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TEACHING

A Tech-Based Model to Teach Math Has Spread Across Higher Education. But for Some Students, Could It Do More Harm Than Good?

By Beth McMurtrie | JUNE 24, 2019

PREMIUM

Virginia Tech

Virginia Tech students work on introductory-level math at the Virginia Tech Math Emporium

Two decades ago, a new way of teaching math drew interest and caught fire across higher education. Instead of having students sit in a lecture hall listening to a professor walk through mathematical concepts, the approach had students spend class time in a computer lab working through online lessons while instructors circulated through the room, tutoring those who get stuck.

It's called the emporium model of learning, and it has been adopted at colleges across the country, mainly in gateway courses at universities and at community colleges. The appeal of the approach is easy to see: It helps colleges save money on instructional costs and allows students to learn at their own pace.

Virginia Tech was the first to introduce the emporium model, back in 1997, and — after a bumpy start — has been pleased with the results overall. Research on the model itself has been limited.

Now, two new studies, of programs in Kentucky and Tennessee, raise questions about the value of that model for some of the least academically prepared students: those enrolled in remedial math courses at community colleges. These studies come at a time when technology-centered instruction is increasingly seen as a solution for cash-strapped institutions — both in high school and in higher education.

It's no surprise that community colleges would look for new ways to approach the longstanding challenges of remedial math. According to a study by the Community College Research Center at Columbia University's Teachers College, only 17 percent of students assigned to a three-course sequence of remedial math completed the sequence within three years. And the emporium model has garnered the support of a diverse set of backers, including the Pew Charitable Trusts, which funded the Virginia Tech program back in 1997; the former National Center for Academic Transformation; and Change the Equation, a program funded by the Bill & Melinda Gates Foundation, which provided support for several community colleges in Kentucky.

Earlier studies looking at how college students have performed under a hybrid model, which blends online and face-to-face instruction, have shown mixed effects, depending on the type of course or institution. But they also did not examine selection bias, unlike the two recent studies.

The Kentucky study found that students were 10 percentage points less likely to pass their courses in one semester, compared with peers in a traditional class. The Tennessee study found that while students passed the remedial math course taught in the emporium model at about the same rate as those taught conventionally, they struggled more in other ways, later on.

The emporium model may, in fact, work well for some students, like those in gateway math courses at four-year institutions. The Tennessee study found that students in emporium-style courses at four-year colleges had higher pass rates in remedial math. (Although they were less likely to pass a subsequent college-level math course taught conventionally.) At Virginia Tech, 86 percent of students earn a C-minus or better in the seven introductory courses it offers through its math emporium.

Nikki Edgecombe, a senior research scholar at the Community College Research Center, has been tracking the findings around technology-based instruction in remedial math. She says it's hard to give a thumbs up or down to the emporium model — there's just too much variation in how it is designed and supported. She says such variability indicates that "we've got sufficient warning signs that we have to be very careful, and very intentional, about the ways in which we apply technology to instruction."

'Great Expectations'

In all, 11 of the 16 colleges in the Kentucky Community & Technical College system began offering the emporium model for remedial math between 2008 and 2013. In addition to the lower pass rates, says Whitney Kozakowski, a doctoral student at the Harvard Graduate School of Education and author of the study, students in the emporium-style courses were six percentage points less likely to be enrolled in college by their second year and five percentage points less likely to have earned a degree within three years of enrolling.

Kris Williams, chancellor of the Kentucky Community & Technical College system, says she was surprised by the findings. "It felt like a model that would be effective," she says. "You have great expectations and hopes a new program will work."

Still, Williams notes, the emporium style of math instruction was already on its way out before Kozakowski's study came out this month. None of the colleges in the system offers it anymore, she says. Like many states, Kentucky has moved to a corequisite approach to remedial math, in which remedial and credit-bearing work are blended into one course, with academically challenged students receiving additional support. "We're trying to help students not get stuck in a developmental space," says Williams.

Williams says she isn't sure why the emporium model did not work well for students in the Kentucky system. While the study did not set out to find out why, Kozakowski posits a few ideas based on her research.

For one, she notes, academically challenged students often don't have good study habits. A program that essentially puts them in control of their learning, without the accountability of teacher-imposed deadlines, might play to those weaknesses.

Another possible challenge, she notes, is that instructional software is typically designed so that students can't advance until they complete each module and get a passing score on the related quiz. Compare that with a traditional math class, she says, in which a student might do poorly on one quiz but ace the next. He can still stay on track and pass the course.

Finally, she notes, technology-based instruction circumvents one of the main benefits of being in college: the sense of belonging to a group and interacting with classmates and the instructor. Struggling students can become better at school by watching others. Kozakowski notes that research on student performance in online classes has found that while students tend to perform worse in these courses than they do in similar face-to-face classes, the most negative effects are often experienced by the least academically prepared.

Kozakowski says she's not advocating for colleges to ditch the emporium model in remedial education; rather, it needs to be studied more carefully to figure out what works and what doesn't. "It could be that the devil is in the details," she says.

Structure and Support

Denise Lujan, director of the developmental=math program at the University of Texas at El Paso, agrees with this assessment. Her campus tried the emporium model a few years ago, "and it was a disaster," she says. "We had one of the largest fail rates we ever had."

"Students would have an unrealistic view of how long it would take them to get it done," she says. "They would leave it to the last minute and they just wouldn't do it."

Her developmental-math classes are still computer based. But they have much more structure than the ones using the emporium model. Classes meet every other day, and attendance is mandatory. Instructors work more as tutors than as lecturers, but if students fall behind on benchmark goals, the instructor steps in to get them back on track. "I know more about my students in this model than I did when I was lecturing," says Lujan. "You know each person and you know what they're struggling with."

As a result, she says, pass rates have increased to 80 percent, compared with 40 percent under the emporium model.

Lujan, who is president of the National Organization for Student Success (formerly the National Association for Developmental Education), worries that when colleges choose technology-driven instruction to cut costs, they're shortchanging students. Technology for academically challenged students can work, she notes, but only if it comes with a lot of support.

Lujan also worries that states act too quickly in scaling up new ways to improve remedial education. Tennessee's adoption of the emporium model, for example, was statewide.

Texas has repeatedly tinkered with developmental math and is moving to a corequisite model. By 2020, 75 percent of remedial students are supposed to be enrolled in such classes, which means that colleges need to place ever more of the academically weakest students into these models.

"They don't give us time to make sure something works, or even adjust it, before something else hits you" Lujan says. "That's gone on across the whole nation."

A Paradox

Angela Boatman, an assistant professor of public policy and higher education at Vanderbilt University, has been studying the emporium model in Tennessee. She found that although emporium students may have fared OK in that course, they received lower grades in their first college-level math class than did their peers from traditional classes. Emporium students also earned fewer cumulative credits over time and were less likely to earn a credential within six years.

In addition to tracking outcomes, she interviewed students — and found a paradox. Even though more students at two-year colleges struggled in a later math class, they had positive things to say about the emporium model. They liked getting immediate feedback on their practice problems, and felt as if the instructor was accessible to them.

Like Kozakowski, Boatman is not suggesting the self-paced model be scrapped. "As colleges are more focused on degree-completion rates, and efficiencies for students and pathways for students, the idea that you can move at your own pace is promising," she says. "You just have to be careful about having the necessary supports in place."

Her research was conducted under the Center for the Analysis of Postsecondary Readiness, a partnership between the Community College Research Center and MDRC, a social-policy group.

At Virginia Tech, administrators attribute the emporium model's success to several factors. For one, the university has developed its own interactive textbooks rather than choosing an off-the-shelf product for its courses. Being able to modify the courseware based on student feedback has been important, says Terri Bourdon, manager of the campus Math Emporium, which has more than 500 workstations that serve about 6,000 students a year.

The staff at Virginia Tech also assigns students to sit in specific areas of the emporium depending on which course they're taking. The tutors and instructors in those areas have been trained to help with that coursework, reducing the earlier frustration they felt at having to know so much material, says Bourdon. When exams are near, the emporium will pull in more tutors to adjust to rising student demand for help. Tutors are quick to reach out if a student doesn't perform well on her first test or falls behind in coursework. And, Bourdon says, they're always looking to add new supports, such as online videos to help students assimilate into the model.

Sally C. Morton, dean of the College of Science at Virginia Tech, says it's a mistake to think of the emporium model as a cheaper way to deliver math education. "The cost of developing a class, and writing the software and the textbook, is quite intensive," she

says. “It’s not so much a cost-cutting methodology as an effective way to deliver education.”

Russ Deaton, executive vice chancellor for policy and strategy with the Tennessee Board of Regents, says that the state’s colleges will continue to use the emporium model but will monitor it closely, with an eye toward faculty development. It’s part of a larger plan to bring more students in and through the state system. And overall the pass rates for the corequisite math courses jumped from 13 percent in 2012-13 to 57 percent in 2017-18

Deaton also says that perhaps the system should expand the use of the emporium model, bringing it into more math courses. The emporium-taught students may have struggled in a subsequent math class, he suggested, because they preferred the technology-based model.

Tennessee, he notes, has tried many strategies over the past decade to improve college access and completion. “It’s hard to untangle the emporium model from our broader strategy.”

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