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Studying Engineering Before They Can Spell It

By WINNIE HU

GLEN ROCK, N.J. — In a class full of aspiring engineers, the big bad wolf had to do more than just huff and puff to blow down the three little pigs' house.

To start, he needed to get past a voice-activated security gate, find a hidden door and negotiate a few other traps in a house that a pair of kindergartners here imagined for the pigs — and then pieced together from index cards, paper cups, wood sticks and pipe cleaners.

"Excellent engineering," their teacher, Mary Morrow, told them one day early this month.

All 300 students at Clara E. Coleman Elementary School are learning the A B C's of engineering this year, even those who cannot yet spell e-n-g-i-n-e-e-r-i-n-g. The high-performing Glen Rock school district, about 22 miles northwest of Manhattan, now teaches 10 to 15 hours of engineering each year to every student in kindergarten through fifth grade, as part of a $100,000 redesign of the science curriculum.

Spurred by growing concerns that American students lack the skills to compete in a global economy, school districts nationwide are packing engineering lessons into already crowded schedules for even the youngest students, giving priority to a subject that was once left to after-school robotics clubs and summer camps, or else waited until college.

Supporters say that engineering reinforces math and science skills, promotes critical thinking and creativity, and teaches students not to be afraid of taking intellectual risks.

"We still hear all the time that little kids can't engineer," said Christine Cunningham, director of Engineering is Elementary, a program developed at the Museum of Science in Boston that offers ready-made lessons, for about $350 each, on 20 topics, and is now used in all 50 states, in more than 3,000 schools.

"We say they're born engineers — they naturally want to solve problems — and we tend to educate it out of them."

The Obama administration's Race to the Top competition, which will distribute $4.35 billion in education stimulus money to states, favors so-called STEM programs, which stands for science, technology, engineering and math.

At the same time, Congress is considering legislation, endorsed by more than 100 businesses and organizations like I.B.M. and Lockheed Martin, to promote engineering education from kindergarten through 12th grade.

In Manassas, Va., which has a thriving biotech industry, the local school district has spent $300,000 on a children's engineering program since 2008, equipping its six elementary schools with tool kits for projects like making musical instruments from odds and ends, building bridges with uncooked spaghetti and launching hot-air balloons made from trash bags and cups.

At the new Midway Elementary School of Science and Engineering in Anderson, S.C., kindergartners celebrated Groundhog Day by stringing together a pulley system to lift a paper groundhog off the floor.

But as these lessons have spread, some parents, teachers and engineers question how much children are really absorbing, and if schools should be expending limited resources on the subject.

Engineering is not a requirement in most states. (New Jersey is an exception: the state standards mandate some exposure to engineering by second grade.)

"Just giving kids an engineering problem to solve doesn't mean it will lead to learning," said Janine Remillard, an associate education professor at the University of Pennsylvania who is not opposed, but believes that good teaching is essential to making any curriculum work well.

She pointed out that schools have long offered project-based learning, without calling it engineering, like building Lego robots or designing a cushion for an egg drop.

"Ideally, you want them to come away with knowledge that goes beyond that problem," Professor Remillard said. "They could just go through the motions and end up with a robot that can do a particular thing, but the next problem they face will be a new problem. This is where good teaching comes in."

William E. Kelly, a spokesman for the American Society for Engineering Education and former dean of the engineering school at Catholic University in Washington, cautioned that engineering lessons for youngsters should be kept in perspective.

"You're not really learning what I would call engineering fundamentals," he said of such programs. "You're really learning *about* engineering."

Here in Glen Rock, where students have long excelled at math and science, administrators and teachers decided to incorporate engineering into the elementary grades to connect classroom learning to real life, as well as to instill social skills like collaboration and cooperation that are valued in the work force, said Kathleen Regan, the curriculum director.

“At first, everybody was like: ‘Engineering? Kindergarten?’ ” recalled Dr. Regan, noting that one school board member joked that she must be married to an engineer (no; a lawyer).

But now, Dr. Regan said, the engineering lessons have become so popular that children are talking about their projects at the dinner table, and some of their parents have started researching engineering colleges.

Ms. Morrow and Jennifer Burke, who also teach classes for the gifted and talented, developed the engineering lessons and run them in all four elementary schools.

They plan multiday projects, often built around classic and popular stories like the Three Little Pigs, and take students step by step through the engineering process: design, build, test, evaluate.

“They have to have the thinking skills of an engineer to keep up with all the innovation that’s constantly coming into their world,” Ms. Morrow said.

First graders were recently challenged with helping a farmer keep rabbits out of his garden.

In teams of four, they brainstormed about building fences with difficult-to-scale ladders instead of doors and setting out food decoys for the rabbits. They drew up blueprints and then brought them to life with plastic plates, paper cups, straws and foam paper.

Then they planned to test their ideas with pop-up plastic rabbits. If the fences were breached, they would be asked to improve the design.

“It gets your brain going,” said Elizabeth Crowley, 7, who wants to be an engineer when she grows up. “And I actually learn something when I’m doing a project — like you can work together to do something you couldn’t do before.”

In the kindergarten class that was designing homes — none out of hay, wood or brick — for the three pigs, Ms. Morrow started the lesson by asking the 20 children sitting cross-legged on the carpet if they knew what engineers do.

“They can write poems?” one girl guessed.

“Well,” Ms. Morrow allowed, “they could write a poem about something they build.”

But if they were still unsure about the language of engineering, the students were soon immersed in its nuts and bolts.

They tweaked their houses, adding ever more elaborate improvements to thwart the wolf. Then they huffed and they puffed.

And not a single house blew down.