Report on the First NSF CubeSat Software Research Experience for Undergraduates

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What is a REU (Research Experience for Undergraduates) site?

• REU sites is a NSF program that funds colleges and universities to host cohorts of undergraduate students who will perform research with a common theme
• REU participants must be U.S. citizens or permanent residents
• Site sizes and durations vary
• The University of North Dakota site:
  • Operated for 3 years (2015 – 2017)
  • Hosted 30 students from around the country
  • Had a theme of small spacecraft software
Building the cohort

• The goal is to give students experience performing real research
  • See if they like it and want to pursue a research career
  • An lead students to pursue graduate degrees

• Cohort building is also important
  • Students make friends with similar interests and friendships last long beyond the 10 week REU.
  • We run numerous activities to build the cohort bonds between the students.
About the Students

• All undergraduate levels
• Strong students (by GPA and other metrics)
About the Students (cont.)

• Minimal prior experience with spacecraft projects
Why did students participate?
Benefits Students Received

• We assessed the benefits that students received
  • We used an instrument that was basically the same as we used for the national survey of participation benefits
  • We used this same instrument for all three years

• Students received benefits that were both technical skills as well as more general benefits
  • Increased confidence
  • Writing / presentation skills

• Most of the students had a presentation experience of some sort, many wrote a paper. Several of the papers were turned into journal articles.
Benefits Students Received – Spacecraft Design

Figure 5. Spacecraft Design Skill, by Program Year.
Benefits Students Received

**Design Comfort**

**Before**
- 18% Very Comfortable
- 18% Somewhat Comfortable
- 57% Not Comfortable

**After**
- 18% Very Comfortable
- 18% Somewhat Comfortable
- 29% Not Comfortable

**Space Excitement**

**Before**
- 18% Very Excited
- 18% Somewhat Excited
- 57% Not Excited

**After**
- 27% Very Excited
- 27% Somewhat Excited
- 27% Not Excited

Figure 5. Spacecraft Design Comfort, by Program Year.

Figure 6. Space Excitement, by Program Year.
Benefits Students Received

Presentation Comfort

Figure 8. Presentation Comfort, by Program Year.

Presentation Skills

Figure 7. Presentation Skills, by Program Year.
Benefits Students Received

Leadership Skills

Leadership Confidence

Figure 9. Leadership Skills, by Program Year.

Figure 10. Leadership Confidence, by Program Year.
Attribution of Benefits

• We also asked students whether they attributed the change in benefits to their program participation.

• There was generally strong correlation between benefit gain and attribution
  • Some students didn’t attribute gains that they felt that they made on their own during program participation to the program
Beginnings of a Longitudinal Study

• We plan to follow up with the participants to see what directions they take
  • Several have already applied (and been accepted to) graduate schools
  • Several others have taken steps in pursuit of aerospace software careers
  • Several pursued research projects at their home institution after REU participation
    • At least one student continued his REU project with support from his home institution
To Boldly Go ...

• Funding for the UND site ended last summer
  • UND was contacted by a number of students who had heard about the program in previous years wanting to attend this summer

• NDSU received funding for a REU site starting this year with a cybersecurity software focus
  • We just had our first group finish last week!
  • There were several aerospace-related projects in this cohort

• A more broadly focused small satellite REU program would be an excellent future project
  • If anyone is interested in taking the lead or helping with this, please let me know. I have a lot of data to support the application!