James J Kaput Center for Research and Innovation in Mathematics Education

University of Massachusetts
Mission

• Established in the spirit and vision of James Kaput, whose innovative thinking and leadership inspired many in the field of technology in mathematics education.

• Provide a focus and support for *sustained investigation* of foundational issues in the field of mathematics education.

• Provide an interdisciplinary research unit where fundamental problems in mathematics education will be studied, discussed and analyzed through conferences, interdisciplinary colloquium series, basic research and development, commissioned reports, think-tank meetings,
Outreach & Dissemination

• Sustaining partnerships with researchers around the world, industry, and schools,
• Connecting research to practice through teacher professional development, and
• Providing on-line web services to researchers, students and practitioners
Foundational Research

- Algebraic Thinking in the Elementary Grades,
- Use of dynamic, interactive technologies and their impact on mathematical experience,
- Classroom connectivity and impact on participation and motivation,
- The development of proof and reasoning across the grades,
- Symbolic Cognition in Advanced Mathematics,
- Evolution and epistemic dimensions on the use of mathematical symbols and notation systems, and
- District-wide improvement of mathematics teaching in elementary & middle grades.
Big Issues

- Algebra Problem (RAND Report 2002)
- Student motivation and alienation in the nation’s schools, especially urban secondary schools (National Research Council, 2003)
- Widely acknowledged unfulfilled promise of technology in education, especially mathematics education (e.g., Cuban, 2001)
Technology

• Dynamic Mathematics
• Mathematically Meaningful
• Engaging
• Enhances student reasoning & expression
Historical perspectives

- The history of writing, from pictographs to alphabets, alphabets to the printing press, teaches: How the presence of a new technology transforms the practice and redefines the nature of that practice…
What is dynamic mathematics?
What is dynamic mathematics?

Clay

\[\downarrow\]

Papyrus

\[\downarrow\]

Paper

\[\downarrow\]

Screen
What is dynamic mathematics?

Clay
↓
Papyrus
↓
Paper
↓
Screen

The history of malleability of media as part of man’s efforts to evolve communication acts.
Move from static to dynamic

- What happens with mathematics when it is embedded in a digital media?
- Is its mode of existence the same?
- Are new mathematical ideas waiting to be represented?

YES!
• In the 21st Century with digital media we cannot provide a teacher with a convenient amplifying device of their existing practice

• Technology should not serve as a prosthetic device to prop up old practices but transform the educational landscape
Dynamic Mathematics

• Construct & Interact
• Manipulate/Navigate/Explore figures
• Develop reasoning in enhanced ways, e.g. metaphors/gestures
• Co-action - technology guides as well as is guided by the user
• Meaning is emergent
• Math objects are more friendly, owned
A is the Center of the Circle. Line $m$ is the perpendicular bisector of BD where D is a free point. C is where this line intersects AB.
“Software without curriculum is not worth the silicon it is written on”
Profound Approach

• Over 20 yrs of R&D Sketchpad
  • 25000+ Teachers and whole country adoption (commercial)

• Over 14 yrs of R&D for SimCalc
  • 1000+Teachers (research model)
  • Development to efficacy to scale research across diverse groups & settings (6-16+)
Need for change

• Important math for more important folks
• We owe it to our children to let them understand the principles of change and complexity at school
• Simple, integrable educational solutions
• No region has done sustained integration from middle school to high school