What to Do When Physics Teachers Don't Know Physics

Education Week, By **Madeline Will** on July 15, 2019 2:22 PM

More and more high school students are getting interested in physics, but schools are in a tough spot: It's hard to find physics teachers, so they often tap teachers with little-to-no training in the subject.

However, **a recent, small-scale study** finds that focused physics professional development, regardless of teachers' prior experience in the subject, can lead to better learning experiences for both students and teachers.

Justina Ogodo, the study's author and a postdoctoral researcher at The Ohio State University's department of teaching and learning, said that when teachers aren't well-versed in physics, it can leave students feeling uninspired and confused.

"When I was in high school, I hated physics, because my physics teacher spoke to the board, he talked to the board, he smiled at the board," Ogodo said. "We were clueless about what he was doing and saying, so I distanced myself from physics."

According to the National Science Foundation, just 47 percent of physics teachers across the country have physics degrees or certification in physics education. But students are **increasingly interested in the subject**, which is often a cornerstone of many professions in science, technology, engineering and math fields.

That disconnect means that either schools don't offer the course at all—a 2016 *Education Week* analysis of federal data **found that 2 in 5 high schools don't offer** physics classes, to the chagrin of STEM advocates—or schools make do with teachers who have a general background in science.

In Alabama, where the study was conducted, only 9 percent of physics teachers have physics degrees or certification.

Ogodo followed a group of seven AP Physics teachers from across the state through a three-year physics-focused professional development funded by the National Science Foundation. At the point of data collection, the teachers who were going through the physics training had completed two of the three years. Ogodo also compared their teaching practices with seven additional AP Physics teachers who didn't go through such an intensive content-focused training.

The difference between teachers before and after the training, Ogodo said, "was like night and day."

A Shift in Instruction

When physics teachers are not trained in the subject, it can be stressful for them, Ogodo said. For example, one teacher who had seven years of experience in the classroom was quoted in the study as saying that before the training, he didn't feel confident teaching concepts like electricity and magnetism.

"They're difficult to teach and difficult to understand," he said. "I was learning the material as I was teaching it."

Before going through the training, teachers said they mainly relied on lectures, note-taking, and problem-solving to teach physics. Afterward, they did more inquiry-based, hands-on labs. The teachers who did not go through the training tended to rely more on lectures, Ogodo said, and all but two used lab experiments as a way to confirm the conclusions of the lecture.

"After the training, [teachers] take their students to the lab and say, 'Figure this out,'" Ogodo said. "The students became the ones who were driving the instruction."

(As one teacher said in the study: "Inquiry-based instruction is the best way to teach because students are more engaged and retain better if they find the answers on their own, rather than being told.")

Ogodo measured teachers' effectiveness in lesson design and implementation, content, classroom culture, communicative interactions, and student/teacher relationships. She found that the teachers who went through the professional development scored higher than teachers who did not participate in the training.

Teachers who received focused physics training also reported feeling greater satisfaction and confidence in teaching physics, which Ogodo said will likely lead to better outcomes for students. Interestingly, the teachers rated themselves higher on a self-efficacy survey before the training than they did after completing two years of professional development.

"Based on my interviews with them, they now realize that they didn't know as much as they should know," Ogodo said. She expects that once the teachers have completed the training, they'll feel more effective, and rate themselves higher.

Breaking the Cycle

"Out-of-field teaching is a problem, and it's not just in physics," said Ogodo, adding that this is common in chemistry classes, too.

But it will be difficult to solve this problem, Ogodo said, because many aspiring teachers have had frustrating experiences with physics in their own schooling, or no experience at all.

"If they did not have a good experience with physics in high school, how would you expect them to go to college and pick physics as a major?" she said. "It's a continued cyclical problem."

Ogodo said she is working to come up with solutions with other scholars. In the meantime, "programs like this ... are great ways to at least make the teachers in the classroom become more proficient," she said. "We can't say, 'Go back to school and study physics,' but we can provide physics-focused training."

In 2016, *Education Week* reported on a professional development program that is **producing more physics teachers annually than any preservice program in the country**. Through the New Jersey Center for Teaching and Learning, teachers are trained on the physics content that they will be teaching. They receive the curriculum and slides for every lesson, as well as ongoing support throughout the school year.

Now, the courses and the coaching are online, a spokeswoman said—meaning teachers anywhere, not just in New Jersey, can go through the training.

This year, the center is on track to graduate 36 new physics teachers, as well as 23 new chemistry teachers and four new math teachers. (This is the center's first year of working with math teachers, and next year, it is planning to train new computer science teachers as well.) In total, since its start in 2009, the center will have produced 259 new physics teachers and 83 new chemistry and math teachers by the end of the summer.

Comments:

To address the issue of unavoidable out-of-field assignments, "just-in-time" instructional support for K-12 subjects, including STEM (physics and chemistry, etc.), are available through https://teaching-point.net. Materials, that work with any textbook assigned, include pacing guide and detailed lesson plans for every day of the school year with editable PowerPoint class notes, complete lab manual, editable assessments and mentoring teacher access. Versions of physics available are: Physics through Inquiry, Honors Physics and AP Physics. In Chemistry, versions include Regular, Honors, AP, IB-SL and IB-HL. Empirical evidence, as demonstrated through 775 teacher enrollments, has proven the success of the Teaching Point program, through pre- and post-test data, to improve teacher content mastery.

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