Introduction
An ongoing challenge in undergraduate engineering and science education is providing students with hands-on experience in the development of space technology, and to engage them in discovering new knowledge. The CUNY/Queensborough Community College, a Hispanic and minority-serving institution, has been very successful at engaging undergraduate students to design, assemble and test 1U Commercial-off-the-Shelf (COTS) CubeSat. With funding from NASA MUREP, this past summer, students participated in a remote 8-weeks QCC-NASA summer internship, in which they were challenged to build a 1U COTS CubeSat. Students CubeSats projects involved both technology demonstrations and scientific payloads. This poster describes the program and also discusses some of the programmatic and technical successes and challenges faced by students during the summer of the COVID-19 pandemic.

Program description

Main Goal:
Design and implement a year-long research experience with two experiential learning opportunities in space science & technology (SST) development

Specific Objectives:

- Provide students, in particular community college students with research opportunities as early as their first year.
- Develop SST educational materials
- Increase the number of students, especially underrepresented minorities, that transfer to 4-year STEM programs and obtain BS degrees.

Activities:
During academic year, students are enrolled in a modified course-based introductory research experience (CURE) where they learn the basics of space weather and research skills.
During the summer, students are placed in research internships at NASA Goddard Space Flight Center (GSFC).

QCC-NASA GSFC VIRTUAL SUMMER PROGRAM
Program activities draws from decades of research about how students learn (National Research Council (NRC), 2012). NASA's BEST (Beginning Engineering, Science and Technology) Engineering Design Model (NASA, 2021), shown in Figure 1, is used as a foundation for course activities, in which students used an iterative process when solving problems.

Project Challenge:
To design experiments to test the scientific and technological capabilities of four commercial-off-the-shelf (COTS) 1U CubeSats prototypes on Earth.

CubeSat Mission consists of:
Two science payloads (sensors--particulate matter & onboard magnetometer sensors).
Four technology demonstration of navigation systems.

Project Development

Project has three main phases:
Phase 1: FlatSat development- Components are laid flat, then interconnected for power, commanding, and telemetry. FlatSat is used to test and troubleshoot systems without integrating everything onto the structure.
Phase 2: FlightSat development: CubeSat frames are designed using an autocad software and 3-D printed. FlatSat is assembled into CubeSat and tested.

Phase 3: data collection and analysis:
Examples of data collected from sensors integrated in CubeSats: particulate matter and magnetometer sensors.

Challenges

- 3D design was a struggle for short term (learning new design software, high demand on computer resources)
- 3D printed parts made of PLA were not very precise resulting in multiple prints and waste of materials.
- Working remotely as a team--some issues are easier to solve in person.
- No access to NASA facilities such as clean rooms.
- Obtaining materials during the pandemic.
- Use of COTS and household items- some items were faulty.
- Performing stress tests (not under well-controlled conditions).

Lessons Learned

1. If project is interesting and engaging, students will rise to the challenge and work together.
2. Virtual format allowed students to work both independently and in teams.
3. Students' confidence and self-efficacy increased because they produced a tangible product that they could be proud of.
4. ALL students contribute to the project and through the process increase their oral communication skills.

References

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