

Maine Impact Study of Technology in Mathematics (MISTM)

Summary

An independent study by the Maine Department of Education, in collaboration with the Maine Education Policy Research Institute (MEPRI) and the Education Development Center, Inc. (EDC), involving 56 rural middle schools found strong scientific evidence that:

- ▶ *Teachers receiving a professional development program centering on the use of online virtual manipulatives, including ExploreLearning Gizmos®, significantly outperformed control group teachers in mathematics content knowledge.*
- ▶ *Their students significantly outperformed those in a control group on mathematics test scores.*

Program Overview

Maine Impact Study of Technology in Mathematics (MISTM) evaluated the impact of a technology-infused two-year professional development program for teachers on the mathematics achievement of rural middle school students.

The program was initiated to address pressing needs in Maine's rural middle schools regarding mathematics instruction:

- *79% of Maine's eighth grade students fail to meet state mathematics learning standards; 85% of low performing schools in mathematics are in rural communities.*
- *More than half of Maine's middle school teachers have limited mathematics content knowledge because they were trained as elementary school teachers.*

“ExploreLearning Gizmos served as an incredibly powerful tool for both increased teacher pedagogical content knowledge in mathematics and increased student achievement in the targeted areas. The power and flexibility provided by these tools create an environment where differentiation can occur dynamically in order to meet the individual needs of a vast array of learners.”

Pam Buffington

Project Director, MISTM

Through a combination of face-to-face and online workshops, peer coaching and mentoring, and site visits, the professional development program focused on improving teachers' math content knowledge, pedagogical skills, and ability to integrate technology effectively into their instruction. In addition to measuring teachers' progress in these areas, researchers also investigated whether these gains translated into higher student achievement as evidenced by their math test scores. Online virtual manipulatives, including ExploreLearning Gizmos, were integral to the program and were chosen because of their strength in building conceptual understanding while catalyzing inquiry-based teaching methods.

Research Methodology

The MISTM evaluation was funded by the U.S. Department of Education through the Office of Elementary and Secondary Education's School Support and Technology Program, and followed criteria for a 'gold standard' study:

- *A RCT (randomized, controlled trial) design, where participating schools were randomly assigned to treatment or control groups, and pre-existing differences between groups (if any) were measured and statistically controlled for.*
- *An adequate sample size – 109 teachers and 5413 students participated in the study across 56 school sites.*
- *Academic achievement was measured using standardized test instruments whose validity and reliability were statistically confirmed.*
- *Reported results include both the effect sizes measured and statistical tests showing the effect is unlikely to occur by chance.*

Results

Student Performance — Statistically significant differences between treatment and control groups were found in middle school students' overall mathematical achievement, as evidenced by their test scores. The strongest area of improvement was in the area comprising the understanding of patterns, relations and functions, algebra concepts, and mathematical communication.

MEASURE	P	EFFECT SIZE	PERCENTILE*
Total Test Score	$p < 0.01$	$d = .39$	66th
Subtest: Patterns, Relations, Functions; Algebra Concepts; Mathematical Communication	$p < 0.01$	$d = .50$	69th

* Example: the average student in the treatment group scored better than 66% of the students in the control group on the Total Test Score measure.

Teaching Practice — Statistically significant differences were found between teachers in the treatment and control groups in mathematics content knowledge, frequency of use of laptops in lessons and activities, and the use of interactive applets to support inquiry-based learning methods.

MEASURE	P	EFFECT SIZE	PERCENTILE*
Mathematics content knowledge of teachers: Number & Operations	$p < 0.01$	$d = .79$	79th
Mathematics content knowledge of teachers: Patterns, Relations & Functions	$p < 0.01$	$d = 1.14$	86th
Frequency of use of laptops in lessons and activities (scale of 1-10)	$p < 0.01$	$d = 1.23$	89th
Use of interactive applets to support inquiry-based learning methods (scale of 1-5)	$p < 0.01$	$d = 1.24$	89th

* Example: the average teacher in the treatment group scored better than 86% of the teachers in the control group on the knowledge of Patterns, Relations, and Algebra measure.

Professional development focused on the integration of online virtual manipulatives, including ExploreLearning Gizmos, into classroom instruction resulted in significant increases in teachers' content knowledge, their use of inquiry-learning methods, and their students' mathematical achievement.



MISTM Participants Love Gizmos

"Easily, the most useful item I discovered was the wealth of online tools and activities available."

"I liked the flexibility of the simulations and the nature of their setup, from strictly structured to fairly open-ended. This is a great model of there not being just ONE way to do things. Flexibility, flexibility, ... the name of the game."

"In my school, the students are lacking strong skills in using fractions, decimals, and percents. I think that the tools are a great asset to the classroom to help aid in a deeper understanding of these concepts."