Morehouse College Swarm Robotics

Morehouse Outreach Paper

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Purpose:

The purpose of this outreach was to encourage minority students to enter into the science, technology, engineering, and mathematics (STEM) field. One of the biggest reasons why there is a lack of diversity in the STEM fields here in America is due to the lack of exposure. Furthermore, those few minority students who actually love STEM and enjoy it rarely have access to it. For those reasons, amongst many others, our outreach team's primary objective was to use robotics as a way to expose students of color to STEM fields while making it relatable.

Outreach Recipient:

The NASA Swarmathon gives students from all backgrounds who are interested in robotics an opportunity to develop and apply new skills as an engineer. This outreach opportunity allows Swarmathon teams to continue this trend by using their knowledge of robotics to further develop and cultivate the interests of younger students in the field of engineering. When researching schools that could possibly allow us to partake in an outreach program, we focused on schools that were in the vicinity of our own and one in particular had a rather robust robotics program. Brown Middle School in S.W. Atlanta, GA is the only middle school in the district with a robotics program in a predominantly African-American neighborhood. Brown Middles School is a part of the G3 Drones for Good competition held by Motorola. This competition pits 20 middle schools in the Atlanta area against each other to see who can construct the best drone to fly through obstacles.

The competing drones were scored on their ability to fly through an obstacle course, where each successful flight scored 40 points. The obstacle course was made of hula hoops that formed a 5 foot tunnel horizontally then another 4 foot tunnel vertically. The pilot and the co-pilot had one minute to fly the drone as many times through the obstacle successfully. Our Morehouse group aided and assisted in the design of a drone that was going to be used for the competition. Our assistane consisted of constructing the frame of of the drone and helping the students fly the drones without crashing them. The frame for the drones not only had to be sturdy enough to endure impact from relatively high altitudes, but also formed such that it could smoothly contort its way through the competition's obstacle course. With the practice drones everyone built, we made sure that the students were able to skillfully hover, land, and maneuver through the air with the controller. Lastly, we also helped configure and calibrate the controller to the Arduino.

The competition was a success in many aspects. Not only did everyone gain more knowledge about how these drones operate, but also out of the 20 teams that competed, Brown Middle School tied for 14th place with one other group. The previous year they had not competed in the

competition so to have a working drone that met all the regulations and was competitive was a feat in itself.

Beneficial Outcome:

This outreach inspired the members of the Brown Middle School Robotics Team to continue to compete in these types of competitions and augmented their knowledge of computer science. Specifically, the Arduino's interface with the drone's controller directly contributed to their understanding of computer science. Also, the Arduino's connectivity to each of the four motors was purely computational. Of course we had to perform testing on each motor to verify that the direction that they spun were proper. To fly the drone, motors that were diagonal to one another had to spin in the same direction. Therefore, each motor spun in the opposite direction as its neighbor motor which was configured using the software provided by the Arduino in testing phases. Morehouse students helped the middle school students with this step largely. These functionality mechanisms at their core are how we elected to infuse our outreach in a computational aspect.

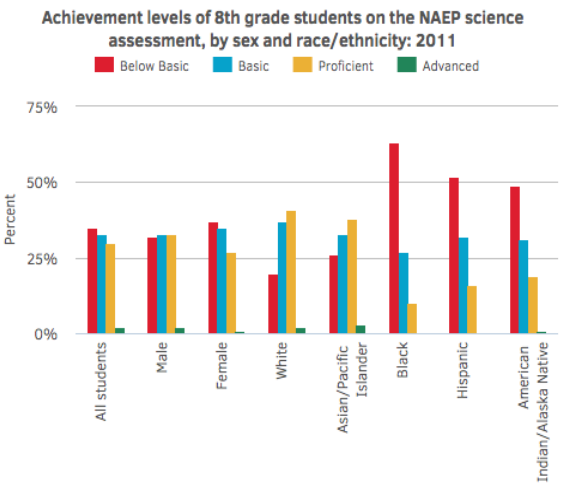

Figure 1: A graph of percentage yields scored on the National Assessment of Educational Progress in science.

Many students currently in middle school and possibly even high school have had a formal introduction to how STEM can transform their careers. In an article by *Popular Science*, Chris Ransom wrote,

In the end, we cannot expect students to choose careers in science and technology simply because they should or because that is where the jobs will be. They will make a life in those fields only if they are excited and empowered to do so.

Part of becoming empowered in STEM is having more experienced researchers training younger researchers who will be the next-generation of STEM job holders. There is one problem students find with this model however. Students in middle school who have the potential to go into STEM careers, oftentimes have difficulty thriving in STEM because their experienced educators do not match their demographic. This is a problem because they can become less confident in their own ability to become a STEM professional if they have no active role model that matches their demographic.

Currently we live in an era where African Americans are among the most marginalized groups in STEM careers. In fact, Black and African Americans comprise only 8.6 percent of computer and mathematical occupations (U.S Department of Labor). This means that if students of color need are less likely to be

educated by people from their same demographic, in this case African American, because there is such a small portion of them in a professional STEM setting. When assessing the proficiency level of 8th grade African American students in science, as can be seen in *Figure 1*, there is a noticeable gap between them and other demographics. This brings to question if the achievement gap can be mitigated by empowering students with an education in STEM at earlier stages of development. And if so, in what manner can a mentor or educator best be utilized to foster an optimal environment for students to be exposed to STEM.

Another reason why Brown Middle School was selected was because the robotics group was composed mostly of girls. In total, five girls and two boys were on the team. Women are vastly under-represented professionally according to a study in 2016 by the Department for Professional Employees in computer, math, and engineering (only 15.1% in engineering, and 24.7% in computer/math). We worked with Brown Middle School's Robotics Team because we wanted to be models that come from the same demographic that these students might need to stay in the STEM field. It is important to reach out to students like these because they are the future generation of ground breaking science and engineering. All in all, this endeavor helped both Morehouse and Brown understand the importance of diversity in STEM and will be a cornerstone once he or she reaches the next level.

Future Work:

The experience with working with each of the students was hands on and interactive. It offered a great way to become involved with younger students of the community. Morehouse College Swarmathon members were able to serve great role models for Brown Middle School's students. This relation allows us to continue work with the Brown Middle School Robotics Team. We will now begin to work with them on their submarine drone project and competition which is held in May. This is a project where they have to construct an apparatus that will be able to be controlled remotely to get objects underwater and navigate through an obstacle course. Currently, their apparatus is made of PVC pipe and a plastic mesh which will hold the objects. This experience has been tremendously beneficial to both parties and has empowered, engaged, and enlightened students in robotics and computer science.

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