WIP: K-12 Aerospace Academy Program at ECSU: Implementation and Evaluation

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Abstract

In this Work-in-Progress (WIP) paper, an aerospace-themed STEM outreach program for all levels of education in rural North Carolina is discussed. This comprehensive outreach project is a partnership between NASA, Elizabeth City State University, school districts, state agencies, private foundation, and other STEM enrichment programs. The goal of this K-12 outreach project is to improve STEM literacy by engaging students, family members and teachers. The K-12 outreach program adopted NASA STEM curriculum at its core and integrated 3D printing technology, robotics programming, and Unmanned Aerial Vehicle (UAV) design to enhance authentic and experiential learning experiences. In its first year of implementation, a total of 646 students received 36-40hours of hands-on STEM experience. Other activities included teacher professional development and STEM engagement/skills for family members of the participants.

Keywords

K-12 STEM Education, Aerospace Education, STEM Engagement, Evaluation, Out-of-School

Introduction

Research has shown that the out-of-school environment advances STEM knowledge and increases interest in STEM-related careers[1]. These delivery models combined with 21st century learning technologies are required to close the opportunity gap that prevents youth from reaching their full potential in fast growing STEM fields[2]. The goal of the NASA supported Aerospace Academy program is to improve STEM literacy by engaging students, family members and teachers through integration of emerging technologies. The K-12 Aerospace Academy program at Elizabeth City State University (ECSU) is unique in that it introduces students in rural districts, especially groups traditionally underrepresented in STEM fields, to topics and careers in aerospace through a balanced mix of theory, hands-on activities, field trips, and guest seminars/lectures. The program offered out-of-school hands-on STEM learning experience for students from elementary to high school. The project target area comprised of 21 counties surrounding ECSU. This region has long suffered the effects of poverty and has lacked the opportunities for most students to encounter the 21st century workplace that is readily accessible in more urban areas of the state. However, with recent growth in the aviation and aerospace industry in the region, there now exists the potential to link K-12 STEM education to the aerospace industry.

The three key components of Aerospace Academy program at ECSU are: (i) Curriculum Enhancement Activities (CEA) – Hands-on, inquiry-based K-12 STEM curricula, (ii) Aerospace

Educational Laboratory (AEL), and (iii) Family Connection – parental involvement and informal education.

The CEAs adopted grade level appropriate NASA STEM curriculum and integrated 3D printing, robotics programming, and mini quadcopter UAV design, further enhanced the learning experience. Students participating in the program completed between thirty-six (36) to forty (40) hours of STEM focused exposure and learning during this project year. Hands-on experience was provided through the AEL, a state-of-the-art laboratory, that features collaborative learning environment that can accommodate up to 60 students. The lab includes hands on setup and operation of a Wind Tunnel, 3D Printers and 3D Scanners, Flight Simulator stations, Weather stations, Data Logging stations, Wind and Solar Energy stations, Computer Programming (Raspberry PI/Arduino) stations, Aircraft/Airfoil Design stations, and more, ready to inspire the next generation of STEM professionals. These laboratory modules augment various STEM topics, align with NASA's Aeronautics and Science Directorates and meet the core objectives of the Next Generation Science Standards. The Family Connection, an interactive forum, involves parents/families as a partner with the ECSU Aerospace Academy Site in the planning, design and implementation of the NASA inspired curriculum. Parents/Guardian were provided STEM skills to engage them in supporting their children's learning at home.

The project team had proposed to directly impact at least 625 students/year. During its first year (October 1, 2015-September 30, 2016), students participated through Friday Academies (middle school) , Saturday Academies (middle and high school) , and Summer Academies (all grade levels). In order to meet student target, ECSU Aerospace Academy site established partnerships with five school districts, a STEM school on campus, and a Math and Science Education Network (MSEN) program on campus. Teachers were provided 25-30 hours of STEM professional development sessions prior to their delivering CEAs to students.

Project Evaluation and Preliminary Data

The research questions (both implementation and outcomes related) guided project evaluation are as follows: (i) What are the characteristics of project activities and their participants? (ii) To what extent do Aerospace Academy activities meet program quality expectations (STEM engagement) as defined by the Dimensions of Success (DoS) rubrics? (iii) What staff, materials, and project resources are necessary for successful STEM activities? (iv) Did participating students' levels of STEM interest changed significantly between the pre and post 36-40hrs of instruction?

The project team used multiple instruments to collect evaluation data to assess project impact/outcomes. These data collection instruments included: a STEM Career Interest Surveys (STEM-CIS) for students, student interviews, onsite observation using Dimensions of Success (DoS) rubric, parent/guardian survey, student evaluation of project staff, hands-on activities, filed trips, and guest speakers, and focus groups/interview with teachers. The STEM-CIS is a 44-item, five level Likert scale survey that was developed and tested in rural, high-poverty districts in the southeastern United States. Student STEM engagement was evaluated using the Program

in Education, Afterschool & Resiliency's (PEAR) Dimensions of Success (DoS) observation tool. The DoS tool measures twelve dimensions that fall in four broad domains: *Features of the Learning Environment, Activity Engagement, STEM Knowledge and Practices, and Youth Development in STEM*. While STEM-CIS was used with summer participants, DoS was used with both summer and academic year participants.

A total of 646 students participated during the first year of this three-year K-12 Aerospace Academy program at ECSU. The participants comprised of 46.44% male students and 53.56% female students spanning K-12 grade levels. As shown in Figure 1, overall program participants comprised of 19.04% elementary grade students, 38.23% middle grade students, and 42.72% high school students. Table 1 shows ethnic makeup of program participants during the first year of the program. As shown in Table 1, over 75% of program participants belong to underrepresented groups in STEM fields. In its first year, the program had 35.4% African-American female participants compared to 26.62% African-American male participants.

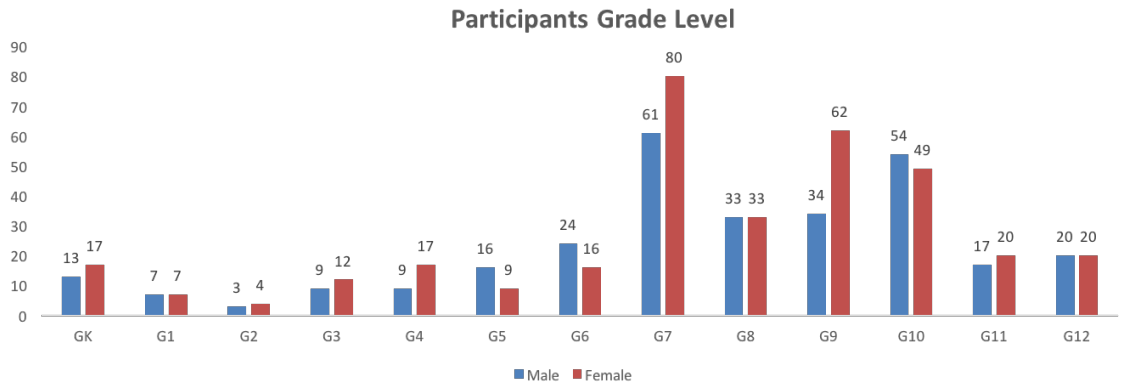

Figure 1: Program Participants (Male and Female) By Grade Level

Table 1: Program Participants (Male and Female) By Ethnicity

Ethnicity / **Gender**	African-American	White	Hispanic	Native-American	Asian	Native-Hawaiian	Two or More	Others	No Response
Male	172	88	4	7	5	0	18	6	0
Female	229	75	2	14	2	1	17	4	2

Currently, the project team is tabulating and analyzing data collected through evaluation instruments. In addition, during the first year of the K-12 Aerospace Academy program, feedback was gathered from all participants (Instructors, mentors, students, staff). Based on the feedback, the team will be taking several steps in the second year to improve the project further. The program recommendations and detailed first year results will be available during the final presentation.

References

1 Afterschool Alliance, (2012) *Afterschool essentials: Research and polling*. Retrieve from http://www.afterschoolalliance.org/documents/2012/Essentials_4_20_12_FINAL.pdf.

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