

Thesis Portfolio

The Virginia CubeSat Constellation Mission (Technical Report)

Exploration of Undergraduate Engineering Students' motivations within the Virginia CubeSat Constellation (STS Research Paper)

An Undergraduate Thesis

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Bachelor of Science in Engineering

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SocioTechnical Synthesis

Body of SocioTechnical Synthesis

Current atmospheric density models utilize antiquated data, which makes predicting drag values on orbiting spacecraft in Low Earth Orbit (LEO) difficult and inaccurate. This leads to inaccuracies with orbit propagation, which can affect deorbit time calculations, collision prevention efforts, and reentry location predictions. The University of Virginia, Old Dominion University, and Virginia Tech together as the Virginia CubeSat Constellation (VCC) have created three CubeSats measuring GPS, velocity, and acceleration data during their lifetime in LEO to develop a new atmospheric density model for the upper atmosphere in an attempt to eliminate the issue of inaccuracies.

In combination with developing a more accurate atmospheric density model, one main objective of the VCC mission is to provide a hands-on learning experience to undergraduate engineering students. Although the mission itself is a great opportunity for students to learn about large-scale engineering projects, it is important to analyze the structure with which the design courses of the three universities are taught in order to best prepare the students for their entrance into graduate school and industry. In this research I do exactly this, utilizing the Self Determination Theory (SDT) of education to analyze the intrinsic and extrinsic motivations of these students over the course of the mission through three universal needs: Autonomy, Competence, and Relatedness. My research will aid in determining the effectiveness of these courses in the context of CubeSat missions as well as provide feedback on how they can be improved.

By conducting interviews and rated question surveys tailored to the SDT and the specifics of the VCC mission, I have analyzed trends of intrinsic and extrinsic motivation and identified areas of improvement for future missions. The results showed very high levels of intrinsic and extrinsic motivations, with some trends between the variables emerging. All three universal needs displayed similar scores across each variable with some exceptions. Through 2017 to 2019, scores for Relatedness increased significantly between all three schools indicating an increase in cooperation and teamwork between the three universities. Virginia Tech displayed the highest Relatedness score out of all of the universities, scoring drastically higher than the other two schools. The University of Virginia consistently scored the lowest for all three universal needs, though still falling within range to conclude that overall, the mission was successful in motivating and provided a quality educational experience to students throughout the lifetime of the mission. This research in the context of the VCC mission will help to improve future CubeSat missions conducted by each university and create an emphasis on student development and reflection to serve as a model for other universities.