

YOGENDRA PANTA, Leonard C Nelson School of Engineering, West Virginia University Institute of Technology (WVU Tech), Beckley, WV, 25801 and MAYA PANTA, Woodrow Wilson High School, Beckley, WV, 25801. Integrating Experiential Engineering Design into Middle and High School STEM Summer Camps

This paper describes the design, implementation, and outcomes of several engineering-focused summer camps developed to strengthen STEM engagement among middle and high school students as well as teachers. The camps were offered during the summers of 2024 and 2025 and included the West Virginia GEAR UP program for middle school students, the STEM Camp and AcES Camp for high school and pre-college students, and both student and teacher camps through the Health Sciences and Technology Academy (HSTA). Each program introduced participants to fundamental ideas in mechanical and aerospace engineering through hands-on, inquiry-based activities that connected scientific concepts with real-world engineering applications.

Participants explored engineering principles through interactive projects such as gear mechanisms, hovercraft construction, AP bottle racers, and small aerodynamic car models designed with fins to study stability and drag. These activities encouraged experimentation, teamwork, and iterative design. Along the way, students examined concepts of motion, forces, and aerodynamics by applying Newton's laws and observing pressure–flow relationships through demonstrations using Bernoulli apparatus, water flumes, and simple aerodynamic models.

Learning outcomes were assessed using both pre- and post-tests along with participant feedback. Results showed clear gains in students' understanding of motion, forces, and energy transfer, as well as increased confidence in problem solving and teamwork. Teachers participating in the HSTA program also reported greater confidence in bringing similar hands-on engineering activities into their own classrooms.

Overall, the camps provided an engaging setting where participants connected theory with experimentation while experiencing the engineering design process firsthand.