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# Starting Points for Involving Underrepresented Graduate Students in International Engagement: A Case Study on the Collaborations Between the University of Maryland Baltimore County (UMBC) and Educational Institutions in Latin America

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# Starting Points for Involving Underrepresented Graduate Students in International Engagement: A Case Study on the Collaborations Between the University of Maryland Baltimore County (UMBC) and Educational Institutions in Latin America


## Abstract

Graduate students in engineering and IT do not have many chances to participate in study abroad opportunities, and those who do, may do so as individuals based on their graduate advisor's collaborations. In this globalized world of technological advances, developing international collaborations between scholars within the STEM fields is not only beneficial; it is essential, thus opportunities should not be limited to a select few. The National Academy of Engineering has developed a list of Grand Challenges, and there is growing concern that there won't be an international workforce with enough training to develop solutions for real-world issues. Despite involvement of some graduate students in international research, there remain subsets of graduate students from underrepresented minority (URM) groups who have neither been encouraged nor invited to participate in international projects. The Council of Graduate Schools' 2013 publication, "Graduate Education for Global Career Pathways," included papers that encouraged graduate students to participate in global conferences as means to engage, and serves as the premise for our strategy to broaden participation of URM graduate students in international projects.[1] The Graduate School at UMBC and the National Science Foundation's PROMISE: Maryland's Alliance for Graduate Education and the Professoriate (AGEP) program have started to develop cohorts of students and faculty who travel to international conferences and report on their experiences. Cohort travel models are not unique in undergraduate circles; however, for our group of participants, the model serves as a pathway to broaden the participation of STEM-trained women and minorities in international engagement. The model includes immersing the cohort into a culture through participation in an international conference, presentations at a host university to develop collaborations with faculty and students, scientific excursions, discussion sessions addressing research questions, and plans for building on the short-term experience. This model started in 2012 with a graduate student presentation at the Latin and Caribbean Consortium of Engineering Institutions (LACCEI) conference in Panama. In 2013, participation in LACCEI in Mexico increased to two graduate students, a postdoctoral fellow, and an alumnus who is a member of the faculty at another institution. By 2014, a group of 15 participated in LACCEI in Guayaquil, Ecuador. Plans for 2015 include travel to the Dominican Republic, and affiliations with Tecnológico de Monterrey in Mexico. Given graduate students' 12-month continuous research and laboratory responsibilities, the short-term experience provided a sound introduction. Participants were part of the PROMISE AGEP, Louis Stokes Alliance for Minority Participation Bridges to the Doctorate program, and the UMBC/Puerto Rico ADVANCE Hispanic Women in STEM program. Many of the participants had little to no experience abroad. The 2014 trip included

collaborations with the CEDEI - Centro de Estudios Interamericanos in Cuenca, Ecuador for acclimation to the region, graduate student mentoring, and a presentation at the Foro Latinoamericano de Estudiantes sobre Educacion en Ingenieria conference at the Escuela Superior Politécnica del Litoral (ESPOL) for engineering students throughout Ecuador. Students from the U.S. and Latin American universities discussed the academic models of each country, career/life balance, development of cultural competence, and plans to engage in international research collaborations. This paper will present the model and the social science results from questions posed before, during, and after the trip which addressed barriers to entry such as the challenges of family and language, and the rewards associated with international collaborations.

## Introduction

International collaborations between researchers have been increasing in the last few decades; this increase has been particularly successful because advances in technology have facilitated the exchange of ideas between individuals from different countries. As a result, these collaborations can lead to an increase in global options to engage, which will be leveraged by those researchers who are prepared to take advantage of the new opportunities. In 2013, the Council of Graduate Schools published the Proceedings of the 2012 Strategic Leaders Global Summit on Graduate Education,[1] and put forth the goal of preparing graduate students to participate in both local and global knowledge transfer activities. The reports from the conference discussed a desire to create new pathways for supporting student mobility and global careers. One of the main challenges for graduate students will be to integrate ideas and communicate their learning with collaborators around the globe. However, the students cannot do this alone; therefore, there is a need for deans and faculty at institutions to be involved in this process. For example, Lisa Tedesco, Vice Provost for Academic Affairs, Graduate Studies at Emory University, suggested that the role of institutions may be more central in this process, indicating that institutional policies need adjustments and innovations to facilitate more fluid international exchanges or opportunities for students and faculty to participate in activities.[1]

The University of Maryland, Baltimore County (UMBC) has many undergraduate and graduate students from different countries; however, the numbers of students who participate in study abroad programs is low. Examining one region, the Partners of the Americas noted that the number of U.S. students that study in Latin America and the Caribbean (44,000) is less than the number of Latin American and Caribbean students who study in the United States (67,000).[2] To address this issue, the Graduate School at UMBC and PROMISE: Maryland's Alliance for Graduate Education and the Professoriate (AGEP, a program of the National Science Foundation (NSF)) are combining this new interest in developing pathways for global careers with the mission of broadening participation of women and minorities in Science, Technology, Engineering, and Mathematics (STEM) fields. Currently, the opportunities at UMBC for graduate students to engage in international experiences (e.g. internships, conferences or

research) are very low, and most of them depend upon opportunities that are either shared or sponsored by their graduate faculty advisors. UMBC is trying to create new pathways for supporting student mobility and global engagement to broaden participation of underrepresented minorities (URM) graduate student in international projects.

The foundation for developing an extended pathway began in 2003 with a partnership between UMBC and Universidad Metropolitana (UMET), an Hispanic Serving Institution from the Ana G. Mendez University System (AGMUS) in Puerto Rico. While Puerto Rico is a U.S. territory, UMBC's participation in their STEM student research conferences facilitated connections with universities, projects, and colleagues from surrounding regions in the Caribbean and Latin America. For more than ten years, UMET and UMBC have collaborated in preparing UMET's undergraduate students for graduate studies. In addition, UMBC has been an active participant at the AGMUS Research Symposium, where graduate and undergraduate students present their research. This collaboration led to a greater awareness of the benefit of international collaborations.

In 2010, The Graduate School at UMBC noticed the gap in the professional development offerings that were being presented to its graduate students with regard to issues such as global career pathways, cross-cultural competence, and ways to develop international collaborations. To address this gap, we developed workshops and activities to bring attention to international activities. Our first stage of programming began with providing awareness of the need to pay attention to research in different parts of the world, showcasing international postdoctoral and faculty opportunities, and discussing cultural competence. We designed a series of seminars and workshops to broach the subjects of international awareness and intercultural communication among graduate students. To date, we have held seminars with speakers from Professors Beyond Borders (a program that grew out of the International Institute of Education), faculty with projects in other countries, the Peaceworker Fellows Program (a Peace Corps Fellows Network member), the Fulbright program, and panels with advanced graduate students from countries other than the U.S. Table 1 lists a series of activities that describe ways that members of the PROMISE AGEP from UMBC have engaged in international activities. The list starts with activities that commenced in 2011, but does not showcase early, relationship-building activities between 2003 and 2011 that occurred between the PROMISE AGEP director and the UMET university community. The activities in Table 1 demonstrate the results of those early activities, and showcase information and dissemination events that were developed by PROMISE at UMBC to serve larger groups of students. We spent 9 years with UMET in small-scale meetings that led to expanded engagement. Between 2003 and 2010, UMBC and UMET spent time building relationships through meetings, facilitating faculty and administrator exchanges, mentoring students, collaborating with faculty on ideas for expanding curricula, and writing some grants to the National Institutes of Health, and the National Science Foundation to support our activities. In 2012, UMBC and UMET received an ADVANCE grant from the National Science Foundation to provide professional development for women STEM faculty in

Puerto Rico, and UMBC continues to have collaborations with UMET and other universities in Puerto Rico around issues of advancing women in STEM, with particular emphasis on women in engineering, information technology, and computer science. However, the activities described in Table 1 are student-centered, and focus on developing students. Some of the awareness events were held on UMBC's campus, and other activities took place in Puerto Rico, and in other locations throughout Latin America. The PROMISE AGEP's engagement in Puerto Rico and recruitment activities at national conferences of the Society of Hispanic Professional Engineers (SHPE) facilitated the introduction to Latin America's organization for engineering education. The Latin and Caribbean Consortium of Engineering Institutions (LACCEI) learned about UMBC's connections to Puerto Rico through the SHPE Graduate Institute, and invited the PROMISE AGEP at UMBC to the 2012 LACCEI conference in Panama. The invitation was also based on graduate school preparation information that PROMISE at UMBC was providing for the students at SHPE, and LACCEI wanted their international student audience to have the benefit of learning that information. PROMISE at UMBC developed a paper for LACCEI on the topic of preparing for STEM graduate programs, and presented the information in Panama. The information was well-received and the PROMISE AGEP was invited to continue to replicate their U.S.-based student development model to contribute content to programming for students at LACCEI in subsequent years.

Table 1. Seminars, workshops and panels geared toward undergraduate and graduate student audiences, where students and faculty from UMBC have developed international collaborations.

| Year | Location | Event | Speaker(s) |
|---|---|---|---|
| 2011 | UMBC | Workshop: Preparing for Global Leadership: Cultural Competence and Connections with and for International Students and Colleagues. | Panel of UMBC faculty and students from different countries outside of the United States. |
| 2011 | UMBC | Session: Professors Beyond Borders | Dr. Sabine O'Hara, (former) Executive Director, and past Vice President of Council for International Exchange of Scholars/ Institute of International Education |

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| 2011 | UMBC | Seminar: Being Abroad, Learning from the Peaceworker Experience | Featuring the UMBC Shriver Peaceworkers who were placed in countries throughout Latin America |
| 2012 | UMBC | Seminar: What is it like to work at a university in another country? | UMBC Faculty who have worked outside of the U.S. |
| 2012 | LACCEI (Panama City, Panama) | Paper and Presentation: Preparing for Engineering and Other STEM Graduate/Post-Graduate Masters and Doctoral Programs | Paper written by the PROMISE AGEP Team at UMBC: Miguel Nino, Natasha Ramoutar and Renetta Tull, presentation by Tull & Nino. |
| 2013 | U.S. Department of State, Washington, D.C. | Forum: UMBC graduate student delegation participated in the Third Annual Global Diaspora Forum (GDF) | Hosted by The U.S. Department of State and U.S. Agency for International Development (USAID), at the invitation by the Deputy Science and Technology Adviser to the Secretary of State, U.S. Department of State. |
| 2013 | LACCEI (Cancun, Mexico) | Forum: LACCEI – SPEED - NSF Engineering Student Leadership Forum<br>FLEI – Foro de Liderazgo Internacional de Estudiantes de Ingeniería | UMBC organized the forum for students at the LACCEI conference. Members of the PROMISE AGEP, Hector Medina and Nandadevi Cortes, participated on the panel along with UMBC alumna, Frances Carter-Johnson. |
| 2013 | LACCEI (Cancun, Mexico) – 9th Annual Global Student | Paper and Presentation: QoLT Engineering Education Outreach Facilitates Systems Analysis Study for | Paper written by Hector Medina, Renetta Tull (UMBC) and Jonathan Pearlman, Mary R. Goldberg (University of |

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| | Development Forum | Wheelchair Use in Mexico. | Pittsburgh). Presentation by Hector Medina. |
| 2013 | Forum (GSF) organized by the Student Platform for Engineering Education Development (SPEED) during the World Engineering Education Forum (WEEF) – Cartagena, Colombia) | Extended Abstract and Presentation: An Emerging Impact from an Engineering Education Outreach Collaborative "Bridge" Program: Graduate Student Participation in Wheelchair Mobility Research for Mexico. | Extended Abstract written by Hector Medina, Renetta Tull (UMBC) and Jonathan Pearlman, Mary R. Goldberg (University of Pittsburgh) |
| 2013 | UMET-Puerto Rico | Workshop: Writing for Publication | Dr. Kevin Omland, Dr. Renetta Tull, Nandadevi Cortes (UMBC) |
| 2014 | UMBC | Panel: Global Pathways to Careers | Representatives from The Fulbright Program, the U.S. Department of State, and Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM, Mexico) |

Table 1 shows that the PROMISE AGEP at UMBC was engaging in several activities that facilitate international engagement. However, we still had not solved the issue of facilitating an experience for larger numbers of graduate students to engage in an engineering-based activity in a more meaningful way - on-site in another country. Therefore, we developed a proposal and plan to immerse a group of underrepresented graduate students and faculty in a different country, within the context of an engineering activity. We decided that the best venue for short-term engagement in an international location would be choose a conference that is dedicated to

engineering education, and one that would assist us with developing activities for our participants. Our positive experiences with LACCEI in Panama in 2012, and in Mexico in 2013 led us to seek a stronger collaboration with the organization. The staff and organizing committee for the July 2014 LACCEI conference in Ecuador worked with us, and we developed a plan that would involve our graduate students in the conference. We also arranged for them to connect with engineering students at the university with the largest engineering population in the region. We developed an initial report with faculty from Escuela Superior Politécnica del Litoral (ESPOL) in Guayaquil, Ecuador during the 2013 LACCEI in Mexico. Upon the recommendation from UMBC's Office of International Education Services, the PROMISE AGEP director engaged the assistance of The Centers for Interamerican Studies (CEDEI) in Cuenca, Ecuador to learn more about the Andean region and culture, and to prepare for a collaboration meetings on ESPOL's campus. The first collaborative meeting on ESPOL's campus in Guayaquil, Ecuador took place in January 2014, following three weeks of CEDEI training in Cuenca, Ecuador about Ecuador's higher education system and the Andean culture. The meeting in Guayquil included the PROMISE Director, engineering faculty and students, and members of the 2014 LACCEI conference planning committee.

The plan to bring a group of graduate students from UMBC's College of Engineering and IT (COEIT) to Ecuador for the LACCEI conference and for engineering education mentoring activities on ESPOL's campus required significant financial support. The collaboration involved development of funding proposals, with letters of support from LACCEI and the CEDEI. The proposal was funded by the National Science Foundation. Our approach for the trip involved broadening the international participation of graduate students and faculty who are underrepresented in STEM. Therefore, we focused on graduate students who were fellows of NSF's Louis Stokes Alliance for Minority Participation Bridge to the Doctorate (LSAMP-BD) program, students who participated in the PROMISE AGEP program, and women faculty who had participated in an NSF's program from the Directorate of Education and Human Resources, Division of Human Resource Development (EHR/HRD) such as LSAMP, LSAMP-BD, AGEP, or ADVANCE that supports women faculty. The plans included giving the LSAMP-BD students an opportunity to meet and interact with students from other underrepresented communities in Latin America at the LACCEI conference in Guayaquil, Ecuador. This plan fit well with LACCEI's interest in broadening the participation of students from the coastal regions of Ecuador, and parts of Colombia that have large indigenous and Afro-Latino populations. The meetings in Ecuador were designed to allow the students to exchange ideas about engineering and education in their country of origin, and facilitate connections between underserved populations from both the US and Latin America. The experience was also designed to give the students an opportunity to compare policies, research practices and discuss the limitations on research that exist in other countries, per recommendations from the Council of Graduate Schools.[3] We also included women of color faculty in STEM fields such as engineering and computer science in our project who participated in ADVANCE or Women of Color in STEM projects, and were interested in developing a wider international circle.

The plans to develop a project that would involve U.S. citizen underrepresented minority STEM populations in an international engagement experience were based on polling experiences of URMs in engineering and IT on UMBC's campus, and finding that their global experiences were severely limited, but that their interest in engagement was high. Studies from the Institute of International education (IIE) report that most of the U.S students who participate in study abroad studies are white, and only 7.6% are from Hispanic backgrounds, and a mere 5.3% are African-American. Diverse Issues in Higher Education's article about this disparity that noted that an obstacle to underrepresented groups' participation in international experiences may be connected to fears of leaving their comfort zone, and for those who have traveled, reluctance to discuss and address [negative] experiences once they have returned to the U.S.[4] However, our hypothesis for lack of URM engagement in international experiences goes beyond addressing comfort zone, we believe that URM students in STEM may fail to travel abroad due to the lack of opportunities or knowledge. For this reason, our project was based in providing such an opportunity, and our target group includes people with designations who have typically do not participate in study abroad experiences: 1) Graduate Students, 2) Underrepresented Students, 3) Underrepresented Graduate Students in STEM fields.

Methods

To create new pathways for supporting student mobility for global careers and in the interest of developing a community that engages in international collaboration, the graduate school at UMBC has created a new model of organized cohort travel for underrepresented STEM graduate students and faculty. This model connects URM graduate students from STEM disciplines to URM faculty members who serve as mentors, and who also want to increase their global presence. The goal of this model is to immerse a group of students/faculty in a culture in another country through their participation in international engineering-based conferences. The participants are part of the PROMISE AGEP,[5] Louis Stokes Alliance for Minority Participation Bridge to the Doctorate program, and the UMBC/Puerto Rico ADVANCE Hispanic Women in STEM program. Most of the participants had little to no experience abroad. The model included immersing the cohort in a culture through participation in international conferences, presentations at a host university to develop collaborations with faculty and students, scientific excursions, discussion sessions that addressing questions about the experience, and plans for building on these short-term experience. This model includes two parts: 1) International Engagement and 2) Blog Discussion.

With funding from the National Science Foundation (NSF), we took a group of male and female URM graduate students and URM women faculty from different STEM disciplines to the Latin and Caribbean Consortium of Engineering Institutions (LACCEI) conference in Guayaquil, Ecuador. During the conference, the students attended sessions that discussed access to engineering careers, advances in engineering research, expansion of access to engineering

education around the world, demographics of engineers and the corresponding disparities, career-life balance, and solutions for increasing the engagement and advancement of groups that are underrepresented in engineering, e.g., URMs, women, people with disabilities. In addition to attending the conference, the cohort of graduate students participated in a forum about graduate study, engineering proficiency, and critical-thinking skills with engineering students from Ecuador and Colombia on the campus of Escuela Superior Politécnica del Litoral (ESPOL), a top public university in Guayaquil, Ecuador. The faculty from our cohort included women minorities from different institutions.

We wanted this experience to be documented on-site via a blog. We developed the "International Engagement & Broadening Participation in STEM Blog" that would include conversations on topics related to career-life balance and overcoming barriers to global collaborations. In order to assess the experiences of our cohort, we required that all the participants publish their impressions on the following "International Engagement" blog that was developed for this project:

https://promiseagep.wordpress.com/promise/collaborative-projects/international-engagement-and-broadening-participation-in-stem-project/.

The blog included several questions that were developed based on the events that were occurring during the conference, using a phenomenology methodology. The questions were answered "on-site" by all the participants answered the questions daily while they were in Ecuador, and then had time to reflect upon additional questions once they returned to the U.S. Each day, we posted a new question and by the next morning, we would have group discussions about their previous responses, and perceptions about upcoming activities. The questions were posted as follows:

1. For those participants who are preparing for the LACCEI conference in Guayaquil, please share your general thoughts over the next few days regarding your experiences with international collaborations, preparing for an international conference, observations as you travel, challenges, and expectations.

2. a) What did you learn from the Wednesday plenary and the Women in STEM and Diversity panels? b) Is there a research benefit to meeting someone in person versus using technology to connect?

3. a) Please describe the impact of having a mixed group of faculty (external to your university) and graduate students. b) Has this trip facilitated any collaborations or research ideas that move you closer to your academic goals? c) How can an excursion like this one contribute to career-life balance?

4. How does this picture of people from different countries sharing a meal during the conference convey collaboration and international engagement? [The question refers to a picture that is embedded in the post.]

5. When discussing career-building strategies: a) How did this international engagement experience influence your career strategies? b) How will you encourage and model career-life balance for your current and future female mentees?

6. Based on your opinions and observations, please list: a) Five things that impede underrepresented graduate students and faculty in STEM from taking advantage of international research or collaboration opportunities, b) Five suggestions for increasing the numbers of underrepresented graduate students and faculty who will develop international collaborations, c) Five ways that international research and collaboration travel threatens or challenges the concept of career-life balance, d) Five ways that international research and collaboration travel can facilitate career-life balance.

This blog was designed to showcase topics such as balancing work and family, how family decisions affect career advancement, and subconscious "imposterism" in the company of males at work and at home. While most of the participants in our project were women, we engaged our male participants in the discussion on career-life balance because between them, some were married and are helping their wives to achieve their education goals, and all currently serve as UMBC College of Engineering and IT formal or informal peer mentors for the PROMISE AGEP. They currently mentor women in STEM of all races and they have strong leadership qualities, and may be in a position to effect change throughout their careers.

Results

A subset of the responses is presented here. Table 2 shows some of the that responses we received from questions about expectations that each participant had before the trip

Table 2. Subset of responses from cohort participants to Question 1: "For those participants who are preparing for the LACCEI conference in Guayaquil, please share your general thoughts over the next few days regarding your experiences with international collaborations, preparing for an international conference, observations as you travel, challenges, and expectations."

| URM PARTICIPANTS FROM ENGINEERING, COMPUTER SCIENCE, AND IT | RESPONSES TO QUESTION 1, POSTED ON THE BLOG, WITHOUT PRIOR DISCUSSION |
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| Graduate Student | "I'm looking forward to discussing STEM education with people coming different educational systems. For example, different systems move students toward specializations at different times, which I imagine creates challenges specific to each system. It's always enriching to spend time in places where one's unconscious assumptions are challenged. Looking forward to reporting on those as the week progresses." |
| Faculty | "I am excited because this is not just any conference, it is the Latin and Caribbean Consortium of Engineering Institutions (LACCEI) – which involves many opportunities to meet a diverse group of potential collaborators. It is my first international conference, but not my first international experience." |
| Graduate Student | "This question had, and has been, circling my thoughts this past year as a result of previous conferences, and the opportunities I have had trying to guide some of my current undergraduate research assistants. The only concern I have regarding international collaboration is that everyone wants to do something for the greater good (no problem at all there!), BUT there seems to be a barrier due to the fact that the participants in this group are not in the same location, and the planning and execution of a big strategy then has a new bar of "difficulty" since there has to be even more and better coordination. I strongly believe that anything is possible, and that our team players are extremely capable, and this will eventually lead to a positive and desired outcome. I am looking forward hearing the new and sexier paths that will eventually lead to reform how engineers are trained and ultimately rearrange pedagogy methods to prepare more people to make a change." |

One of the main points of this trip was to facilitate direct, in-person connections among our participants and researchers from countries outside of the U.S. The goal was to develop within the participants a "spirit of collaboration," by which they would comfortably engage in conversations, share ideas, and develop collegial relationships. Table 3 showcases the answers

that we received after posting Question 2 which asked about the benefits of meeting people in-person versus using technology to connect.

Table 3. Subset of responses from the cohort participants to Question 2: "Is there a research benefit to meeting someone in person versus using technology to connect?"

| PARTICIPANTS FROM ENGINEERING, COMPUTER SCIENCE, AND IT | RESPONSES TO QUESTION 2, POSTED ON THE BLOG. INCLUDES PARTICIPANTS' SENTIMENTS FROM IN-PERSON COHORT DISCUSSION |
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| Faculty | "Technology will never be able to replace person-to-person meetings. I believe that most fruitful research collaborations are when you build up a friendship with your collaborations. It must be a relationship of trust and commitment. Therefore, when you meet in person you are able to make tighter relationships that go beyond work issues… and that is when the friendship starts to build up. Technology is very important too. When we are not able to meet in person, technology allows to meet frequently and cheap." |
| Faculty | "I think that beginning a collaboration via face to face meetings would be much easier. If time zone and language differences are factors then it would be especially important for me to connect in person first. There was some mention in the session yesterday about discussing authorship, responsibilities, etc. up front in collaborations. I imagine that the initial conversations might be easier in person." |
| Graduate student | "In my opinion, absolutely yes. When communicating through technology, you are most likely going to receive a lower fidelity of contextual information than you would from a face to face meeting. Things such as emotional cues and body language can easily be missed; even when teleconferencing. This is not disparage computer mediated communication. I just believe that it should be used as a supplementary method of communication rather than a primary one. Use Skype to discuss smaller details, just not to |

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| | plan out your entire research project. Otherwise, thing will get lost in translation." |

Questions 3, 4, and 6 asked questions about the composition of the cohort, i.e., students and faculty, building community, and ways that the cohort model and an organized excursion could facilitate career-life balance. Question 5 also discusses career-life balance, but it does so in the context of career-building. We share some of the responses from Question 5 in Table 4 because the question was posted online following a LACCEI plenary discussion and subsequent forum on Women in STEM by representatives from the National Science Foundation, the United States Agency for International Development (USAID), The Prometeo Project of Ecuador. The posting of the question also followed a session about research advances in countries other than the U.S. We wanted to focus on ways that this international experience might influence the participants' careers.

Table 4. Subset of the responses from cohort participants to Questions 5a and 5b: "When discussing career-building strategies: a) How did this international engagement experience influence your career strategies? b) How will you encourage and model career-life balance for your current and future female mentees?"

| PARTICIPANTS FROM ENGINEERING, COMPUTER SCIENCE, AND IT | RESPONSES TO QUESTION 5a & 5b, POSTED ON THE BLOG. INCLUDES PARTICIPANTS' SENTIMENTS FOLLOWING CONFERENCE PLENARY, CONFERENCE SESSION, AND IN-PERSON COHORT DISCUSSION |
|---|---|
| Graduate Student | "This international engagement experience helped me open my eyes about opportunities outside the United States. I was not aware of different programs that many countries are offering to bring people in, and help them further prepare in their respective fields. Specifically, I learned that Germany is trying to bring in new talent, and they are offering scholarships to obtain a graduate degree. This made me think about potential post-doc opportunities, or research grants as a professional." |
| Graduate Student | "I learned that it is possible to participate and maintain active leadership roles in multiple organizations globally. All that it |

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| | takes is the dedication. You never know what opportunities might arise from speaking to a complete stranger at a conference, if you always put your best foot forward when introducing yourself. The amount of professors who spoke about educational reform was a very pleasant surprise. To me, it means that change in the classroom is coming. Some of the issues that I have faced with the educational system in the United States are being encountered in Latin America. Some approaches just do not work. As a result of this conference, I am very interested in the different approaches to education reform that will start happening in the near future, and possibly getting involved." |
| Graduate Student | "I haven't been outside the country since 2010, and had forgotten how much I enjoy experiencing new cultures. At work I typically seek out domestic opportunities for conferences, since it appears to be generally easier to get approval for cheaper trips. However, I've become aware of some other funding resources at work, and as part of this trip I thought more about traveling could make for fruitful collaboration opportunities. Thus, I will no longer limit my ambitions to domestic trips!" |

Discussion and Recommendations

The trip to LACCEI in Guayaquil, Ecuador was a success because it introduced U.S. citizen graduate students and faculty who are underrepresented in engineering, computer science, and IT fields to an engineering-based, collaborative environment that is outside of the U.S. Being a member of a cohort provided confidence, and a shared awareness of the processes and experiences that one will encounter when traveling abroad. Experienced travelers take for granted traveling experiences such as having a passport, going through security and customs clearance areas, and managing time away while maintaining responsibilities at home. New travelers manage these processes for the first time, and being part of a "community" contributed to the success of the project.

This work utilizes the social science construct of McMillan and Chavis' 1986 theory for a "Psychological Sense of Community (PSOC)," from Community Psychology research.[6] The PSOC theory has four elements: 1) Membership, 2) Influence, 3) Reinforcement: Integration

and fulfillment of needs, and 4) Shared emotional connection. Our organized cohort model for international engagement tapped into each of the elements in the following ways. The participants felt a "sense of belonging" or membership as part of the group. They were able to relate to one another, and they had a shared purpose. The second element of influence was met as each member was able to share opinions and thoughts that mattered, or made a difference to the group.

The international context, and group dynamics allow members of the group (our cohort of participants) to share suggestions and make decisions about everything from which sessions to attend, to sharing opinions on academic sessions, to choosing locations for meals. These contributions to decisions on all levels combine to create what McMillan and Chavis call, "a sense of mattering, of making a difference to a group and of the group mattering to its members." The international engagement trip and its structure also allowed for the third element, which is defined as "reinforcement: integration and fulfillment of needs." For this third element, our participants' needs had to be met "by the resources received through their membership in the group."

The organized structure of our international engagement project provided resources that were greater than those that would have been available to them if they had been traveling outside of the group. For example, since the leadership of our project had traveled to Ecuador prior to the cohort trip, logistics and group activities were established in advance. Some of these activities included organized meals outside of the conference with our graduate students and engineering students from ESPOL, organized coffee hour discussions between our faculty and the conference's guest speakers, transportation to conference activities and pre-arranged visits to local sights. The fourth element, shared emotional connection, was met because our cohort shared "history, common places, time together, and similar experiences."[6] All four of the elements for Psychological Sense of Community were met through this excursion, and participants' answer to Question 2 in particular demonstrates that even developing a "sense of community" among other researchers can open the door to collaboration. Jamal Mazyck specifically wrote about the lack of minority participation in international experiences,[3] which exposure to international opportunities. Our observations from developing this international engagement project have led to several suggestions that can increase the number of underrepresented graduate students who will engage in a global academic experience.

1. Increase awareness of international opportunities within the engineering departments; make existing opportunities more visible and accessible. Start this process at the undergraduate level, but continue to share information with graduate students and faculty.

2. Establish an initiative within the university that assists with developing international research collaborations in STEM, and include a clearinghouse for funding opportunities. . Many faculty have their own independent streams of funding, but a university's attention to

researchers who have existing global efforts, and those who want to develop them, can ignite a community of practice that can foster support for stronger collaboration. A university-wide effort should also include a database of international agencies that provide funding for international experiences or collaborations.

3. Arrange travel in cohorts for graduate students, postdoctoral fellows, and faculty.

4. Organize the international trip so that it models an "immersion" experience that is used by study abroad programs. This model includes conference activities, but it also includes planned activities outside the work schedule, so that the participants can experience the culture of another country, separate from the conference venue.

5. Consider internationalizing the graduate dissertation committee, by including an outside a faculty member from a university in a different country.. This inclusion will allow the student to forge new collaborations and to increase their international engagement. Such relationships can be reciprocal, where the US faculty member serves on the committee of a international collaborator's student in another country.

The final purpose for immersing a group of graduate students into an international setting was to have them realize that collaborations are an important part of doing research, and that in order to have meaningful collaborations on a global scale, they must understand how research is done in other countries. For example, some things that seem common for a student from the U.S., may not be common for a student from a Latin American or European country. Being in a different country exposes scholars to a new environment and a new, expanded vision for their research. There may be challenges that pose barriers to engagement, such as commitments to family, teaching schedule, or other responsibilities back home. Hence, there is also a need for a support network that includes family, so that they can understand the importance of international trips for work purposes, and that they are not being developed for recreation. We believe that continuing these models and encouraging graduate students to travel abroad and establish new connections, will be beneficial for the researcher, and that the inclusion of URMs in international opportunities will enhance the global research network.

## Conclusion

Based on the results from our project, we don't believe that "fear of leaving a comfort zone" is a primary reason for underrepresented STEM students' lack of participation in international engagement. The students have already moved past other situations where they are underrepresented such as going to college, majoring in a STEM field, getting an undergraduate degree, and entering graduate school to pursue a STEM master's or doctoral degree. They already have a "pioneering" spirit, and are willing to take risks and accept challenges. This "pioneering spirit" can come from URM's strength gained from learning and absorbing STEM

knowledge needed to master concepts within the discipline, while navigating cultural issues based on their ethnic backgrounds. We believe that by pursuing a graduate degree in STEM, the URM students have already "left" their comfort zones, therefore the lack of international engagement is based on other factors such as lack of information, lack of opportunity, and lack of funding. However, even when information is available, e.g., flyers on the walls in halls of a college campus, URM students may not engage if they are not invited to learn about clear pathways that explain "how" to engage.

The PROMISE AGEP in Maryland incorporates the elements of sense of community,[6] which has been used to develop international partnerships, and expose URMs to global experiences. The cohort models allow members to feel attracted to space, both within their internal group and the targeted international community, where they feel that they are influential. The experiences and recommendations shared in this paper represent a snapshot of success in the area of international engagement for underrepresented graduate students in STEM, and can be replicated by other programs that seek to broaden participation in global research.

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