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Engaging Pre-college Minority Students at a Technical Engineering Research Conference

Tizoc Cruz-Gonzalez, University of Michigan

Tizoc Cruz-Gonzalez is a Ph.D candidate in mechanical engineering focusing on design with smart materials at the University of Michigan. His research focuses on model-based design of dielectric elastomer devices. He received his Bachelor of Science from the Massachusetts Institute of Technology. After receiving his degree, Tizoc worked for five years as an aerospace engineer and as a Presidential Campaign Field Organizer in 2008. Ultimately, Tizoc desires to expand his research into advancing smart material technology, while continuing his work to recruit and retain underserved students in STEM fields.

Sarah Rose Sobek, University of Michigan

Earned her Master of Arts degree in Higher Education, with a concentration in public policy, from the University of Michigan-Ann Arbor. Currently works as an academic advisor with the College of Engineering at the University of Michigan, and is passionate about engineering education research.

Dr. Julianna Marie Abel, University of Minnesota, Twin Cities

Julianna Abel is a Benjamin Mayhugh Assistant Professor in the Department of Mechanical Engineering at the University of Minnesota. Julianna was awarded her Ph.D. in Mechanical Engineering from the University of Michigan in August 2014. She received her M.S. in Mechanical Engineering from the University of Michigan in 2008 and her B.S. in Mechanical Engineering from the University of Cincinnati in 2005. Julianna's current research interests lie in the model-based design of smart material technologies. She is particularly interested in flexible actuators that leverage material and geometric properties to enable innovative actuator forms.

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Abstract

Increasing diversity in the science, technology, engineering, and math (STEM) workforce and attracting diverse students into STEM disciplines have become issues of national importance. One method to aid in achieving this goal is through offering pre-college interventions to underserved students. This paper discusses and examines a novel pre-college STEM intervention that occurs at a technical engineering research conference. The intervention consists of a mini-workshop that has six components: (1) an introduction of graduate student mentors, (2) a general introduction to the engineering field of Smart Material and Structures through a PowerPoint presentation and live demonstrations of smart materials, (3) a low-cost design and build engineering activity that uses smart materials to demonstrate the applicability of the field of research, (4) an interactive tour of the conference hardware competition which provides concrete examples of cutting edge research, (5) a small group Q&A with graduate students engaged in research, and finally (6) a panel discussion with diverse research faculty committed to post-secondary engineering education. The challenges associated with this approach to outreach, the advantages of incorporating a STEM intervention into a technical research conference, and successful methods for locating a group of underserved students are discussed. In addition, the scale and impact of the intervention are evaluated through open-ended and quantitative surveys. The survey results document the positive student reaction to this intervention. The positive student feedback and logistics discussed in this paper demonstrate the feasibility of adoption of a similar outreach model at other technical conferences.

1. Introduction

An innovative engineering workforce is imperative for the transforming US economy. Such transformations place a high demand on technological innovation and creative solutions. Given this high demand, an effective way to produce innovative engineers is to attract a more diverse body of engineers. Diversity can help to enhance the problem-solving ability of the engineering workforce by opening the field to new ideas, designs, and solutions. Building a diverse engineering workforce has proven to be difficult as there are many challenges for underserved students to enter the field of engineering. It is necessary to expand and extend the avenues to reach students who otherwise may be unable to realize engineering as a career. One method to help recruit underrepresented students into the science, technology, engineering, and math (STEM) pipeline is to provide STEM interventions to pre-college students.

This paper discusses a novel STEM intervention that occurs at a technical engineering research conference and targets underserved high school students from varying geographic conference locations. The primary categories of underserved students targeted for this intervention are African American, Hispanic/Latino, Native American/Pacific Islander, and socioeconomically disadvantaged students. In this paper, we discuss the challenges associated with this approach to outreach, the advantages of incorporating a STEM intervention into a technical research conference, and successful methods for locating a group of underserved students for pre-college intervention. We examine the utility of this conference-based intervention through a survey evaluation of participants' rated enjoyment and rated informative nature of the activities. We discuss the scope of the intervention and opportunities to expand the implementation of interventions at research conferences.

2. Background

The diversification of the STEM workforce has quickly become an issue of national importance. In 2009 when President Obama announced the "Educate to Innovate" campaign, he made clear that one of his goals was to expand STEM education and career opportunities for underrepresented minorities in that sector of the workforce[1]. During his announcement of this initiative, the President stated that "reaffirming and strengthening America's role as the world's engine of scientific discovery and technological innovation is essential to meeting the challenges of this century"[1]. This statement would indicate that cultivating a highly skilled STEM workforce and increasing the nation's global competitiveness requires identifying and harnessing the talent and creativity of underrepresented populations. To reaffirmation America's role as a leader in scientific discovery, issues of access to minorities' participation in STEM must be overcome.

Diversification of the STEM workforce can occur through widening the pipeline to allow more underserved students access to an undergraduate STEM education. However, there are entrenched societal inequities in place that do not allow equal access to a STEM education. Understanding pre-college factors that influence interest and persistence in STEM education is important for consideration and formulation of pre-college interventions. Many researchers have found that students' pre-college experiences are integral in students' decision making regarding their decisions to major in STEM as undergraduates[2,3]. In addition to these pre-college experiences, STEM role models can positively contribute to students' decisions to enroll and continue in STEM majors [4,5,6,7]. Students' academic self-confidence and interest in entering STEM fields also predict students' enrollment and success in STEM fields[4,8]. Given the demonstrated benefit of self-confidence and STEM role models, it reasons that students without access to such role models would benefit from pre-college STEM outreach experience.

Research has demonstrated that in the absence of STEM interventions, formative STEM experiences are lacking for minority students[9]. Without formative interventions and experiences, underserved students may begin their postsecondary education underestimating their abilities and lacking a clear picture of the STEM workforce and those who participate[3,10]. The importance of addressing this gap and the relevance of pre-college interventions has been recognized by educators, as indicated by the creation and expansion of STEM intervention programs.

In their recent paper, Valla and Williams[11] note that given their personal experiences with STEM interventions in high schools, there are a large number of pre-college interventions occurring that are absent in the scientific literature. In this 2012 study, Valla and Williams[11] describe, and review the K-12 STEM intervention programs present in the body of scientific literature. The researchers used several databases to find and review relevant peer-reviewed literature that detailed STEM-related interventions. In their review of approximately forty relevant papers, they found the target population of most interventions was underrepresented minorities in the STEM fields. They also found that high-school aged interventions focus on increasing high school achievement in science and math. However, of the approximately forty papers that were described and critiqued, no intervention was indicated to have occurred at a national engineering research conference. The absence of STEM interventions at national research conferences indicates educators are missing key intervention opportunities, as many STEM fields engage in large research conferences in diverse geographic locations.

3. Unique Intervention at an Academic Conference

American scientists and engineers have been exchanging ideas at conferences since 1848 when the American Association for the Advancement of Science held its first meeting[12]. Since that first meeting, the scientific community has grown, and there are now thousands of science and engineering related conferences each year. Scientists and engineers from academia, industry, and national labs attend research conferences to listen to presentations, converse with other researchers, and discuss new ideas, techniques, and tools. Conferences are an excellent forum for the exchange of ideas, but there is an opportunity to do a better job using those ideas to inspire future generations.

Most conferences are composed of numerous activities that could be used to inspire future generations of scientists and engineers. The oral and poster presentations at conferences provide motivation for the research and technical details. While many high school students may not understand the details of the presentations, they can gain exposure to a range of new ideas. Most importantly, conferences have a large number of expert researchers in one location. Student exposure to the knowledge and passion of such researchers can spark student interests in fields with which they were previously unfamiliar, as exposure to research has been shown to formulate science identities, and engage students in science fields[13].

Alongside sparking student interest, an additional benefit of research conferences is that they are held in locations all over the country. The conference location depends on the history of the conference, conference organizer preference, and venue availability. Some conferences are held in the same location every year while others rotate throughout the country. Many of these conferences are held in or near cities with large underserved populations (e.g. Las Vegas, Orlando, San Diego). The location of the conference may not have an academic or research facility nearby, or, if there are academic institutions near the location, they may not have strong outreach ties to the local community of underserved populations. Many conferences provide an opportunity to reach out to these underserved students.

4. Logistical Organization of Mini-Workshop

A research conference is an ideal location to host a positive pre-college STEM experience targeted at underserved populations. We designed and executed an outreach event at a research conference to inspire future engineers. The outreach event, titled “Smart Materials and Structures Mini-Workshop”, was held at a technical conference and leveraged many of the existing conference activities to introduce high school students to cutting-edge research in the field. The specifics of the workshop will be outlined throughout the paper; all conferences, however, have the foundation to host this type of outreach event. The execution of such a workshop requires significant buy-in from conference organizers and requires a small team to execute. Support is needed in the form of facilities, funding, materials, volunteers, and scheduling.

Facilities, including snacks, the room, and any computer support, must be arranged in the contract with the conference facility (typically a hotel or conference center). The students come to the conference immediately after school and stay until 5:15 PM. We have found that we need to provide substantial snacks, or the students become hungry and distracted. All of the agreements with the conference facilities state that all food and drink must be supplied through the conference facility. For this reason, we include the visiting students in the coffee break count for the day of the Mini-Workshop. A room with large desks and seating is required to facilitate a design and build experience with up to thirty high school students. A maximum of thirty students was determined because it is the typical enrollment in a high school class and requires a reasonable number of volunteers. Because the students become excited during the design and build activity, it is best if the room is not adjacent to a conference presentation room. A projector is required to present an introduction and provide information during the design and build portion of the workshop. The more flexibility the space permits (reorganizing table and chairs) the easier it is to adapt to the particular needs of the workshop and engage students in the activities.

Funding is required to pay for busing students to and from the conference location and to pay for the design and build activity. The cost of the bus transportation has varied from $280 to $420, depending on the city and the desired bus service of the high school. The design and build activity costs approximately $10 per student to implement. Since the high school student attendance is limited to a maximum of 30 students, the direct costs of the activity are less than $750. This cost has been covered by a variety of sources including industrial sponsors (money and materials), the National Science Foundation, professional societies, and the general conference budget. The conference recognizes the need for and benefit of a STEM intervention and now budgets for the Mini-Workshop to ensure the continued success of the outreach intervention even when external funds are not available.

Materials are needed so that the students can experience the smart materials technologies working rather than just seeing them in a presentation. Faculty across the country have been very generous in lending materials and devices for the activity. The added benefit of borrowing demos from different research labs is that the high school students are exposed to the breadth of technologies that are being developed across the country. Additionally, some manufacturers and faculty have donated materials to be consumed during the hands-on activity. An added advantage of using faculty donated materials is that it stimulates investment in the project, which encourages faculty and their graduate students to invest time volunteering to support the workshop.

Volunteer support is recruited through several different approaches. Six to ten graduate student volunteers are required to lead various activities throughout the workshop. Several months before the conference, conference organizers suggest individual students from their labs or the labs of their colleagues. At this time, graduate student volunteers who previously volunteered are contacted and invited to participate. Past volunteers are also asked to suggest names of other graduate students who may be interested in volunteering. Ideally, this results in a group of four to six dedicated graduate student volunteers who will work together to plan the outreach event. On the first day of the conference, the conference organizers also make an announcement asking for additional volunteers. Graduate students who volunteer the day of the event take on a smaller role of escorting students between sessions or helping with the design and build activity. A set of professional volunteers is required for a Faculty Panel. In the first two years of the workshop, efforts were made to recruit faculty volunteers in advance of the conference, however, very few responses were received. Now, faculty volunteers are recruited on-site with little difficulty.

The timing of the workshop must be coordinated with the conference organizers and the high school teacher. The conference organizer must be involved in the scheduling to minimize interruption of conference events and to guarantee the workshop overlaps with the desired conference activities (presentations, demonstrations, competitions, coffee break). Since high school schedules vary, the high school teacher must be consulted to minimize interruption to the students' academic day. A sample schedule is provided in Table 1.

Table 1. Typical schedule for Smart Materials and Structures Mini-Workshop

<table>
<tr><td>2:15</td><td colspan="2">Graduate students volunteers meet (Room A)</td></tr>
<tr><td>2:45-3:00</td><td colspan="2">Introductions and Smart Materials Presentation(Room A)</td></tr>
<tr><td>3:00-3:25</td><td>Group 2 – Hardware Competition</td><td rowspan="2">Group 1 – Design & Build Activity (Room A)</td></tr>
<tr><td>3:25-3:45</td><td>Group 2 – Small Group Q&A</td></tr>
<tr><td>3:45-4:00</td><td colspan="2">Coffee Break/Snack Time</td></tr>
<tr><td>4:00-4:25</td><td>Group1 – Hardware Competition</td><td rowspan="2">Group 2 – Design & Build Activity (Room A)</td></tr>
<tr><td>4:25-4:45</td><td>Group1 – Small Group Q&A</td></tr>
<tr><td>4:45-5:15</td><td colspan="2">Faculty Panel</td></tr>
</table>

Facilities, funding, materials, volunteers, and scheduling are all aspects requiring significant logistical consideration to execute a successful mini-workshop. These areas have been addressed and refined since 2010, resulting in a well-run outreach activity that aims to encourage underserved students to pursue STEM careers. An additional logistical challenge is recruiting underserved high school students.

5. Underserved Student Group Recruitment

A unique challenge of organizing an outreach event in a new location each year is that a new group of underserved students must be identified as the location shifts, limiting the opportunity to build relationships that can be reused each year. Therefore, a methodology was developed to streamline the process of identifying students in a new location each year. The methodology stems from logistical priorities; the first priority is to ensure that a student population is found for the event, and the second priority is to try to ensure the targeted students come from an underserved population. The target students for the project are underserved students within a 45-minute driving distance from the conference. The challenge is to identify schools or extracurricular programs with underserved students and to convince them to participate in the event. The methods used to find a group of students are contacting teachers and principals, local elected officials, and elected school board members. The initial contact with all individuals was by email, and the message contains the information needed to convince them to participate. The feasibility and effectiveness of three methods of recruitment varied, as demonstrated through a review of the use of these methods at several research conferences.

The recruitment email sent to ask people if they wish to participate evolved to address the primary concerns and barriers for groups wishing to participate and to ensure the widest distribution. The main barrier to participation is transportation cost. The invitation email explicitly states that transportation will be paid for by the conference. Another concern is the legitimacy of the opportunity since the email is unsolicited and no previous relationship has been established. To address these concerns, each email recipient is individually addressed, the email contains links to the conference website, the email sender has an official title and position associated with the conference, and a complete schedule and summary of all the events are provided. The last portion of email asks the recipient to forward the invitation to their colleagues they believe would be interested in participating. All these components have led to the successful recruitment of students for the past three years.

In 2013 and 2014, local teachers and principals were contacted by email to find a group of students. Local high schools were found using an internet search. Individual high school websites and public school district annual reports were used to determine which schools had a high population of underserved students as well as the email contact for all STEM teachers and principals in the region. Six weeks before the event, an initial email was sent out to the people associated with schools that have the targeted demographic of students, but if a group was not located by four weeks before the conference, then a second email is sent out to all STEM teachers in the region. A second round of email was required in 2013 and 2014. In 2013, a school with the ideal demographics responded to the email two weeks before the mini-workshop, but a school without the ideal underrepresented demographics had already been selected to participate. In 2014, the second round of emails led to multiple responses, and one was selected that had the ideal demographics. The techniques outlined above have been very effective in ensuring a group of students is located to participate in the workshop.

In 2013 and 2014, local politicians were contacted and asked to aid in finding an underserved group of high school students. In 2013, the politician identified a promising group targeted toward involving at-risk Hispanic youth in STEM. Unfortunately, the group did not respond to the invitation to participate until two weeks before the event, and another group had already been chosen. The advantage of this technique is that politicians can use local knowledge to identify a community group that has the desired demographics. Contacting local politicians to find an ideal group is a promising recruitment strategy, but the Mini-workshop organizers must be persistent to obtain the desired information.

In 2015, an email introduction was given to an elected school board member for a district that was composed of the ideal targeted demographic located within driving distance. When the board member received the outreach opportunity, they forwarded it to a local principal of a newly formed STEM magnet school. The principal immediately committed to participating in the event. The advantage of contacting a school board member is their knowledge of high schools and groups in the region. This method proved to be quite effective in the location of a target group with relative ease and efficiency. The utilization of different methods over the years has proved effective in finding the most efficient ways to located target groups of students, allowing for more time for preparation and organization of the multi-part workshop intervention.

6. Smart Material and Structures Mini-Workshop

The structure of the Mini-Workshop has evolved over several iterations of the intervention. The mini-workshop is separated into multiple parts, starting with a brief introduction to the workshop. Graduate student volunteers present an introduction to smart materials and structures with live demonstrations of smart materials. The high school students are separated into two smaller groups to facilitate rotation between two parallel tracks. The first group participates in a smart materials design and build activity while the other group tours the graduate student hardware competition and participates in a Q&A with graduate student volunteers. The Mini-Workshop concludes with a faculty panel.

6.1. Introductions

The Mini-Workshop begins with an introduction of the organizers and graduate student volunteers to build a rapport and present the volunteers as role models. The presenter and the other graduate student volunteers begin by telling their personal history. Graduate student volunteers typically highlight their hometowns, communities, undergraduate institution, graduate institution, and specific research interests.

6.2. Smart Material and Structures Introduction and Demonstration

After the introductions, a brief explanation of the purpose and components of a professional engineering conference is communicated and the theme of the conference, smart materials and structures, is introduced. To fully engage all types of learners - visual, auditory and kinesthetic - an interactive presentation with live demonstrations is used to explain smart materials and structures. A portion of the explanation includes real world examples of how the students interact with smart materials in their everyday lives. Hand-held demonstrations of smart material are passed around so that the students can feel how smart materials function. The final demonstration includes an audience participation portion where the students use the knowledge they have gained to explain an experiment performed in front of them. The experiment uses materials and ideas which will later be incorporated into the design and build activity, where their understanding of smart materials will be further reinforced.

6.3. Design and Build Activity

A low-cost design and build activity was created for mini-workshop. The 45-minute activity incorporates smart materials while combining electrical and mechanical engineering skills to create a device that solves a real world problem. Identifying a societal need for the project transforms it from just a class experiment to a real useful device. While each student builds their own device, students are encouraged to work in teams to address small problems during the design and build activity. Graduate student volunteers interact with the students to ensure they can complete the activity in the allotted time.

The design and build activity is called "The SMA actuated gripper." The activity modifies a 30" reach extender that is typically used to pick up trash or to reach things on high shelves. The students reverse engineer the gripper and replace the mechanical mechanism with a Shape Memory Alloy (SMA) actuator wire. Before beginning the redesign, the students are asked to consider the motivation for designing an actuated gripper device. The students identify people lacking the grip strength to actuate the mechanical closing mechanism as the ideal user of the device. Students will often link this immobility to people with disabilities and the elderly. Another common motivation provided by the students is a robotic arm that provides a repetitive motion or works in a harsh environment. The discussion about the motivation for the device grounds the design and build activity in reality and provides a practical reason for why someone would develop this type of device.

Once the motivation for the project has been established, the students begin to reverse engineer the gripper. Students are aided in the redesign by written instructions and by help from the graduate student volunteers. To ensure all students participate, each student creates their own gripper. However, the students are encouraged to partner up to help each other work through the steps. During the reverse engineering portion, students learn that taking a product apart is an important part of the engineering process and provides them with a greater understanding of the internal function of a device. Students learn to use mechanical components and tools while working with a graduate student volunteer to ensure they are not causing irreversible damage to the part. Students also learn basic electrical engineering skills by soldering wires to complete a circuit between a battery pack and the SMA wire. Ideally, there is one volunteer to every four high school students participating in the design and build activity. The volunteers evaluate the assembly of the device and check its functionality, ensuring every student leaves the activity with a working prototype that they can use at home.

6.4. Hardware Competition Tour

The national research conference that hosts the Mini-Workshop includes a hardware competition in which graduate students bring an experimental research setup. Each graduate student takes five minutes to explain and demonstrate their research project to the high school students. A graduate student volunteer guides the high school students to ask questions of each graduate student about their project. This portion of the workshop allows the high school students to experience the passion that the graduate student volunteers have for their field and the research. This portion of the Mini-Workshop also demonstrates the potential impact that smart materials and structures will have on the future of society and presents concrete examples of state of the art engineering research.

6.5. Q&A with Graduate Student Volunteers

The small group Q&A with the graduate student volunteers has a dual purpose. The first reason is to talk to the students in small groups and on an individual basis to create a connection with them. The graduate student volunteer can address personal questions, and the students are more comfortable with them since they have been engaged with the volunteer during the hardware competition. The second reason is that the Q&A session is used to occupy time so that the students are engaged throughout the Mini-Workshop.

6.6. Faculty Panel

The panel is carefully selected from the research faculty attending the conference. The faculty panelists are selected for their ability to be engaging. A serious effort is made to include faculty from underserved populations and to include a faculty member from a local university. The panel moderator starts the Q&A session by having the faculty introduce themselves and explain what makes their university exceptional. The Q&A sessions are lively and typically cover a broad range of topics from how to get into and pay for college, to how to excel in college, and how to prepare yourself for a bright future while in college.

7. Evaluation and Results

The final part of the mini-workshop is an evaluation of the day's activities. The purpose of the evaluation is to assess what part of the workshop worked for the students and how the workshop could be improved. The survey, administered at the end of the workshop, is important for evaluating the intervention and gauging student response. From the perspective of an intervention organizer, students appeared both interested and engaged by the presentations, Q&A sessions, and the design and build activity. However, for truly informative feedback, this more formal assessment of the intervention is necessary.

To more formally assess student reaction to this form of outreach, students are given a survey to assess enjoyment and informativeness of activities. Students are asked to rank how enjoyable the introduction to smart materials presentation, design activity (SMA gripper), hardware competition, small group Q&A, and faculty panel were using a 1 to 5 scale, ranging from 1 (not enjoyable) to 5 (extremely enjoyable). Students are also asked to rank how enjoyable and informative the smart materials presentation, the design and build activity (SMA gripper), the hardware competition, the small group Q&A, and the faculty panel were using a 1 to 5 scale, ranging from 1 (not informative) to 5 (extremely informative). The survey also contained open-ended questions, which probe students on what they learned during the mini-workshop, their favorite part of the mini-workshop, and what they feel could be improved about the mini-workshop. Data has been collected three years of the conference (2013, 2014, and 2015).

An examination of student responses to the quantitative portion of the assessment was conducted by examining the proportion of students that ranked activities as "enjoyable" or "extremely enjoyable" and "informative" or "extremely informative", a value of "4" or higher on the scale. A brief analysis of the quantitative data collected demonstrated student's positive response to the outreach activities, as over three years 70 percent of students found rated the activities enjoyable or higher and informative or higher, with the exception of two activities during 2015, and one during 2013. The proportions of students ranking the activities "enjoyable" and "informative" or higher are detailed in Table 2.

Table 2. Proportion of students each year ranking the activities as informative and enjoyable.

	2013 (n=15)		2014 (n=23)		2015 (n=28)	
	Enjoyable or higher	Informative or higher	Enjoyable or higher	Informative or higher	Enjoyable or higher	Informative or higher
Introduction to Smart Materials (Presentation)	0.933	1.000	0.957	0.955	0.536	0.786
Design Activity (SMA Gripper)	1.000	0.800	1.000	0.955	0.714	0.821
Hardware Competition	0.533	0.733	0.913	0.864	0.679	0.821
Small Group Q&A	0.867	0.800	0.957	0.955	0.714	0.892
Faculty Panel	1.000	1.000	0.957	0.955	0.750	0.750

As detailed in Table 2, this simple analysis of student survey responses indicates that students had a positive response to the intervention, as indicated by the reported enjoyment and informativeness. While the simplicity of the survey does capture overall student response to the activities, the quantitative portion does not incorporate the more complex responses students had to the intervention. Students' responses to the open-ended questions aligned with the results of the quantitative portion of the survey. While a formal qualitative analysis of student responses to the open-ended questions, the majority of student responses indicated a positive reaction to the intervention, exhibited through students mentioning what they learned and their confidence in their ability to engage in a STEM career. Demonstrating this, one student responded: *"I learn* [sic] *that if you want to do something that* [sic] *is nothing that can stop you,"* another student stated: *"I learned that you can succeed in life,"* another student stated: *"I learned that these smart material are being researched and implemented. I also learned a lot about what the smart materials do"*, and a final student shared: "*How to use tools - and becoming a student at different colleges."* These quotes, while simple, demonstrate the impact of the novel conference intervention.

8. Discussion and Conclusion

Through a thorough examination of the structure of the conference intervention and student survey responses, we have demonstrated that students react positively to this unique STEM intervention. The positive reaction is indicated by student survey responses, which reports that students enjoyed the intervention and found the activities informative. Students' qualitative responses also indicated their positive reaction to the intervention. While students' survey responses were positive as a whole, the last year of survey response indicated a change in the enjoyment of intervention activities. We believe this change may be due to an increase in the number of participants, coupled with fewer volunteers, and a change in event leadership. Additionally, we also recognize the importance of an impassioned and interesting introduction presentation of the material. Better volunteer recruitment and documentation will be used in future iterations to improve the learning experience and enhance the students' enjoyability. Through reflecting on the event details, and the simple quantitative and qualitative components of the survey, we have begun to demonstrate there is a benefit to students participating in design and build activities at a large conference.

Given the positive reaction of students to the intervention over three years of implementation, the demonstrated benefit of STEM role models to students' decisions to enroll and persist in STEM majors[4,5,6,7], frequency, and varied geographic locations of STEM conferences, interventions such as the one discussed in this paper present an opportunity to reach traditionally underserved populations. This paper details a successful and easily replicated outreach opportunity that exists for participants in STEM research conferences. We have detailed our experience and written this paper to encourage organizers and participants of STEM conferences to consider offering a similar impactful STEM outreach opportunity at a conference to underserved students.

While we hope to encourage other participants of STEM conferences to engage in similar outreach to underserved students, we recognize that future outreach could be improved through changes to the intervention and research protocols. To demonstrate the effectiveness of this type of outreach, a longitudinal study would be necessary. An ideal longitudinal study would follow students for 6-10 years through college and into the professional workforce to link the intervention to underserved students' STEM outcomes. Additionally, future iterations of interventions at STEM conferences could be improved through emphasizing more rigorous data collection and evaluation. Data collection could be improved by utilizing validated surveys for assessing students' reaction to the intervention. The effect of the intervention could be better assessed through engaging larger groups of students in pre- and post-assessment measures. In addition to pre- and post-assessments, future interventions should include a more robust qualitative assessment to substantiate the benefit that students obtain from participating.

Several changes to the research protocols implemented alongside the administration of such interventions would substantiate this type of intervention in an academic context. Exploration and substantiation of the benefits associated with this novel type of STEM intervention is critical, however, equally important is seizing the opportunity to use the intellectual talent present at large scale research conferences to make such interventions less “novel.”

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