

# Sharing Peace Engineering with US-based Minority Students, through the UN's Sustainable Development Goals, in Peru

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**Abstract**— The University System of Maryland's Louis Stokes Alliance for Minority Participation (LSAMP) shares the United Nations' Sustainable Development Goals (SDGs) with underrepresented minority (URM) STEM students. In July 2018, faculty and students from three institutions within the USM LSAMP worked with World SPEED - the Student Platform for Engineering Education Development, to share the UN's SDGs during the 2018 conference of the Latin and Caribbean Consortium of Engineering Institutions (LACCEI) in Lima, Peru. Students from the US, Peru, Colombia, Brazil, and other countries were exposed to the SDGs in both English and Spanish through World SPEED's SDG-focused panel and team-based exercises. The exercises allowed students, working in teams that mixed countries (and languages), to develop solutions to challenges based on the SDGs. Students discussed research in the context of the SDGs, such as SDG 3: Better health solutions for people around the world, SDG 4: Global quality education, SDG 5: Gender equality, and SDG 7: Affordable and clean energy solutions that will allow humans to generate clean, reusable power. This project allowed URM students from the US to consider engineering in the context of "peace," contributing to STEM identity, retention, and utilization of their talents for a peaceful purpose.

**Keywords**—Diversity, Inclusion, Global Engagement, Sustainable Development,

## I. INTRODUCTION

### A. What is LSAMP?

"Who will do the work?" is a question that everyone from higher education institutions, to governments and their agencies, to private industry, grapples with constantly. In the

United States, this is a particularly acute concern given the high proportion of international students enrolled in STEM graduate programs around the nation, and the need for the U.S. to have citizen engagement in engineering projects. Funded by the National Science Foundation, The Louis Stokes Alliances for Minority Participation (LSAMP) program assists colleges and universities with diversifying the national workforce in Science, Technology, Engineering and Mathematics (STEM). It is through the work of programs like LSAMP, and the alliances therein, that we can frame an effective and extensive response. This program represents one of the critical ways that the progress of science in the U.S. can be promoted. Institutional university partners within the University System of Maryland (USM) LSAMP are building foundations for cultivating and mentoring the next generation of leaders through the four pillars of: STEM Identity, Sense of Community, Strength-based approaches, and Institutional Culture Shift. This foundation draws upon constructs from work on STEM Identity for underrepresented scholars [1], expansion of the environment that develops a Psychological Sense of Community (PSOC) [2], and use of strength-based approaches rather than deficit-based approaches as part of a shift in the culture of the institution to value diversity and achievement as inclusive excellence.

The four pillars have been operationalized via four programmatic focus areas: **1) Participation** - transitions to the 4-year institutions for first year students and students from the community colleges; **2) Performance** - Fortifying students' math knowledge and increasing their performance in

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mathematics courses; **3) Preparation** - Increasing students' preparation for research by increasing opportunities for research training; **4) Presentation** - Developing opportunities for students to present their work locally, nationally, and internationally, and to have their work recognized through prestigious awards and scholarly publications. Through focus area 4, the USM LSAMP has developed an initiative to increase students' global engagement, cultural competence, and civic awareness.

*B. Global Student Exposure*

The partners of the USM LSAMP Alliance firmly believe that exposing students to scholarship on a global level can have a life-changing impact on how our students see the world, and their place in it. We have framed that exposure through sharing knowledge and contexts surrounding the Sustainable Development Goals (SDG) which were accepted in 2015 by heads of governments and high representatives at the United Nations, with the goal to address the world's big challenges and set a new agenda for 2030 (see Fig. 1). Students participating in undergraduate research through LSAMP and other university programs receive faculty mentoring and training on conducting research, writing papers, preparing posters and presenting at conferences. They are able to practice and hone their presentation skills at USM LSAMP Alliance-wide research symposia held during the fall and spring semesters. Using email, social media, and meeting announcements, active LSAMP program participants were invited to submit an abstract for the Latin America and Caribbean Consortium of Engineering Institutions (LACCEI) student competition to present a paper or poster highlighting their undergraduate

research at the 2018 international conference in Lima, Peru. We selected this STEM-based conference because regardless of its location, the conference is multilingual. In addition, leaders of LACCEI provided the USM LSAMP with a partnership and commitment to provide the students with a welcoming, global experience. The conference offers translation services for all participants, and the participants are invited to present research and content in their preferred language. All of the students who had their abstracts selected to present at the conference were awarded USM LSAMP travel grants to attend the conference in Peru.

**II. Methods**

All students were required to participate in the Student Platform for Engineering Education Development (World SPEED)-sponsored student session of the conference, the 10<sup>th</sup> International Student Leadership Forum on Engineering Education (FLEEI). The focus of FLEEI at this year's conference centered upon design thinking around the SDGs. The intentional focus on the SDGs and incorporating them on the front end of design thinking, was an anchor for the questions that we designed to ask students throughout the conference. FLEEI is a pre-conference activity, so it provided the students with a strong segue and introduction to engineering conversations in global contexts. Students were also required to attend the "Mujeres en Ingenieria" (Women in Engineering) panel, the general attendee plenary talks, and presentations held in breakout sessions. The participants were required to present their research at the conference and expected to attend presentations of their fellow students in the delegation.



Fig. 1 UN Sustainable Development Goals [10]

LSAMP sought to curate the students' experiences at the international conference based on the Grounded Theory (GT) approach [3]. In GT, qualitative responses are coded and combined to develop hypotheses and/or theoretical frameworks from the responses themselves. Typically, codes are developed and assigned to the responses. Those codes are grouped into concepts. Those concepts are then aggregated into categories. Finally, the categories are used to develop a hypothesis. In this work, we are not developing a hypothesis due to the sample size of the participants. Instead, we used the codes to determine categories as the final outcome. Additionally, given the small sample size and limited number of questions, we did not use lexical and/or semantic software to search for keywords and quantify their frequency. The responses were hand-coded by the authors. Studies have shown that social media, Twitter specifically, have been effective mechanisms for facilitating student interaction and structuring student learning [4] [5]. As such, the questions posed to, and the responses collected from the students and any professionals, both within LSAMP leadership and from the public, were all communicated through Twitter.

#### A. Data Collection

A condition of the travel award for students was that they observe and share/report their experiences via Twitter. Ten questions were posted via the USM LSAMP Twitter account by the team leaders. The students were instructed to reflect on their experiences at the conference in real-time, and strongly encouraged to share their opinions about the activities and interactions they were exposed to daily with their peers. On several occasions, we posted the questions after one of the plenary presentations, or during lunch sessions to activate the idea sharing. We posted variations of these "verbal group discussion" questions so that the participants could respond in writing, following their informal conversations. This process can be viewed as a variation of crowdsourcing, since it combines reflections from the written answers captured via Twitter, and the reflections from oral responses [6] [7]. The views and contributions from faculty and staff that served as mentors for the participants at the conference were not required in writing but were (in some cases) shared by the students as part of the oral conversations data.

The Tweets/responses were products of several open-ended questions, designed to facilitate the discussion. Those questions were posted based on the students' daily activities and focused on encouraging participants to reflect upon their new, global experiences. The Twitter exercise summoned graduate students and faculty from the LSAMP, the graduate student LSAMP Bridge to the Doctorate (BD) program, and the National Science Foundation's PROMISE: Maryland's Alliance for Graduate Education and the Professoriate (AGEP) communities from Maryland and colleagues from Puerto Rico to contribute to online discussions about STEM Identity, the National Academy of Engineering's 14 Grand Challenges, international engagement, global engineering and culture, the "Matilda Effect" (gender equality) [8], and the 4<sup>th</sup> Industrial Revolution.

Participants were informed that their responses would be used for research and that we were interested in challenges and strategies that either affect or facilitate global sustainability. All who visited our Twitter account were invited to participate in the discussion. We welcomed and encouraged participation from the general public and the international audience.

#### B. Participants

There were nine total project participants, but only seven participants contributed to writing the answers in Twitter. Of the seven students who actively participated on Twitter, five were undergraduates, and two were graduate students. The other two participants did not contribute to the blog directly, but they participated in oral conversations during the conferences. These oral responses were captured and posted to Twitter by other participants. The participants were purposefully chosen from a variety of the majors across engineering disciplines (mechanical, electrical, and chemical).

These participants had different research areas, and all were from groups that are underrepresented in STEM. There was a unified intention to create an interdisciplinary environment with people from different ranks (undergraduate students, graduate students, and faculty) to stimulate conversation.

#### C. Questions

Q1. *What do you expect to gain and learn from this international meeting?* (6 Responses)

Q2. *What did you learn during the FLEEI Student Forum for @LACCEI\_Engineer #LACCEI2018 in Peru?* (7 Responses)

Q3. *Several speakers @LACCEI\_Engineer #LACCEI2018 discussed the 4th Industrial Revolution during the conference in Peru. a) What did you learn about this concept? b) Why is it important? c) Did you know about this concept before you had this experience in Peru?* (2 Responses)

Q4. *This morning we are discussing blockchain, Nakamoto, and characteristics of Big Data @LACCEI\_Engineer conf. in Peru. a) What did you know about these concepts before #LACCEI2018? b) What did you learn that was \*new\* about these concepts?* (4 Responses)

Q5. *"The Matilda Effect" - introduced by Dr. Guerrero Cusumano from @Georgetown in Peru @LACCEI\_Engineer #LACCEI2018. Discuss! This is definitely a #ThinkBigDiversity topic!* (6 Responses)

Q6. *As the delegation representing Maryland's @NSF\_EHR @Univ\_System\_MDLSAMP & @NSF\_ENG progs. in Peru, in the audience of the @LACCEI\_Engineer #LACCEI2018 @OAS\_official Summit on #WomenInEngineering, what messages would you share with the world about #SDG 5?* (6 Responses)

Q7. *Tonight, you had a chance to be immersed in culture. You walked through a protest, saw/learned dances, & made new friends. Describe your experience (holistic reflection.) Please*

reply with "A7." and include photos & videos. (6 Responses. In addition to the written responses, 4 videos and 1 picture were posted which captured the protest and the performances presented by The Association Brisas del Titicaca).

Q8. *The @LACCEI\_Engineer #LACCEI2018 conference has been a mix of engineering & culture. Use photos, text, etc. --> 8a) Describe your research, incl. aspects from your presentation, 8b) Describe the research of group members, 8c) Connect your work to @UN #SDGs.* (5 Responses)

Q9. *There were several experiences today. Include photos & videos in your Discussions of: a. Cultural experiences, b. Science & engineering observations, e.g., infrastructure of the catacombs, elements in the environment.* (5 Responses)

Q10. *#LACCEI2018 @LACCEI\_Engineer has ended. a. How has this conference influenced your identity as a scientist or engineer? b. How has learning about the @UN #SDGs via @SPEEDOrg influenced the way that you will pursue your science or engineering degree?* (5 Responses)

#### Data Analysis

We examined qualitative response data from Twitter via content analysis approach and grouped and disaggregated the data based on the relevance. Content analysis was used for these responses because the method "yields unobtrusive measures, in which the sender nor the receiver of the message is aware that it is being analyzed" [9]. The analysis looks at the experiences that each participant had and attempts to describe their impact.

### III. RESULTS

Ten questions were posted on Twitter and included topics related to: STEM Identity - **Q1, Q10**, FLEEI Student Forum & UN SDGs - **Q2**, the 4th Industrial Revolution - **Q3**, Big Data - **Q4**, the Matilda Effect (UN SDG #5, gender equality and women empowerment) - **Q5, Q6**, the relationship between engineering and culture - **Q7, Q8, Q9**. Two hundred seventeen (217) tweets mentioned hashtags #ThinkBigDiversity and #LACCEI2018 from the delegation. Participants provided 52 qualitative responses. Some of those responses included multiple statements, coded separately.

Initial analysis included 87 responses that were used to identify 50 distinct codes. These codes were then used to develop 12 concepts, per the GT approach. Those concepts included: Developing cultural competence, fostering diversity and equity, developing global perspectives, aligning work with international efforts, embracing global challenges, increasing awareness of international activities, building networks and relationships, collaborating internationally, finding ways to make a difference, strengthening commitment to succeed, fighting for social justice, and being a change agent. The 12 concepts were grouped into 5 overall categories, in descending order of frequency:

1. Facilitating equality and diversity in STEM. (24 instances)

2. Growing a broader understanding of challenges that face the world. (24 instances)
3. Building international relationships for networking and collaboration. (13 instances)
4. Making their work globally impactful. (9 instances)
5. Using research to benefit the broader community. (8 instances)

These categories are reflected in the responses to many of the questions that were posed to the students. Given the medium, students were able to embed multiple-coded responses into a single answer. Additionally, several of the questions were multi-part, encouraging more robust thought and more introspection. The goal was to encourage students to create mental connections between the experiences, the concepts that served as themes for the questions, and the SDGs.

### IV. DISCUSSION

We were pleasantly surprised by how often students made creative connections, and even extrapolations from the interactions. For example, in response to Q10, one student wrote:

*"A10a. @LACCEI\_Engineer I learned about culture and that developing strong relations outside your home can affect the "bigger" picture. The little things you accomplish contribute to improving quality of life. We have to continue working with passion. A10b. Learning more about @UN #SDGs via @SPEEDOrg @LACCEI\_Engineer helped reaffirm that I need to complete my Ph.D. I felt refreshed listening to why we do things the way we approach them and who depends on the outcome of a great performance."*

The question itself was anchored in STEM Identity. The student not only made that connection, but also tied in passion for one's work and saw the sessions from the conference as a means of understanding underlying motivation for now, and beyond.

#### A. Facilitating equality and diversity in STEM

Responses in this category were derived from two concepts: enhancing cultural competence and fostering diversity and equity. The exposure to culture, in and of itself, was eye-opening for many of the students. For some of the students, this experience gave them their first time abroad. There were cultural activities embedded into the conference, and we designed the activities that allowed the students to experience aspects of Peru, beyond the walls of the hotel. Questions 7, 8, and 9 asked about the ties between engineering and culture. They may have elicited a higher volume of responses, but we felt it important to emphasize global, cultural reflections. Diversity and equity were considered in terms of both ethnicity and gender, which ties very directly to culture and the exposure thereof. The responses regarding this concept were primarily from questions 5 and 6 which focused on the "Matilda Effect."

### B. Growing a broader understanding of challenges that face the world

The “understanding” in this category is a continuum of sorts. Students indicated that they wanted to develop a global perspective in order to embrace global challenges by aligning their work with international activities. Interestingly, the questions that prompted these responses (2, 4, and 10) did not ask about international activity explicitly. They were more summary questions about the takeaways from the activities for the students. This serves as anecdotal evidence that international exposure can lead to global perspectives.

### C. Building international relationships for networking and collaboration

Another seemingly obvious outcome from participation in the conference was networking. We strongly encouraged the participants to network with other attendees at the conference. To help students overcome any potential discomfort with interacting with people from other countries speaking other languages, students were encouraged to seek opportunities to collaborate as an entry point to the conversation.

### D. Making their work globally impactful

Extending from the previous point, participating in the conference instilled within the students a sense of having their work make a difference. The presentations and conversations at the conference allowed the students to use a lens that focused on the needs of others, in others place in the world. The sights and sounds of Peru grounded that glimpse in the realities of how those theoretical challenges are made manifest. To their credit, the students saw that as a call to action, *a contribution to peace*, which would allow their own work to mean more within a global context. The SDGs provide the students with a practical anchor for that desire.

### E. Using research to benefit the broader community

The final category can be couched as a natural conclusion of the previous segments. This category, “using research to benefit the broader community,” must be explained further as it includes both being a change agent and fighting for social justice. This result was not among the categories that we anticipated as an outcome. In an unexpected turn of events on the ground in Lima, the students witnessed a large-scaled protest while walking with other conference participants to an activity at one of the conference’s off-site city venues. The students had to walk through the crowds of people in order to stay with their assigned group and move to the location for LACCEI’s next ceremony. That experience, serendipitous though it may have been, gave the students a very different perspective on the trip as a whole, and on the experience at the conference. This experience tied in specifically to several of the SDGs, such as needs to address poverty and hunger (SDGs 1 and 2), sustainable cities and communities (SDG 11), and peace, justice, and strong institutions (SDG 16). Walking amongst the protestors shed light on the motivation for the

UN’s SDGs, allowing the students to reflect upon the dire circumstances that people all over the world experience. The urgency and intensity of the citizens’ displeasure was unmistakable and undeniable. It would have been easy for the students to be thankful for their privilege and to ignore the plight of the protestors. Instead, several of the students expressed a desire to find a way to make sure that their engineering work “does more.” If that is the only thing that they take away from the experience, it was well worth it.

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