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An Update on UND’s OpenOrbiter CubeSat

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Overview
The OpenOrbiter program [1] is developing a low-cost framework for the creation of spacecraft [2] by researchers and educators worldwide [3]. In line with the objective of enabling future educational use by others, educational assessment [4, 5] has been a key focus. Several areas were assessed: students were asked what types of benefits they sought from their participation [6], assessment of benefit attainment is ongoing. Work on the development of a design [see Figure 9] that can be used to build a spacecraft with a cost of under $5,000 [7] using primarily COTS parts and testing (see Figure 3) thereof also continues.

How Do Students Participate
Students participate in the OpenOrbiter program in several ways:
• Extracurricular activity
• Class project
• Academic capstone / design project
• Independent study course
• CSCI 297—Software Project Management through Experiential Learning course
• Paid worker

Students design, develop, manage, test and troubleshoot under all participation types, gaining valuable experience. Most participate in an area related to their major; some choose to gain experience in an alternate area.

Research Experience for Undergraduates
In the summer of 2015, 12 undergraduate students from around the United States came to UND to participate in a NSF-funded Research Experience for Undergraduates Program. A Brazilian student participated with support from the Brazilian government (Figure 4 right).

Developing and Prototyping
We have created a simulation platform, called the ROOFSAT [11], the parts for which are shown in Figure 10, to facilitate spacecraft software development and testing concurrently with the spacecraft design and development. This allows students to gain the valuable hands-on experience in working with hardware that is sought by many private- and public-sector employers prior to hardware completion. The ROOFSAT costs under $2,000.

What Has Been Determined?
A more detailed discussion of assessment activities can be found in [3, 4, 6]; however, several key points are illustrated herein.
Areas where students believe that they can receive benefit from participation are numerous and varied (see Figure 1).
• Significant benefit is shown in multiple categories of performance (see Figures 5 and 6). These include:
  • Technical Skill
  • Spacecraft Design
  • Presentation Skills
• Students also gained in their excitement about space and comfort giving presentations (see Figures 5 and 6).
• Benefits attainment is attributed to participation (Figure 7). This attribution is strongest for technical skills and space interest.
• Team leads and non-lead participants gain benefit from their participation (see Figure 8, with leads being shown to gain benefit in more (3 versus 2) areas.
• Students gain valuable skills and find participating exciting and enjoyable (Figures 2-4).

Scholarly Activities
The OpenOrbiter Program has produced:
• nine peer-reviewed journal articles [2-6, 13-16]
• twenty-six conference papers [1, 7, 17-40]
• twelve oral / poster presentations at national conferences [41-52]
• eighty-three local and regional oral / poster presentations [8-12, 53-130]

The topics covered have ranged from technical presentations, discussion and analysis of the structure, software and other spacecraft elements, to papers considering spacecraft use and its impact on policy to educational / participation benefit evaluation papers.

Acknowledgement
This poster is updated from [10].