

## **Developing Engineering and Computer Science Skills for Middle School Minority Male Students**

**Otsebele Nare, Chutima Boonthum-Denecke, Jean Muhammad,  
Marci Turner, Elaine Dietz, and Arthur Affleck**  
*Hampton University*

### **Abstract**

A year round program to help cultivate engineering and computer science skills in middle school minority males' was initiated to address some of the disparities observed among African American and Latinos. Electrical Engineering, Computer Science, and Architecture faculty instructed the students along with the support of undergraduate students in respective fields. This report discusses the approach used in the initial summer program launch, which focused on 6 local schools from 2 districts resulting in 49 student participants. Preliminary results indicate that 51% of the student participants have increased interest in STEM subjects and 45% have increased STEM proficiency based on a pre- and post-survey and assessment outcome. In addition, 41% of the participants increased their programming and coding skills whilst 36% increased their knowledge of digital manufacturing and 3D printing after a 2-week summer program. The program is continuing through the academic year.

### **Keywords**

STEM Outreach, Pre-College Engineering.

### **Introduction**

Only 59 percent of African-American and 65 percent of Latino male students in the class of 2012-2013 earned a high school diploma<sup>1</sup>. Even fewer minority males earned STEM Bachelor's degrees. According the data compiled by the National Science Foundation<sup>2</sup> and analyzed by US News and World Report<sup>3</sup>, the number of black men who earned science and engineering doctorates grew by more than 25 percent in 10 years (2003-2013). However, based on raw data, the representation of black men essentially stayed the same, between 4.5 percent and 4.8 percent of all science and engineering doctorates<sup>2</sup>. The comparison of black men who earned science and engineering degrees over a similar 10-year span also reflected a related trend showing a 6.1 percent representation in 2002 and 6.2 percent in 2012<sup>3</sup>.

### **Program Approach**

In response to addressing challenges in improving the minority male pipeline in STEM, Hampton University is implementing the Verizon Innovative Learning (VIL) program for Minority Males attending middle schools. The primary goals and objectives of the program are summarized in Table 1:

Table 1: Primary Goals and Objectives of the VIL program at Hampton

| Goals   | Objectives  |
|---|---|
| (1) Increase curiosity, creative problem solving and confidence while enhancing the students' academic performance and opportunities such as college, high-paying STEM careers and entrepreneurship; and<br>(2) Enable minority males to become creators and makers through the transformative power of technology, improved STEM instruction and effective mentoring, thereby increasing minority male student empowerment, engagement, and achievement in STEM. | (1) To cultivate new abilities through personalized training and hands-on engagement in designing and developing apps, 3D modeling, 3D design, 3D printing, robotics, basic coding and entrepreneurship.<br>(2) To strengthen student's science skills and increase their interest in becoming creators and makers so they will pursue STEM majors and STEM careers.<br>(3) To demonstrate the application of mathematics.<br>(4) To create an environment whereby middle school minority male students will engage and bond with their college student mentors and seek to emulate their academic and personal success.<br>(5) To engage the students participants and teachers during the school year to track their progress and to encourage regular school attendance, good behavior, hard work and interest in attending college. |

In order to meet the program's objectives, minority male students are identified in middle schools with greater than 70% population qualifying for free and reduced lunch. An outreach to superintendents, principals and teachers in the local school districts was done to secure Middle School partners for this program. Two local public school systems closest to the university were selected and 3 schools became partners from each district. The selection of the teachers and students were from the partnering schools. The summer program was designed as a 5-week program. During the first week, training was planned for the student mentors and teachers. During the next four weeks, the engagement involved the student participants with selected University faculty and student mentors in a well-defined program of instruction, coding, designing, building, making, marketing and presenting. The instruction to the students was based on two 2-week workshops. The first summer targeted 50 students from 6 schools for engagement with a plan for an additional 50 in the second year. After the summer program ends, the engagement continues with the students and teachers on a monthly basis in the school and/or on the University campus. The academic school year engagement is customized for each school with consultation with middle school partners. Over a two-year period, a minimum of 100 minority male students and 10 teachers are targeted for this exciting STEM experience. The students will also be supported by college student mentors who will help guide them through the program along with university faculty in the engineering, computer science, and architecture.

**Activities**

The middle school male students who participate in the program during the summer and the academic year learn high-level skills like App Design, App Development, 3D Modeling, 3D Printing, Circuit Design, Coding, Robotics, and Entrepreneurship. As an example, the skills are delivered to students through interactive lectures to introduce them to STEM and particularly technology concepts that relate to creating and making. University faculty and guest instructors/speakers delivered the information and skill development sessions using the platforms/approaches summarized on Table 2.

Table 2: Activities and Technology Platforms

| High-level Skill Development | Technology Platform/Approach               |
|------------------------------|--|
| App Design & App Development | App Inventor; Mobile Apps                  |
| 3D Modeling & Design         | TinkerCAD                                  |
| 3D Printing                  | 3D Printers (Makerbots)                    |
| Coding                       | Code.org                                   |
| Programming & Robotics       | Finch Robots                               |
| Circuit Design               | Solderless Breadboard, LEDs, Sensors       |
| Entrepreneurship             | Business incubation; team project pitches. |

**Targeted Benefits and Progress**

There is widespread agreement that minority males face many roadblocks, in school and in society, that prevent them from excelling and persisting in school and from pursuing STEM majors and careers. Minority males, especially African American males have a lower high school graduation rate, lower college going rate and lower college graduation rate when compared to other groups. Some of the reasons for this state of affairs are a lack of resources, role models and few programs that can help them to develop key skills, attitudes and a work ethic that will give them opportunities for a positive future. The Verizon Innovative Learning program for Minority Males is being implemented as part of the solution for selected middle school boys. The designed program provides hands-on-learning experiences with advanced technology, exposure to entrepreneurship and long-term mentoring. There are many tangible targeted benefits. The students are expected to leave the program with a new perspective about school, learning and STEM. They will also be motivated to become creators and a makers who will go to college and have an exciting STEM job and career. During the first summer of the program, 49 students participated and 6 teachers were involved. Preliminary results indicate that 51% of the student participants have increased interest in STEM subjects and 45% have increased STEM proficiency based on a pre- and post-survey and assessment outcome. In addition, 41% of the participants increased their programming and coding skills whilst 36% increased their knowledge of digital manufacturing and 3D printing after engaging in a 2-week summer program. The program is continuing through the academic year with a focus on circuit design and app development.

**Acknowledgements**

*“This work is supported primarily by a grant from the Verizon Foundation under the Verizon Innovative Learning program”*

**References**

1. Beaudry, Ann (ed), “The Schott 50 State Report on Public Education and Blacks Males,” Schott Foundation for Public Education Report, Feb. 2015.
2. NSF, available at <https://nsf.gov/statistics/sed/2013/data/tab20.pdf>

**2017 ASEE Zone II Conference**

3. Bidwell, Allie, "African-American Men: The Other STEM Minority," US News & World Report, May 7, 2015, available at <http://www.usnews.com/news/stem-solutions/articles/2015/05/07/african-american-men-the-other-stem-minority>.

**Otsebele Nare**

Associate Professor of Electrical Engineering at Hampton University  
([otsebele.nare@hamptonu.edu](mailto:otsebele.nare@hamptonu.edu))

**Chutima Boonthum-Denecke**

Associate Professor of Computer Science at Hampton University

**Jean Muhammad**

Associate Professor and Chair of Computer Science at Hampton University

**Marci Turner**

Assistant Professor of Architecture at Hampton University

**Elaine Dietz**

Instructor of Computer Science at Hampton University

**Arthur Affleck, J.D.**

Associate Vice President of Development at Hampton University