THE ARECIBO OBSERVATORY SPACE ACADEMY: 4 YEARS OF STEM ENGAGEMENT
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Introduction: The Arecibo Observatory Space Academy (AOSA) is an intense ten (10) week research program, for highly qualified pre-college students residing in Puerto Rico. The program seeks to increase public engagement efforts of the Arecibo Observatory [1]. On Saturdays, selected students from 9 to 12th grade, participate in this semester long research program targeted to aid in their individual academic and social development. The students are welcomed as candidates or "cadets-to-be" the first weeks. They become cadets, while experiencing designing, proposing and carrying out research projects related to the exploration of space focusing in STEM fields such as Physics, Astronomy, Geology, and Engineering.

Through a research, experiment, and analytical experience we seek to motivate and prepare the next generation interested in pursuing careers in areas of science related to NASA research and its spin off-technologies. During the fall semester they create and develop activities for the celebration of World Space Week [2] and during the spring semester for Yuri’s Night [3] along with the Observatory’s Visitor Center staff. AOSA provides students with the opportunity to share lectures with Arecibo Observatory staff, who have expertise in various STEM fields.

Our mission is to prepare students for careers in Science, Technology, Engineering, and Mathematics (STEM) related fields via a student-centric immersive research experience. Our vision is to allow students to receive an independent and collaborative research experience on topics related to space and aid in their individual academic and social development. AOSA’s objectives are: (1) Supplement the student’s STEM education via inquiry-based learning and indirect teaching methods, (2) Immerse students in an ESL (English as a Second Language) environment, further developing their verbal and written presentation skills[4], and (3) To foster in every student an interest in science by harnessing their natural curiosity and knowledge in order to further develop their critical thinking and investigation skills.

Pedagogy: The AOSA program applies multiple instructional methods for students to expand their skills and knowledge[5, 6]. Being part of a scientific environment immersion helps to promote student ingenuity. During the Saturday meetings, the cadets are exposed to the following teaching methodologies:

Explaining or lecturing: the process of teaching by oral communication, usually with the aid of visual enhancements, such as PowerPoint, videos, and white board.

Demonstrations: teaching process that uses examples and experiments as the main instructional technique. Demonstrations are a preferred technique, as it has been shown to reinforce memory retention by linking scientific facts with real–world applications.

Collaborative Teaching: allow students to become engaged in the learning process by sharing ideas and debating opinions. Inquiry based learning assists students in establishing a personal connection among their teams, bringing together their topic, ability to work as a team, presentation and leadership skills.

Teaching: using role switching, students assume the role of the instructor and teach their topics to their peers. Students exposed to this teaching methodology tend to increase their self-confidence, leadership, and ESL skills. The students participating in the program are required to have an interest to explore the world around them. This is a very demanding program that requires a great amount of dedication and time management skill development.

Selection and Evaluation: Hispanic students are among the most underrepresented groups in science and engineering, so this program is especially important to reach the Puerto Rican community. Students interested in participating in the program go through an application, interview and trial period before offering admission as a cadet. Each individual is evaluated with program compatibility based on peer interaction, preparation, participation, contribution to class, group dynamics, attitude, challenges and inquiry[7]. This helps to ensure that specialized attention can be given to students who demonstrate a dedication and desire to learn.

Research: During the semester, AOSA students are responsible for designing, proposing, and implementing a research project. Project topics and designs are very flexible to accommodate anything related to space exploration and humans in space. Each Semester
cadets get the opportunity to explore their topic of choice while practicing many of the foundations of scientific research focusing on four fields: Physics/Astronomy, Biology, Geology, and Engineering. For many students, this is a new experience, and they find that real science is nothing like cinema magic. Students are encouraged to find innovative ways to find answers, and to use all available resources in their research.

Deciding how to proceed in the face of set-backs and unexpected problems is central to the learning experience. At the end of the semester students present their research to the program mentors, peers, and scientific staff. In Puerto Rico, education is in Spanish, although English is part of the curriculum. To continue in STEM fields, students must be proficient in English, so cadets are strongly encouraged to work on both writing and speaking skills. Students are also challenged to create a space settlement design and to submit to the National Space Society-NASA Ames Space Settlement Design Contest during the Fall Semester [8]. With the goal of creating a habitable colony in free space and a zero-waste environment, cadets expand their zero waste plans to their schools and communities. Outstanding students travel in the spring semester to present their design at the International Space Development Conference (ISDC®).

Figure 2: AOSA Alumni and staff with Astronaut Buzz Aldrin, at the ISDC® 2015

Conclusions: Puerto Rico offers very little opportunity for pre-college students to gain experience in learning through active participation because few local schools have any resources at their disposal. We aspire to liberate our students from the box of standardized education and testing that high school students often experience. The Academy provides a place for students from around Puerto Rico with common interests in space and other technical fields to collaborate and meet their future peers. We ensure that the students are given the chance to interact and make lasting connections with each other, mentors, and people in their fields of interest, whom they might not have met otherwise.

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References:
[4] WIDA Consortium. (2012), Board of Regents of the University of Wisconsin System, Madison, WI.