Going to the Head of the Class

Stevens' CIESE program advances engineering curriculum standards in the classroom, the state and nation, spurring U.S. leadership in innovation

By Peter C. Benedict
Director of Alumni Publications

To train a new scientist or advanced engineer takes 15-plus years and starts when a child is first interested in science and math in elementary school, journalist and author Thomas L. Friedman points out in his best-selling book on globalization, *The World Is Flat*. And nations such as India and China are catching up to the United States in their capacity to train innovative engineers and scientists who can add value to and compete and succeed in the global economy.

Therefore, we should be embarking immediately on an all-hands-on-deck, holds-barred, no-budget-too-large crash program for science and engineering. Friedman says in describing what's been called the "quiet crisis" in U.S. science and technology—the erosion of America's scientific preeminence due to gaps in leadership, government funding and policymaking, high-tech infrastructure and advanced degrees in science and math.

While not the sole solution to the multi-faceted challenges of outsourcing, "off-shoring" of jobs and businesses, addressing gaps in primary and secondary science education is one important step.

"Scientists and engineers don't grow on trees," Friedman says. "They have to be educated through a long process, because, ladies and gentlemen, this really is root science. The fact that we have not been doing this is a crisis. It may be a creeping quiet crisis, but it is here and it is real."

Well, Stevens Institute of Technology is doing something about it.

Engineering Our Future NJ is a new initiative of Stevens' Center for Innovation in Engineering and Science Education (CIESE) to promote engineering in the mainstream K-12 curriculum by training thousands of New Jersey teachers over the next several years.

*Continued on Page*
Through Stevens' Engineering Our Future NJ program, Randolph (N.J.) High School students learn about electrical and communications systems using the "Engineering the Future" curriculum.
Middle school students in Bayonne, N.J., participate in “A World in Motion,” an engineering curriculum developed by the Society of Automotive Engineers, in which students form a mock corporation to design a toy racecar.

Continued from Page 24

“Our goal is to ensure that all children experience engineering as an integral part of their K-12 education, not merely as an elective or extracurricular activity,” says Beth McGrath, director of CIESE. “We need to begin this process early, so that when students are confronted with a complex, multidisciplinary challenge in the real world, they have developed the habits of mind to use their technical foundations as well as their creativity, ingenuity, critical thinking, teamwork and other resources to come up with the best solution,” she says.

Influenced by thinkers such as Thomas L. Friedman and Daniel H. Pink (author of A Whole New Mind: Moving from the Information Age to the Conceptual Age), Engineering Our Future NJ aims to not only introduce engineering concepts to students early on but to also cultivate in students a sense of invention and innovation—following Stevens’ philosophy and practice of Technogenesis (visit www.technogenesis.org)—by stimulating both their left-brain and right-brain thinking abilities in class, says McGrath. Open-ended problems that don’t have a single, correct answer, for example, encourage the students to learn by doing, using the iterative approach of engineering and fine-tuning their designs to come up with an optimal solution.

“Many students have no familiarity with what engineers do, the types of jobs they hold or the contributions they make to the world around us,” McGrath adds. “This is a critical gap because by the time students reach high school, many have opted out of the rigorous math and science courses they need in order to pursue technical studies in college.”

With support from the National Science Foundation, Verizon Communications, the state of New Jersey and other sources, CIESE is addressing this gap by providing professional development to more than 2,000 K-12 teachers in New Jersey over a three-year period by partnering with school districts, other institutions of higher education and related engineering, technology, science and research organizations.

Engineering Our Future NJ is working with partners such as the Museum of Science, Boston, Mass., the Society of Automotive Engineers, other New Jersey universities and two-year colleges to provide the teachers with exemplary elementary and secondary-level engineering curricula, district-based professional development programs, technical assistance, leadership training and in-class support.

This spring the New Jersey Department of Education awarded CIESE the first year of a three-year grant totaling over $2 million to improve the teaching of science and mathematics in elementary grades through the use of engineering problems and curricula. The Partnership to Improve Student Achievement will impact 8 teachers from 20 elementary schools in Hudson and Essex counties in New Jersey.

One of CIESE’s main goals is to promote a strong engineering strand within New Jersey’s educational policy framework, known as the New Jersey Core Curriculum Content Standards. McGrath will involve industry groups, alumni, faculty, students, K-12 teachers and administrators, parents, policymakers and other education stakeholders in advocating for engineering as a core component of New Jersey’s K-12 curriculum (see sidebar article). To date, Massachusetts is the only state to require engineering as an integral part of K-12 education, along with associated testing that measures student learning of engineering competencies. This engineering strand is seen as a critical means of acquainting all students in New Jersey with the discipline of engineering and the importance of science and mathematics. Statewide hearings on curriculum standards will begin next year.

“By motivating more students to become interested in engineering, technology, science and mathematics before they reach college, we expect to increase the pool of students who will go on to become the next generation of engineers and technology professionals. Such a talent pool is critical to fortify America’s and particularly New Jersey’s, economic future, which depend on innovation and invention, and to advance technology’s frontiers to address pressing national and social challenges,” says McGrath, who points out a National Academies Press report that says 85 percent of U.S. economic growth per capita stems from technological innovation.

Hands-on discoveries

At one New Jersey middle school recently, eighth-grader were engaged in a lesson from “A World in Motion,” an engineering curriculum developed by the Society of Automotive Engineers, in which students formed their own mock corporations to design a toy for girls and boys ages 6 to 10.

The students learned about principles of physics, motion flight and electronics as they experimented with gears, wheel axles and a motor to build a toy racecar (photo above) that could achieve one of three objectives: move three meters in less than three seconds, scale a 30-degree incline for one meter or climb...
Creating a Vision

EOFNJ spring conference to focus on implementing effective models

"Our world is becoming more dependent on high-tech products and services," says Virginia Ruesterholz '83, president of Verizon Telecommunications.

"A curriculum that creates interest in engineering and technology will produce an innovative workforce capable of keeping our digital economy growing for generations to come."

As one of the featured speakers at Stevens' Engineering Our Future NJ Conference on the campus this spring, Ms. Ruesterholz will share a vision of the technological competencies needed by citizens and workers in the 21st century global economy—the theme, "Creating a Vision," of the conference.

With the goal of spurring New Jersey school administrators to visionary leadership in engineering education, Stevens is hosting the May conference to share the vision of leading thinkers in how to build the necessary skills in science, technology, engineering, and mathematics for students to succeed in the global workforce.

"These skills include the ability to think creatively, to invent and innovate and to be problem-solvers and collaborators with geographically distant and culturally diverse individuals," says Stevens President Harold J. Raveché. "These are skills, according to these visionaries, that will distinguish those who will thrive in a knowledge-based, global economy."

Co-sponsored by Stevens, Verizon Communications, the New Jersey Department of Education and the New Jersey Principals and Supervisors Association, the conference will offer curriculum resources for K-12 engineering programs and research findings into the impact of such programs.

Featured speakers at the conference will also include Lucille Davis, New Jersey's commissioner of education, and Ioannis Mytilinis, president of the Museum of Science, Boston.

Verizon Telecommunications President Virginia (Mahoney) Ruesterholz '83—scheduled to speak on "Business's Role in Sustaining the Next Generation of Engineers"—provided a preview of her conference talk. She said the EOFNJ curriculum is important to Verizon for two reasons: "Our first interest is ensuring that we can draw from a pool of prospective employees who have the right education and technical skills to fuel innovation and who are dedicated with a better understanding of how rewarding a technical career can be."

Spring 2004

Continued on Page 29
Explaining ‘Why’

CIESE seeks volunteers and support in the effort to strengthen curriculum standards in engineering and science

Alumni like Jason Sayres ‘95, seated, are advocating for New Jersey curriculum reform. Sayres and colleague Greg Bartus, standing, are employed as education technology associates in CIESE’s Engineering Our Future NJ program.

Events. Alumni companies could also host field trips for students, teachers, and guidance counselors.

- Have their companies sponsor a teacher through EOFNJ’s new Engineering Externships for Educators (E'), a pilot program that will provide middle school and high school teachers with intensive, four-week summer work experiences in engineering-intensive corporate and research environments.

Among the champions of the EOFNJ cause are Stevens benefactors Warren Wells ’42 and Virginia Ruesterholz ’83 and Stevens Alumni Association officers Enrique Blanco ’72 and Edward Eichhorn ’69.

“Physics, chemistry, biology and math teachers have always been hearing the same complaint from the students: Why do I have to learn this?” says SA President Enrique Blanco, whose wife is a teacher in Union City, N.J. “Engineering will give them the reason why. They will be able to apply all of the concepts they have been learning into practical, working solutions. By placing engineering in the curriculum we are providing a catalyst the students need to learn the sciences and at the same time provide a spark for innovation.

“For years we have been seeing the U.S. lose the technical edge it once enjoyed and which took it to the forefront of the world,” Blanco said. “Engineering Our Future NJ is a big step in the effort to reverse the trend and make education of our students more effective.”

A school board member in Dumont, N.J., for 12 years (including two years as president), SAA First Vice President Ed Eichhorn said: “I believe that the Engineering Our Future NJ initiative is an important program that can improve the quality of education in New Jersey if fully implemented around the state.”

For more information about advocacy for Engineering Our Future NJ, and how you, too, might get involved, visit the site www.stevens.edu/ciese/eofnj/getinvolved.html.
Drive Innovation

K-12 talent base key to our future

By Harold J. Raveché
President, Stevens Institute of Technology

Technological innovation is vital to the success of America's largest and most important industries, including biotechnology, healthcare, homeland security, energy, telecommunications and finance. The global marketplace demands that the U.S. workforce be empowered to think outside the box, in addition to having an excellent grasp of the principles of science, engineering and business practice. What we need is a national initiative for funding advanced research in science and technology, in priority areas and industries, as well as more statewide initiatives that spur innovation.

Home to an amazing concentration of world-class academic institutions and research laboratories, with some of the most tech-savvy citizens in the world, New Jersey has been pioneering new collaborative programs that encourage our K-12 youth, including the under-represented African-American and Latino talent base, to pursue careers in engineering and science.

Stevens’ Center for Innovation in Engineering and Science Education has joined forces with leaders in government, education and industry to create a statewide educational initiative called Engineering Our Future NJ. Initiated with grants from the National Science Foundation, the K-12 program has been greatly expanded through generous funding from the Verizon Foundation.

Engineering Our Future NJ introduces a hands-on engineering curriculum early on in a child's education. Teachers are trained to lead students in challenging, skill-building projects that instill important science and engineering concepts. The program is already proving to be an effective means of getting kids excited about problem-solving and seeing concrete results—hallmarks of good engineering, and they're having fun while learning about teamwork.

While the Engineering Our Future NJ curriculum has taken hold in a number of school districts, it is up to government, higher education and industry to ensure that all children in New Jersey experience pre-engineering curricula with a focus on innovation as a required component of their primary education—within the next five years.

By exposing all students, not only those who take elective courses, to science and engineering practices, more students will be motivated to succeed in science courses in middle school and high school. And those who experience the excitement of scientific discovery early on are far more likely to attain baccalaureate and advanced degrees in the "STEM" disciplines—science, technology, engineering and mathematics—and subsequently pursue engineering and other STEM careers.

Nurturing and widening our technological talent pool is critical to fortifying our economic future. Our future depends on innovation and invention that advances the frontiers of technology and addresses pressing national and global challenges.

The next few decades will bring amazing breakthroughs in R&D, and the potential for new industries is unlimited. Visionary and collaborative leadership in K-12 education, and in other state and federal innovation initiatives, will place us on the crest of the wave of global technology innovation.

Grammar school students at the Clarendon School, Secaucus, N.J., conduct a water purification experiment as part of the “Engineering is Elementary” curriculum.

Continued from Page 27

than 100,000 students in 35 countries annually. In 1993, CIESE received one of the nation's first grants ($2.9 million from the NSF's Networking Infrastructure in Education Program) to explore Internet use in K-12 science education; this program reached approximately 3,000 teachers from nearly 700 schools in New Jersey. CIESE has received accolades from the White House Office of Science and Technology Policy, the American Association for the Advancement of Science and the National Science Teachers Association.