Promoting Global Engagement in Chemistry

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University of Puerto Rico, Río Piedras

San Juan, Puerto Rico

Kimberly Jackson, Spelman College

Yassin Jeilani, Spelman College

Shanina Sanders, Spelman College

Albert Thompson, Spelman College

Leyte Winfield, Spelman College

A Global Perspective

It is recognized that technological advances and scientific innovations are not confined to geographic borders. Instead, it is the transgeographic exchange of ideas that allows the impact of science and technology to be broadly manifested. Therefore, modern curriculums and academic research must embody a global perspective that does not consider domestic and international perspectives separately, but as integrated in the formation of a whole. Institutions are creating comprehensive learning environments by engaging both faculty and students in initiatives that expand the boundaries of the classroom. While it is believed that science, technology, engineering, and mathematics (STEM) are inherently global, international travel opportunities can be leveraged to ensure that faculty are able to expand the curriculum and students understand the universal relevance of their discipline.

Spelman College is one of only six institutions in the country designated by the National Science Foundation (NSF) as a Model Institution for Excellence in undergraduate science and mathematics education. Spelman has a longstanding record for preparing women of African descent to obtain doctoral degrees in STEM. Building on this legacy, the College continues to expand its academic environment to respond to today's student demographics and to sustain the competitiveness of its STEM graduates. To this end the College has implemented a strategic plan that calls for an "internationalized" curriculum and learning environment, the Spelman Going Global Initiative (Spelman 2014). The initiative holds that all students will have a global experience before degree completion, and that academic departments will be positioned to both broaden the educational experiences of students and enhance faculty scholarly activities. To assist with the effort, the Gordon-Zeto Center for Global Education has been established to implement meaningful ways of increasing faculty and student involvement in international research and learning activities. Through the center, a required study-travel seminar (STS 100) was developed to prepare students for impending international experience. The course, comprising four 1-hour sessions, provides students an overview of the culture, language, and safety concerns related to the foreign destination. The Department of Chemistry and Biochemistry has capitalized on the Going Global campaign by supporting faculty efforts (individual and collaborative) to bring an international perspective to their work, particularly the work of nurturing the development of

future scientists. As described herein, these efforts highlight outcomes that have led to increased globalization in the department.

Globalizing STEM

The Global Research and Education in STEM (G-STEM) program at Spelman College seeks to prepare minority women in STEM to be globally engaged. Established in 2009, the program is housed under the Gordon-Zeto Center and funded through the National Science Foundation (NSF) and the Department of Education Title III. The program provides quality international research opportunities by identifying suitable locations for student placement. Students receive $7,000 toward program costs and airfare. In addition, they receive a $4,000 stipend for the six- to eight-week placement. Each scholar is assigned two research mentors, a faculty member from Spelman and one from the international institution. The Spelman mentor is provided a stipend of $1,000 and an additional $2,000 to supplement the cost of a site visit. Chemistry and biochemistry majors have completed research projects in London, England; Strasbourg and Grenoble, France; Madrid, Spain; Monteverde, Costa Rica; Johannesburg, Cape Town, Bloemfontein, and Bellville, South Africa. Their projects have spanned the fields of biochemistry, polymers, nanotechnology, cheminformatics, organic chemistry, and analytical chemistry.

Students are screened prior to applying for the program. This involves attending a pre-applicant meeting to review qualifications and discuss potential placements. Once clearance is granted and the student has been accepted into the program, they attend a mandatory orientation meeting and complete STS 100. In addition, they meet with the Spelman advisor to prepare for the visit by reviewing technical and scientific literature, discussing the project, and completing a communication plan. During their time abroad, students are required to complete weekly reflections on their research and cultural experiences, attend seminars and group meetings, and make a formal presentation on their work. A ten-page research report is submitted by the students upon their return. The students also present at the College's Annual Research Day and complete mandatory post-trip evaluations. To date, 106 G-STEM scholars, including ten chemistry and biochemistry majors, have successfully completed the program. This reflects a 35% increase in the number of students completing an international research experience. Past scholars displayed increased awareness of the cultural norms and research practices of their host site. In addition, they expressed enthusiasm towards further international research and travel after this experience. Ten of the twelve full-time chemistry/biochemistry faculty have served as mentors in the program. The department has established a G-STEM site in Grenoble, France, with Leyte Winfield serving as the Spelman collaborator. The site is slated to host two students annually at Grenoble Innovation for Advanced New Technology (GIANT) campus and Joseph Fourier University.

Study Travel

The STEM Learning and Understanding New Careers Horizons (LAUNCH) - Germany Summer Study Travel program was established in 2013 with Albert Thompson and James Brown as co-directors for Spelman and Morehouse Colleges, respectively. The trip was offered again in 2014 with Tiffany Oliver (Spelman) as co-director. The program will continue in the summer of 2015. The effort was funded by Cultural Vistas (New York) and the Halle Foundation (Atlanta). The latter was founded by Claus M. Halle, who once said, "I feel very strongly, taking history into account and everything I have experienced in my life on both sides of the Atlantic, that there is nothing more important for peace and prosperity in our hemisphere than the friendship between America and Germany" (Halle 2014). It is fitting that Spelman and Morehouse received funding from the Halle foundation for this study-travel opportunity in Germany. The two-week trip is offered to students in their sophomore or junior year of college and occurs in mid-May, allowing them to pursue other summer opportunities (e.g. internships and summer course work) upon return. The goals of the trip are to:

- Increase the reciprocal knowledge and understanding of both countries' (the United States and Germany) geography, cultures, and political, educational, and legal systems.
- Introduce students to Germany's scientific history, culture, and operations in corporate and academic environments.
- Expose students to Germany's ongoing research and research opportunities for undergraduates.

For the 2013 trip, participants traveled by airplane to various cities in Germany. The itinerary included connections in Frankfurt, and stays in Berlin and Munich. While the travel was enjoyable, participants

were unable to view points between these sites. Therefore in 2014, participants flew to Amsterdam for connection to Berlin; then traveled by train to Munich to complete the itinerary. This afforded participants an opportunity to see more of the countryside. The group lived in hostels during the visit and utilized the public transportation available at each location. Institutions visited in Germany included popular industries (i.e. BMW, Bayer, Bausch and Lomb, and Siemens) and academic institutions (i.e. the Max Planck Institute, Berlin Mathematical School, and Technical University of Munich). In addition, the group visited a job placement agency, a private start-up company involved in environmentally friendly research, and the U.S. Embassy.

(Figure 1: Poster of Etta Falconer seen at the Berlin Mathematical School) The students completed a pre-trip survey detailing their expectations for the trip and a post assessment that summarized whether their expectations were fulfilled. Many students expected there to be a language barrier. However, they found that most of the people they encountered preferred to speak English. A highlight of the trip was a poster of Etta Falconer, Professor Emerita of Mathematics at Spelman College (now deceased), who received international recognition for her contributions to STEM and Spelman College. The poster was on display at the Berlin Mathematical School (Figure 1). Students were also able to identify German-based companies that are currently on our campus such as Siemens.

The German experience dispelled many myths students had regarding the challenges of global travel, including the difficulties they expected to encounter because of language, cultural, and societal differences. The program greatly assisted students to more broadly define and refine career goals. German participants expressed an interest in having our students return for longer visits to complete internships. Because the trip is offered to students in their second and third year of study, students have the opportunity to pursue these experiences. Overall, the trip afforded STEM majors a broader understanding of how they can make an impact in various scientific avenues. Students expressed a greater understanding of the importance of being an active global citizen well versed in matters beyond the boundaries of their native country.

Similar to the Germany trip, the CIEE-Spelman College Intercultural Engagement in Peru study-travel course, co-directed by Yassin Jeilani, allowed a team of students and faculty to explore the culture, politics, and geography of a foreign city. This course spanned two weeks and involved both in-class (occurring at the Pontifical Catholic University of Peru, PCUP) and out-of-class activities (including Spanish language instruction). The course was graded as pass/fail and required students to complete an exam and submit a reflective essay. Students completing the course received three course credits. The trip allowed students the chance to experience PUCP campus life and to meet with Peruvian students as well as American students taking regular classes on PUCP campus. To engage with local culture, students visited communities in Chincha and an elementary school and museum in Lima. Witnessing the struggles of these citizens, students were able to draw similarities between the Civil Rights movement in the US and that of the Afro-Peruvian community. It was found that because the students were able to relate to the struggles of the community, they were able to connect to their surroundings despite the language barrier. Like most study-travel opportunities of this nature, participation by STEM majors was low. Efforts are underway to increase participation of these students. For example, courses are being scheduled such that the time frame does not prevent students from engaging in summer research and other enrichment activities.

Faculty Engagement

With Going Global's emphasis on student-centered activities, it is important to ensure that faculty have the experiences needed to provide meaningful curricular and co-curricular activities. Consequently, faculty at the College began reexamining its liberal arts mission. This allowed faculty to work towards transforming the curriculum to include more interdisciplinarity and globalization. The Chemistry and Biochemistry Department held several meetings to compile new ideas for curriculum enhancement. As a result, Kimberly Jackson created a food chemistry course and corresponding laboratory manual. Designed as a four-hour studio course (originally based on an MIT OpenCourseWare class), students are able to discuss the chemistry of cooking in one two-hour class period, and then cook a dish illustrating

the application of chemistry in the following class period. The course, offered for non-STEM majors, can be described as a survey of biochemistry (focused on water, fats, sugars, and proteins) that allows students to create edible chemistry. For instance, ice cream is prepared and the role of freezing point depression in the formation of the dessert is discussed. Food chemistry has been immensely popular with students in the six years that it has been offered. Most impressively, it boasts huge gains in students' comprehension of chemical concepts. Completion of the course allows students to fulfill the natural science course requirement.

The success of the food chemistry course created an opportunity for Jackson to use food as a model for interdisciplinarity. As a result, she co-developed (with Patricia Ventura, English, and Mona Phillips, Sociology and Anthropology) a two-day workshop for twenty faculty members from UNCF institutions with funding from the UNCF Mellon program. Across the Disciplines and Around the Table: Rethinking Interdisciplinary Research Using Food as a Model promoted an opportunity to form alliances among faculty from across disciplinary boundaries through a shared examination of the most basic questions, such as "Why interdisciplinarity?" and "How do we use food studies as a model for interdisciplinary pedagogy and research?" Faculty attending the workshop were also able to create modules for course implementation at their particular campus and engage with facilitators who spoke on various "food" topics. Therefore, the workshop allowed the organizers to advance the College's strategic plans by utilizing food as a platform for conversations of universal significance. The next step for Jackson was to engage in a dialog on food in a global setting. She attended a two-week CIEE International Faculty Development seminar on food from a global perspective in Pollenzo and Naples, Italy—an experience which she describes as "a once-in-a-lifetime opportunity that provided a multi-experiential understanding of food through guided tastings, seminars, in-class lessons/exercises, and cross-country travel with a group of colleagues learning from each other's varied disciplines" (CIEE 2015). During the trip, she was able to learn from an exchange of ideas, become acclimated to new initiatives in food studies, and receive insight on food from a global perspective that can be integrated into the Spelman curriculum. Based on these three experiences—the creation of the food chemistry course, the development of the food workshop, and the CIEE international seminar—the "Think Food" initiative, a new interdisciplinary food studies minor at Spelman College, is being established with Jackson and Daryl White (Sociology and Anthropology) serving as directors.

Conclusion

The international opportunities summarized herein highlight new possibilities for the Spelman community. The initiatives have led to significant faculty, student, and college-wide impacts. One question that has arisen relates to the students' propensity to pursue degrees or permanently relocate to an international venue as a result of these experiences. While this has not been formally analyzed, it is worth mentioning that many of the foreign institutions have expressed interest in students spending longer periods in their labs (in a pseudo-post baccalaureate model) and enrolling in their graduate programs. The potential for this to occur is still being explored. Nevertheless, these collective efforts demonstrate the necessity of leveraging travel in the engagement of both students and faculty as global citizens.

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