

Teacher finds a solution to our science problem

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A new way of teaching physics — developed by a Bergen County teacher — could offer a solution to American students' poor performance in math and science.



ELIZABETH LARA / STAFF PHOTOGRAPHER

Liz Henriquez, a teacher at Bergen County Technical Schools in Paramus, helping Evan Carmona, 16, with a physics problem. Remote controls held by students let teachers know instantly which students and concepts need more attention. The pilot program also moves physics from 12th grade to ninth grade.

"We're saying we think we have a better way," said James Lerman, director of the Progressive Science Initiative, or PSI, at Kean University in Union. "We have 10 years of data to support it, and we're expanding cautiously to see if what we think is going to happen happens the way we think it ought to. If it doesn't, we're going to fix it. If it does, we've invented a better model."

Early results are so promising that the state touted the program, which was developed by Robert Goodman of Bergen County Technical School, as one of its most innovative undertakings in an ongoing competition for federal education money.

The system is being used at the Bergen County Technical School in Paramus, one of 21 schools statewide piloting the program in their ninth-grade classes.

During one recent class there, students reviewed problems on kinetics and dynamics, topics traditionally reserved for juniors and seniors.

But without using advanced math, the students measured how long it would take for a drop of water to fall from a rooftop and a car's velocity after it accelerated for a specified distance. All of this was done with formulas learned in ninth-grade algebra.

As problems flashed on a screen, the students exchanged ideas across circular desks meant to promote discussion.

They entered responses in handheld computer devices, and a pie chart appeared on the board. The boards and remote controls — donated by Canada-based SMART Technologies — help teachers gauge when to move on, which concepts need more work and which students need help.

This time, the chart showed that two-thirds had answered correctly. Their teacher, Liz Henriquez, zoomed in on the most common problem. A quarter of the class forgot to take the square root of their answer, she explained.

"No big deal," she said.

In the wrong order

Goodman, New Jersey's 2005 teacher of the year, developed the curriculum in his Teterboro classroom.

A fast-talking former audio company engineer, he was attracted to the idea that schools have taught sciences in the wrong order for generations.

The traditional science progression — biology in ninth grade, then chemistry, then physics — assumes that high school students can't understand physics until they've taken trigonometry and calculus.

But Goodman, along with other scientists of his generation, thinks modern biology and chemistry are so intertwined with physics that it is impossible to learn one without understanding the others. Under the traditional model, most students rely on rote learning to pass their classes.

"Most people just persevere through it," Goodman said.

Schools have tried to reverse the order of their science classes before. But they generally tried to make physics more accessible to ninth-grade students by stripping it of math. The result, Goodman said, was superficial.

Goodman, however, calculated that only 10 percent of the concepts taught in high school physics required trigonometry.

Pilot program takes off

Robert Goodman developed a new physics curriculum in his Teterboro classroom that emphasizes teaching physics before other sciences. It is becoming a national model for teaching the subject at the high school level.

* Forty percent of students in the physics pilot classes have said they want to continue with Advanced Placement physics next year — while they are taking chemistry.

* Results from the AP test will give the program's organizers their first concrete measure of the program's success, but Goodman and others said they interpret the students' interest merely in taking the class as an extremely positive sign. Typically, about 2 percent of students statewide take the AP test in high school.

* Organizers plan to expand the program to chemistry next year and already have 90 teachers enrolled. They hope to add biology after that, and are developing a program that uses a similar training and teaching model to approach high school math. They have applied for a National Science Foundation research grant to collect more data.

"It's getting very close to a point where I would consider the talk about the Progressive Science Initiative to be viral in nature," said Sandra Alberti, the director of the state Office of Math and Science Education. "A day doesn't go by when someone hasn't heard of this and makes a reference to it. It's spreading at a very fast rate, and people are very excited about it."

How it works

The Progressive Science Initiative takes a three-pronged approach to improving science education in high schools:

* Teach physics before chemistry and biology, rather than at the end of the sequence.

* Use technology to allow teachers to immediately gauge students' understanding.

* Expand the pool of teachers qualified to teach the sciences.

The rest, including the principles of mechanics, electricity and magnetism, he could teach using algebra. Teaching science with algebra also provides context for students who don't easily see how math relates to their daily lives.

For instance, students said they have found themselves thinking about physics outside the classroom — when another player is moving in for a tackle during a soccer game or when a driver slams on the brakes in a car.

"The problems you do in physics, you can use in real life," said 14-year-old Brandon Leone, who is at Bergen Tech in Paramus. "It's just fun doing it."

Goodman's students showed almost immediate improvements.

More than 20 times as many students in his classes took and passed the Advanced Placement physics test as is typical for New Jersey.

Spreading the word

Goodman tracked his students' progress for his doctoral dissertation in 2006. The results were so impressive that other teachers began asking him how to use his techniques, raising another question: How do you train more teachers?

A national shortage of science teachers would inhibit the program's spread, so Goodman partnered with colleges, unions and high schools to create a curriculum that could be easily adapted to any classroom.

The group, including Kean's School of Education, the New Jersey Education Association, the Bergen County Technical School in Paramus and Goodman's own New Jersey Center for Teaching and Learning, created a training program. Teachers who had proved their success in other subjects would learn how to teach physics using the PSI method.

Thirty-nine teachers from participating districts will complete training this year. Of those, 30 who have not taught the subject before will be certified to teach physics, compared with about 10 in a typical year, organizers said.

Making learning fun

Students in the pilot classes say the program has also introduced another concept they once considered alien to science and math classes: fun.

Students in Christopher Callahan's class down the hall tried to talk Callahan into doing a celebratory dance when their monitor showed they had all solved a problem correctly.

The teachers and school administrators said they never expected to see such high levels of energy in a physics class.

"People hear the word 'physics' and it's intimidating," Vice Principal Paul Castiglia said. "They just think it's something they can't do, or it's so hard."

Students said they initially shared their teachers' skepticism, but the class quickly became one of their favorites.

"When I first started, I thought it was going to be hard, because I thought it would be a senior class," said 14-year-old Katherine Cawley. "After the first test, it seemed easy."