viz., temporal precedence of cause over effect, empirical association, and non-spuriousness of

the association between cause and effect. It is the last condition that a classical experiment particularly helps establish.

This experiment is designed to test the effectiveness of Supplemental Instruction on gateway courses with the highest failure rates, MAT 160 (Intermediate Algebra) and MAT 180 (Pre-calculus). This experimental evaluation seeks to make valid inferences about the effects of the treatment and avoid Type I/II errors. It will employ a randomized controlled trial design using simple random sampling. Since selection into the study is based on a chance process, the design ensures that, at the beginning of the study, participants resemble non-participants in *all* respects on average, both measured and unmeasured. Because program participation is the *only* remaining difference between treatment and control groups, any differences in outcomes between groups can be authoritatively attributed to the program. The evaluation plan therefore entails the random assignment of students to the Supplemental Instruction treatment group and control group.

Attrition. It is necessary to maintain low attrition rates in each of the groups in order to meet the WWC standards without reservations. It is for this reason that random assignment will take place only once the student is registered for the study's courses. This will mitigate attrition and improve chances for meeting WWC standards without reservations.

Attrition boundary: A conservative attrition boundary will be used to determine the highest differential attrition for the sample for cluster and sub-cluster levels analyses.

Baseline equivalence: STEM student outcomes for first time students during academic year 2015-2016 will be used as the baseline sample for comparison with the analytic group. Absolute effect size differences from 0.0 to 0.05 and 0.05 to 0.25 with statistical adjustment will be considered to have met the baseline equivalence criteria.

What Works Clearinghouse with reservations: In the event that attrition rates exceed the attrition boundary, the design described above will meet WWC standards with reservations.

Evaluation Design Structure. The architecture of the experimental design is as follows:

There will be two cohorts served over the grant period. The random assignment process will take place at the end of the registration period (due to the institution’s registration procedures) for SI (treatment) and non-SI (control) groups (with approximately 25% among them identified as Hispanic/Latino). Table 14 lays out the sequence, assuming as an estimated total of 800-1,000 students in each group (MAT 160: $n_1 = 800, n_0 = 800$; MAT 180: $n_1 = 1,000, n_0 = 1,000$), where ‘X’ indicates the time of assignment for the Fall semesters and “Y” indicates the time of assignment for the Spring semesters, the shaded area indicates when the treatment will be implemented for each cohort. *Note:* The first cohort will be enrolled in MAT 160/MAT 180 in the Fall 2017 semester.

Table 14: Random Assignment Process for SI										
MAT 160 Cohorts	MAT 180 Cohorts		Year 2 (FY18)		Year 3 (FY19)		Year 4 (FY20)		Year 5 (FY21)	
			F	S	F	S	F	S	F	S
Cohort 1: $n_1 = 200$ (Tx) $n_0 = 200$ (Control)	Cohort 1: $n_1 = 250$ (Tx) $n_0 = 250$ (Control)	X	Y							
Cohort 2: $n_1 = 200$ (Tx) $n_0 = 200$ (Control)	Cohort 2: $n_1 = 250$ (Tx) $n_0 = 250$ (Control)			X	Y					
Cohort 3: $n_1 = 200$ (Tx) $n_0 = 200$ (Control)	Cohort 3: $n_1 = 250$ (Tx) $n_0 = 250$ (Control)					X	Y			
Cohort 4: $n_1 = 200$ (Tx) $n_0 = 200$ (Control)	Cohort 4: $n_1 = 250$ (Tx) $n_0 = 250$ (Control)							X	Y	

Data Measurement. All structure, process, output, and outcome measures, qualitative and quantitative, will be operationalized in consultation with designated BCC personnel. Many of these measures may require the use of existing scales with demonstrated psychometric properties for which collection instruments will also be designed in collaboration with BCC personnel.

Data Collection. All ten evaluation questions will require the collection of primary data at institutional, program personnel, and individual student levels. Table 15 summarizes the data collection plan with specific reference to evaluation questions.

Table 15: Data Collection Tools & Frequency			
Evaluation Question	Description of Data Element	Data Source	Frequency of Data Collection
Q1	Structure	* Interview with key <i>STEMatics</i> staff	Once/year
Q2	Structure	* Interview with key <i>STEMatics</i> staff	Once/semester
Q3	Process	* <i>STEMatics</i> Blueprint * Interviews with <i>STEMatics</i> staff * Focus groups with tutors * Site visits	Once/semester
Q4	Output	* <i>STEMatics</i> records from BCC (IR)	Once/year
Q5 – Q6	Output	* <i>STEMatics</i> records from BCC (IR)	Once/semester
Q7	Outcome	* BCC records (grades, retention, credits attempted/ credits earned, and time to completion of <i>STEMatics</i> and control students)	Once/semester
Q8-Q9, Q12	Outcome	* Student & faculty surveys – self-reports from <i>STEMatics</i> students and faculty	Beginning & end of semester
Q10-Q11	Outcome	* Interviews with faculty, key stakeholders	Once/year

Special Considerations. As the effects of the program have the potential to drastically improve student outcomes, we would like to have the option of removing the control group so as to not deprive needy students of a potentially effective ‘treatment.’ In such an event, each group will be categorized into subgroups based on grades in the pre-requisite math course (MAT048 for MAT160; MAT160 for MAT180), and a regression discontinuity design will be used in Years 4 and 5, with a grade of C+ in MAT048/MAT160 as the cut-off grade; i.e. anyone scoring a C+ or below in the previous course would receive treatment. This quasi-experimental design will allow the data to produce causally valid results that would meet WWC standards with reservations. Considering the complexity of this design and the tendency for most researchers to implement

this model inaccurately, BCC would seek consult from experts at MDRC (MDRC has constructed guidelines in the proper implementation of the regression discontinuity design) in order to ensure adherence to WWC standards. Finally, while we anticipate recruiting the appropriate number of students as described in Table 14, in the event that an inadequate number of participants are recruited in order to make valid inferences, other high enrollment STEM gateway courses will be considered.