Adding technology to geometry class improves opportunities to learn

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A new study co-written by Gloriana González, an expert in math education at Illinois, suggests the students who used dynamic geometry software were more successful in discovering new mathematical ideas than when they used static, paper-based diagrams. Credit: L. Brian Stauffer

A new study co-written by a University of Illinois expert in math education suggests that incorporating technology in high school-level geometry classes not only makes the teaching of concepts such as congruency easier, it also empowers students to discover other geometric relationships they wouldn't ordinarily uncover when more traditional methods of instruction were used.

Gloriana González, a professor of curriculum and instruction in the College of Education at Illinois, says when students used dynamic geometry software they were more successful in discovering new mathematical ideas than when they used static, paper-based diagrams.

The study, published in a recent issue of the *International Journal of Computers for Mathematical Learning*, analyzed how students solved geometry problems over four days, with two days spent using static diagrams and the other two with dynamic diagrams drawn using a calculator with dynamic geometry software.

"There's been a big push to have teachers use technology in the classroom, and there's a lot of incentives for them to use it, the chief one being the motivation kids get from using technology," González said. "But the powerful thing is that integrating technology in the classroom allows teachers to provide students more opportunities for learning, which gets students thinking about mathematical ideas in a new light."

González, who co-wrote the study with Patricio G. Herbst, of the University of Michigan, said that teachers like to use technology in the classroom not only because it's stimulating for students, but also because it's a more efficient use of resources for teachers.

For example, instead of drawing 20 different diagrams on a chalkboard by hand, teachers can create one diagram on a computer and manipulate it using the dynamic geometry software.

Without the software, the teacher is drawing 20 different variations of the same diagram, "which can get very boring very quickly," González said.

"The technology allows teachers to do many things that they couldn't ordinarily do or would be very hard to do by hand, such as call attention

to a particular geometrical pattern or configuration that the students may not have seen otherwise," she said.

But students shouldn't get too excited: González says there's no need for them to throw away the protractors and compasses just yet.

"What we found is that students who did things by hand, although they didn't formulate the same conjectures as when they used the dynamic geometry software, just having the experience with the manual tools really helped them to understand what happens when you try to do the same thing using the dynamic geometry software," González said. "So there is some transference between the two."

The technology, González said, pushed students to think about mathematics in a completely different way.

"Compared to the two days of using static diagrams, students didn't find anything as sophisticated as they did when they used the computer," she said. "The dynamic geometry software really helped them make connections that they hadn't made before."

For teachers, integrating technology into a lesson plan can bring about unanticipated complications.

"Sometimes students may understand the tool, but not the underlying mathematics behind the tool," González said. "Students can play, but teachers are trying to teach mathematics, not a particular tool. As a teacher, you want your students to go beyond the tool. The heart of mathematics is proofs, and only teachers are able to ask students to go beyond the tools and provide a proof."

González said educators have a difficult job gauging how students will react to a lesson, while simultaneously teaching the content they need to

learn and keeping students engaged and focused.

"If we help teachers try to understand what kind of thinking students will have when using technology, then we can help students to have a deeper understanding of mathematical ideas," she said. "Whatever we can do to support teachers' work in terms of having a better understanding of student thinking about mathematics, the better, because teachers have a challenging job," she said.

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