STEM Camps Showcase PBL

Project-Based Learning (PBL) enhances science, technology, engineering, and math (STEM) teaching because "kids get a better understanding of concepts when they do a project [while learning them]," contends Dan Van Pelt, physics teacher at West Brook High School in Beaumont, Texas. Van Pelt attended a Tapia Professional Development (PD) camp at Rice University in Houston to learn how to integrate PBL in his classroom. "It's a good learning tool," he asserts. "It helps me see how to teach abstract concepts more concretely."

Hosted by Rice's Tapia Center for Excellence and Equity, the week-long summer Tapia camps in physics, math, and computer science immerse teachers in PBL. Rice also holds Tapia camps in the three subjects for students in grades 8–12 (*https://goo.gl/nUejTb*). "We want to show students that math and science can explain cool things about the world around them," says Paul Hand, assistant professor of computational and applied mathematics and the camps' director of curriculum and instruction. "The camps target women and underrepresented students" and "draw students from across the country," he notes. Students live on campus, and most attend at no charge because their school or district funds their attendance.

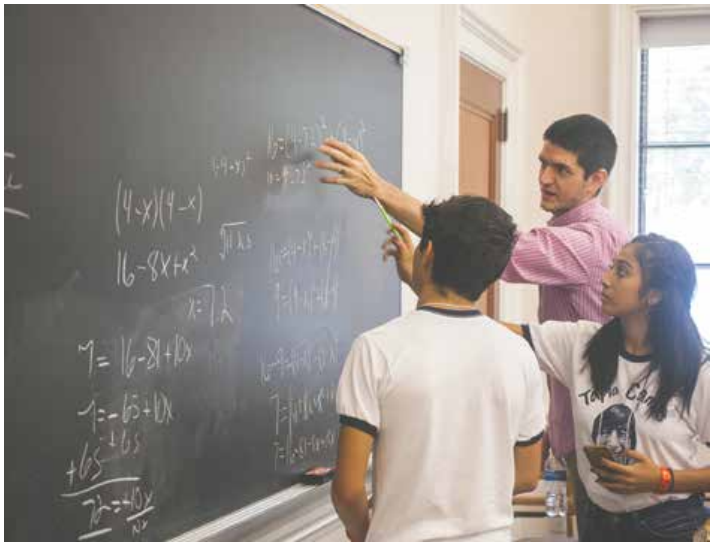

PHOTO COURTESY OF TAPIA CAMPS

Students in a Rice University Tapia physics camp work on a problem related to how the Global Positioning System operates.

In the camps, students learn STEM content and develop skills in communication and design. They complete two projects: an oral presentation and a graphic "that make people want to learn about [various topics] and that also explain the science and math behind them," says Hand. "We want students to be able to explain science and math concepts so that everyone will understand them. If you can explain cool things in math and science, you're more likely to enter those fields."

"We use the same projects for teachers and students," says Ben Olsen, lead

physics instructor. In a physics project involving exoplanets, for example, "students can use a small amount of data and high school algebra to calculate the size of exoplanets and their distance from a star. This is an area of physics that is new to today's high school students; it's cutting-edge to them.

"There's enough data cataloged online of numbers of exoplanets, so [students] can do some computations to see if [the exoplanet] is habitable. They can find raw data and use simple computations for other exoplanets," he adds.

Olsen emphasizes that in the projects, "we link topics students encounter daily with problems [researchers work on]. Linking these scenarios shows students that the same physics is happening and that physics isn't full of complicated equations, and they can do it."

More than 300 students attended the camps this summer. "Not all of them will [pursue STEM careers], but they all will understand how to communicate complex ideas. This is helpful even to those who don't become scientists," Hand maintains.

"Students come with a wide range of abilities, [so] the curriculum is designed to work at a wide range of levels," he explains. "One member may be a whiz at math, one may be a whiz at graphics, and the rest may be less knowledgeable. Students with less background knowledge can still give a good presentation… They enhance the group because they help the whizzes break down the concepts for good communication."

Teacher Camps

Teachers attending Tapia PD Camps earn 40 hours of PD credit and receive training in PBL, the camp curriculum, and communication. Though many STEM teachers attend these camps, they are open to teachers of any subject and to administrators. "Many school districts are considering integrating PBL and want to see it in action," says Hand.

"We get teachers to think about how to adapt the [student] projects to their classroom using the PBL framework," Olsen maintains. The exoplanet project "could be extended beyond the one-week camp, but one week is long enough to get interesting results and discuss them." Teachers also consider how to develop curriculum so that all students, including English language learners, "could work through the problems…Our criteria for choosing [physics] problems include [having] a clear message, [being] relatable [to students], and [having] a small amount of math," he relates.

Physics teacher Van Pelt admits he "had a hard time doing [the exoplanet calculations] without all the physics and math. We could figure it out using Kepler's third law…That never would have occurred to me to teach that aspect." He continues, "Kepler's stuff is way abstract for the kids, but [PBL] makes it more concrete for them."

Ruben Gonzalez, science teacher at James "Nikki" Rowe High School in McAllen, Texas, says the physics PD camp presented "tough ideas and concepts and getting through them in more than just a handout way, in a hands-on and interactive way." The graphic his group created explained the physics behind how safety reflectors work. "It's a lot more complicated than I had previously thought," he observes. But his group learned that "big concepts can be simplified by giving students options on how to present them…For example, Newton's laws can be presented in a comic style, explaining how the laws apply and are relevant."

Instructors lead the teachers on walk-throughs of the students' classrooms. Teachers "can analyze PBL" after observing students and get to "see the whole experience through exposure to different classes taught by different people with various instructional styles and personalities. They can compare and contrast," Hand says. Teachers assess student work and serve as judges during students' oral presentations.

"With the exoplanet graphic, [my group of teachers] didn't hit the target, but we saw how the students did it, and they got it right," reports Van Pelt. "Seeing the kids' graphic projects gave me a new perspective." He hopes to try a graphic project with his students this year. "I think they'll enjoy it! Get some art into physics class." ●