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Impact of Research Mentoring in Transformation of STEM Education at Southern University at New Orleans

Omojola, Joe
Kambhampati, Murty S.
Johnson, Carl P.
and Phyllis Okwan
Southern University at New Orleans

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Joe Omojola, Murty S. Kambhampati, Carl P. Johnson, and Phyllis Okwan.
Department of Natural Sciences
Southern University at New Orleans, New Orleans, LA 70126, USA

Abstract
Performance of minority and women students in STEM education at Southern University at New Orleans has made significant gains for over a decade. This improvement is due largely to research mentoring of undergraduate STEM majors through NSF funded grants such as LS-LAMP, HBCU-UP and S-STEM. This paper documents some of the successes of these grants.

Literature
The severe shortage of manpower in the sciences, especially among the minority population, is well documented [2-8]. We are aware of this shortage and that the origin of this problem, no doubt, can be traced to science education as early as in elementary schools [1, 5]. In addition, it is a known fact that minorities and women are under-represented in science and technology [5, 7].

Introduction
Southern University at New Orleans (SUNO) is a historically black university and a long standing senior state institution in the state of Louisiana. It was founded as a branch unit of Southern University Agricultural and Mechanical College of Baton Rouge in 1959. The mission of SUNO is "to create and maintain an environment conducive to learning and growth, to promote the upward mobility of all people by preparing them to enter into new as well as traditional careers and to equip them to function optimally in the mainstream of the American society". The institution was established primarily, but not exclusively, for the higher education of African American citizens in the greater New Orleans area, the state of Louisiana, out-of-state, and also for internationals. Currently, SUNO's average enrollment is 2,900. Approximately 98% of the students are African Americans (www.suno.edu).

This article will describe the accomplishments from NSF funded HBCU-UP grants – "Program for Excellence in Science, Mathematics, and Computer Technology (PESMaCT)" and "Enhancement, Enrichment, and Excellence in Mathematics and Sciences (E^3MaS)" in the Department of Natural Sciences. These accomplishments are in the areas of students' recruitment, retention, and exposure to STEM disciplines. SUNO PESMaCT grant in 2001 and E^3MaS in 2009.

Goals of PESMaCT
The goals of PESMaCT are: (1) increase the "pipeline" flow of minorities from high schools and junior colleges to science, mathematics, and computer technology fields,

(2) improve retention of minorities in science and mathematics, and (3) improve the quality of graduating science and mathematics majors.

Hurricane Katrina Impact

Hurricane Katrina hit New Orleans and SUNO in August 2005. Due to that hurricane we lost most of our physical, research, and educational infrastructure. This loss necessitated rebuilding our campus and academic programs from the start. Consequently, we proceeded to write a new proposal – E^3MaS to rebuild STEM programs. Specifically, the Co-PIs on this grant built a new research infrastructure so as to continue to allow them to mentor students. As a matter of fact, Dr. Kambhampati has added a new dimension (environmental biotechnology) to the pedagogy and research menu for his students.

Goals of E^3MaS

E^3MaS goals are: (1) increase STEM graduation rate, (2) increase faculty participation in research, mentoring, publications, and grants writing, (3) enhance the quality of undergraduate research experiences, (4) strengthen partnerships with academic institutions and research labs, and (5) increase the number of STEM students completing the path from high school through college to graduate school**.**

Results

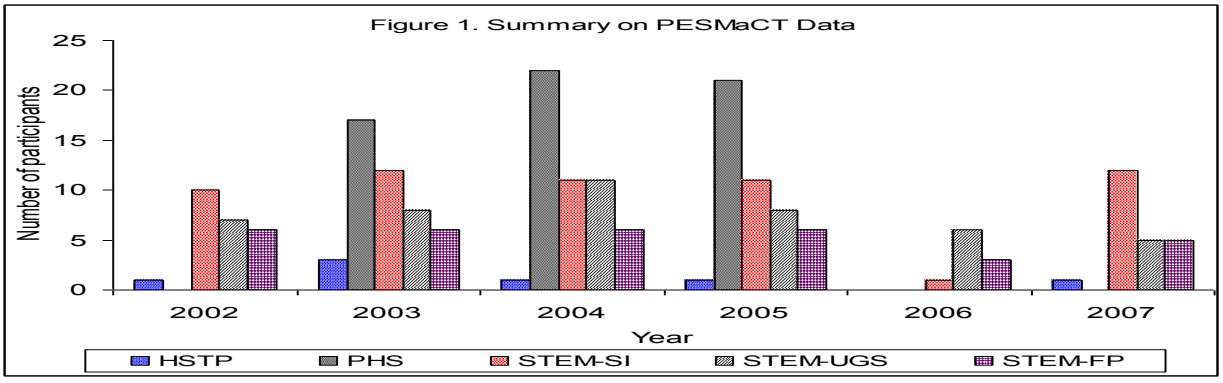
PESMaCT Accomplishments:

Listed below are some of the achievements of PESMaCT between 2001 and 2008.

- Number of STEM undergraduate students participating in summer internships increased from 8 to 39
- The number of student participants at conferences increased from 6 to 51
- Number of students receiving assistance in the tutoring lab increased from 351 to 508.
- In February 2005, Southern University at New Orleans hosted the National Annual HBCU-UP Research Conference with over 600 participants from 62 institutions and organizations
- PESMaCT worked synergistically with other funded grants (such as LS-LAMP, AGEP and MSEIP) to increase STEM production.
- HBCU-UP grant was leveraged to attract more funded grants (increasing from 3 in 2001 to 7 in 2005)
- There has been a tremendous increase in the number of undergraduate students involved in research with faculty. Between 1999 and 2001 there were 7 students involved in STEM faculty supervised research (by two faculty in the areas of biology and physics) funded by LS-LAMP at Louisiana Universities Marine Consortium (LUMCON) and Tulane University LAMP (TU-LAMP). As a result of funding from NSF HBCU-UP, NIH-Biomedical Research Infrastructure Network (BRIN), MSEIP, and LS-LAMP the number of students doing independent research with faculty has increased to an average of 7 faculty per year in the Department of Natural Sciences (40% increase).

- Between1998-2007, 7 different faculty served as research mentors to ~80 students in on-campus/off-campus summer and academic year programs. Several students were able to present faculty mentored work at national scientific meetings and publish their work in national and international scientific journals. Majority of the interns believe that the research experience significantly improved their views and knowledge in science areas. Students have also participated in research with collaborating scientists at several major institutions resulting in a big pool of students (100-120 over the past 6 years) attending scientific meetings and making presentations. Some of our research mentees won awards.
- Since 2002, every year 30-40 high school juniors and seniors spend six-eight weeks on campus and participate in enrichment activities (Summer Enrichment Program – SEP) and conduct small research projects. At the closing ceremony, each participant makes an PowerPoint presentation of his or her research findings. In the last six years 213 students participated in this program.
- NSF HBCU UP and MSEIP programs accomplishments were disseminated by the respective PIs and Co-PIs who were invited at meetings such as: NSF-HRD JAM PI meeting and Technical meetings at Washington D.C.
- During, the Seventh and Ninth Annual National Role Model Conference (2006 & 2008) by Minority Access Inc. at Las Vegas, NV and Baltimore, MD, Dr. Joe Omojola and Dr. Murty S. Kambhampati, respectively, Co-PIs of this grant proposal were honored for outstanding faculty "Role Model" who have contributed to increasing the pool of university STEM researchers through teaching, mentoring, and supporting minority students.
- Dr. Joe Omojola, received the 2006 Presidential Award for Excellence in Science, Mathematics, Engineering and Mentoring (PAESMEM), for embodying excellence in mentoring underrepresented students and encouraging their significant achievements in STEM.
- More than 30 students supported by HBCU-UP and LS-LAMP enrolled in graduate programs – MS/PhD/DPharm/MD.

Figure 1: Significant growth in components of PESMaCT (The decline from 2005 to 2006 was due to the impact of hurricane Katrina)



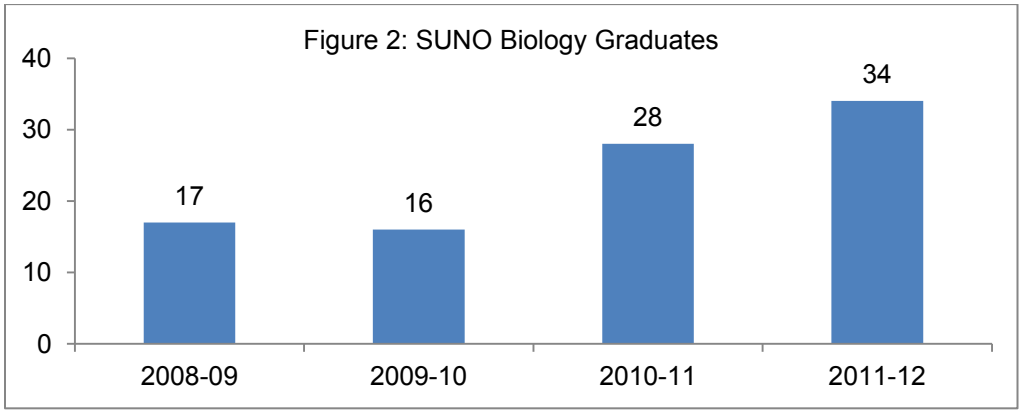
**HSTP = High School Teacher Participants, PHS = Participating High Schools, STEM-SI = STEM Summer Interns, STEM-UGS = STEM Undergraduate Scholars, STEM-FP = STEM Faculty Participants.*

E^3MaS Accomplishments

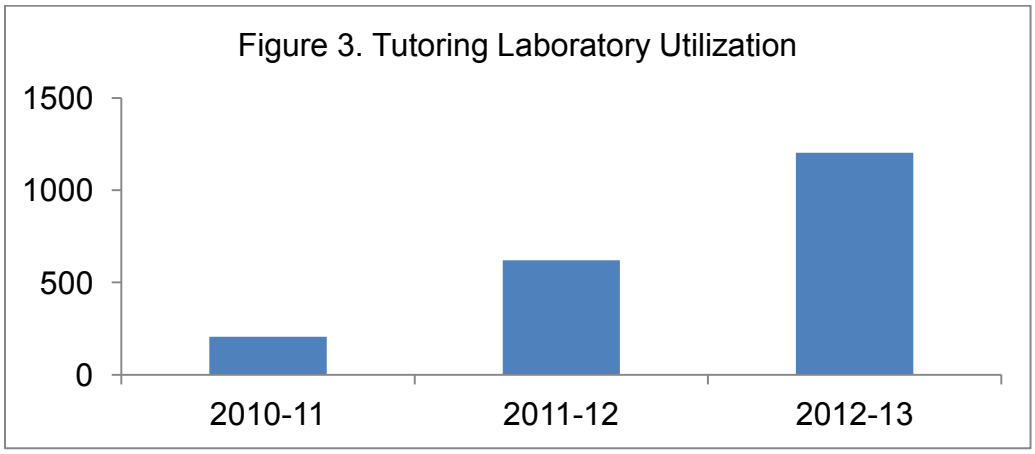
Listed below are some of the achievements of E^3MaS between 2009 and 2013.

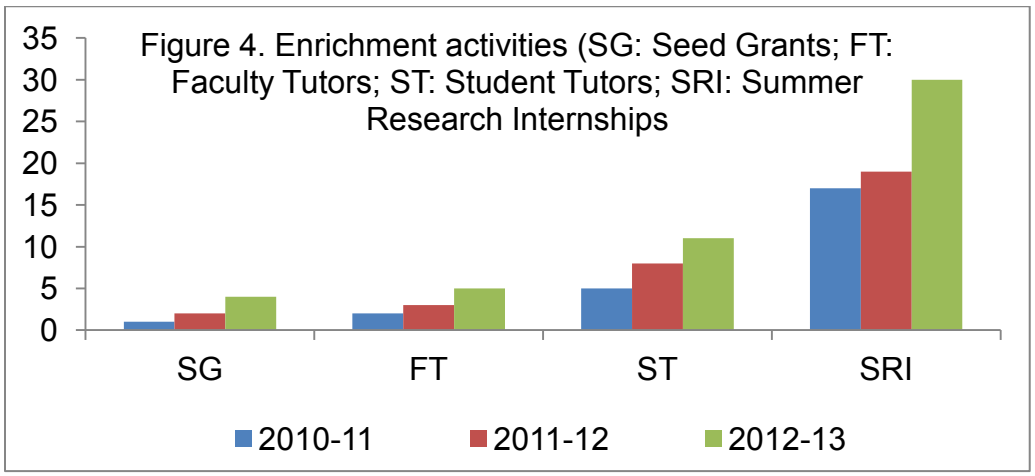
- Increased the participation of undergraduate students in STEM fields
- Reduced time required for graduation
- Increased number of seed grants awarded to faculty members
- Increased number of faculty tutors
- Increased number of student tutors
- Increased number of student participants in Summer Research Internships
- Increased student utilization of tutoring laboratory
- Improved cumulative GPA of student participants

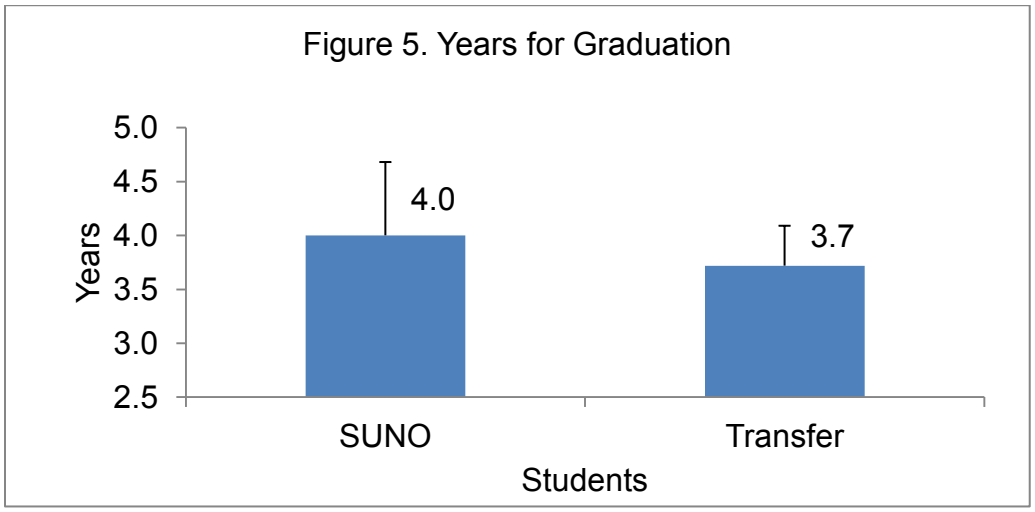
Some of these achievements are shown in figures 2- 6 below.



Compared to national graduation average in biological science/life sciences (5.2% in 2008), SUNO biology graduation was 9.5% during the academic year 2008-09. As shown in figure 1 above, the number of graduates in Biology is on the rise from the 2008-09 baseline.







Contributions to Other Disciplines

The activities of this grant have impacted other disciplines on campus in the following ways:

1. The PIs on this grant won SUNO Campus and Southern University System wide awards in grants writing and mentoring. These awards have served as motivation for other faulty members.

2. At the annual 'Breakfast of Champions' hosted by Office of Academic Affairs and Office of Grants and Sponsored Program, Drs. Joe Omojola and Murty S. Kambhampati were awarded a certificate each for 'Most Funded Proposals' during the 2010- 2011 and 2012-13 academic years. They were also awarded

certificates for 'Most Outstanding Grant Writer Awards for 2011-12 and 2012-13 academic years, respectively.

3. As a result of dissemination of activities, faculty members in other disciplines are getting involved in grant writing activities.

Contributions beyond STEM

Activities within E^3MaS grant have enhanced the self-confidence of undergraduate students towards being able to achieve their academic, personal, and professional goals. In particular, we have observed a significant increase in the GPA of students immediately following their participation in summer research and beyond. Additionally, students that would not have had the opportunity to get a college degree (especially first generation students) have been able to do so through the mentoring and support provided by the grant.

Conclusion

Our activities and efforts have been greatly successful at: (i) enhancing the educational infrastructure at Southern University at New Orleans (SUNO). Especially, we have been able to recover most of what was lost to hurricane Katrina in our STEM program; (ii) enhancing the recruitment and retention of STEM students; (iii) improving the GPA of undergraduate students; (iv) reducing time required for degree completion; and (v) improving the enrollment of SUNO-STEM graduates into graduate and professional school programs. Most importantly, implementation of activities proposed in E^3MaS has helped us to achieve the main goal of enhancing the quality of undergraduate STEM education at a Historically Black Colleges and Universities' campus as a means to broaden participation in STEM workforce.

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