

REPORT DOCUMENTATION PAGE

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14. ABSTRACT Consistent with the Department of Defense (DoD) Air Force Office of Scientific Research's (AFOSR) diversity and inclusion goals, Thurgood Marshall College Fund (TMCF) has aligned its programmatic activities to address the workforce diversity priorities of AFOSR by contributing to the agency in three critical areas: research, higher education, and industry. Specifically, TMCF has devised a cost-effective recruitment and capacity building strategy that will (1) increase the research capacity of underrepresented groups; (2) improve TMCF member-schools' ability to attract, retain, and graduate science, technology, engineering, and mathematics (STEM) students; and (3) identify and prepare a qualified STEM workforce.					
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Mission Critical STEM Partnership with the Air Force Office of Scientific Resear

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THURGOOD MARSHALL COLLEGE FUND

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Final Report

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Air Force Research Laboratory
AF Office Of Scientific Research (AFOSR)/ RTA
Arlington, Virginia 22203
Air Force Materiel Command



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Johnny C. Taylor, Jr.
Principal Investigator

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ABSTRACT

Thurgood Marshall College Fund's (TMCF) programmatic activities are aligned to address the workforce diversity priorities of the Department of Defense (DoD) Air Force Office of Scientific Research (AFOSR) in three critical areas: research, higher education, and industry. Specifically, TMCF has devised a cost-effective **recruitment** and **capacity building** strategy that will: (1) increase the research capacity of underrepresented groups; (2) improve TMCF member-schools' ability to attract, retain, and graduate science, technology, engineering, and mathematics (STEM) students; and (3) identify and prepare a qualified STEM workforce.

TMCF is the only national organization that provides merit scholarships, programmatic support, and capacity building to the nation's 47 *publicly-supported* Historically Black Colleges and Universities (HBCUs). To date, TMCF has provided nearly \$200 million in support of students and member schools. TMCF member-schools are a critical source of higher education for all students. Nearly 80% of all students enrolled in HBCUs attend TMCF member-schools.

TMCF leverages its 28-year relationship with its 47 member-schools to (1) identify, develop, and on-board HBCU students for workplace leadership roles, and (2) build TMCF member-schools' capacity to graduate STEM students and expand STEM research.

ANNUAL ACCOMPLISHMENTS

I. Training, Development, and Placement

TMCF's training, development, and placement activities, which included the annual Leadership Institute, summer internships, and K-12 teacher preparation, address the AFOSR's aim to support the preparation of students who will be equipped for STEM careers in government and industry.

Leadership Institute

The TMCF Leadership Institute is one of the premier programs of its type in the nation. Since 2000, TMCF, in partnership with its 47 *publicly-supported* member-schools, selects top performing students (juniors, seniors, and graduate students) to attend the Institute held in Washington DC. In 2014, 461 students participated, of whom 40 percent were STEM majors. Students participated in workshops, seminars, recruitment events and interviews. Topics included global leadership development and career development training.

During this conference, the DoD AFOSR professionals had the opportunity to interact with students to provide them with information on internship job opportunities with the Department of Defense. DoD AFOSR representatives helped students more fully appreciate the importance of a competitive workforce and the impact STEM careers have on national security.

In addition, students received training in career development fundamentals to prepare them for a transition to the professional workplace. Topic areas included:

- Financial Literacy
- Global Leadership

- Professionalism with emphasis on soft skills
- Personal Branding

Summer Internships

TMCF managed a summer internship program with various DoD AFOSR research directorates to provide placement of STEM students. TMCF provided a turn-key internship solution that included recruiting, screening, hiring, administering payroll, transporting, housing, and managing the students internship experience.

Overview

TMCF identified and worked in cooperation with DoD Directorates to place 28 HBCU students who served as interns at Air Force Research Labs for ten weeks during the summer (June 2 - August 8, 2014) in an effort to increase the representation of traditionally underrepresented students pursuing careers in STEM. These summer employment opportunities, *i.e.*, internships, provided students with the opportunity to engage in scientific and engineering [S&E] as well as research and development [R&D] efforts that would not otherwise be available in their campus educational environments.

Recruitment

TMCF annually touches the campuses of its 47 member-schools, primarily through campus visits, but also through teleconferences, webinars, and other technological means. These touch points with faculty, staff, administrators, and students provided the primary means by which TMCF was able to identify and recruit prospective interns. In addition to the campus touch points, TMCF utilized social media sites (Facebook, Twitter, and LinkedIn, Google+, etc.), email blasts, and word-of-mouth to spread awareness about its internship and other opportunities. These efforts resulted in 171 students submitting applications.

Participant Demographics

16% or 28 of the 171 applicants were selected and placed in internships; selected students represented fourteen (14) of the forty-seven (47) TMCF member-schools. 36% of the interns were engineering majors; 21% were information technology/computer science majors; and an additional 25% were either biological science, chemistry, or mathematics majors. Business majors were represented by 7% of the interns. Intern classifications included three (3) sophomores, six (6) juniors, twelve (12) seniors, and two (2) graduate students. Twenty (20) of the 28 interns were male, while only eight (8) were female. The average grade point average was 3.47 on a 4.0 scale.

Placement

The 28 interns are listed below:

LAST NAME	FIRST NAME	SCHOOL	MAJOR	GPA	INTERNSHIP SITE
Almon	Jamari	Alabama A & M University	Mechanical Engineering	3.52	Eglin AFB, FL
Brown	Jontia	Prairie View A & M University	Mechanical Engineering	3.55	Eglin AFB, FL
Harris	Jordan	Tuskegee University	Chemical Engineering	3.53	Eglin AFB, FL
Snow	Lanisha	Alabama State University	Secondary Education	3.60	Eglin AFB, FL
Turner	Justin	North Carolina A & T University	Electrical Engineering	3.20	Eglin AFB, FL
Williams	Keith	Alabama A & M University	Mechanical Engineering	3.29	Eglin AFB, FL
Lee	Joshua	North Carolina A & T University	Biomedical Engineering	3.38	Fort Sam Houston, TX
Wofford	Amina	Tuskegee University	Integrative Bioscience	4.00	Fort Sam Houston, TX
Galloway	Jordan	Shaw University	Chemistry/Mathematics	3.89	Griffis AFB, NY
Golden	Tyree	Norfolk State University	Electronics Engineering	3.05	Griffis AFB, NY
Greene	Michael	Morgan State University	Electrical Engineering	3.60	Griffis AFB, NY
Jackson	Frank	Tuskegee University	Aerospace Engineering	3.90	Griffis AFB, NY
Maclin	Jessica	Elizabeth City State University	Accounting	3.60	Griffis AFB, NY
Phinisee	Emily	Jackson State University	Accounting	3.40	Griffis AFB, NY
Reede, III	James	Jackson State University	Biology	3.59	Griffis AFB, NY
Bass, IV	Lowell	North Carolina A & T University	Computer Science	3.29	Wright Patterson AFB, OH
Bell	Akeadra	Elizabeth City State University	Chemistry/Biology	3.87	Wright Patterson AFB, OH
Blakemore	Elijah	Prairie View A & M University	Electrical Engineering	3.09	Wright Patterson AFB, OH
Cooper	Bryeshia	South Carolina State University	Computer Science	3.63	Wright Patterson AFB, OH
Cotton	Maso	Virginia State University	Political Science	3.24	Wright Patterson AFB, OH
Harris	Austin	Central State University	Computer Science	3.01	Wright Patterson AFB, OH
Harris	Kevin	North Carolina A & T University	Applied Mathematics	4.00	Wright Patterson AFB, OH
Hines	Patrick	North Carolina A & T University	Computer Science	3.80	Wright Patterson AFB, OH
Moffatt	Donyai	Elizabeth City State University	Aviation Science	3.40	Wright Patterson AFB, OH
Muhammad	Michael	South Carolina State University	Computer Science	3.39	Wright Patterson AFB, OH
Reynolds	Kahlil	Southern University and A & M College	Computer Science	3.20	Wright Patterson AFB, OH
Sheikh	Moiz	Prairie View A & M University	Chemistry/Chemical Engineering	3.88	Wright Patterson AFB, OH
Turner	Keonte	Jackson State University	Biology	3.29	Wright Patterson AFB, OH

Challenges

Over the past several years, TMCF has partnered with government agencies to implement and administer internship programs. Each year improvements are made to the program based on feedback received from supervisors and interns. Challenges for 2014 included:

- The specificity of the skill sets required by DoD often resulted in TMCF recruiting and placing students late in the process because the applicants in the applicant pool did not adequately meet the requirements. Sometimes, in light of the need to on-board students quickly, the students never completed the traditional application process, which resulted in gaps in our database and affected the thoroughness of our reporting
- The number of female STEM majors selected lagged significantly behind the number of selected males
- Directorates requested two non-STEM majors rather late in the process, so they were not a part of the applicant pool. Both were identified and recommended by TMCF's Internship Manager who had met and interviewed one candidate during a campus visit; the other candidate was located in our database of over 300,000 students and interviewed by phone
- TMCF was unable to fill two slots in 2014, primarily due to the timing of selections. The best candidates were often selected by more than one Directorate, resulting in the ultimate placement being made based upon the timing of the submission of the candidate's name. With the most talented students often having several options and making decisions about their summers before mid-March, we recommend that DoD begin the selection process as early as November or December of the year preceding the internship in order to compete with private industry for these students

Technology

As a non-profit organization, TMCF has to be as efficient and cost effective as possible. Towards that end, TMCF continues to leverage the latest trends in human resources technology and process automation to save hundreds of man-hours and thousands of dollars, doing more with less (*i.e.*, human resources). Through these savings, TMCF is able to allocate more funding directly to the students it serves.

JobScience is the platform used to post positions online, process applications, schedule interviews, and score written questions (when applicable) and interviews.

Harvest is the automated time-tracking platform used for processing intern payroll. Through it, interns can input time worked and supervisors verify hours of service in a three-click submission process. A paperless system, Harvest totally removes supervisors from filling out paper forms.

Zarca Interactive is the evaluation tool utilized to capture information about the internship experience from both supervisors and interns. Zarca is an online survey software that is updated quarterly to keep up with technological advances. Through Zarca, each supervisor is sent a unique URL (single-use link) per intern. TMCF is able to track the number of evaluation invitations sent, delivered, or bounced back (due to inaccurate email addresses). Zarca also tracks the number of responses received, the date and time of receipt, and the IP address of the person completing the

evaluation. Zarca also sends up to two reminders to both students and supervisors. TMCF exports responses into Excel spreadsheets for evaluation and reporting purposes.

Preparing HBCU STEM Students to Teach in K-12 Classrooms

TMCF recruited, selected and trained education and STEM majors (Fellows) to participate in a one-week Teacher Quality and Retention Summer Institute (TQRI). Veteran master mathematics and science teachers, as well as veteran National Board Certified Teachers facilitated the Institute. The training is based on the National Math and Science Initiative's (NMSI) UTeach program, which prepares STEM majors to become certified mathematics and science teachers.

Texas Southern University (TSU STEM)

This section presents the results of: (1) the demographic and academic characteristics of Fellows who participated in the Texas Southern University STEM Summer Institute and (2) Fellows' perceptions of their teaching knowledge and skills of teaching.

Recruitment

A total of thirty (30) Fellows were recruited for the STEM Summer Institute; twenty-eight (28) females and two (2) males. Fellows were recruited from HBCUs across the TMCF member-school network; 18% were enrolled/graduated in STEM majors, and 60% were enrolled/graduated in Education majors with concentrations in STEM areas. The academic status of the Fellows was: (21) undergraduate, (3) graduate/Masters, and (4) alumni.

Pre-Assessment of Knowledge

30 Fellows completed the pre-assessment and 27 completed the post-assessment measures. On the pre-assessment, the majority of respondents reported that they had some knowledge of teaching-related strategies: Classroom Management; State Standards; Differentiated Instruction Lesson Objectives; Classroom Teaching Strategies; Technology; and Common Core Standards. On the post-assessment, the majority of respondents rated their knowledge as "extremely well" for all the teaching-related variables.

Analysis of statements Fellows made about their knowledge of these teaching-related variables after the STEM Institute indicated that the majority of them had a better understanding of teaching-related strategies in mathematics and science than prior to their participation in the STEM Institute. These positive results suggest that the summer intervention had a positive impact on the Fellows knowledge of teaching-related strategies.

Institute Experience

Analysis of Fellows' reflections of their experiences during the first and last session of the first week of the Summer Institute indicated that, in general, they made positive statements about what they learned about research-based teaching practices, practices they planned on applying to their own classrooms and believed would make an immediate impact on student achievement.

Post-Assessment of Knowledge

Table I below presents the means and standard deviation (SDs) of the overall ratings of the pre- and post- assessments as well as the ratings of the seven teaching-related components of the assessments: Classroom Management, State Standards, Differentiated Instruction, Lesson Objectives, Classroom Teaching Strategies, Technology and Common Core Standards. The results indicate that, on average, Fellows' overall knowledge changed from pre- to post- assessment as well as their knowledge of specific teaching-related variables.

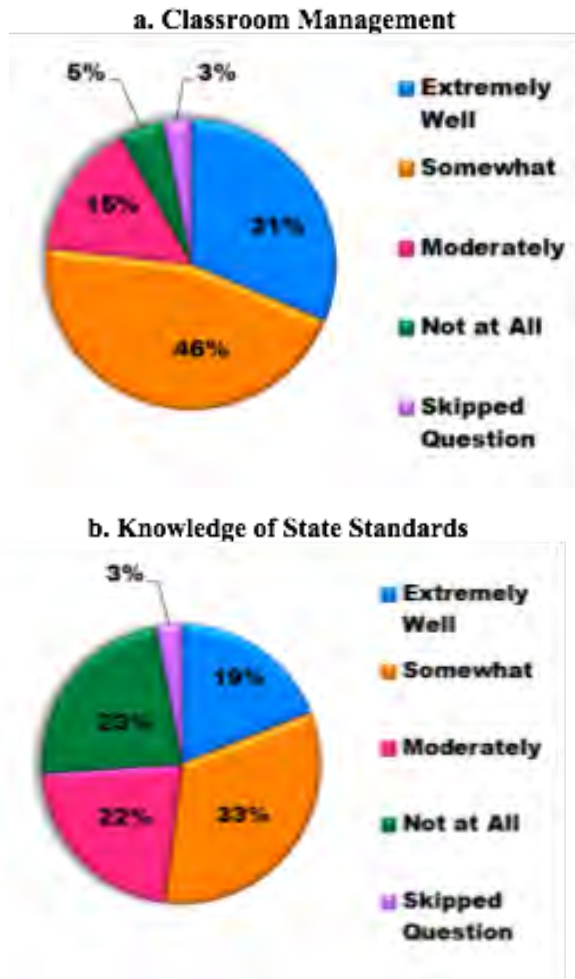
Table I
Pre-Assessment Means and Standard Deviations (SDs) - TSU STEM

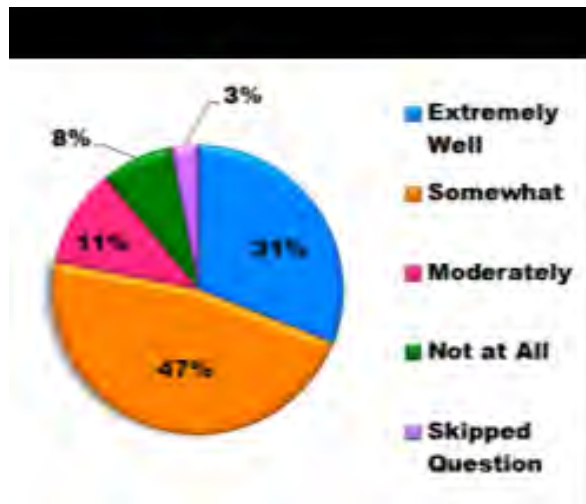
Pre and Post Assessment	Mean	N	Std. Deviation
Pre-Assessment – total	2.8269	26	.73569
Post-Assessment – total	3.4615	26	.33236
Classroom Management – pre-assessment	3.0385	26	.75476
Classroom Management – post-assessment	3.6000	26	.51225
Curriculum Standards – pre-assessment	2.4500	26	.91662
Curriculum Standards – post-assessment	3.2808	26	.53592
Differentiated Instruction – pre-assessment	3.0692	26	.85966
Differentiated Instruction – post-assessment	3.6231	26	.41309
Lesson Objectives – pre-assessment	2.9077	26	.85460
Lesson Objectives – post-assessment	3.5846	26	.47303
Classroom Teaching – pre-assessment	2.9577	26	.87186
Classroom teaching – post-assessment	3.6808	26	.47330
Technology – pre-assessment	3.0385	26	.79603
Technology – post-assessment	3.6808	26	.47330
Common Core Standards – pre-assessment	2.3038	26	.91323
Common Core Standards – post-assessment	2.8269	26	.61420

A paired sample T-test was also performed to determine if the differences in the pre- and post-assessment total and specific ratings were significant. A paired sample T-test was used because the assessment responses were obtained from the same subjects (i.e., STEM Summer Institute Fellows) under two conditions: (1) prior to the start of the Institute; and (2) after the completion of the Institute. The results showed that the difference between the total pre- and post- assessment ratings means was significant. On average, the post-test ratings ($M = 3.46$, $SD = 0.33$) are higher than the pre-test ratings ($M = 2.82$, $SD = 0.70$), $t = -4.887$ $df = 25$, $p < .001$. Moreover, the difference in the pre and post-assessment ratings was significant for the following teaching-related elements. Classroom Management: $t = -3.952$, $df = 25$, $p < .001$; State Standards, $t = -5.907$, $df = 25$, $p <$

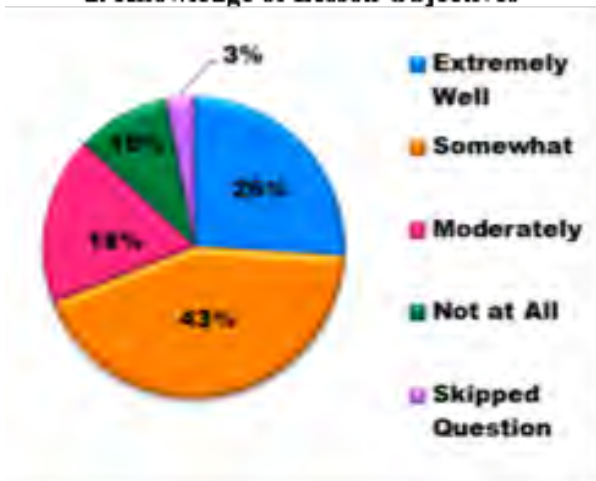
.01; Differentiated Instruction: $t = -3.493$, $df = 25$, $p < 0.01$; Lesson Objectives: $t = -4.510$, $df = 25$, $p < .01$; Classroom Teaching: $t = -4.291$, $df = 25$, $p < 0.01$; Technology: $t = -4.009$, $df = 25$, $p < 0.05$; and Common Core Standards $t = -2.665$, $df = 25$, $p < 0.05$.

Figure 1. Summary Ratings of Fellows' Perceptions of Teaching Prior to Summer Institute TSU STEM

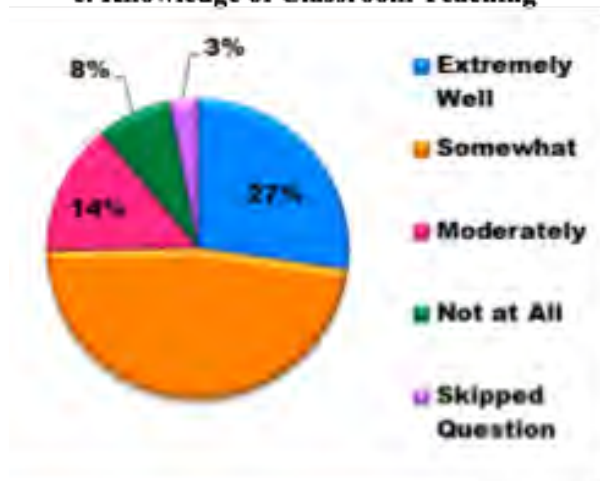




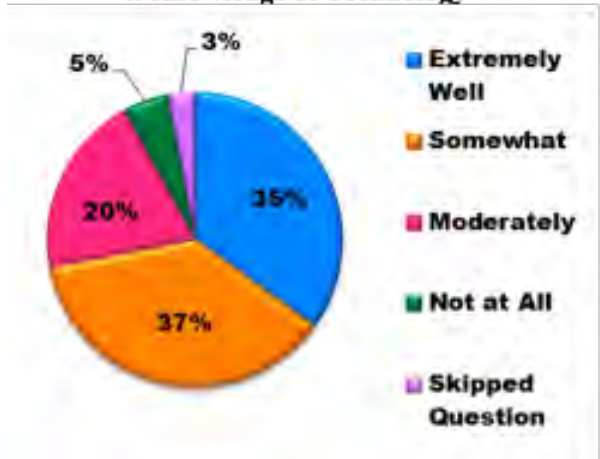
d. Knowledge of Lesson Objectives



e. Knowledge of Classroom Teaching



f. Knowledge of Technology

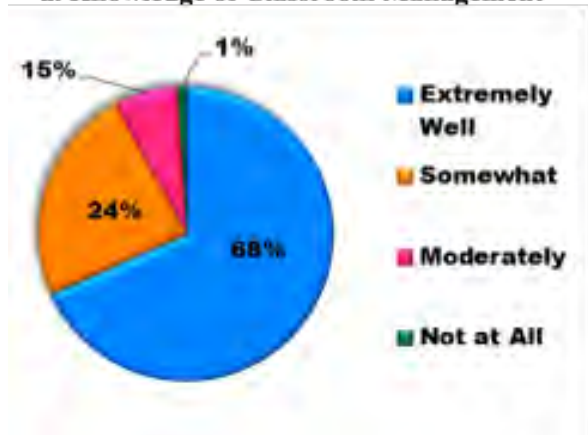


g. Knowledge of Common Core Standards

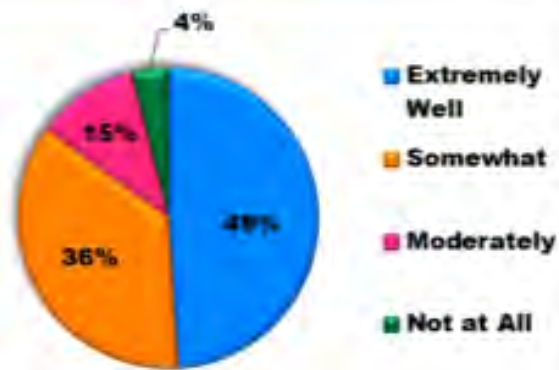


Figure 2. Summary Ratings of Fellows' Perceptions of Teaching after Summer Institute TSU STEM

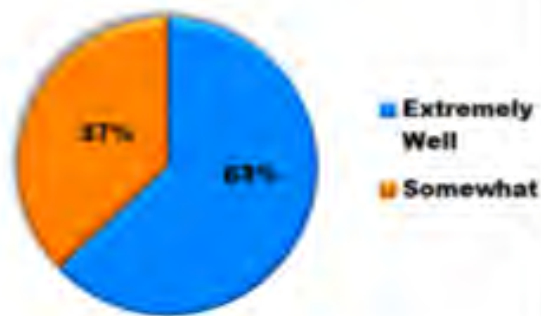
a. Knowledge of Classroom Management



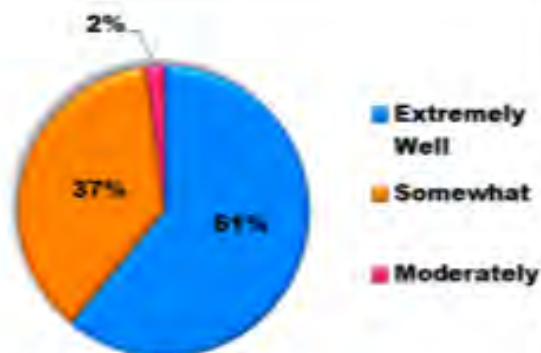
b. Knowledge of State Standards



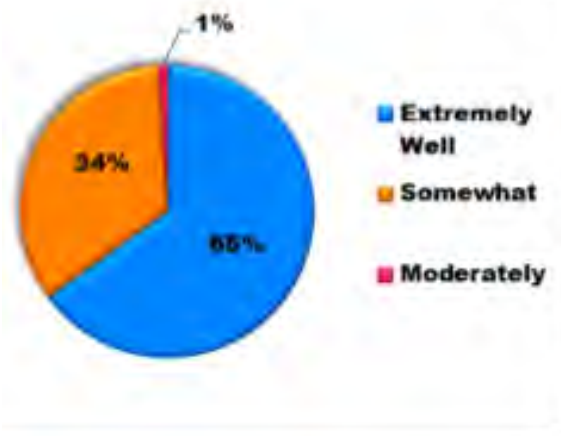
c. Knowledge of Differentiated Instruction



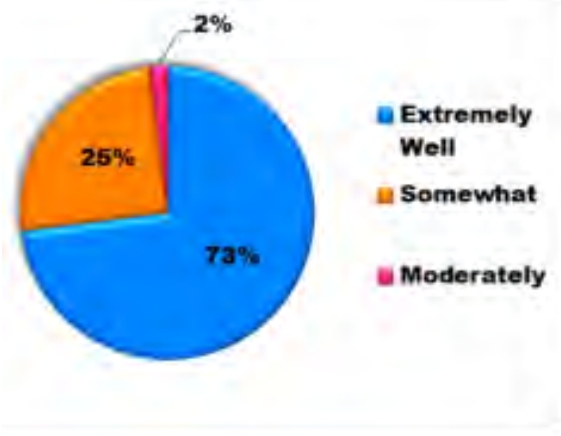
d. Knowledge of Lesson Objectives



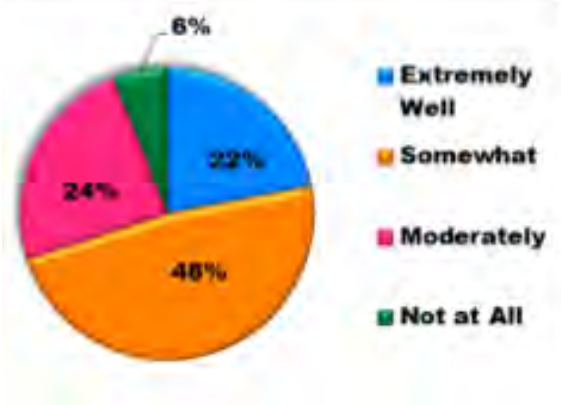
e. Knowledge of Classroom Teaching



f. Knowledge of Technology



g. Knowledge of Common Core Standards



**Texas Southern University
TXSU New Teachers**

This section presents the results of: (1) the demographic and academic characteristics of Fellows who participated in the Texas Southern University New Teachers Summer Institute; and (2) Fellows’ perceptions of their knowledge and skills of teaching.

Recruitment

A total of twenty-five (25) Fellows were recruited for the New Teachers Summer Institute; 19 females and 6 males. Fellows were recruited from HBCUs across the U.S., the majority of whom are currently employed as new teachers in various school districts. The academic status of the Fellows was: 2 undergraduate, 8 graduate/Masters, 2 alumni and 13 teachers (teaching in the classroom).

Pre-Assessment Results

Twenty-four (24) Fellows completed the pre-assessment and twenty-six (26) completed the post-assessment measures. On the pre-assessment, the majority of Fellows reported some knowledge of *Classroom Management, State Standards, Differentiated Instruction, Lesson Objectives, Classroom Teaching Strategies, Technology, and Common Core Standards*. On the post-assessment, there was little change in the respondents’ ratings of their knowledge of these teaching-related variables. Analysis of statements Fellows made about their knowledge of these teaching-related variables after the STEM Institute indicated that the majority of them had similar responses about teaching-related strategies prior to and after the Summer Institute, suggesting that the intervention had no overall impact on the Fellows knowledge of teaching-related strategies.

Table II below presents the means and standard deviation (SDs) of the overall ratings of the pre- and post- assessments as well as the ratings of the seven teaching-related components of the assessments: *Classroom Management, Curriculum Standards, Differentiated Instruction, Lesson Objectives, Classroom Teaching, Technology and Common Core Standards*. The results indicate that, on average, Fellows’ overall knowledge changed from pre- to post- assessments as well as their knowledge of some specific teaching- related variables.

**Table II
Means and Standard Deviations (SDs)-TSU New Teachers**

Pre and Post Assessment	Mean	N	Std. Deviation
Pre-assessment - total	3.2130	23	.46545
Post-assessment - total	3.3870	23	.49018
Classroom Management – pre-assessment	3.2870	23	.58099
Classroom Management – post-assessment	3.5391	23	.49151

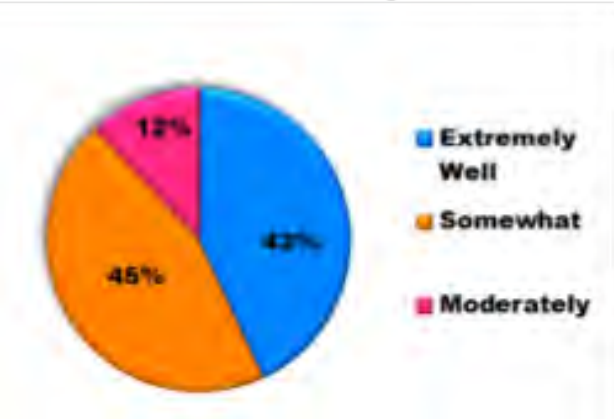
Curriculum Standards – pre-assessment	3.3174	23	.64148
Curriculum Standards – post-assessment	3.3391	23	.75783
Differentiated Instruction – pre-assessment	3.2348	23	.64287
Differentiated Instruction – post-assessment	3.4261	23	.55368
Lesson Objectives – pre-assessment	3.2348	23	.58357
Lesson Objectives – post-assessment	3.4870	23	.42566
Classroom Teaching – pre-assessment	3.3130	23	.59338
Classroom Teaching – post-assessment	3.5739	23	.44027
Technology - pre-assessment	3.3304	23	.45770
Technology – post-assessment	3.3565	23	.72100
Common Core Standards – pre-assessment	2.6870	23	.92604
Common Core Standards – pre-assessment	3.0696	23	.99015

A paired sample T-test was also performed to determine if the differences in the pre- and post-assessment totals and specific ratings were significant. A paired sample T-test was used because the assessment responses were obtained from the same subjects (i.e., New Teachers Summer Institute Fellows) under two conditions: (1) prior to the start of the Institute and (2) after the completion of the Institute. The results showed that the difference between the total pre and post assessment ratings means was significant. On average, the pre –test ratings ($M = 3.21$, $SD = 0.46$) are similar to the post-test ratings ($M = 3.38$, $SD = 0.49$), $t = -1.666$, $df = 22$, $p > 0.05$. However, the difference in the pre and post-assessment ratings was significant for only some teaching- related strategies: Lesson Objectives: $t = -2.088$, $df = 23$, $p < 0.05$; Classroom Teaching, $t = -2.299$, $df = 23$, $p < 0.05$; and Common Core Standards, $t = -2.110$, $df = 23$, $p < 0.05$.

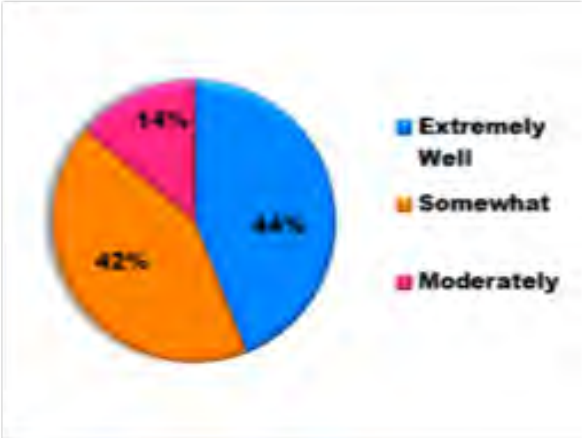
In addition, Figure 3 shows a summary of the Fellows’ knowledge in various teaching areas prior to the Institute, and Figure 4 shows a summary of the Fellows’ knowledge after the Institute.

**Figure 3. Summary Ratings of Fellows' Perceptions of Teaching Knowledge Prior to Summer Institute
TSU New Teachers**

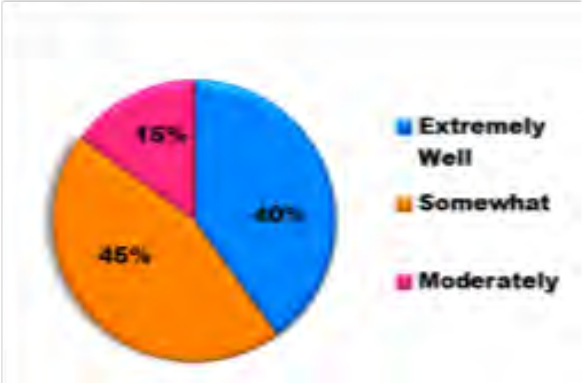
a. Classroom Management



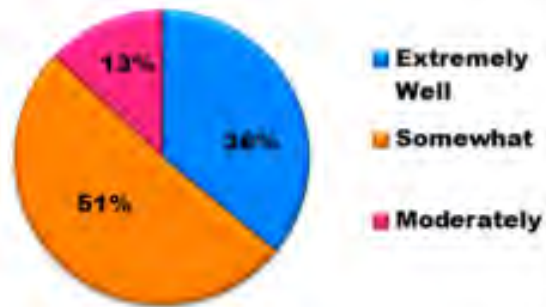
b. Knowledge of State Standards



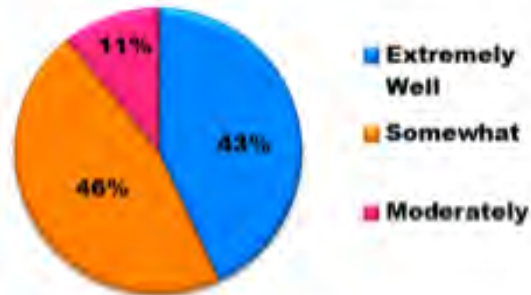
c. Knowledge of Differentiated Instruction



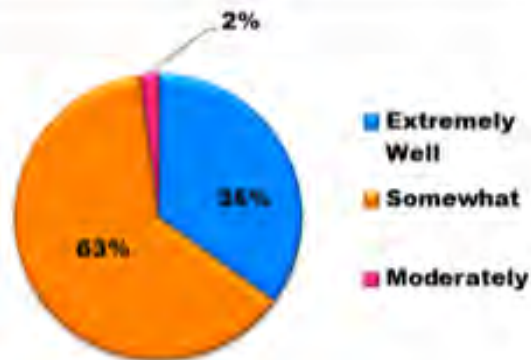
d. Knowledge of Lesson Objectives



e. Knowledge of Classroom Teaching



f. Knowledge of Technology



g. Knowledge of Common Core Standards

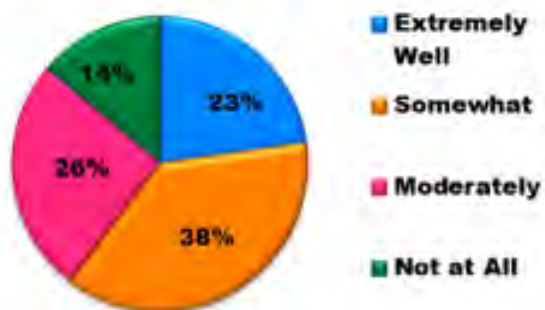
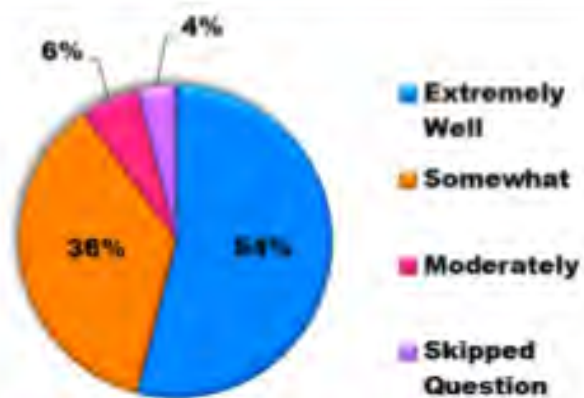
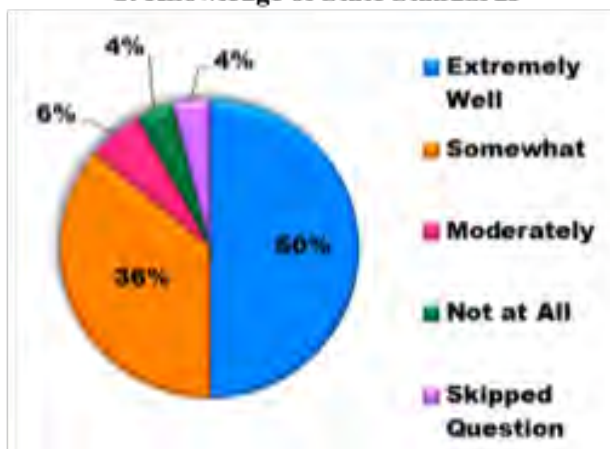


Figure 4. Summary Ratings of Fellows' Perceptions of Teaching after Summer Institute TSU New Teachers

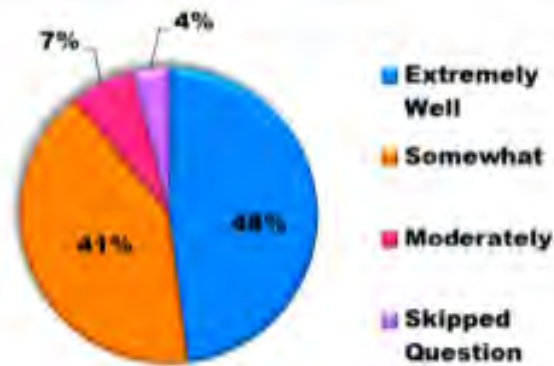
a. Classroom Management



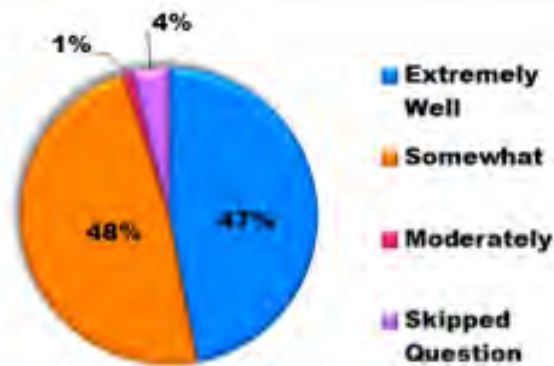
b. Knowledge of State Standards



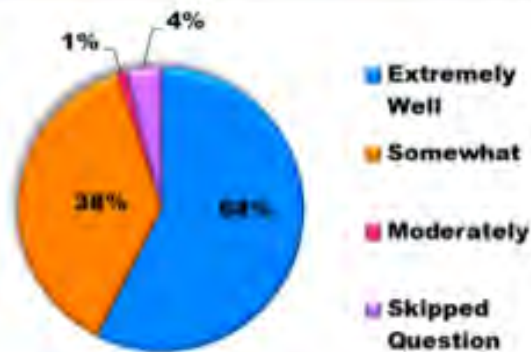
c. Knowledge of Differentiated Instruction



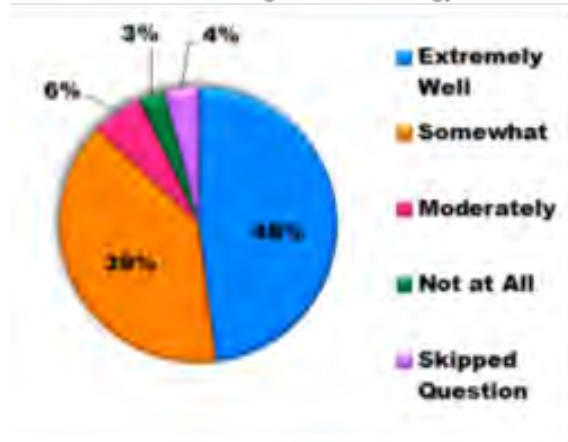
d. Knowledge of Lesson Objectives



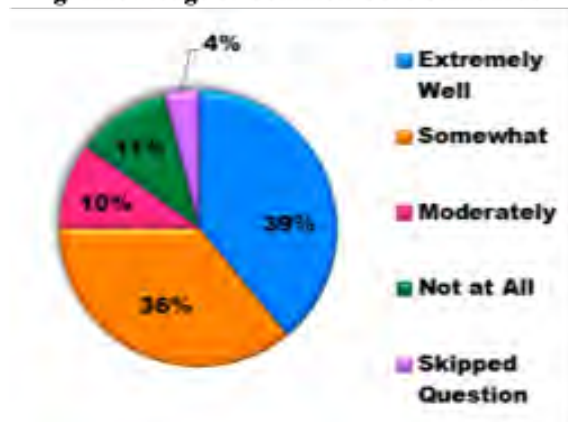
e. Knowledge of Classroom Teaching



f. Knowledge of Technology



g. Knowledge of Common Core Standards



II. Filling the STEM Pipeline

Introduction

Serving as an adjunct to America's preeminence in science and technology, *public* historically Black colleges and universities (HBCUs) continue to strengthen the quality of programs in Science, Technology, Engineering, Agriculture and Mathematics (STEAM). The ability to compete for the best and the brightest in STEAM is inextricably linked to the capacity of *public* HBCUs to produce globally sophisticated students who have the technical knowledge and skills, as well as the language and cultural proficiency to contribute to the marketplace of ideas and innovations in the scientific enterprise.

As the world enters a new era of dramatic progress in the sciences, *public* HBCUs are investing heavily and wisely in recruiting high-achieving students, providing academic support to increase retention and graduation rates and preparing students for advanced degrees and careers in emerging S&T disciplines. The role of *public* HBCUs remains critical given the underrepresentation of minorities in the sciences. A recent report of the National Science Foundation shows that Black students constitute "4.2 percent of all graduate students in computer science, 2.5 percent in the physical sciences, 3.1 percent in mathematics, 4.8 percent in the biological sciences, and 2.6 percent in engineering fields." The report also found that "only eight Black students nationwide are enrolled in graduate programs in astronomy, about 0.6 percent of total enrollments in the field." Given the scale of this challenge, the TMCF continues to build transformational relationships with flagship universities that are producing large numbers of students with advanced degrees in STEAM.

But the issue is more than simply building partnerships with transnational universities. It requires a firm commitment to equality of opportunity and a highly resourced program that starts with K-12 and ends with post-doc. Properly designed; the programs should include curriculum reform, a solid grounding in academic inquiry and a strong impression that the study of science and technology pervades the entire campus. There must be a public commitment to make STEAM one of the most powerful and prominent academic departments on campus offering a welcoming and intellectually engaging teaching and learning environment. Universities must devote greater attention to creating imaginative recruitment and orientation programs that not only introduce students to the sciences, but introduce them to the new realities of globalization in all its rich dimensions. The new realities of globalization and dramatic growth in the scientific enterprise present unprecedented challenges and opportunities for American higher education and particularly for those universities that lack the resources to compete with research intensive universities in the U.S. and around the world.

The work of the TMCF becomes consequential only as it draws on the intellectual capital at member-universities that have the capacity to support new ways of thinking and doing to strengthen the production of African-American students in STEAM. Facing nearly intractable challenges, universities must find better ways to use the experience and insights of faculty and deans who are steeped in the theory and practice of teaching and learning in STEAM. As noted in the World Bank's "Road to Academic Excellence," "...*the modern university is the ideal space for the ecosystem of scholars to search for new ideas in a spirit of free inquiry.*" As we proceed in our continued quest for academic excellence in the sciences, TMCF's aim is to engage *public* HBCUs in producing the essential resources to serve as a generator of new and diverse leadership in the world of science and technology.

TMCF's STEM pipeline activities are designed to address the AFOSR's aim to support the preparation of students who graduate with STEM degrees. To this end, TMCF created the **Payne Global Initiative**, which has conducted the following:

- 1) Established student and faculty exchange with Stellenbosch University
- 2) Conducted a fact-finding mission to China
- 3) Established partnership planning meetings with key leaders in higher education and government and industry in China

Forging Partnerships

The TMCF's aim is to develop transformational partnerships that will radically change the structure and nature of academic programs at *public* HBCUs. Ideally, these partnerships will allow participating universities to share best practices in teaching and research, create dual degree programs and facilitate peer-to-peer dialogue between faculties. It should give students an opportunity to engage in expanded educational and research programs and provide opportunities to better understand international cultures and languages.

South Africa

In an effort to continue to build our STEM program with Stellenbosch University, TMCF traveled to South Africa to meet with then-Rector (Campus President), Dr. Russel Botman. During this trip (from April 23-30, 2014), TMCF and Stellenbosch agreed to exchange 25 students and faculty (total of 50). The program envisioned 50 STEM students from HBCUs traveling to South Africa during July 2015 for an 8-week program. Unfortunately, Dr. Botman died unexpectedly on June 28, 2014, which forced us to postpone the program. TMCF is continuing to attempt to revive this program concept.

During the same trip, TMCF met with Consul General Earl Miller of the US Embassy in Johannesburg to discuss other opportunities to partner with companies in South Africa to fund the summer exchange program.

Finally, TMCF met with the Motsepe Foundation to identify funding opportunities to support the summer exchange program. Mr. Motsepe is South Africa's first black billionaire and is a major supporter of US/South Africa education initiatives.

China

The primary purpose of our mission to China in 2014 was to meet with higher education leaders and senior government and industry officials to generate support for the development of mutually beneficial partnerships with two to three world-class universities. We selected flagship universities that had the resources and expertise to contribute significantly to the creation of programs and innovative approaches to teaching and learning in STEAM. Like previous missions, this effort will facilitate our ability to transform the quality of academic programs in S&T.

While few students from HBCUs get an **opportunity to study in China**, a report on "Postgraduate Student Mobility Trends through 2024," indicates that "...China will continue to send the largest number of students to the U.S. to study and will account for 44 percent of growth in inbound postgraduates at American universities. Moreover, while innovation in information technology

dominates the U.S. market, China's growth in science and technology is being driven by strong entrepreneurship in nanotechnology. China's growth in STEAM is undergirded by substantial and sustained support from government and industry through complementary and expanding research activity in science and industrial parks.

The mission to China was carried out on September 4-14, 2014 and was planned around three overarching interest—*engagement, innovation and investment*. To address the structural and systemic factors that contribute to the scale and pace of the ongoing revolution in science and technology, the TMCF will serve as a bridge between participating universities. Partnership will be guided by:

- Engagement -- To foster mutually beneficial relationships between participating universities
- Innovation -- To design and implement new and promising models of cooperation
- Investment -- To provide substantial and sustained support in maintaining and growing partnerships in STEAM

In keeping with these interests, the TMCF will continue to focus on creating innovative programs in STEAM to improve the academic performance and productivity of students. While we were successful in establishing partnerships in Taiwan, our intent was to strengthen our presence in the region by developing similar relationships with transnational universities in China.

Following extensive consultation with key U.S. authorities on higher education in China, we identified universities that demonstrated the ability to:

- Define scholarship in ways that illuminates academic excellence among students and faculty
- Produce pedagogical plans and procedures that dynamically interact in preparing academically competitive students in STEAM
- Provide a seamless network of exceptional academic resources and services
- Graduate a substantial number of students with advanced degrees in the STEAM
- Produce innovative educational models and instructional technologies
- Maintain a robust academic and research environment supported by a modern infrastructure

We then engaged our distinguished list of partners in planning and organizing our delegation to China, which included the leadership of the 100,000 Strong Foundation and the Humpty Dumpty Institute. The TMCF planned and executed the mission under the leadership of Johnny C. Taylor, Jr., President and CEO of the TMCF. Dr. N. Joyce Payne, Senior International Affairs and STEAM Advisor to the President and Christopher Lopez, Executive Assistant to the President and Education Advisor prepared briefing materials, scheduled appointments and managed all aspects of the mission.

The delegation included:

Ralph L. Cwerman
President & Co-Founder
The Humpty Dumpty Institute

Mark Epstein
Member of the Board of Directors

Humpty Dumpty Institute

Reverend Miao Hong (Hsiangju Liu)
Member of the Board of Directors
Humpty Dumpty Institute

Carola McGiffert
President

100 Strong Foundation

Humpty Dumpty Institute (HDI): The TMCF established a partnership three years ago with the Higher Education Alliance (HEA) of HDI to better position TMCF and our member-universities in Asia and beyond. The HEA has a membership of more than 58 universities and a reach of nearly 500,000 students. They sponsored a wide range of educational programs designed to prepare a new generation of leaders in development and international cooperation.

100,000 Strong Foundation: Launched in 2013 by then-Secretary of State Hillary Rodham Clinton, the 100,000 Strong Foundation is an independent, bipartisan non-profit organization housed at the American University in Washington, DC. The Foundation’s mission is to strengthen US-China relations through Mandarin language learning and study abroad. The Foundation is leading a national movement to ensure that the next generation of Americans is equipped to engage effectively with China. They engage U.S. and Chinese government, business and academic communities to expand the number and diversity of Americans studying in China. It is an offshoot of the U.S. Department of State’s “100,000 Strong Initiative,” which aimed to achieve President Barack Obama’s call for 100,000 Americans to study in China by the end of last year.

In addition to these key partners, the TMCF recently joined the Institute of International Education’s “Generation Study Abroad.” This is a 5-year initiative designed to double the number of U.S. students studying abroad by the end of the decade. Through our combined networks, we have the ability to reach new partners and offer our member-universities services to strengthen international relationships.

To inform the development of this initiative, the delegation collected and translated information providing a framework for long-term partnerships that will lead to opportunities for the TMCF’s 47 member-universities and institutions in China to engage and invest in areas of mutual interest. With support from government and industry, we intend to create seamless relationships across a number of disciplines. While we focused on the capacity of our 47 member-universities, the paramount goal is to draw on their resources and expertise in strengthening the national security mission of the U.S. Department of Defense.

The delegation held extensive meetings with the leadership and senior staff of China’s Vice Minister of Education and the Secretary General of the China Education Association for International Exchange (CEAIE). We met with university presidents and deans and faculty in science and technology and established partnership agreements with:

- Tsinghua University
- Schwarzman Scholars Program,
Tsinghua University
- Peking University
- Zhejiang University
- Shanghai Jiao Tong
- YenChing Academy

In addition, we met with U.S. officials and staff of the:

- U.S. Embassy Beijing
- U.S. Embassy Shanghai
- U.S. Consul General
- American Chamber Beijing
- American Chamber Shanghai

The delegation also met with students who are studying in China through Project Pengyou, which is a non-profit advocacy organization created to encourage study abroad. In addition, we met with the leadership of the Wanxiang Group Corporation, which is one of the largest auto parts manufactures in China. Wanxiang also trains S&T professionals through their academy and provides scholarships for international students for summer educational and research programs in the field. In all of these meetings, we presented a framework for partnerships and emphasized the importance of generating resources to support STEAM initiatives through:

- Bilateral faculty exchanges
- Bilateral student exchanges
- Jointly sponsored research projects

Through these partnerships, the TMCF intends to:

- Accelerate the production of students who are prepared to compete in the world's scientific enterprise
- Produce more students who are culturally and linguistically fluent in Chinese
- Strengthen the capacity of *public* HBCUs to serve as laboratories where solutions to national defense and security issues are addressed

One of the important steps in producing the savvy workforce needed for the 21st century is to invest in the internationalization of American higher education. In a world where global citizenship is a passport to international success, it is imperative that students at *public* HBCUs are afforded opportunities to travel, learn, and experience academic life abroad and particularly in the field of STEAM. Ever mindful of America's global challenges in science and technology, in a recent speech, former Secretary Clinton talked about American higher education as the global gold standard and said, "Education...is one of the most valuable assets that the United States has. It's something that we have to continue to invest in..."

In the face of this challenge, the TMCF intends to craft new and innovative ways for *public* HBCUs to play a more prominent role in the all-important marketing of American ingenuity in science and technology. As science takes on increasing importance in the new world order, the TMCF's aim is to intensify efforts to produce students and faculty for the scientific enterprise of tomorrow. These partnerships will focus on cooperation--rather than competition—with a select group of member-universities and institutions in China working together toward a common set of principles, policies and practices—aimed at dramatically increasing the enrollment and production of students in STEAM, while building a global learning community enriched by a shared sense of cultural understanding.

Our universities have the capacity to create opportunities for exchanges and collaboration across a wide range of disciplines, including engineering, agriculture, nanotechnology, nuclear physics, biological sciences and other rapidly expanding fields of interest. Given their size and organizational structure, they offer an environment unencumbered by layers of decision-making and lines of authority. While research represents a major part of their enterprise, the primary mission of *public* HBCUs is to contribute to the stock of human knowledge.

Producing Human Capital in STEAM

Today, *public* HBCUs enroll 80 percent of all students attending HBCUs and are located in 22 states, the District of Columbia and the U.S. Virgin Islands. HBCUs represent about 3 percent of American universities, but enroll 12 percent of all Black college students. While they constitute a small segment of higher education, they produce 23 percent of all Black graduates, award 40 percent of all degrees in STEAM and produce 60 percent of all engineering degrees earned by Black students. It's also worth noting, that these institutions have established an enviable track record of educating half of the nation's Black teachers and 40 percent of all Black health professionals.

Public HBCUs are littered with the names of scholars whose inventiveness has contributed to a myriad of agriculture, information technology and biological science products that are changing the way we live, work and play in the U.S. and around the world. They have demonstrated the capacity to stimulate innovation, strengthen links between science and society, and play a more prominent role in the all-important marketing of American ingenuity. Building a strategic relationship with world-class universities in China will strengthen and influence science for the 21st Century.

John Coughlin of MIT says, “. . . Real innovators look systematically across ‘accepted boundaries’ of competition--and find unoccupied territory that represents a real breakthrough.” In our continued effort to maintain a competitive edge, the TMCf has intensified efforts to look across accepted boundaries and find new opportunities to introduce students to the rich diversity of cultures and languages around the world--through dual degree programs, language immersion programs, study abroad and jointly sponsored research initiatives.

With partners in China, we intend to:

- Create a faculty-to-faculty interactive communications network
- Provide opportunities for face-to-face meetings among faculty
- Share resources and expertise across disciplines
- Facilitate collaborate in real time in sharing and accessing information
- Cooperate in the development of innovative educational model in STEAM

These relationships offer great promise in stimulating new approaches to teaching and learning, while fostering creativity in interdisciplinary and unrelated fields of study. Significantly, these linkage will have a multiplier effect that ensures sustainable peer-to-peer relationships. Moreover, these linkages will not only contribute to the flow of information, but may be highly

valuable in strengthening workplace performance and productivity among faculty and offer promising channels for expanding the boundaries of scientific discovery.

Next Steps

To continue to support and expand the development of partnerships, the TMCF will create a “S&T Working Group” made up of deans and faculty in STEAM that will be tasked with the responsibility of:

- Constructing an interactive cloud-based communications system
- Identifying pedagogical policies and practices that drive success in the recruitment, retention and graduation of students
- Disseminating and replicating model curriculum and best practices
- Imbedding new technologies in teaching and learning
- Constructing professional development programs for faculty
- Developing peer-to-peer relationships across scientific disciplines
- Constructing an online platform listing courses, research labs and centers and teaching and research interests of faculty
- Assisting the TMCF in generating resources to support study abroad opportunities
- Engaging students and faculty in Chinese cultural and language immersion programs

Drawing on the knowledge and expertise of deans and faculty in the sciences, the TMCF will probe the many strands of policies, practices and programs that contribute to the production and performance of students in the sciences. With the support of scholars in the sciences, the TMCF hopes to strengthen the tradition of excellence at *public* HBCUs as we continue to carry out our commitment to producing a new generation of world leaders in the sciences. HBCUs employ highly successful professors, researchers and peers who work collectively to compete in the scientific marketplace. They hold a unique legacy to the specific needs of young African-Americans and continue to produce highly competitive students who are contributing to the advancement of S&T.

As noted by Dr. Joseph Graves, Associate Dean for Research and Professor of Biological Sciences, North Carolina A&T State University, “the field of S&T is failing to attract and maintain the diversity desired in America’s scientific workforce. In an effort to advance our scientific community, it is imperative that we recruit highly qualified students from an ever-increasing diverse population. When an inclusive culture is at work, a diverse scientific team becomes capable of producing a broad range of original and engaging ideas not possible among homogenous groups and to the ultimate benefit of the greater scientific community and the world.”

CAPACITY BUILDING

I. Increasing Retention and Graduation

TMCF’s fourteenth annual Member Universities Professional Institute (MUPI): *Full STEAM Ahead: Improving Retention, Graduation and Career Readiness in Science, Technology,*

Engineering, Agriculture and Mathematics (STEAM), occurred April 13 – April 16, 2014 in Atlanta, Georgia, and involved over 100 participants. MUPI is a capacity-building conference that promotes best practice sharing and collaboration among TMCF's member-school network.

By enhancing the skills and knowledge of HBCU faculty and senior staff, the annual conference increases their expertise across a range of areas including student retention and graduation. Guest speakers were pioneers in the advancement of science, research and higher education such as Dr. Gregory Parham, Assistant Secretary for Administration at the USDA and Joletta Patrick, Manager of Minority University Research and Education programs at NASA. Panel discussion and roundtable topics included:

- Using Writing in the Sciences
- Improving Undergraduate Life Sciences
- Retention Strategies
- Closing Gaps in College Preparation
- Expanding Research Grant Opportunities

The institute agenda is located below.

SUNDAY, APRIL 13, 2014

3:00 pm - until
Hotel Check-in

4:00 pm – 6:30 pm
Registration

6:30 pm - 8:00 pm
Opening Reception

MONDAY, APRIL 14, 2014

7:30 am – 9:00 am
Registration

8:30 am – 10:00 am
Morning Plenary Session

FOCUS: PERSPECTIVES ON STEM OPPORTUNITIES FOR STUDENTS

Dr. Harvey Westbrook
Assistant Director, Office of Quantitative Research
Division of Economic and Risk Analysis
Securities and Exchange Commission

Ruth Harris
Workforce Development Special Projects Advisor

10:15 am – 11:30 am

Morning Concurrent Sessions

FOCUS: COURSE AND INSTRUCTIONAL DESIGN

From Application to Theory: An Upside Down Approach to STEAM Education

Historically, the bridging of theory and application in STEAM teaching has been approached using a lecture-then-lab model. The intention of this paradigm is to develop students' applied behavior from their understanding of theory. There are concerns that this approach, particularly during the middle grades, is neither fueling interest and engagement in the STEAM disciplines on the part of teachers, nor is it supporting learning and broader inquiry on the part of students.

In spite of the intended outcomes of the lecture-then-lab model, students continue to exit STEAM courses without a clear mastery of the theory-practice connection and a diminished or even extinguished interest in science beyond that experience. Given this finding, teacher preparation programs are moving away from this approach of preparing teachers. This session describes an alternative approach; an upside down model of STEAM teaching and learning that builds theoretical understanding by reasoning through authentic STEAM scenarios. Case study data showing improved learning outcomes and satisfaction for students and suggestions for a model to build a more comprehensive STEAM pipeline will be shared.

Presenters:

Dr. Jeffery Fleming, Chair, Department of Mathematics and Statistics

Dr. April Massey, Acting Dean, College of Arts and Science

Dr. Lena Walton, Assoc. Dean for Academic Programs, College of Arts and Science

University of the District of Columbia

Enhancing Guided Pathways in STEAM

For public HBCUs STEAM academic programs represent connections to institutional history, but also American history at the local and national level. Given the economic and social benefits STEAM fields and industries confer to individuals and communities, this workshop will focus on research related to guided pathways as a framework for improving recruitment and retention. In addition to discussing the elements of guided pathways (i.e., clear roadmaps to student end goals, on-ramps to programs of study, and embedded advising, progress tracking, feedback, and support), the presenter will highlight the importance of timely higher education issues (i.e., dual enrollment, developmental education, financial aid, learning communities, and undergraduate research) and how they fit in a guided pathways framework for STEAM specifically. The session will close with a description of guided pathways implementation at one site and open to a discussion on institution, system, and state-policies that can help promote STEAM education and degree completion.

Presenter:

Dr. Valerie Lundy-Wagner, Senior Research Associate, Community College Research Center

Teachers College, Columbia University

Reimagining STEM Courses Using a Hybrid Online/Laboratory Model

Active learning is increasingly popular, particularly among this generation of traditional college students due to technological development in consumer electronics. The success of active online learning (AOL) in theoretical courses sets an encouraging basis for implementation of AOL into laboratory courses. The incorporation of AOL (OWL Labskills) into the curricula is known as the dynamic laboratory manual (DLM). In this session, presenters share the benefits of both the active online learning and dynamic laboratory manual models for general and organic chemistry courses into laboratory components of the general and organic chemistry course sequences.

Improved student learning outcomes will be discussed within the context of state and system-wide course redesign initiatives. In addition, the amalgamation of AOL, skill builders, team learning and competitive learning activities will be demonstrated to the audience in a series of interactive workshop activities. Finally, the presenters will provide attendees with key tools for assessment in course redesign and student feedback during different stages of the course redesign process will be shared.

Presenter:

Dr. Victoria Volkis, Assistant Professor of Chemistry
University of Maryland Eastern Shore

Realignment and Growth of Food Science and Nutrition Programs at Tennessee State University

According to the Bureau of Labor Statistics, the need for trained food scientists and nutritionists has increased substantially and is predicted to grow even more in coming years. With a predicted increased need of 21 percent for dietitians and nutritionists and 9 percent for food scientists by 2022, it is imperative that universities train a more diverse workforce. Additionally, with the estimated annual cost of foodborne illness of \$77 billion, the need for specialists in food safety is even greater. With the increased concern over the health and safety of individuals and communities, funding for research in these areas is available from many entities. In spite of this, most HBCUs have done little to enhance their programs and realign them with changing needs. Assessment of strengths and weaknesses of our programs both internally and by accrediting bodies, increased research and extension funding, and reorganization of the College of Agriculture, Human and Natural Sciences and its faculty have allowed for rapid expansion and advancement in the food science and nutrition programs at Tennessee State University (TSU). For example, the number of faculty and staff members in these areas has grown from two full-time individuals in 2001 to 14 full-time and three adjunct faculty in 2014. This has allowed us to develop new academic programs and provide superior student training. This session will describe the changes in the programs at TSU and the plans for the future.

Presenter:

Dr. Sandria Godwin, Professor Director, Didactic Program in Dietetics
College of Agriculture, Human and Natural Sciences
Tennessee State University

Pathway for Recruiting and Retaining Minority Students for Graduate Education in STEAM Fields

This presentation will examine recruitment and retention strategies that will attract and reduce attrition among minority graduate students to STEAM programs at HBCUs. It will also examine how building relationships, offering competitive fellowships, applying a holistic application review criteria and engaging undergraduate students in summer research programs can assist in attracting minority students to STEAM graduate education.

Presenters:

Dr. Micheal E. Orok
Dean, School of Graduate Studies & Research
Stashia Emanuel
Director of Research, Recruitment and Analysis
Tennessee State University

Student Centered Active Learning and Assessment Reform in Lower-Division STEM Courses

This presentation will highlight the results of an NSF-funded project at Florida A&M University (FAMU) entitled “Student-Centered Active Learning and Assessment Reform (SCALAR),” that seeks to completely revamp and enhance the instructional approaches and undergraduate course curricula in the STEM programs of the newly formed FAMU College of Science and Technology. The presenters will highlight key strategies for enhancing faculty development, "flipping the classroom," increasing faculty use of pedagogical best practices for enhancing student learning and assessment, and enhancing the student academic experience. The successful implementation of the SCALAR project is expected to result in improved teaching and learning in STEM areas, which will lead to higher student retention of content, increased recruitment and retention of students in STEM majors, shorter time toward degree.

Presenters:

Dr. Maurice Edington, Dean, College of Science and Technology
Dr. Lewis Johnson, Assistant Dean, College of Science and Technology
Dr. Desmond Stephens, Associate Professor of Mathematics
Dr. Erroll Wilson, Associate Director, Innovative Academic Instruction Project
Dr. Donald Palm, Associate Vice President for Academic Affairs
Florida A&M University

Changing Paradigms: Practices in Student Preparation in STEAM Disciplines

This presentation addresses the cognitive aspects of education and makes a few recommendations for better preparation of the student in the STEAM disciplines for college or workforce. Several cognitive approaches will be presented with example practices. The approaches will be discussed with pros and cons from each practice. The presenters suggest different approaches to different types of the class depending on the class objectives and the

students' level of preparedness. For instance, the presenters find that project based instruction, while generally seen as an effective means for educating students, is not applicable to learners of all styles. Seymour Papert's approach of a "thinking model" is another approach that yielded excellent results but again not for every learning style. The presenters will offer viable approach to instructional approaches that has a high potential for much improved preparation in STEAM disciplines.

Presenters:

Dr. A. Anil Kumar, Professor, Electrical & Computer Engineering

Dr. Doeun Choe, Assistant Professor, Civil & Environmental Engineering

Funding STEAM Projects: The Role of Academic Leaders

Come hear the Council for Advancement and Support of Education share strategies on how STEAM deans and faculty can pursue and garner funding. Through this session, academic leaders will discuss the partnership with advancement officers and learn to engage potential donors in a more productive and meaningful way - leading to a more effective relationship and greater success in fundraising.

Presenter:

Richard Ammons, Senior Consultant

Council for Advancement and Support of Education (CASE)

Prairie View A&M University

12:00 pm – 1:30 pm

Luncheon Plenary Session

FOCUS: ADVANCING OPPORTUNITIES WITH THE USDA

Dr. Gregory Parham

Assistant Secretary for Administration

USDA

1:45 pm – 3:00 pm

Afternoon Concurrent Sessions

FOCUS: STUDENT ENGAGEMENT AND SUPPORT

Minority Student Participation in Biomedical Research

In this session, the presenter will highlight the success small HBCUs can have by leveraging programs funded through the National Science Foundation, National Institutes of Health and others to engage undergraduate students in research. The presenter will share his lessons learned from 14 years of research projects funded by various programs like NSF-LSAMP (Louis Stokes Alliances for Minority Participation), NIH-EARDA (Extramural Associates Research Development Award), and NIH-MARC (Minority Access to Research Careers) that have helped undergraduate students prepare for careers in the STEM fields.

Presenter:

Dr. Hirendra Banerjee, Professor, Biology
Elizabeth City State University

A Student-Centered Approach (SCA) for Empowering STEM Programs

In 2011, TMCF was awarded a multi-year grant to examine the factors related to the retention and migration of students in and out of STEM disciplines. This comprehensive research project examines data from both HBCUs and majority serving institutions. After three years participating in the project, the University of Maryland Eastern Shore developed an idea, which requires paradigm-shift, from analyzing the preliminary data.

This session will explore the idea of Student-Centered Approach (SCA), which can empower STEM programs in terms of student success and program level student learning outcomes assessment. The practices of SCA in European higher education institutions and the U.S. higher education institutions will be introduced. Some best teaching practices in STEM education based on SCA will be introduced. The session is designed to facilitate sharing challenges, solutions, ideas, and best practices.

Presenter:

Dr. Jichul Kim, Planning Analyst
The University of Maryland Eastern Shore

Undergraduate Research Experiences: A Proven PhD Pathway

To develop competitive STEM students, the undergraduate curriculum must provide a strong balance of technical background, professional development, and research experience. Undergraduate research experience has often been cited as one of the most effective tools in helping students refine their problem-solving skills.

In this session, presenters will discuss the plant sciences-biotechnology program at Fort Valley State University. This program exposes students to basic principles and application of biotechnology through hands-on experiences in molecular biology techniques. In addition, student program recruitment and retention are supported by financial support in the form of STEM scholarship (80 scholars). The program also includes collaborations with major institutions where students conduct 8-10 week summer internships, make scientific meeting presentations and prepare to attend graduate school.

Presenters:

Dr. Sarwan Dhir, Professor and Director, Center for Biotechnology
Dr. Melinda Davis, Professor of Biology
Dr. Naghedolfeizi Masoud, Professor of Math & Computer Science,
Professor Seema Dhir, Department of Biology
Fort Valley State University

Changing the Game: Improving the Aspirations of Students to Study Science and Math

Changes in the processes of science education have produced many unexpected and counterintuitive results. One result is the decline in students choosing to major in STEM after high school. The effort and money spent on STEM supplemental programs should have the effect of increasing the number of students studying STEM majors significantly; however, this has not occurred. Despite increased emphasis on STEM, the number of students studying STEM continues to decline. Considering that STEM education is a complex system, one must remember that complex systems have long time lines. Therefore, it behooves us to note that short-term results may be entirely opposite from long-term results. In this session, participants will discuss the root causes of students' negative aspirations about STEM and recommend fundamental changes to make the aspirations positive.

Presenter:

Dr. Oscar Criner, Professor, Computer Science & Interim Associate Dean
Texas Southern University

Helping Orient Minorities to Engineering (HOME)

The College of Engineering (COE) at North Carolina A&T State University offers a five-week bridge program entitled, Helping Orient Minorities to Engineering (HOME). This program seeks to recruit/retain high achieving students in STEM by providing academic, personal and professional development and mentoring. Since 2005, approximately 20 students per year (total of 142) from around the United States have participated in this corporate-sponsored program. Corporate support includes scholarships, internships, co-ops, and mentoring. During the summer, participants are enrolled in Calculus I and upon successful completion receive college credit. In addition, the group has assigned mentors to aid in their transition as well as supplemental instructors to assist them academically. As such, students adjust to the college environment quickly. In this session, program results as well as strategies for implementing similar programs will be shared.

Presenter:

Leotis Parrish, Assistant Dean for Student Affairs
North Carolina A&T State University

“No Excuses”: The Use of Intrusive Advising to Prepare Students for Success

The National Center for Education Statistics estimates that 16% of first-time undergraduates in public 4-year institutions leave during their first year of enrollment and of these students, 36% never return to postsecondary education (Horn and Carroll, 1998; Caison, 2005). Earl (1988) observed that Intrusive Advising targets identification of the problem and the recommendation of the appropriate intervention. This approach to advising is active rather than passive in its effort to motivate students to seek remedy before the impediment becomes large. A goal of Intrusive Advising is to convince the student that participation is indicative of academic strength rather than weakness. This presentation will define intrusive advising as used by the Texas Undergraduate Medical Academy (UMA) team and identify the components. Further, the

presentation will share strategies that enhance the migration of the efforts used by the UMA team to other academic environments. The presentation will also share strategies for implementation in diverse student populations some of whom might have been resistant historically. Intrusive advising in the UMA has contributed to a retention rate of 93% and a graduation rate of 95% for its 10 year history along with a >95% acceptance rate to graduate studies at institutions such as Washington University, Hofstra University and Georgetown University.

Presenters:

Dr. Dennis E. Daniels

Associate Vice-President of Research, Associate Dean of the Graduate School, Director of the Undergraduate Medical Academy, Professor of Epidemiology

Texas A&M University System Health Science Center

Dr. Maxwell Fontus - Assistant Professor of Chemistry

Prairie View A&M University

The Persistence of African American Students in STEM in the First Two Years of College

In this session participants will explore Tinto's theoretical model of persistence, this phenomenological study analyzed the experiences encountered by fifteen students' participation in STEM pathways after first two years of college study. The study examined how academic integration, faculty interaction, social integration, and student interaction impacted students' persistence. The fifteen students in the study were traditional age college students and the results of the findings indicated that they were academically and socially integrated into their college environment. The college environment encouraged social and academic integration of participants through quality classroom instruction, mentoring, and campus activities.

Presenters:

Dr. James Maddirala, Associate Vice President of Academic Affairs and Student Life

Jackson State University

Latitia McCane, Ph.D. Candidate

Jackson State University

Strategies to Mitigate Self-Handicapping Behaviors among HBCU Students

Self-handicapping is the creation of self-imposed obstacles that impede performance. Self-handicapping allows one to attribute failure to the obstacle instead of ability. Self-handicapping is associated with poor outcomes in math and overall academic performance. The achievement goal theory (AGT) provides insight into the development and maintenance of self-handicapping and attempts to explain how goal directed behaviors influence achievement by focusing on how goals influence cognitive, affective, and behavioral processes towards learning and achievement.

In this session, the presenter will review studies from on the influence of self-handicapping on cognitive and academic outcomes through the lens of AGT and self-efficacy; and facilitate a discussion of methods by which self-handicapping behaviors can be reduced.

Presenter:

Dr. M. Omar Faison, Director, Office of Sponsored Research
Virginia State University

4:00 pm – 5:15 pm

Special Session

A GATEWAY TO SUCCESS USING STEM ONLINE COURSES

In this session, join the Apollo group as they present online HBCU partnership opportunities to expand students' successful completion of STEM gateway courses.

Host

Apollo Group

Refreshments will be served.

TUESDAY, APRIL 15, 2014

8:30 am – 10:00 am

Morning Plenary Session

FOCUS: MEMBER-SCHOOL OPPORTUNITIES WITH NASA

Keynote Speaker:

Joletta Patrick

Manager, Minority University Research and Education Program
NASA

10:15 am – 11:30 am

Morning Concurrent Sessions

FOCUS: FACULTY DEVELOPMENT AND FUNDING

Out of the Shadows: Maximizing Limited Resources to Develop Exemplary STEAM Programs

This session will illuminate best practices for program development and relationship building in order to create opportunities for students in STEAM areas. Methods for embracing globalization will be discussed along with ways to bench-march progress toward pathway development. Most institutions view money as the major impediment to developing exemplary programs. In this session participants will learn how, with limited resources and ingenuity, institutions can be successful in their endeavors to chart new courses/pathways. During the course of the presentation the audience will be engaged utilizing polling technology with clickers and by being given the opportunity to share thoughts about their current best practices and how their methods can be improved or modeled if they are successful.

Presenter:

Dr. Sharron Herron-Williams, Interim Associate Provost for Academic Affairs

The Power of Junior-Senior Faculty Mentor/Advocate Relationships

It is critical that junior faculty members are equipped to cultivate students in an environment of high expectations, while dealing with high teaching and service loads, and effective junior-senior faculty relationships promote collegiality, cohesiveness, and career advancement among junior faculty transitioning from a postdoctoral to tenure-track positions.

Mentor/advocate relationships help junior faculty manage key responsibilities that impact obtaining tenure, i.e., effective teaching, research, and service. In this interactive session participants will learn how junior faculty can: 1) identify good mentors/advocates, 2) sustain effective scholarship through collaborations/networks, 3) establish a fluid work-life balance, and 4) devise a plan of writing.

Additionally senior faculty will be challenged to reflect on their role in: 1) identifying/ managing talent, 2) engaging in mentorship/advocacy, and 3) fostering an academic climate that promotes/encourages junior faculty.

Presenters:

Dr. Jill Keith Harp, Professor and Chair, Department of Life Sciences
Winston-Salem State University

Dr. Tennille Presley, Assistant Professor of Physics
Winston-Salem State University

Funding STEAM Projects: The Role of Academic Leaders

Come hear the Council for Advancement and Support of Education share strategies on how STEAM deans and faculty can pursue and garner funding. Through this session, academic leaders will discuss the partnership with advancement officers and learn to engage potential donors in a more productive and meaningful way - leading to a more effective relationship and greater success in fundraising.

Presenter:

Richard Ammons, Senior Consultant
Council for Advancement and Support of Education (CASE)

Securing and Administering Research Grants

In 2013, with support from the U.S. Department of Defense, TMCf awarded a series of \$25,000 Undergraduate Research in STEAM grants. Hear from selected recipients as they share their projects, the lessons learned and next steps to leverage the results to expand their work and secure additional funding.

Presenters:

2013 TMCf/DoD Undergraduate Research Grant Recipients

Funding STEAM Projects: Doing Business with NASA

In this session, participants will gain information on how institutions can fund STEAM projects vis-à-vis the small business procurement and subcontractor process.

Presenter:

David Brock, Small Business Specialist
NASA

12:00 pm – 1:30 pm

Luncheon Plenary Session

FOCUS: FROM SURVIVING TO THRIVING: THE CALL TO ACTION

Keynote Speaker:

Dr. N. Joyce Payne
Founder
Thurgood Marshall College Fund

1:45 pm – 3:00 pm

Afternoon Concurrent Sessions

ROUNDTABLE DISCUSSIONS

During these closed-door discussions, participants will engage with their peers in solutions-based dialogue related to the strengths, barriers, opportunities, and next steps for increasing student retention, graduation and career readiness in STEAM fields.

Discussion Group 1	Provosts
Discussion Group 2	Deans/Department Chairs
Discussion Group 3	Faculty/Researchers
Discussion Group 4	Campus Coordinators
Discussion Group 5	Student Ambassadors

6:30 pm - 8:00 pm

Closing Reception

MUPI Participants

MUPI was an invitation-only conference that connected over 100 registrants from 36 TMCF member-schools. TMCF invited persons with direct decision-making authority related to STEM curriculum, research, fundraising, retention, and graduation (e.g., administrators/faculty). As shown in figure 1 below, institute attendees represented a range of participants including **administrators** (presidents, provosts, deans, department chairpersons), **faculty** (STEM

professors, researchers), and **university staff** (career service, retention service, grants and advising).

Figure 1:

MUPI Participants	
University Staff	34%
Administration	38%
STEM Professors	25%
Other	3%

To determine the views of attendees with direct decision-making authority, TCMF asked presidents, provosts, researchers, professors, deans and department chairpersons to complete a post-institute survey. The response rate was 54%.

Institute survey data suggest that participants were satisfied with the institute. Of note was the percentage of participants who felt that the information they learned could be immediately used at their institutions.

Figure 2:

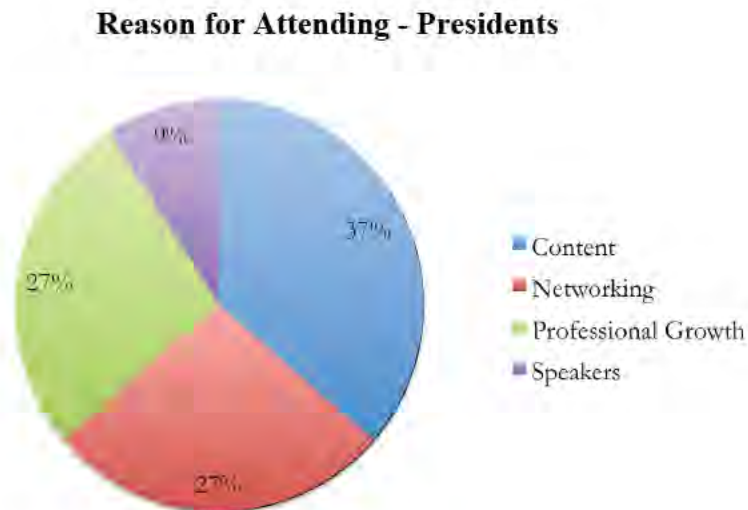


Figure 3:

Met Reason for Attending - Presidents

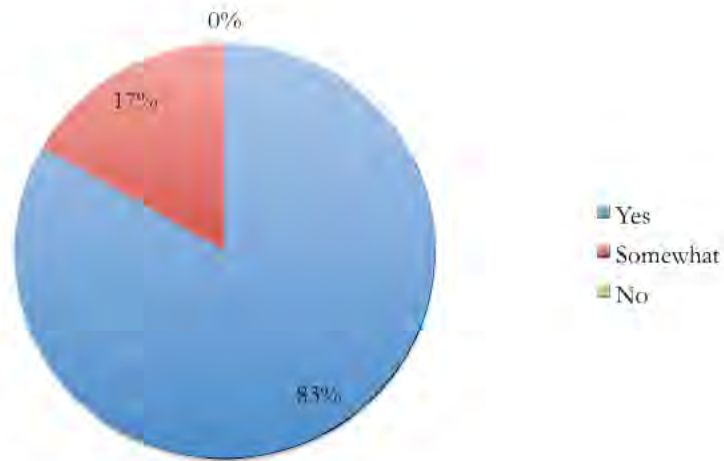


Figure 4:

Overall Satisfaction - Presidents

	Satisfied	Somewhat Satisfied	Neutral	Somewhat Dissatisfied	Dissatisfied
Conference Content	83%	17%			
Registration Process	100%				
Venue	83%	17%			
Food & Beverage	100%				

Figure 5:

Reason for Attending – Deans/Department Chairs/Provost

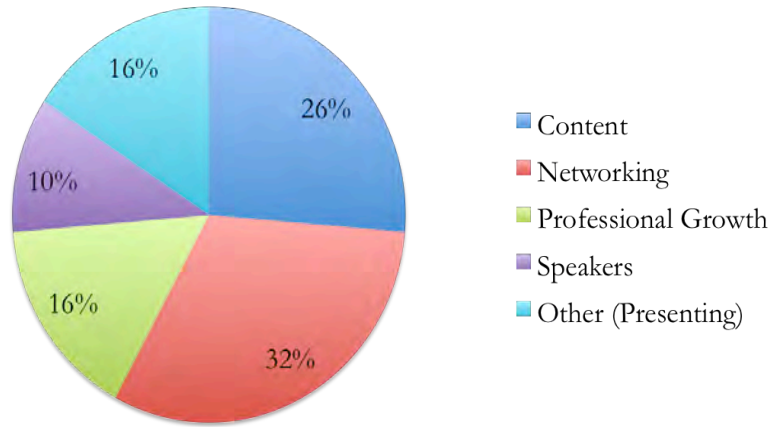


Figure 6:

Met Reason for Attending – Deans/Department Chairs/Provosts

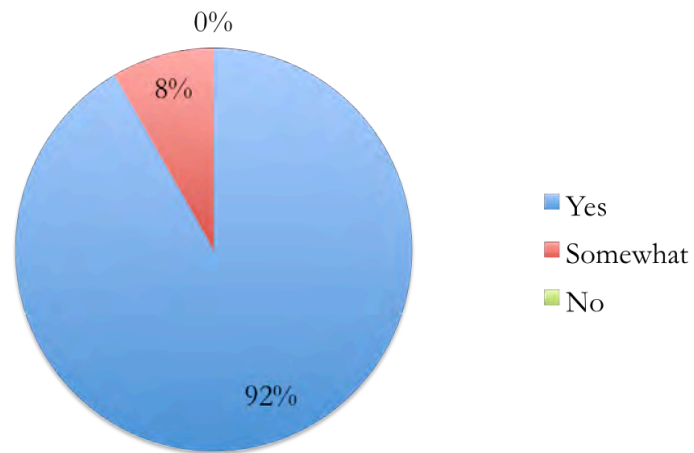


Figure 7:

Overall Satisfaction - Deans/Department Chairs/Provosts

	Satisfied	Somewhat Satisfied	Neutral	Somewhat Dissatisfied	Dissatisfied
Conference Content	85%	15%			
Registration Process	100%				
Venue	85%	15%			
Food & Beverage	69%	31%			

Figure 8:

Reason for Attending-Professors/Researchers

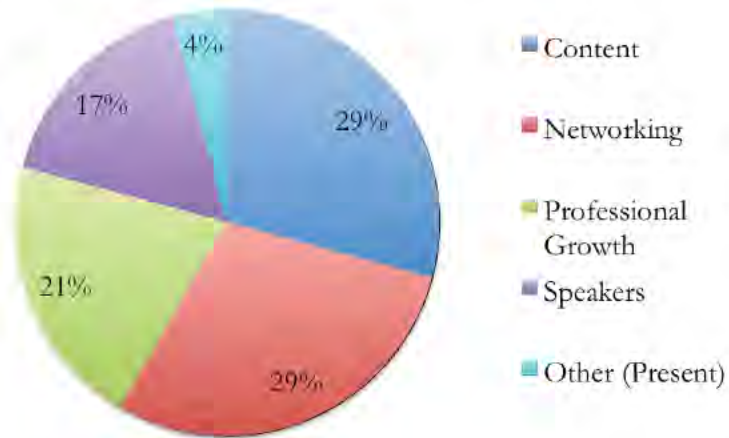


Figure 9:

Met Reason for Attending – Professors/Researchers

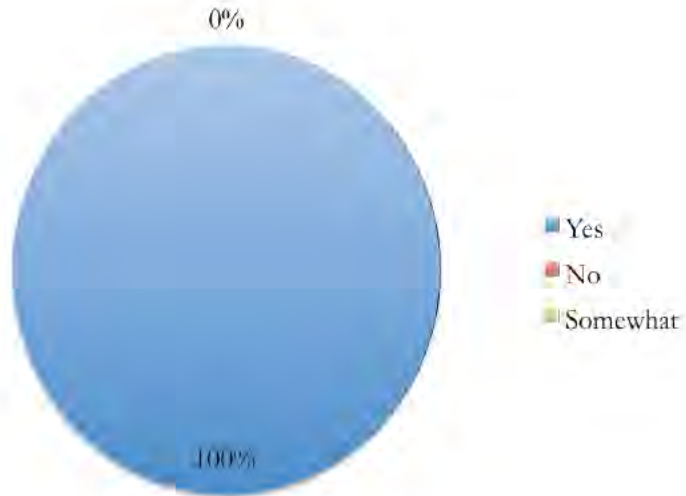


Figure 10:

Overall Satisfaction – Professors/Researchers

	Satisfied	Somewhat Satisfied	Neutral	Somewhat Dissatisfied	Dissatisfied
Conference Content	88%	12%			
Registration Process	100%				
Venue	81%	6%	13%		
Food & Beverage	94%	6%			

III. Expanding STEAM Research

TMCF identified and supported STEAM research activities at five TMCF member-schools that paired undergraduate and graduate students with experienced faculty.

When students participate in undergraduate research, their confidence increases and they develop expectations of earning a Ph.D.¹. During TMCF's 2014 MUPI, the principal investigators who received funding in 2013 from TMCF through the DOD, shared research to help TMCF's entire member-school network increase its undergraduate research capacity. In 2014, TMCF continued the work started in 2013 and provided five (5) undergraduate research experiences for member-school faculty and students.

Purpose

The purpose of the project was to determine the types of **undergraduate research experiences** that lead to student retention and graduation in STEAM fields, including the *characteristics of students* who pursue undergraduate research coupled with the research exposure they receive.

Grant resources were used to: (1) provide research opportunities to undergraduate STEAM students; (2) document the research process (i.e., student selection, training, mentoring and laboratory work); and (3) track participating students' matriculation from their research experience through graduation.

Proposals had to address the following questions:

- Why do you feel a program of this nature will be valuable to your institution and students?
- What are your previous successes managing an education program where participation was voluntary?
- What components of your proposed undergraduate research experience might be replicated at other institutions?

Final reports from participating schools are included below.

Southern University A&M College at Baton Rouge Louisiana (SUBR)

Principal Investigator: Dr. Wesley G. Gray

Project Title: "SREEP, Pathway to Success in STEAM at Southern University"

Abstract

The TMCF's-SREEP at SUBR is a research and academic career preparation program within the College of Sciences and Agriculture designed to help students get the most out of their first two years at SUBR. Our cradle to the Grave P-reparation Boot Camp is a special program during the summer and fall that makes the transition from high school to college as smooth as possible thus enhancing and strengthening their academic preparedness in the biological and chemical

¹ Russell S, Hancock MP, McCullough J (2007). Benefits of undergraduate research experiences. Science 316, 548-549.

sciences. SREEP's aims are geared towards enhancing the academic and research preparedness of SUBR students, ultimately increasing the number of underrepresented minorities in the biomedical fields and are designed to substantially impact the students' academic and research training by providing them with the necessary skills and expertise to complete a rigorous STEM graduate program after graduating from SUBR.

Progress

- We successfully completed the SREEP, which ran from June 20, 2014 to December 1, 2014. The program had fourteen participants, four fellows, four peer-peer mentors and two SI leaders. In addition, we had three faculty mentors and two program directors. The program had four central activities that served to achieve our objectives. (1) A rigorous 21-day Science Boot Camp designed to positively impact the success of our students who will join the program. The content lectures were delivered by Drs. Caroline Telles, Assistant Professor of Biology, Deborah Clarke, Associate Professor of Mathematics, Physics and SMED, and Kinesha Harris Assistant Professor of Chemistry. These students received over sixty hours of review in biology, chemistry and math, which was in line with their fall curriculum. The boot camp introduced the students to course content critical for success in Chemistry 132, Math 140 and Biology 108 freshman courses. The average score for the student on the pre- assessment exam were 55%, 27% and 44% for biology, chemistry and math respectively. After the content review, introduction to cognitive scientific strategies and learning skills, 66% of the students showed significant increase in the score in chemistry (80% increase) and math (63% increase) on their post-test assessment. There was no change between pre- and post test in the biology section, although the students scored the highest in this subject on the pre-test. Overall, the boot camp increases the student course content and preparation for the fall. It should be noted that two of the students received a grade of "B" in their respective chemistry courses during the fall semester.
- The second component of the SREEP is our summer and academic year research program designed to introduce participants to scientific research and match each student with an academic and research mentor. During the summer the SREEP fellow spent one week becoming familiar with their research topic and completing a biochemistry-microbiology boot camp. They were introduced to the scientific method, writing abstracts and organizing a poster presentation. Drs. Eduardo Martinez-Ceballos, Associate Professor of Biology, Dr. Bagayoko, SU System Distinguished Professor of Physics; Conrad Jones, Associate Professor of Chemistry, Wesley Gray, Walter Dumas, Endowed Professor of Chemistry and Environmental Toxicology, and Ibekwe Samuel, Professor of Mechanical Engineering presented their research program to the students. SREEP fellows continued to develop their research and analytical potential by spending 15-20 hrs a week with their assigned mentors. Since the SREEP fellows were freshman students, who did not have prior research experience they were teamed up with a graduate student or postdoctoral researcher. During the course of the semester they attended and provided weekly or biweekly progress reports. At the end of the Fall semester, each student made a twenty

minute presentation of their research at the SREEP closing program.

- Professional and scientific development was achieved by engaging students in research presentations at regional and national meetings and placement in internships. During the program our students attended the 2014 Annual Biomedical Research Conference of Minority Students. At the conference they engaged in professional workshops designed to help obtain internships and success in undergraduates. The students participated in a one-on-one and group talk with career planners from FASEB. They also had a chance to talk (via Skype) with recent SUBR alumni who are now in graduate or medical school. Our fellows were introduced in different career paths through weekly field trips to the Architecture research lab Laser Interferometer Gravitational-Wave Observatory (LIGO) research facility and natural and historical museums. As part of their professional development, the fellows were taught how to organize their resume, write their personal statement and how to introduce themselves in a professional setting. By the end of the fall semester all SREEP fellows had applied to at least two summer internships for Summer 2015.
- Our students were engaged in a two-hour week supplementary instruction (SI) in Chemistry 121 and 108 as well as received peer-peer mentoring. This activity has fostered the building of our “Science Living and Learning Community”. During the SI and peer-peer mentoring sessions, students discussed their weekly progress and acclamation to college life. The peer mentors and SI leaders provided the program director (Dr. Wesley Gray) with a summary of how the fellows were progressing.
- We were able to integrate the SREEP program into the universities’ one-week Jag365 orientation program. In 2015, the SREEP program will run in conjunction with the Jag365 and involved two separate 21-day science boot camp. We expect that a large number of incoming freshmen will register for this program next year.

Lessons Learned

“This summer was an amazing experience. Not only did I learn educational things, I also learned things to help me out socially. The boot camp completely refreshed my memory with the science and math that I would need in the lab and so I could have a jump start in the classroom. At the same time I got to know two of my classmates very well and we formed a friendship bond. An important thing that I can’t forget to mention, are the guest speakers that we had. They gave important tips about getting through college and making the matriculation easier and more efficient.”

“The summer boot camp was intense and challenging. It made me realize what I will need to do in fall to get good grades. The most exciting part of the program was the field trips. I enjoyed seeing science in action, even though I did not understand all of it. What I learned from the summer, is that it will take commitment and all available resources such as student mentors and tutors to achieve my goal at Southern”.

“SREEP at Southern was exciting, challenging and fun. The best part was the field trip to the Museum, science center and the meeting. -Lets do it again”

“My SREEP research experience gave me an insight on how simple concepts can make such a large impact”.

“The SREEP (Science Research Educational Enhancement Program) has presented me with an inconceivable opportunity. During the summer months of June and July, we were taught various classroom and laboratory skills. For example, the program required us to have lectures on such subjects like chemistry, biology, and mathematics. Also, I was assigned with a personal mentor; her name is Taylor Washington, sophomore biology major. Through the SREEP program, I was able to obtain knowledge, that was previously foreign to me, and apply those applications to my daily course work. One interesting project we conducted was making buffers in the lab. My assignment was to learn how to calculate the conjugate base and acid ratio and test my calculation with a pH meter. During the fall I was assigned to an engineering lab under the direction of Dr. Ibekwe. While in Dr. Ibekwe's lab, I began to learn how to synthesize and characterize composite materials. Overall, my experience with SREEP has been beneficial. The basis of my research conducted with Mr. Micheal under Dr. Ibekwe, was testing for structural efficiency of aluminum composites. We were comparing our experiments vs. structural steel. Our project consisted of a 4x4 in square caste. The caste was fabricated by bonding aluminum and stainless steel. The caste experiments varied from 3, 5, and 7 stainless steel rods embedded in the piece. We tested for tensile strength, flexibility, compression force load capacity, yield strength, etc. My SREEP research experience gave me an insight on how simple concepts can make such a large impact”.

Challenges

The biggest challenge we faced was recruiting students to stay after the one week, Jag365 orientation program. This challenge was addressed by selecting students from different orientation sections and giving them the weekend off before the start of the boot camp. As a preventative measure for the future, the Jag365 orientation program committee will include a check box on the application where students can indicate if they are able to stay on campus for additional times.

Dissemination Plan

Our dissemination plans for this project involved presenting the results at a national meeting, on our campus web site and office of sponsoring program news brief. We have disseminated the intention and result program through the university web site and campus community. This has resulted in an increase in faculty inquiries about the program and recommendation of students that may benefit from the program. We also obtained requests from upper classman asking to participate in the program. Dr. Telles, the co-PI, is planning to present a poster on this project at the Experimental Biology Meeting in June 2015.

Student Outcomes

SREEP is an academic and research intensive to develop students' research potential. Students participated 20 hours per week during the academic year conducting research activities that can be presented at professional meetings. The SREEP fellows spent one week during the summer becoming familiar with their research topic and completing a biochemistry-microbiology boot camp. The SREEP fellows, working as a team, will address the problem as to what are the specific phytochemicals responsible for antimicrobial bioactivity in *Kola acuminata* (Bizzy Nut). They will test the hypothesized that solid-liquid extraction of Bizzy Nut, followed by antimicrobial screening (minimum inhibitory concentration, MIC) would reveal its chemotaxonomic significance. During the one-week biochemistry boot camp, the fellows learned: to read scientific papers; make buffers and solutions; how to analyze graph data and make a research poster together. All the fellows were able to complete the pipette calibration, calculate statistical parameter and graph their results. Two of the students were able to complete the calculation and make the buffer solution correct the first time.

Next Steps

The three incoming-freshmen that were selected as SREEP fellows and participated in both summer research and the science boot camp along with five new chemistry and biology students will be monitored for the duration of their undergraduate studies. These students will be provided SI as needed. They will also be involved in community service at the middle and elementary science club and fair during the spring 2015. The three SREEP fellows will continue their research and present their findings at the LS-LAMP seminar in the spring. We are currently planning for the next cohort of SREEP students.

York College

Principal Investigator: Dr. Jain Shweta

Project Title: Engaging Undergraduates in Research that Speaks their Language

Abstract

The overall aim of this project was to provide students the opportunity to participate in current research in Computer Networks and teach them the tools necessary to engage in Computer Science research. In order to achieve this goal, students were training in the arts of reading and writing formal research articles. They were also given hands-on training in the JAVA programming language for Android application development as well as wireless networking using Wi-Fi Direct technology.

Progress

- The research phase of this project has completed
- Students have developed working applications that enable content sharing using Wi-Fi Direct as well as other tools.
- Applications and research presentations were demonstrated at the York College Arts and Science Exposition of December 11, 2014
- An article titled "Engaging Undergraduates in Research that Speaks their Language --

author Shweta Jain” has been submitted for peer review to the IEEE Integrated Stem Engineering Conference

Lessons Learned

Student researchers have learned about research in Computer Networks through several articles that they read and summarized. They have also experienced product development, presentation and time management skills. They learned about the intricacies of the Future Internet Architecture projects and saw the stumbling blocks when conducting research in an area that is still under development. They have learned how to analyze problems and to solve them.

The PI has learned that the main problem at York College is not how to attract students to do research but how to manage the increase in student and faculty workload when research is being integrated as an extra-curricular activity. Integration of research in a senior design or capstone project through curriculum change might be a good solution. However, one of the reasons why students were taking the risk of working on difficult problems was because the outcome did not have any impact on their grades. Curriculum integration might remove that choice and hence the outcome might not be as grand.

Challenges

The main challenge was workload management. This program did not account for the faculty and student workload in both summer and fall semesters. Although students were receiving stipends, they still had coursework. The additional effort was managed by maintaining structure through meeting schedules and time allocation during student club hours as well as weekends. A second challenge was making third-party software to work on our system. In the end, the team decided to develop and use its own software solution and techniques.

Dissemination Plan

The project website has been updated and is being managed regularly to disseminate the outcomes. An article title “Engaging Undergraduates in Research that Speaks their Language -- author Shweta Jain” has been submitted for peer review to the IEEE Integrated Stem Engineering Conference and a journal version will be prepared after peer-reviews of the conference submission are received.

Student Outcomes

- Out of 3 students who are graduating at the end of spring semester, two have already applied for graduate school education. One student has applied to the York College honors program. One student is scheduled to join another on-campus research program. All others will be applying to REU programs across the country
- Students have learned how to program in JAVA, experienced object oriented and even driven programming, had hands-on experience in product development and writing skills.
- Students were very excited and appreciative of this opportunity to present their posters and have expressed interest in continuing the work in the spring semester.

- Students have developed strong bonds with each other and are inspiring their peers and successors.

Next Steps

1. Prepare a journal paper that contains more detailed results and outcomes.
2. Curriculum proposal for a 3 credit special topics course that covers research, writing and software development skills
3. Explore options and funding sources for another year of a similar program with some variations such as curriculum integration to compare outcomes.

York College

Principal Investigator: Dr. Elizabeth Alter

Project Title: Bridge to Research in Environmental and Applied Metagenomics: An inquiry-based module to build core scientific competencies and improve retention among underrepresented students in STEAM

Abstract

The goal of the Bridge to Research in Environmental and Applied Metagenomics (BREAM) project was to increase the retention of underrepresented students in STEM by engaging them in an authentic research project based around a local environmental issue (the restoration of Jamaica Bay). Students at two academic levels (freshmen and seniors) collected their own environmental and metagenomic data in the fall of 2014-winter 2015. This exposed them to cutting-edge interdisciplinary scientific technologies and concepts, while also helping them learn about a variety of career paths in science.

Progress

- Twenty-six students participated in the project (ten freshman level and 16 senior level).
- Of these students, 89% were from groups underrepresented in STEM and 60% were female.
- All students collected environmental samples during three field trips to Jamaica Bay, New York. Students created their own research hypotheses, and completed three hands-on data analysis exercises on nutrient pollution and ecosystem processes using classroom laptops.
- All students learned the following state-of-the-art molecular techniques: DNA extraction, DNA purification, nucleic acid quantitation, and next generation sequencing. Senior students acted as mentors for freshmen students and guided their lab-based learning experiences.
- Students learned to use a command-line statistical analysis program (R) and worked in groups to conduct both basic and advanced statistics to test their hypotheses. Students developed e-portfolios, which they used in project management.
- Students designed and produced their own research posters, and presented them in oral presentations at the Fall 2014 York Research Day. Each student wrote a formal scientific report.

- Students met and worked with National Park Service employees and CUNY graduate students and learned about both traditional academic and alternative science careers.
- The effectiveness of the BREAM module was assessed using external evaluation. Students completed both pre-course and post-course assessment to gauge their interest in and aptitude toward science and research, and made above-average gains in almost all areas (see results below).

Lessons Learned

The project was very successful in achieving the goal of providing students with an authentic research experience, and was an extremely positive (if intensive) experience for both students and instructor. As the project designer and instructor, I learned that allowing students to guide their projects, rather than handing them pre-defined research questions, is absolutely critical to their buy-in to the project. However, this means that students need to gain background in the study system quickly and intensively early on, so they have the knowledge necessary to design meaningful experiments. I relied primarily on readings and occasional short lectures to provide students with this background, but I had a difficult time finding background material at the right level and ended up cobbling together papers and chapters from a variety of sources. I have begun assembling a manual/primer that I plan to use in the future. I also learned that that planning for contingencies upon contingencies is very important, particularly when fieldwork is involved, and that it is wise to budget at least two times the amount of time originally estimated for an activity. The students involved in the project learned a host of new skills and techniques including field sampling (see photos below), molecular methods, data analysis, scientific poster design and structuring a research paper. They learned about some of the important aspects of research and scientific practice that are typically not taught in classrooms, including the elements of scientific communication, ethical conduct, and the process of peer review. Beyond these concrete skills, I believe the students also learned that conducting original research is difficult and often messy, but can be extremely rewarding. Many of them learned about the environmental challenges facing their neighborhood parks and natural areas for the first time, and were able to experience how scientific research can be used to address and mitigate these issues. Student learning gains in numerous areas were measured using the CURE Survey and are detailed below. BREAM students also gained confidence in themselves as scientists, as measured by the CURE survey: nation-wide, students who were asked to respond between 1 (strongly disagree) to 5 (strongly agree) to the statement “I can do well in science courses” actually dropped from 4.00 pre-course to 3.97 post-course, whereas the BREAM students gained from 3.15 to 3.92. I also observed these gains in the classroom. Most students had never handled their own data before and taking it through from analysis to public research presentations gave them enormous pride.

Challenges

Principal challenges related primarily to logistics and also to the scientific and technical background of the freshmen students. A number of incoming freshmen lacked the necessary computer skills to conduct computer-based analysis exercises. For example, many students had never used a spreadsheet program (e.g., Excel) before. I improvised by having students work in teams with the senior students to accomplish the exercises, and devoting more time to reviewing basic computing skills. In addition, I found that students' schedules (particularly for the

freshmen) are extremely tight. Given that research can be unpredictable and the fact that sometime additional time is needed, this can be a challenge. For the fall semester, in which I hope to conduct these courses again, I will request a longer time block in the course schedule for student research. Finally, for the freshmen, because they had not explicitly signed up for a research experience, some of them were resistant to the process at first. It took longer than I expected to convince these students that they would gain from the experience, regardless of whether they intended to go on in STEM or not. In the end, I believe most or all of the freshmen came away with a solid understanding of what it takes to carry out a research project, and gained skills (including basic computing and reasoning skills) that they will be able to use in other courses.

Dissemination Plan

Students presented their results at a college-wide Research Symposium in December 2015 (see photo below). Out of the 26 students who completed the experience, eight are continuing work on the project, and will present the updated results based on winter semester work in the Spring Research Day in May 2015. These students are collaborating to combine their written reports to be written up for publication in an undergraduate research journal. One student will be traveling to a conference in July 2015 to disseminate her results in an oral presentation (Evolution meeting in Guarujá, Brazil) and I will present our project results at the Ecological Society of America meeting in August 2015. Finally, a team of web-savvy students is helping to design a website that will make our course data, elements of the student e-portfolios, and experiences freely available to the public.

Student Outcomes

Students made substantial gains in (a) targeted skills, including collecting and analyzing data, and presenting results orally and in written form, and (b) in overall learning gains (tolerance for obstacles faced in the research process, clarification of career path, self-confidence, etc). I used the CURE survey (<http://www.grinnell.edu/academics/areas/psychology/assessments/cure-survey>) to assess course element and learning gains pre- and post-experience. The results of the survey are shown below in Figures 1 and 2, where “Your Students” refers to the students in my course, and “All Students” refers to a nation-wide sample of >4800 students who have filled out the same survey. Compared with other students nation-wide, students in the BREAM course made greater gains in key areas related to research preparation and science attitudes. For example, in the category “Skill in science writing”, BREAM students gained 4.08 points on average, compared with 3.31 nation-wide (the scale is 1 to 5, with 5 being the largest gain).

Next Steps

The TCMF Award allowed me to initiate the BREAM project in the Fall of 2014, and the project is continuing in this current semester. Eight of the participating students have signed on to carry the project through to publication. At least four of these students are planning to apply for summer research fellowships to continue some aspect of the project. In the summer, we will also recruit new undergraduates and high school students to participate. I am planning to conduct the BREAM courses again in Fall 2015, taking into account the lessons learned last Fall. Moreover,

students will have the benefit of larger datasets as we will be able to fold in each subsequent year's data. Finally, I am tracking each of the students individually via CUNY's student portal as they continue their education, in order to determine whether they choose STEM majors and whether they pursue higher education in STEM.

Winston Salem State University

Principal Investigator: Dr. Johanna Porter-Kelley, Dr. Vanessa Duren-Winfield

Project Title: The Effect of Funded Undergraduate Research Experiences on Achievement of Low Performing Students in STEAM Disciplines and their Graduate School Interests

Abstract

Our hypothesis is that students with lower GPAs (<3.0) that participate in funded undergraduate research experiences will experience an increase in understanding, confidence and awareness of STEAM courses leading to increase in academic performance and retention in the STEAM pipeline?

To that end, the following objectives are promulgated:

- Objective 1: To provide research opportunities to undergraduate STEAM students with GPAs between (>2.5<3.0).
- Objective 2: To document the research process (training, mentoring and research project).
- Objective 3: To design and implement a tool to track participating students' data from their research experience through graduation.

Progress

- Objective 1: To provide research opportunities to undergraduate STEAM students with GPAs between (>2.5<3.0)
 - Initially, four students were recruited to participate in the Thurgood Marshall Fellowship. All but 1 of those students was able to continue their participation with the program into the fall semester of 2015. Of the students that were unable to continue, one student became Mr. WSSU and the time commitment required for that position was too great to continue. Another student had a conflict with work study. She was unable to participate in both programs. The student elected to remain in the work-study program because it ran for the entire year. The third student, because of a rumor, thought that she would not receive payment for her work in the program but that the funds would be applied to her loans, decided not to continue in the program. Only one student from the first cohort continued with the program and continued to work with Dr. Duren-Winfield in the fall semester.
 - Because the cohort of students available during summer school is much smaller than that which would be available during the fall and spring semesters.

- Four additional students were recruited to work in Dr. Porter-Kelley’s laboratory during the fall semester. Two of those students actually worked during their scheduled time. One student has committed to working in the laboratory in the spring. Because this group was unable to receive substantial training, we had to choose students with some laboratory training. Fortunately, our Biotechnology program has many pre-trained students that can walk into the laboratory and begin working. Three of the four additional students were selected from this group.
- Eight students took part in the study with a range of grade point averages of 2.624 – 3.732. Only one student was significantly out of the range and will be observed as a control subject (Table 1).
- Overall, the GPAs did not change significantly. We will continue to monitor these students until they graduate.

Table 1: Student Researchers and GPA

Students Enrolled into the program /Time-in Program	Hours Passed/GPA Summer 2014	Hours Passed/GPA Beginning Spring 2015
A /summer only	15/2.866	45/3.075
B/summer only	63/3.084	77/3.028
C/ Summer and Fall	60/3.252	70/3.028
D/summer only	91/2.681	110/2.800
E/ fall only- no show	32/2.819	83/2.939
F/fall only	77/2.624	89/2.596
G/spring only	90/3.732	107/3.583
H/ fall and spring	69/3.192	89/3.096

- Although, this was a small cohort of STEAM students, there are some very interesting observations we can make about student behavior
 - Students are highly motivated by financial incentives.
 - Students tend to over extend themselves.
- Objective 2: To document the research process (training, mentoring and research project).
 - The students spend 4 weeks training, 2 weeks in clinical research and 2 weeks in wet bench research.

Clinical Research

- During the clinical training, students received human subject research training and were certified in research protocol via the on-line Collaborative Institutional Training Initiative (CITI). (CITI.org.)
- Students participated in the design of a survey to assess knowledge, attitudes and beliefs about sickle cell trait among student athletes attending WSSU.
- Student athletes (112) were recruited via flyers, media, and the athletic department to be screened for sickle cell trait.
- Student athletes (112) completed a survey designed to assess knowledge, attitudes

- and beliefs about sickle cell trait.
- Student athletes (112) were screened for sickle cell trait by faculty from the Clinical Laboratory Science Department at WSSU and Sickle Cell of the Piedmont Triad clinical staff.

Wet Bench Research

- During the wet bench research, students were instructed in laboratory safety and standard techniques that would be needed for future work at the bench as well as understanding the techniques available.
 - During the two weeks between the end of summer school and the beginning of the fall term, students were given an opportunity to put in practice what they learned from the literature searches and standard techniques available. To that end, students were assigned to write a short proposal to design a small project with one aim to assess some question they had about athletes and sickle cell. Of the 4 students, one student completed the project by submitting the paper.
 - During the fall 2014 and spring 2015, students worked and are continuing the work to determine the sickle cell and mutation prevalence among athletes at WSSU. The students are learning single nucleotide polymorphisms analysis using Real Time PCR.
 - Each week students attended a laboratory meeting to share the progress, get feedback on their work and review relevant literature.
- Objective 3: To design and implement a tool to track participating students' data from their research experience through graduation.
 - A tracking tool (survey) was developed to capture student data to include the following: academic performance, research experience, graduate school interest, interest in STEAM, and evaluation of the program and mentors.
 - A baseline survey was disseminated and completed by participants upon recruitment into the program. Follow-up after 8 weeks yielded 14 surveys. The data is being assessed.
 - Subsequently, a survey was sent during the fall semester of 2014. Forty-one students responded to the survey. This data will be assessed.
 - Students will be tracked on a continuous basis each fall and spring semester through graduation anticipated 2017.
 - A manuscript will be prepared based on the results of our study.

Lessons Learned

There are numerous lessons learned by the student researchers (Thurgood Marshall Fellows) as they worked with Dr. Porter-Kelley and Dr. Duren-Winfield on this project. Students learned the significance of having background knowledge in the research focus area, sickle cell trait prior to beginning the intervention. Prior to acceptance in the program they knew very little on the subject sickle cell trait and/or sickle cell disease. Therefore, each student conducted a literature review on the topic and wrote a 2-page summary (APA format) of the journal articles reviewed. This activity was in preparation for survey development and was useful knowledge to assist with

designing flyers and brochures and to market the study to the intended population (student athletes). Learning how to conduct a literature review also facilitated enhanced knowledge how to use the library as a resource to access required research topic information; how to thoroughly analyze and carefully evaluate the relevance of an article; how to synthesize and use reference citations. The literature review assignment was transformed into a rich information literacy project that will be beneficial as Thurgood Marshall Fellows progress to develop abstracts and manuscripts for publication. Students were immersed in human subject research protocol and completed the Collaborative Institutional Training Institute (CITI) certification, which strengthened their knowledge concerning conducting human subject research. In addition, Co-PI Duren-Winfield, instructed students on aspects of behavioral research methodology to include recruitment, consenting, data management and collection. In the future, Dr. Duren-Winfield will build upon the previous activities and expose students to qualitative research, to include focus group methodology, descriptive research methodology, and qualitative data analyses. This will have a positive impact because Thurgood Marshall Fellows will facilitate focus groups with individuals who have sickle cell disease and volunteer to be interviewed. Hand-on experience (experiential learning) in real-life settings allow for a richer experience and exposure to behavioral research.

Additionally, students received an opportunity to read biomedical literature related to sickle cell. During the reading process many questions came to the students. Here, they were able to explore those questions and develop their own ideas. Subsequently, those ideas were taken to the wet bench. This process gave the students an understanding of discovery in science. Some students determined their true interest either in behavior or biomedical research. We could observe a parallel in the interest and the chosen major of the students. Further, the PIs on this project gained an experience in running an overlapping program and a study. To that end, there were successes and pitfalls that we did not anticipate. Yet we were able to overcome. One pitfall was the students not continuing in the program. One success was the excitement of the students when they could design their own project.

Dissemination Plan

We are currently analyzing quantitative survey sickle cell trait data in preparation for conference abstracts. Focus group data on experiences of individuals with sickle cell trait and sickle cell disease has been transcribed; qualitative analysis will follow. On January 26, 2015 we received notification from the Association of Social and Behavioral Scientists (ASBS) our abstract, *Implementation of a screening protocol to assess knowledge and sickle cell trait among minority athletes enrolled at a Historically Black College and University* was accepted at the 80th ASBS annual conference. Another dissemination opportunity will occur April 14, 2015, which is University Scholarship Day. Students present data to their peers as well as faculty. Students are scheduled to present at the Annual Biomedical Conference for Minority Students (ABCMS) this fall. Manuscripts will be developed from all data collected in this study and submitted for publication.

University of Maryland Eastern Shore

Principal Investigator: Dr. Victoria V. Volkis

Project Title: Horticultural Phytochemistry of Aronia Melanocarpa as a Model for Interdisciplinary STEAM Research Training for Undergraduate Students in UMES

Abstract

Using interdisciplinary research in horticultural phyto-chemistry of specialty crop Aronia Melanocarpa as a model project for early involvement of undergraduate students in research to improve retention in STEAM, we aim to:

- Recruit student-trainees-ambassadors who will get research experience and will act for recruiting more students to this project under our mandatory courses in independent study and research.
- Track the academic performance of student-trainees and all affected research students of research courses before and after this research experience, in order to test its efficacy in student retention in STEAM.
- Improve preparedness of students for agricultural chemistry related jobs and doctoral positions, while aiding under-served farms and agribusinesses.
- Investigate successful practices allowing retaining undergraduate students in research from early stages of their career.
- Investigate how early involvement in research influence student's career development

Progress

- The research about aronia and isolation of anthocyanins from aronia was presented on UMBC STEM Research Symposium. Not only students funded by this grant but also all other research students in the group (total students affected are 16) participated. Two students won the second prize in the poster competition
- The recruitment to CHEM 498 and CHEM 499 research courses was performed by student ambassadors. The result – amount of research students on these courses in Dr. Volkis group has grown from 7 in fall 2014 to 14 for spring 2015 semester.
- Aronia Interest Day was held in UMES. Total of 127 participants. Out of them 10 were local farmers, 12 faculty and administration, and the rest are current and prospective undergraduate and graduate students. 12 presentations, including scientific talks, student presentations and demonstrations, USDA representative talk, industry talks, were made.
- Students in Dr. Volkis research group both those involved in research previously and those funded by this grant to do research first time in their life have significantly improved their academic performance and all will continue the research for the next semester.
- Two students that are still not eligible to participate in research courses applied to become volunteering researchers in Dr Volkis group.
- Two new graduate students applied to Dr. Volkis group being inspired by Aronia Interest Day.
- Dr. Volkis has presented her experience in working with undergraduate students in research and their successful retaining on the Fall MRS National Meeting and has submitted a full paper about the same topic to the Meeting Proceeding (Cambridge press)

Lessons Learned

- The greatest problem with retaining students in research is finding the support for them. More students would join this and other similar projects, if they would not have to work outside to support their education. We need more scholarships for talented undergraduate students who are doing research from the early stage of college.
- For undergraduate students it works better if research project is assigned not to individual student but to the pair of students where one is a bit more experienced than the other one. This allow to students not only to learn from each other in addition to learning from graduate students in the lab and from their mentor, but also synchronize their schedule and run longer experiments in the lab the way that one student starts the experiment and the other continue it.
- Interdisciplinary research is more beneficial for students and can attract students of different majors to the one same project. This better shows to students their career possibilities and application in real life of what they learn in different courses.
- The best pathway for successful undergraduate research is to start on sophomore year as a volunteer, then do two research courses and then be funded from external grant. This would allow student to graduate with paper and number of presentations.

Challenges

The following table illustrates the challenges involving undergraduate students in research and presents ways these challenges are addressed under this project:

Challenges	Solutions
Low level of preparedness and science background for beginner undergraduate researchers	Blackboard active learning modules for main techniques, methods, instrumentation, project history
Progress of undergraduate researchers is limited and their work rarely leads to significant publications. The duration of their involvement in the research lab is limited	Availability of tasks in each project for different levels from high school students to graduate students. The longer student is in the project, the more tasks he learns
An undergraduate student's class schedule does not leave a space for long blocks of hours to spend in the research lab	Course sequence allowing students to stay for two years in the same research lab
	Rewarding opportunities for presentations, internships, competitions etc.
	Projects in which research operations may be divided into short steps
Student's immaturity prevents undergraduate students from discussing problems in research projects	Students work in pairs in each project Generation teaches Generation
	Graduate student constantly oversees 2-3 pairs of undergraduates Weekly individual and group meetings, report writing, lab book

Dissemination Plan

- Publication in UMES Keys about the grant and the project

- Presentation of results on UMBC Research Symposium
- Presentation of experience in MRS Meeting
- Aronia interest Day presentations
- Participation in UMES Agricultural open house
- Publishing one paper. Three other papers about aronia project are in preparation and to be published during spring 2015
- Planned presentations on UMES regional research symposium during spring 2015
- Application for additional grants has been made

Student Outcomes

The table below indicates the baseline data for two students funded by this grant and other students in Dr. Volkis research group in fall 2014. In this table the baseline data (beginning of fall 2014) is provided in black and new data as for December 2014 is added in red.

Student name	Your status (freshman, senior, graduate etc.)	You GPA after summer 2014 After fall 2014	Since what time you are in project?	Your graduation goal (what you want to do after graduation?)	What you did last summer?	Your program	How many presentations and/or publications you have so far?
Goldsborough Heather Funded by TMC	Sophomore	4.0 4.0	Fall 2014	Graduate program in Chemistry Graduate program in Chemistry of natural products	NASA Internship	TMC CHEM 498	3 presentations
Taiwo Ola Funded by TMC	Junior	3.4 3.5	Fall 2014	Pharmacy school or graduate school Graduate school	Non-professionally related job	TMC CHEM 498	0
Ndam Tina	Senior	3.8 3.87	Fall 2013	MD/PhD M.Sc. in chemistry and a preparation pass to MD/PhD	UC Davis internship	MARC. 498, 499 CHEM 498, 499	4 presentations
Aroh Blessing	Graduate	4.0 Graduated with M.Sc. in Chemistry	Fall 2012	Medical School Accepted to medical school	Graduate research in UMES	graduate	1 paper and 8 presentations

Fadipe Motunrayo	Senior	3.5 3.42	Summer 2014	Medical school or graduate school Post-bachelorette program	CHEM 499	499 CHEM 499	0
Park So-Jin	Junior	4.0 4.0	Fall 2013	Medical School Graduate school USDA oriented	Industrial Internship	498, 499 CHEM 499	1 paper and 3 presentations
Nwaeze Diamond	Junior	3.7 3.8	Fall 2013	Graduate school Graduate school	U Colorado internship	498, 499 CHEM 499	0
Rhoades Courtney	Junior	3.7 3.74	Spring 2013	Medical school Graduate school with degree in science	Scribe America internship	498, 499 CHEM 498, 499	1
Non-aronia research students							
Preeti Sharma	Graduate	First semester 4.0	Fall 2014	Postdoctoral training Postdoctoral training	Industrial job	Graduate Graduate	0
Muhammad Haneef	Senior	4.0 4.0	Fall 2014	Medical school Medical school	U Boston internship	LCAMP CHEM 498 and LCAMP	0
Volkis Baruch (shared with another professor)	Graduate	3.4 3.44	Fall 2012	Postdoctoral training Postdoctoral training or job market	Graduate research	Graduate Graduate	2
Dawn Turnquist	Senior	3.2 3.31	Fall 2014	Master degree in immunology Master degree in toxicology	none	498 CHEM 499	0

For new students joining the group in spring 2015 the data will be collected in the beginning of spring semester.

All students were able to successfully learn chemical safety, the topic they are working on, chemical techniques supporting their research, the art of presentation, GLP and other lab related skills. As can be seen from the table working in this project has influenced the perception of future career to some of students.

Next Steps

- First and the most important, we are going to apply for some research grants that would allow us to fund some of undergraduate students during their whole time in the research lab. This is our most strong struggle for now.
- We expand the approach we took with undergraduate students in aronia project to some other projects such as antifouling protection using extracts of specialty crops and using waste of local seafood businesses to prepare effective sorbents for reversible carbon dioxide capturing.
- We will be tracking the further progress of all current students in this research project and all those students using the table of students' progress shown in previous chapter.
- We will complete papers, which are currently in preparation and will submit it.
- We will prepare presentation for UMES regional symposium and also Dr. Volkis is an invited speaker on Midwest Aronia Growers Association Annual Meeting in March 2015.

ARCHIVAL PUBLICATIONS (PUBLISHED) DURING REPORTING PERIOD: None

CHANGES IN RESEARCH OBJECTIVES, IF ANY: None

EXTENSIONS GRANT OR MILESTONES ALIPIED, IF ANY: None

CHANGE IN AFOSR PROGRAM MANAGER, IF ANY: There was not a change in the AFOSR Program Manager, but there was a change in the Thurgood Marshall College Fund's Program Manager/Principal Investigator from Dr. Misha Lesley to Mr. Johnny C. Taylor, Jr. Dr. Lesley resigned her position with TMCF.