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TPHS' top-flight math students compute on the cutting edge

By Ian S. Port

The conference attendees were stunned. Here they were, professional technical specialists — engineers, professors, researchers — convening to discuss a high-powered mathematics program, a meet hosted by the company that developed it. They'd used the software in their careers for calculations, analysis and presentations.

And, sitting in the ballroom, they were being showed up by high school students. That's how Torrey Pines High math teacher Abby Brown recounts a conference she recently attended with four students from her Advanced Topics in Mathematics II class, which, by any measure, is a far cry from your typical high school math period.

For starters, most of the students in her class aren't fulfilling requirements — they're present purely for enjoyment, most of them having long ago run out of math classes at the high school level.

Their exceptionality is matched perhaps only by the class' curriculum, which can't be found in any dog-eared textbook.

The students in Advanced Topics in Mathematics II work with a program that is so new and advanced, it can't be purchased yet. They're part of the beta testing team for Wolfram Research's Mathematica Version 6 — the latest version of a tool used most commonly by top-flight mathematicians and researchers.

"At its most basic level it works as a giant calculator," Brown explains, banging mysterious commands into a prompt. "You can do arithmetic. We can create graphs versus trying to imagine. Even on the graphing calculator its like these chunky little pixels — here it's in color and you can easily make changes."

Brown's excitement is easy to understand, even if the math isn't. The program is helping her visualize the relationships of calculus — which is partly why it's become an essential teaching tool for her.

"That's what I really like about the class, because a lot of the stuff you learn in calculus you kind of wonder why you learn it," explains Cindy, a senior. "It's math and you like it, but you're just like 'What is the application in this?' But when you look at Mathematica, you do stuff and can know that that's what they do in 3-D movies."

In her class, Brown's students basically get to play with this ultra-secret tool. There aren't really assignments or homework because the students are so enamored with it that they basically motivate themselves.

"My original plan had four different types of projects," Brown says. "I had this plan where it was all going to be more organized into categories. The whole structure, it didn't fall apart but what I've noticed that's happened is that almost every project fits like all four of the categories."

Community service was one of the four categories, with students using the software to write little programs that visually represent basic math concepts from algebra on up to more advanced math. But, not satisfied with merely animating boring graphs and images, students have turned the tools into interactive stories, with music and animation to help illustrate math concepts.

"So now for younger students or someone trying to learn some mathematics, or a teacher that doesn't have time to learn how to type exactly what needs to be typed, the students in the class are going to be developing things — now they have this little module that somebody else can use to demonstrate in class in this much more user-friendly way," Brown explains.

She's been using earlier versions of the program in her classes for years, and has even set up a Web site that allows remote use of the software. She didn't realize it for a long time, but her Mathematica Web site was a pioneering display of how to use the software in the high school classroom, and it got the company interested in letting her classes beta-test the latest version.

"I tell the students that Mathematica is my video game," says Brown with a giggle. "Because it's that engaging and it will suck me in and it's like 'OK, I got to figure out the next thing, how do I get the next part or I want this to work — it's like getting to the next level and the hours can just slip by. And I know some of the students have started to get that addiction too, especially when you're working on something that you're really passionate about."

The passion is apparent in Brown's students.

"It is fun and it's really self-motivated because they're our own projects," says Karen, another one of Brown's bright seniors. "We have to have our own plans of what we want to do."

Brown says the students she brought to the conference were the stars of the show, because they were already familiar with new features of the not-yet-unveiled program.

"Most of the people at the conference had never had their hands on their program. I brought four students with me and they were showing work they had already been doing in this. We know this stuff and nobody else knows and that's really exciting,"

"It's like you're making your own footprint in the world," Cindy says.