

Case study: math education

SRI is using technology-based solutions to transform teaching and learning.

We are a community of innovation.

investigate. evaluate. improve.



SRI's Center for Technology in Learning is helping students understand complex math concepts so they can succeed in school and in the high-tech careers of the future.

The Center integrates classroom technology, such as handheld computers and educational software, with math curricula and teacher professional development to increase students' learning and teachers' effectiveness. Through scientific research using randomized experiments and other designs, we are examining the impact of a tighter integration of these factors on students' mastery of critical math concepts. Using the knowledge gained, we are developing approaches to help students grasp math concepts more quickly, making math accessible to greater numbers of students.

SRI's vision is to build effective math programs for late elementary school through Algebra II by adapting the best curricula, applying the most powerful and appropriate technologies, and scaling them to benefit students in classrooms everywhere.



TechPALS:
Learning Fractions Collaboratively
In the TechPALS project (Technology-mediated Peer-Assisted Learning), a cooperative learning strategy was used to help fourth-grade students understand fractions—a strategic building block to algebra and higher-level math. Funded by the U.S. Department of Education, the project used the TechPALS interactive learning software developed at Pontificia Universidad Católica de Chile, a partner on the project.

In experiments held at several elementary schools, students worked on carefully selected and sequenced fractions problems in groups of three, using TechPALS on handheld computers connected by a wireless network. The students first worked independently on fractions problems, but the software required each group to come to consensus on an answer. If they disagreed, the students were encouraged to discuss the problem—explaining how they arrived at their solution and why they reasoned the way they did—and then input new answers. Researchers often observed students who were initially confused about why the fraction $\frac{1}{2}$ and a pie shape with two of four equal parts

shaded represented the same number. After careful discussion with their peers, the students began to master the concept of equivalent fractions. Teachers also received immediate feedback on their handhelds about student performance, enabling them to focus their attention on those who needed it most.

Findings: At the experiment's conclusion, the students working in groups of three using TechPALS had learned more than fellow students working individually using popular commercial software on laptops or in a computer laboratory. TechPALS students also engaged in cooperative behaviors more often than would be observed in a traditional classroom, offering an average of three explanations per class period.

What's next? SRI researchers are applying for additional funds to revise the TechPALS technology, create new curricular materials, and train teachers how to adapt their instruction based on feedback from the system—all steps toward an integrated approach to improving students' learning of fractions.

SimCalc:
Making Difficult Math Accessible
How can a teacher with typical resources help a middle school student progress from basic math skills to proficiency in more advanced math? SRI is determining whether the answer lies in an innovative integration of paper curriculum, teacher professional development, and dynamic software.

Using the SimCalc MathWorlds® software developed at the University of Massachusetts Dartmouth, students manipulate mathematical representations to learn about proportionality and related pre-algebra concepts. For example, students vary a graph that controls an animation of two soccer players running at varying rates on a playing field. Through this, students gain an understanding of the relationship between the graph and the runners' motion, which provides the foundation for then representing this relationship using formal algebraic symbols.

Integrating the SimCalc software, curricular materials, and teacher training, SRI developed a complete package of resources the average

About the Center for Technology in Learning

SRI International's Center for Technology in Learning (<http://ctl.sri.com>) focuses on designing, evaluating, and implementing educational technologies. Our multidisciplinary teams of psychologists, computer scientists, content specialists, anthropologists, and educators use research-based insights to improve how teachers teach and students learn.

The Center works with universities, other nonprofit organizations, and schools, and receives funding from such organizations as the National Science Foundation, the U.S. Department of Education, Texas Instruments, and the Bill & Melinda Gates Foundation.

teacher needs to succeed in teaching complex mathematics to diverse student populations. The integrated curriculum was used for three weeks with 95 teachers and 1,600 seventh-graders from 75 schools across Texas—girls and boys from middle- and low-income families, including both native and nonnative English speakers from rural, suburban, and urban settings.

Findings: Students using the SimCalc curriculum moved from the 50th to the 80th percentile. No matter how the data were sliced—by gender, region, socioeconomic group, native language, or other measure—all groups showed significant gains in learning math. Studies in the subsequent school year and a different grade level revealed similar results.

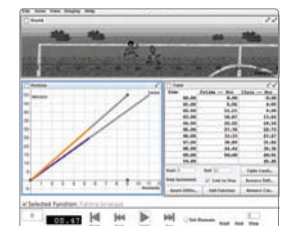
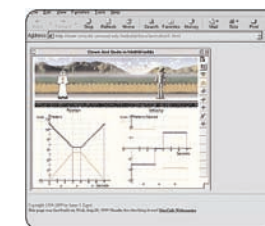
What's next? SRI is seeking partners and funding to scale the lessons learned from SimCalc to cover the full scope of the learning progression from late elementary school through algebra to calculus,

to address more strongly the most needy students and schools, and to achieve sustainable high-quality implementations in medium and large school districts. SRI and the University of Massachusetts are also collaborating to support studies of SimCalc in Singapore schools—a first step toward international impact.

Through research such as that with TechPALS and SimCalc, SRI is gaining strong evidence that the strategic integration of technology with other necessary factors can be a powerful stimulant to student learning in math.

These research programs have important characteristics that make them successful:

- Strong partnerships with teachers, school districts, and funders
- Teacher professional development
- Thoughtful identification of the most appropriate technologies
- Development of integrated curricula



Here's a look at some of the exemplary projects in the Center for Technology in Learning at SRI International.

Tapped In®

The Tapped In Online Community Testbed Project hosts more than 20,000 K–12 researchers and educators. SRI, with a grant from the National Science Foundation, designed the original community and subsequently reengineered the underlying technology to enhance management of research data.

Principled Assessment Designs for Inquiry (PADI)

From a handful of things that students say, do, or make, we want to infer what they know, can do, or have accomplished. PADI is a patented online technology developed by SRI and partners to help design ways to evaluate difficult-to-measure skills such as scientific inquiry, critical thinking, and creativity.

Transforming Instruction by Design in Earth Science (TIDES)

Focusing on teachers and students in grades 6–8, SRI and partners are comparing three approaches for improving teachers' instructional practice, their understanding of Earth science, and student learning.

About SRI International

Silicon Valley-based SRI International is one of the world's leading independent research and technology development organizations. SRI, which was founded by Stanford University as Stanford Research Institute in 1946 and became independent in 1970, has been meeting the strategic needs of clients and partners for more than 60 years.

Perhaps best known for its invention of the computer mouse and interactive computing, SRI has also been responsible for major advances in networking and communications, robotics, drug discovery and development, advanced materials, atmospheric research, education research, economic development, national security, and more. The nonprofit institute performs client-sponsored research and development for government agencies, businesses, and foundations. SRI also licenses its technologies, forms strategic alliances, and creates spin-off companies.



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