



# The Role of International Research Experiences in the Development of Minority Undergraduate Scientists

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## Abstract

**Introduction.** There continues to be a disparity in the participation of underrepresented minorities collectively (National Science Foundation, 2019). Specifically, White and Asian Americans have representation within the science and engineering (S&E) workforce at rates higher than their African Americans, Latino/a Americans, Native Americans, Alaskan Natives, and Pacific Islanders peers. Given the continued underrepresentation of these groups in the STEM workforce, i.e., 33% of the population versus 13% of the STEM workforce, policymakers and educational leaders have focused on diverse approaches to address the cultivation of talent across all of our nation's populace.

Undergraduate research and international experiences are claimed to be high-impact educational practices beneficial for undergraduate student success and support the development of science identity and intercultural competencies (Brownell & Swaner, 2010; Carey, 2012; Daniels et al., 2016; Haegar & Fresquez, 2016; Kuh, 2008; NASEM, 2016). Statistics show that there is low participation of some racial minorities in these experiences. For students from groups historically underrepresented in STEM, undergraduate research opportunities can particularly prove beneficial in developing their identity, confidence, and sense of belonging in STEM despite the lack of representation (Bangera & Brownell, 2014; Carlone & Johnson, 2007; O'Donnell et al., 2015). Consequently, several studies have shown how URMs are impacted by engaged learning through undergraduate research and similar experiential learning with significantly positive effects (Crawford et al., 2018; Daniels et al., 2016; Davidson et al., 2018; Fakayode et al., 2016; Fakayode et al., 2018; Haegar & Fresquez, 2016; Wilson et al., 2016; Wilson-Kennedy et al., 2019).

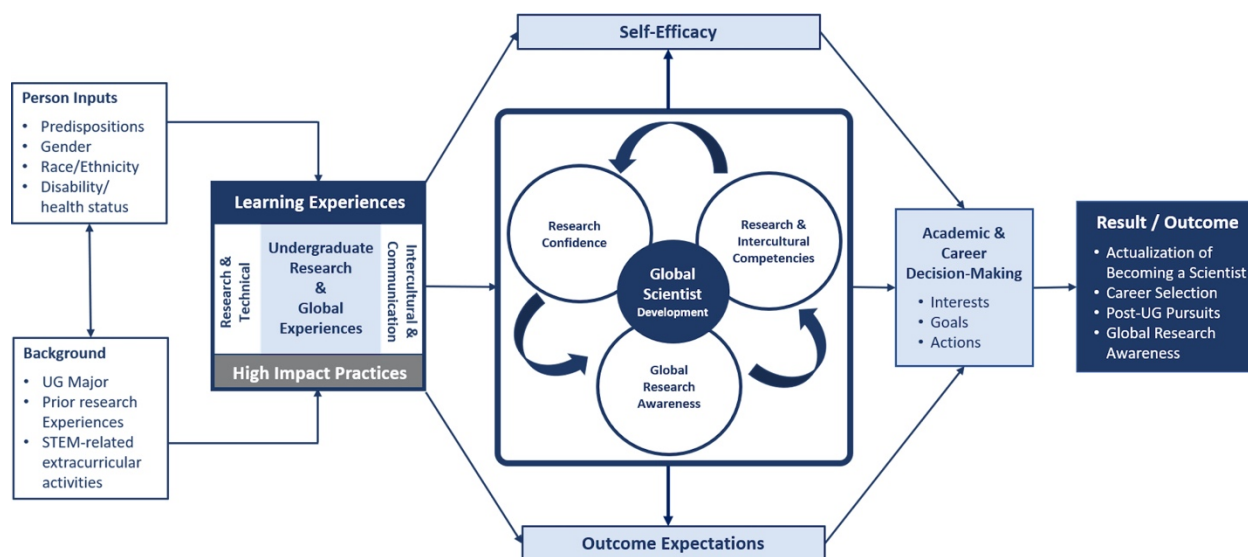
Our study focuses on the benefits of international research opportunities for underrepresented racial minorities within STEM disciplines. Namely, international research experiences offer a hands-on learning opportunity to develop one's self-efficacy, identity, and competencies as a researcher while exposing them to potential career pathways and graduate studies not previously considered. International research experiences also offer the added benefit of

developing students' intercultural competence and understanding of global research. This study was guided by three research questions:

- i. How are international research experiences contributing to the educational experience of minority STEM undergraduates?
- ii. How do participants describe their growth in intercultural competence after living and working at an international research site?
- iii. How does minority students' participation in undergraduate international research programs support their actualization of being a scientist?

This study is framed by the theoretical frameworks of Science Identity (Carlone & Johnson, 2007), Social Cognitive Career Theory (Byars-Winston et al., 2016; Lent et al., 1994), and the Intercultural Competence Model (Deardoff, 2000), this present study explores the benefits of participating in an international research experience for minority undergraduate scientists (Figure 1).

**Figure 1. A Conceptual Model Integrating Social Cognitive Career Theory, Science Identity, and Intercultural Competencies and Awareness to promote the development of undergraduates at Global Scientists**



**Methods.** Using a qualitative case study methodology, we examined the evolution of students' science identity, research competencies, and intercultural competence after engaging in a three-month international research opportunity in France and Belgium. The general population of interest for the study was science majors who participated in the France-Belgium iREU program during their undergraduate academic careers. The study's participants included eight (8) students; five (5) women and three (3) men. The primary mode of data collection was one-on-one semi-structured interviews that lasted approximately one hour. The interview protocol included questions about the selection of their undergraduate degree path, current career and education path, iREU program experience, perspective on global research, and a reflection of their growth in research abilities and intercultural competence. The research team also analyzed the iREU program's grant, iREU year-end reports, promotional



materials, and the LSAMP-NSF website to gain a better understanding of the organization's mission and context.

For the data analysis, each transcript was read thoroughly to gain an understanding of each participant in the study (Yin, 2017). Next, each transcript was open-coded to develop a preliminary codebook. To further develop the codebook, the transcripts underwent several rounds of axial coding. Using axial coding, connections were made between the open codes to identify major codes (Strauss & Corbin, 1998). Throughout the analysis, multiple sources of data were actively examined to develop an in-depth understanding of each case individually in relation to the research questions (Yin, 2014; 2017). Once the codebook was finalized, the codes were grouped into categories, and emergent themes were recorded. Throughout the data analysis process, researchers employed member checking and peer-debriefing throughout the coding process to make sure the data was trustworthy.

**Results.** After analyzing the interview data and documents, four salient themes emerged across the eight minority undergraduate scientists interviewed.

**Theme 1: Increased confidence in their science identity and abilities.** Participants shared how their international research experience helped them validate their sense of belonging and actualize their future in STEM. Specifically, participants experienced a significant increase in their research confidence and self-efficacy. Further, their confidence was solidified by the positive feedback from their mentors in France and the U.S.

**Theme 2: Gained and strengthened skills necessary to be a successful researcher.** Participants discussed the substantial improvement in their research, technical and professional skills. Specific improvements included learning to work with large scale reactions, communicating research findings to various audiences and being able to develop and teach lab protocols to others.

**Theme 3: Recognized the influence of international exposure on their growth personally and professionally.** For many of the participants, this international research experience broadened their understanding and awareness of research collaborator relationships across countries. Participants remarked how imperative it is to have international research collaboration in the advancement of STEM to solve world issues.

**Theme 4: Expressed how monumental this research opportunity is for all minority students to experience.** After reflecting on this international research experience, all of the participants resoundingly expressed how this opportunity affirmed the trajectory of their lives as scientists. Given the significance of this iREU on their overall development as scientists, all of the participants exclaimed how monumental this opportunity would be for all minority students to experience.

**Conclusions and Discussion.** Aligned with our conceptual framework, our findings corroborate the substantial contribution of iREUs to our participant's research self-efficacy and science identity development. Therefore, we concur that international research experiences can



contribute substantially to the research self-efficacy, confidence, and competencies development of undergraduate students. With a general understanding of research in the United States, participants were exposed to science and research conducted through the lens of another culture. As a result, they recognized the value and importance of international research collaboration with researchers worldwide for the advancement of their respective STEM fields. For many of the participants, this international research experience was their first time viewing themselves as contributing members of their STEM field on a global scale. Certainly, their prior research experiences were impactful on their development as scientists, but several of the participants indicated that the independence gained in the lab through their IRE gave them a different level of confidence in their abilities. In sum, our findings illuminate the interplay of each sphere of development supported the participants' foundation of their global scientist development.

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