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Author: Ms. Maaheen Zulfiqar
Institute of Space Technology (IST), Pakistan

Dr. Rehan Mahmood
Institute of Space Technology (IST), Pakistan

CSAT: INTEGRATING HANDS-ON CUBESAT DEVELOPMENT INTO UNDERGRADUATE EDUCATION FOR STEM AND LEADERSHIP SKILL ENHANCEMENT

Abstract

article

CSAT: Integrating Hands-On CubeSat Development into Undergraduate Education for STEM and Leadership Skill Enhancement

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Abstract

The increasing role of CubeSats in space research presents an opportunity for academia to merge theoretical learning with hands-on experience. This paper presents the **CSAT (Classroom Satellite) initiative**, a novel undergraduate curriculum where an entire class of approximately 50 students collaborates to design, develop, and test a functional CubeSat as part of their coursework. This program serves as an educational framework that enhances **STEM capabilities, project management, interdisciplinary teamwork, and conflict resolution skills** among students.

Through the CSAT approach, students gain exposure to **real-world satellite development processes**, including mission planning, systems engineering, payload integration, communication, and testing. The program integrates a **structured project-based learning (PBL) methodology**, where students work in **subsystem teams** (e.g., power, communication, ADCS, structure, and thermal). A **rotational leadership model** ensures that students develop **management, decision-making, and conflict resolution skills**, mimicking professional industry and research environments.

Longitudinal assessment of student outcomes over multiple cohorts has demonstrated improvements in **technical proficiency, problem-solving abilities, and collaborative skills**. Additionally, the CSAT model bridges the gap between academia and industry by fostering **hands-on experience in spacecraft development**, enhancing student employability in the space sector.

The findings highlight how integrating CubeSat development into the undergraduate curriculum not only advances technical expertise but also cultivates essential soft skills, positioning students for leadership roles in aerospace and STEM fields. This work contributes to the IAC 2025 theme, **"Sustainable Space: Resilient Earth,"** by advocating for sustainable human capital development in space technology.

Keywords: Classroom Satellite, CubeSat education, STEM learning, project-based learning, interdisciplinary collaboration, space systems engineering.