New study utilizes Kinect for Windows technology to teach elementary school students geometry

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Carmen Petrick Smith, assistant professor of mathematics education at the University of Vermont (center), works with undergraduate education majors (left to right) Tegan Garon, Sam Scrivani and Kiersten Barr on movements that are used to help elementary school children learn geometry. Credit: Andy Duback

Picture this: a classroom full of 9-year-olds are up and moving around, contorting their bodies and waving their arms. But it's not gym period or even music class getting them moving—these kids are learning math.

That's what a math class should look like, according to research by

UVM's Carmen Petrick Smith. As a high school teacher, Smith found her students learned geometric principles more easily when she incorporated physical movements into her lesson plans. Today, as an assistant professor of mathematics education, she's producing empirical evidence that substantiates what she observed in her classroom.

Smith's most recent study, published in the *Journal of Mathematical Behavior*, showed significant gains in the understanding of angles and angle measurements by elementary school students who performed body-based tasks while interacting with a Kinect for Windows mathematics program. The Kinect is a motion sensor input device that allows people to interact with computers based on their natural movements.

Smith and her research team engaged 30 third- and fourth-grade students in a series of tasks that involved moving their arms to form angles projected on a large Kinect screen. The screen changed colors when the students' arms formed acute, right, obtuse and straight angles. A protractor helped students measure and refine their movements. Students were asked to figure out the hidden rules that made each of the four colors appear on the screen.

"It's exciting to ask, 'What if we rethink what a math class looks like and rethink the tools that are available to students to help them with their learning?'" says Smith, who once taught students how to write geometric transformations by having them do the Electric Slide on a giant coordinate plane she placed on a dance floor. "It's another tool out there for teachers to use in their instruction."

Embodied cognition and re-invention of the math class

Smith's paper, "Learning angles through movement: Critical actions for

developing understanding in an embodied activity," adds evidence to a developing area of cognitive science, known as embodied cognition, which posits that the brain alone does not generate behavior, but that it actually works in concert with physical movements and other environmental and neural processes such as perception, action and emotion.

Her most recent findings could impact traditional math pedagogy that typically has teachers standing in front of the class presenting angles by using static representations of drawings on chalkboards. Smith's research shows that a more dynamic learning environment where students use their bodies to create angles is more effective when blended with other teaching methods. In her study, Smith found that students who focused on static representations of angles experienced less dramatic learning gains than those who participated in the movement-based lessons.

"When students are acting out a math problem and using their body to help them explain the answer, that's another modality," says Smith, who is using programmers to further develop the Kinect program, which she envisions in a growing number of Vermont classrooms. "Maybe they don't know the words quite yet, but they have a way to express it using their body that they didn't have before when they were sitting in a row of desks looking up at the teacher and searching for an answer."

Student research opportunities

Smith's been investigating this area of pedagogy since her graduate school days at the University of Texas at Austin, where she worked with a professor to explore not only how students learn by moving things around—but how students learn when they move themselves around. There, her interest in movement ranged outside the academic, as well: she helped set a world record for the most people dancing to Michael Jackson's "Thriller" in one place at one time. Also while at UT, Smith

pursued another off-beat area of interest by improving her notable punning ability to become the 2008 O. Henry Pun-Off World Champion, demonstrating an ease and creativity with language that comes in handy today in front of a classroom.

Here at UVM, she's sparking an interest in math and movement in a new generation of scholars. Her research team included graduate research assistant Diana Gonzalez, two programmers and a graphic artist—and also seven undergraduate students.

Senior education major Tegan Garon has worked with Smith for the past three years helping to prepare interview protocol, organize data, analyze effective procedures, and contribute to a paper that Smith presented at the American Education Research Association conference in Philadelphia.

"Carmen completely immerses her undergraduate students in the research process and allows us to be a part of major decisions and discussions regarding essentially every aspect of the procedure," says Garon, who's working on an Honors College thesis with Smith as his adviser. "This innovative approach has shown me a new lens for teaching and is one that I will definitely take into the classroom when I begin my professional career."

More information: *Journal of Mathematical Behavior*, www.sciencedirect.com/science/ … ii/S0732312314000522

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