Engineering Turns on K-12 Students

Groups of seventh graders hunch over tables at Quibletown Middle School in Piscataway, N.J. A subdued murmur percolates through the classroom as they pick through gears, shafts, motors and wheels. Slowly, vehicles begin to take shape.

Referring to their original designs - pencil drawings of gear combinations - students mount motors and spin gears. When everything works, they rush their creations to teacher Ed Cohen so he can time the vehicles on a test track behind the lab bench. When gears jam or fail to spin, students revise their design.

"At the beginning of the year, they didn't even understand that you had to connect the gears to transfer power from the motor," says Cohen.

The class itself is as much an experiment as the students' cars. It is part of a pilot program to introduce K-12 students to engineering. Once, this type of curricula might have targeted the school's brightest students. This class, however, aims at everyone, including girls and minorities now under-represented in college engineering classes and in the field as a whole.

"Some of them did not do well in regular science classes," says Cohen. "But when they have a chance to learn by building and testing, they pay better attention and learn more."

"We have seen all types of students respond favorably to engineering activities, from elementary through high school students, and gifted and talented to English language learners and special education students," said Beth McGrath, Director of the Stevens Center for Innovation in Engineering and Science Education, which is spearheading a statewide initiative to expose all K-12 students to engineering. "The hands-on design, the opportunity for students to be creative and invent their own solution to a problem and the real world challenges are all key motivators for students."

A project like the motorized car does more than teach the theory of mechanical advantage. It lets students apply the theory and math of gear ratios to a real challenge. Instead of test scores, students show what they have mastered by racing a car up an incline.

They also learn to continuously improve their designs while developing a deeper understanding of the scientific principles behind their operation. In other words, they learn the scientific and engineering process - theory, test, revise and test - as well as facts.

"Engineering design and problem solving help students look at the world and apply the science, math and teamwork skills they learn in school," says McGrath. "Students can use these skills throughout their lives, as workers, consumers and informed citizens who must make decisions about increasingly technical subjects."

Founded in 1988 to improve K-12 science and mathematics education, CIESE received one of the nation's first grants to develop ways to use the Internet in K-12 education. Today, its educational websites attract more than 100,000 users from 35 countries.

The emphasis on engineering is more recent. It is part of a nationwide trend to interested more students in engineering and to promote technological literacy for all students, whether they pursue engineering careers or not. Hands-on engineering classes not only promote the value of engineering, but show how math and science relate to exciting, real-world challenges.

According to the Boston Museum of Science, a leader in engineering education and a CIESE partner, students who take engineering do better in science and mathematics and improve their problem-solving skills.

CIESE's Engineering our Future New Jersey program is laying the groundwork to bring engineering to every school in the state. This starts with teaching teachers to teach engineering and developing curricula.

CIESE works with some of the best educational lessons available. The Society of Automotive Engineers, for example, developed the vehicle kits used by Cohen's class. The Boston Museum of Science's elementary school curriculum helps students build water filters, windmills and other engineering solutions to real world problems that young children can relate to.