Winter 2013

Outcomes of Texas Southern Univerity's Summer Undergraduate Research Program

David Owerbach, *Texas Southern University*

CUR Quarterly
COUNCIL ON UNDERGRADUATE RESEARCH

David Owerbach, Sunny E. Ohia,
Adebayo Oyekan, *Texas Southern University*

Outcomes of Texas Southern University's Summer Undergraduate Research Program

It is widely acknowledged that participation in mentored undergraduate research can influence students' career choices and encourage them to pursue graduate education and research careers (Crowe and Brakke 2008; Taraban and Blanton 2008; Jones, Barlow and Villarejo 2010). Most of the data on undergraduate research for African-American students is not derived from research programs at HBCUs, but is drawn from student experiences at external research sites funded by organizations such as the National Science Foundation (Beninson et al. 2011). Furthermore, most of these external undergraduate research programs are in traditional biological and chemical sciences, and only a small percentage of the student applicants are accepted into these programs (Beninson et al. 2011).

In one study that involved 19 African-Americans, only two students did their undergraduate research on campus, while the other students obtained those experiences at external sites (Kendrics and Arment 2011). In another HBCU study, 12 students were involved in an undergraduate research program on-site, but only for several hours per week over a 12-week period and no evaluations of their experiences were provided (Hand, Betters, McKenzie and Gopalan 2011).

In addition, one HBCU, Howard University, has served as a host undergraduate research institution for the prestigious Amgen Scholars Program, with approximately 20 African-American undergraduate summer students and Howard University faculty participating each year, but little evaluation data has been reported (Amgen Scholars Annual Reports, 2007-2010). Similarly, Spelman College has received Howard Hughes Medical Institute support since 1991 to support undergraduate research, but again no evaluation data is reported in educational databases (Spelman College website). It is therefore important to analyze undergraduate research programs at HBCUs that have on-site, strongly structured mentor/student undergraduate research programs.

Texas Southern University (TSU), in Houston, Texas, is an HBCU with approximately 7,500 undergraduates, of whom 82 percent are African-American. TSU has approximately 300 tenured or tenure-track faculty members, of whom 73 percent are African-American. In addition, TSU has graduate-school programs, and many of the faculty members are involved in research activities that involve both undergraduate and graduate students. TSU has had a 10-week summer undergraduate research program for the past three summers. The program has evolved during this time, and here we evaluate TSU's 2012 summer program.

Outlines of the Summer Program

Information about the availability of the 10-week summer program was posted throughout the TSU campus. Research was defined as hands-on basic research. This could include instruction in laboratory techniques, enrichment activities, and field work. Students could also be involved in formulating qualitative and mixed-methods research questions, receive training in research methods, and get hands-on experience in the creation and use of such discipline-specific research tools as surveys, bibliographies, indices, and data series. Interested undergraduates were required to find a mentor and fill out an application that included student information, a personal statement, three letters of recommendation including one from the mentor, a certified copy of their transcripts, and acknowledgement from their chosen mentor that he or she would act as the student's mentor. The mentor also provided a short description of the student's research plan. The Office of Research determined if each of the mentors and research projects was appropriate.

Sufficient funds were available so that all 30 students who completed the application process, regardless of GPA, were accepted into the program. Two students dropped out early in the program for personal reasons and are not included in the program evaluation below. A stipend of $2,000 was provided for full-time participation (30 or more hours per week). The program consisted of an orientation meeting, a progress report submitted by the student after four weeks, a closing poster presentation by all students, and oral presentations by selected students. In the orientation meeting, topics such as research ethics, laboratory safety, and scientific methodology were covered. Mentors did not receive monetary payments for salary or supplies for participation in this program and generally had summer teaching responsibilities in addition to research mentoring. Following completion of the program, a booklet was printed that contained all the student abstracts and names and departments of the students and mentors, which was distributed to all faculty and student participants and was posted on the Office of Research website. Table 1 shows further details regarding the participating students and mentors.

Table 1. Description of Summer 2012 Research Students and Mentors

- 28 undergraduate students participated and completed the program.
- 68% of students were female.
- 32% of the students were freshmen or sophomores.
- 79% of the students were identified as African-American or Hispanic.
- 20 primary faculty mentors participated.
- 70% of mentors were African-American or Hispanic.
- 32% of the students' projects were in traditional laboratory sciences, including biology and chemistry, and are referred to as "bench science students."
- 68% of the "other students" pursued projects in sociology, psychology, political science, journalism, art, mathematics, or health sciences.

Methods for the Evaluation

This study addresses the following research questions:

1. To what extent does GPA correlate with student achievement in the program?
2. How do the experiences and achievement compare between "bench science" and "other students"?

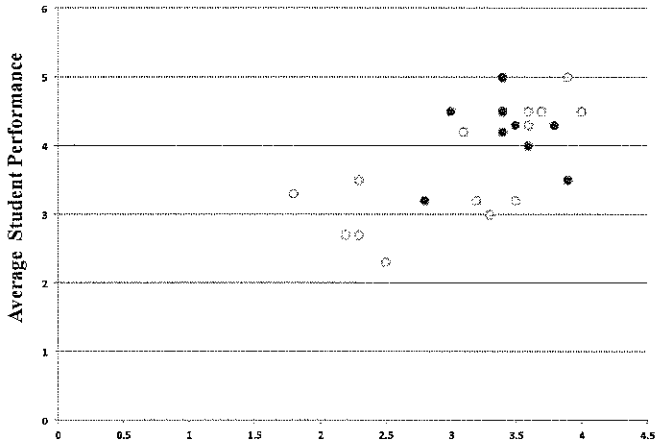
The program was evaluated through surveys completed by students and mentors after the program ended; the evaluation was approved by TSU's Institutional Review Board. Mentors completed surveys regarding 89 percent of the participating students. One faculty member mentored four students, five faculty members mentored two students each, and the remaining 14 faculty members each mentored a single student. Among the student participants, 75 percent completed the survey.

The mentors' survey evaluated students' performance on a 5-point scale (1-excellent, 2-very good, 3-good, 4-fair, and 5-poor), asking about organization, professionalism, responsibility, dedication, command of the basis of the project, and level of independence. Initially, the combined scores were averaged and plotted against GPAs obtained from certified student transcripts, using the Spearman Rank Order Correlation method (corrected rs; Wessa 2012). Later, the individual parameters were also examined by the Spearman Rank Order Correlation method. Statistical significance was demonstrated at $p < 0.05$.

The students' survey also asked students to rank variables using the 5-point scale and addressed their satisfaction with the mentor and with the overall program, and whether the experience increased the students' likelihood of attending graduate school and their likelihood of pursuing a career in research. Other variables consisted of GPA, gender, race, year in college, and amount of mentor contact. Comparison of results between "bench science" students and "others" was done by the Pearson chi-square test for unpaired samples or the Fisher exact test if the frequency was less than five in any cell. Limitations of the study are that the sample sizes are relatively small and that the study is from a single institution.

Results

Figure 1. Scatterplot: Student performance as measured by the average of 5 mentor ratings and student GPA



Student GPA: closed circles-Bench Research; open circles-Other

Figure 1 shows the correlation between student GPAs and the average rating of students' performance by the mentors in the subsets of students' that have "bench science" projects (closed circles) and all "other" students (open circles). The correlation coefficient is used to indicate the relationship of two random variables. It provides a measure of the strength and direction of the correlation varying from -1 to +1. Positive values indicate that the two variables are positively correlated, meaning the two variables vary in the same direction. Negative values indicate that the two variables are negatively correlated , meaning the two variables vary in the contrary direction. Values close to +1 or -1 reveal the two variables are highly related.

The correlation value for the entire student population for student GPA and student performance is $r_s = 0.59$ with a significant probability of 0.0032. Because bench science and other forms of research projects generally use different

Table 2. Correlation of Student GPA and Rating of Students' Performance by the Mentors for Bench Science and All Other Student

Grouping	Bench Science (n=9) r_s value; p	All Others (n=16) r_s value; p
Total (average)	0.25; ns	0.73; 0.0042
Organization	0.28; ns	0.78; 0.0020
Professionalism	-0.07; ns	0.51; 0.0340
Responsibility	-0.14; ns	0.86; 0.0008
Dedication	0.00; ns	0.52; 0.0324
Command of Subject Matter	-0.05; ns	0.49; 0.0404
Independence	-0.34;ns	0.67; 0.0078

Table 4. Student Survey Result

	STUDENT RESPONSES*				
	1	2	3	4	5
Mentor Satisfaction	17	3	0	1	0
Overall Program Satisfaction	10	9	2	0	0
Career in Research	6	10	3	1	1
Graduate School**	7	3	5	1	2

**Student responses were rated 1-5 with 1 being the highest rating and 5 the lowest rating.*
Career in Research and Graduate School refer to an increased desire after completion of the program to have a career in research or enter graduate school.
***Three students who returned the survey did not answer this question.*

research methods, we compared the subset of students from each group. Bench science students' average ratings by mentors and their GPAs were poorly correlated (r_s = 0.25; ns), while there was a high and significant correlation (r_s = 0.73; p = 0.0042) between "other" students' ratings by their mentors and the students' GPAs (Table 2).

In addition to the average mentor scores of students' performance, we also examined the correlation between the mentor's rating of each individual performance measure of their student's performance and his or her student's GPA in the "bench science" and "other" groups. None of the "bench science," but all of the "other" students showed a significant positive correlation (Table 2). Mentors' rating of students on

Table 3. Comparison of "Bench" and "Other" Research Projects

	Number	Mean GPA	URM*	Female	Underclass#	Mentor/ Student Daily Contact**
Bench	9	3.33	78%	78%	44%	89%
Other	16	3.11	75%	69%	31%	31%

** URM—under-represented minority*
*** Fisher exact test two-tailed; p = 0.011. All others: ns.*
#Underclass (freshmen and sophomores).

the variable of "responsibility" correlated the most with the students' GPAs (r_s = 0.86), and mentors' rating of students on "command of the subject matter" correlated the least with students' GPAs (r_s = 0.49).

In an attempt to decipher why the mentors' ratings correlated only with one group, we compared a number of variables between the two groups, including GPA, gender, race, year of college, and amount of contact with the mentor (Table 3). Only the variable of "daily mentor/student contact" differed significantly between the groups.

The student surveys indicate a very strong satisfaction with their chosen mentor and an overall satisfaction with the program (Table 4). In addition, the majority of students indicated an increased desire to have a career in research and an increased desire to go to graduate school following the summer program (Table 4). There were no significant differences between "bench" and "other" students in these responses (data not shown).

Discussion

TSU's goal of promoting undergraduate students' interest in research appears to have been met. There was an extremely high level of student satisfaction with their mentors and with the program overall. More importantly, most of the students indicate that they now are more likely to pursue a career involving research because of the program. These students will be tracked for a number of years to determine if the summer experience had an effect on their GPAs and to ascertain how many students actually go on to graduate school.

In the faculty mentors' ratings of student performance, there was a strong correlation between student performance and GPA for the subset of students who were doing projects that were not traditional biology and chemistry laboratory bench science. Within this "other" group, faculty mentors ranked

students the highest on the characteristic of "responsibility" ($r_s = 0.86$), while "command of the subject matter" was ranked lowest ($r_s = 0.49$). It is possible that some very intelligent students are not getting optimal grades because of a lack of responsibility in doing assignments or studying, while some less intelligent students who are very responsible are compensating by working harder. All five of our mentors' assessment parameters appear to be related, in that all were significantly associated with GPA in the "other" subgroup. These results are consistent with another study that shows significant differences in undergraduate achievement between biology and psychology majors in an undergraduate research program (Taraban and Logue 2012).

A major question is why there is a different correlation between mentor ratings of student performance and their GPAs between the "bench science" and "other" students? The differences do not appear to be due to gender, race, class level, satisfaction with mentor, or satisfaction with the program. A significant difference was seen in the amount of mentor/student interaction between "bench" students and "others," in that the "bench" students met daily with their mentors much more frequently than did the "other" students (89 percent versus 31 percent, $p = 0.011$). The significance of this finding is unclear and may simply mean that laboratory science requires a higher level of mentor/student interaction than other types of research. While mean GPAs for both groups were not significantly different, the "other" students had the five lowest GPAs and a much wider distribution of scores (see Figure 1). The lack of correlation of GPA and ratings of "bench" students by their mentors may simply be due to the smaller sample size and attracting higher-quality biology and chemistry students into the program. Additional studies will be required to resolve this issue. It seems reasonable for future undergraduate research programs at Texas Southern University to require student participants to have a GPA of 3.0 or higher

References

Amgen Scholars Annual Reports. 2007-2010. www.amgenscholars.com

Crowe, Mary and Brakke, David. 2008. "Assessing the Impact of Undergraduate Research Experiences on Students: An Overview of Current Literature". *CUR Quarterly* 28(4): 43-50.

Hand, James, Betters, Chad, McKenzie, Michael and Gopalan, Himanshu. 2011. "Increasing Academic Engagement at HBCU's Through the Implementation of an Undergraduate Research Showcase". *MountainRise, the International Journal of the Scholarship of Teaching and Learning* 6(3): 1-13.

Jones, Melanie T., Barlow, Amy E.L. and Villarejo, Merna. 2010. "Importance of Undergraduate Research for Minority Persistence and Achievement in Biology". *The Journal of Higher Education* 81(1): 82-115.

Kendricks, Kimberly and Arment, Anthony. 2011. "Adopting a K-12 Family Model with Undergraduate Research to Enhance STEM Persistence and Achievement in Underrepresented Minority Students." *Journal of College Science Teaching* 41(2): 22-27.

Research Associates Program, Spellman College. www.spelman.edu

Taraban R., and Balnton, R.L. (Eds.). 2008. "Creating Effective Undergraduate Research Programs in Science: The Transformation from Student to Scientist." New York, NY: Teachers College Press.

Taraban, Roman and Logue Erin, 2012. "Academic Factors that Affect Undergraduate Research Experiences." *Journal of Educational Psychology* 104(2): 499-514.

Wessa, P., 2012. "Free Statistics Software, Office of Research Development and Education" version 1.1.23-r7. URL http://www.wessa.net/

David Owerbach

Texas Southern University, owerbachd@tsu.edu

David Owerbach is a proposal-development officer in the TSU Office of Research and program coordinator for the 2012 summer undergraduate research program. Before coming to TSU, Owerbach was an associate professor of pediatrics at Baylor College of Medicine in Houston and was recognized for his research on the genetics of type I diabetes.

Sunny E. Ohia has been the provost and vice president for academic affairs and research at TSU since 2008. He also holds an academic appointment as professor of pharmacology in the university's College of Pharmacy and Health Sciences. Ohia's accomplishments include the establishment of a new honors college, several new online degree programs, new graduate and undergraduate degree programs, new research partnerships, and an improved student enrollment and retention infrastructure.

Adebayo Oyekan is interim associate provost and associate vice president for research at TSU. He is also a professor of pharmacology in the College of Pharmacy and Health Sciences and has been director of the college's Center for Cardiovascular Diseases since 1999. Oyekan has used resources from his National Institutes of Health grant to promote undergraduate research training at TSU since 2000, with many of the participants in the annual summer research internship subsequently entering graduate and professional programs around the nation.