STEVENS INSTITUTE of TECHNOLOGY
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University News

Rebuilding America's Technological Workforce, One LEGO at a Time

Swimming, Diving Robots Make Science Fun at Stevens WaterBotics Summer Camps

Serious scientists agree: LEGOs aren't just child's play anymore.

Because what better way to attract young kids to science, technology, engineering and mathematics (STEM) than with robots and LEGOs?

Forty-eight middle school students are on campus at Stevens this month for two five-day sessions of WaterBotics Summer Camp, which challenges students to design, build, program and test underwater robots made of LEGOs and other components. Their eyes lit up in excitement and awe as their robots – directed by wireless controllers they programmed – completed increasingly-sophisticated missions, such as maneuvering through an underwater slalom course and retrieving wiffle balls from the bottom of a pool.

"WaterBotics is really fun and interesting and you really learn a lot," said Peter Prastakos, a rising eighth-grader who said he might like to work with robots when he grows up.

WaterBotics is an innovative program implemented originally in New Jersey classrooms that was developed by Stevens' Center for Innovation in Engineering and Science Education (CIESE). Now also expanded to Ohio, Illinois, Texas and Kentucky, it is part of a $2.5 million National Science Foundation (NSF) program to provide hands-on experiences for middle and high school age youth in engineering design, information technology tools and science concepts, and to increase awareness and interest in engineering and IT careers.

The Lockheed Martin-sponsored camp, which was held in the state-of-the-art facilities of the Babbio Center and facilitated by a team of CIESE instructors and Stevens students and

counselors, featured team engineering games, tours of the Davidson Lab at Stevens where students saw real engineers working with real underwater robots, STEM-related guest speakers including professors, scientists and engineering students, and of course, daily robot-building activities.

“Our focus at all times was to have the kids building,” said Adam Scribner, director of the 2012 WaterBotics Summer Camps and CIESE science professional development specialist. “They were constantly engaged in hands-on programming and engineering tasks and then got to experience the results of their work by entering their robots in four challenges in the pool.”

Scribner said LEGOs are the perfect tool for introducing young kids to the basics of robotics.

“LEGOs are intuitive; most of the students have worked with them before,” he said. “They also allow for rapid prototyping – when something doesn’t work or when they have a new idea, the students can easily take them apart and put them back together.”

Building robots that can swim, grab objects and navigate obstacles teaches students complex science concepts such as density, buoyancy, stability and torque, engineering concepts such as brainstorming and systems analysis, and technology concepts such as programing and sensors and motors.

“The secret is to have stability and balance so it’s easy to maneuver and turn,” said Prastakos, displaying a brain full of fresh scientific knowledge. “You can make your robot fast but you also have to have torque.”

The hands-on and group project-focused curriculum also introduces important 21st century skills such as teamwork, problem-solving and critical thinking.

“What I liked most was meeting new people and working together to learn about gears and programming and to invent different things,” said rising seventh-grader Jacqueline Trieu, who was a newcomer to the world of robotics.

CIESE Director Arthur Camins said underwater robotics presents a motivating and exciting opportunity for scientific investigation.

“WaterBotics goes beyond trial and error or step-by-step building activities,” he said. “It is intentionally designed so that students must apply understanding of core science ideas in order to address successively more sophisticated design challenges.”

And it’s true: Statistics show that WaterBotics has proven highly effective at encouraging students to study engineering and science by making it fun and engaging. During the three-year pilot program, the percentages of students who wanted to become engineers and who would consider a career in engineering both increased after participating in the program.

So did the number of girls – long considered the hardest students to reach by science teachers – who considered science their favorite subject. Of the 48 campers enrolled in WaterBotics at Stevens this summer, 14 were girls.

“Our campers have the invaluable experience of seeing how engineering and science can solve real problems, and this context helps them visualize what it would be like to study and work in these disciplines,” said Mercedes McKay, deputy director of CIESE.

WaterBotics also aligns closely with the K-12 science education framework released in 2011 by the National Research Council (NRC) which is currently being translated into a set of next generation standards that states can adopt and implement. The framework highlights the importance of engineering being part of the science curriculum for all students.

Researchers and policymakers agree that more STEM-educated talent is needed for the nation to sustain its economic growth and for America's future workforce to address the most complex problems in energy, healthcare, transportation and more. Only four percent of Americans are employed as scientists, engineers or technologists, and the U.S. currently ranks just 27th among developed nations in the proportion of college students receiving undergraduate engineering and science degrees.

"Primarily, WaterBotics is a lot of fun," said Scribner. "But we also hope students leave camp thinking they might consider careers in science and engineering."

"America's low number of aspiring scientists is a problem, but WaterBotics was developed to be part of the solution," added McKay.