



The Integration of Curriculum, Technology & PD

“Democratizing access to the
mathematics of change”
- Jim Kaput




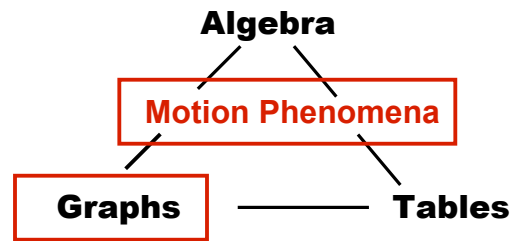
- Representations that are more:
 - Visual
 - Dynamic
 - Linked(“*Math with Connections*”)


Overview & Plan

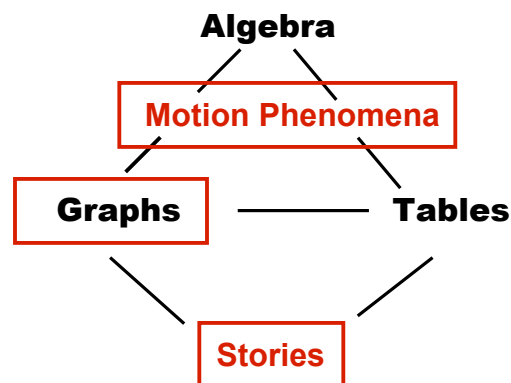
- Part I: Introduction to the logic and goals of *SimCalc*
- Part II: Description of the program and how it works -- Jeremy Roschelle
- Part III: Demonstration of a lesson with examination of student and teacher materials
- Part IV: Research on Scaling-up and evidence of effects
- Part V: Discussion and applications to MN

Part I: Program Logic and Goals

 **SimCalc** Connecting Visual & Linguistic Forms,
Expressing Graphically & Narratively



 **SimCalc** Connecting Visual & Linguistic Forms,
Expressing Graphically & Narratively




vertical sequence of modules, grades 7-12

The Context

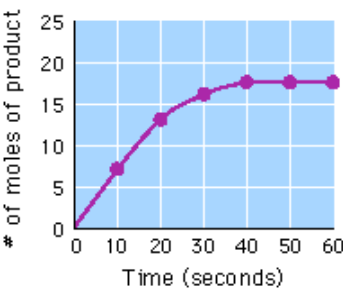
- NCTM “focal points” emphasizes 7th grade proportionality
...Students graph proportional relationships and identify the unit rate as the slope of the related line.
- Proportionality is critical to the transition from middle school to high school mathematics and science
- Interagency Educational Research Initiative (IERI) calls for **scaling up research**


The Third International Mathematics and Science Study (TIMSS), and the TIMSS-Repeat Study ... indicate that U.S. students are less likely to master and/or be taught more complex and conceptually difficult material during their middle and high school years, resulting in lower achievement.... IERI projects can help address these serious concerns by scaling up the most powerful and promising approaches to mathematics and science education....



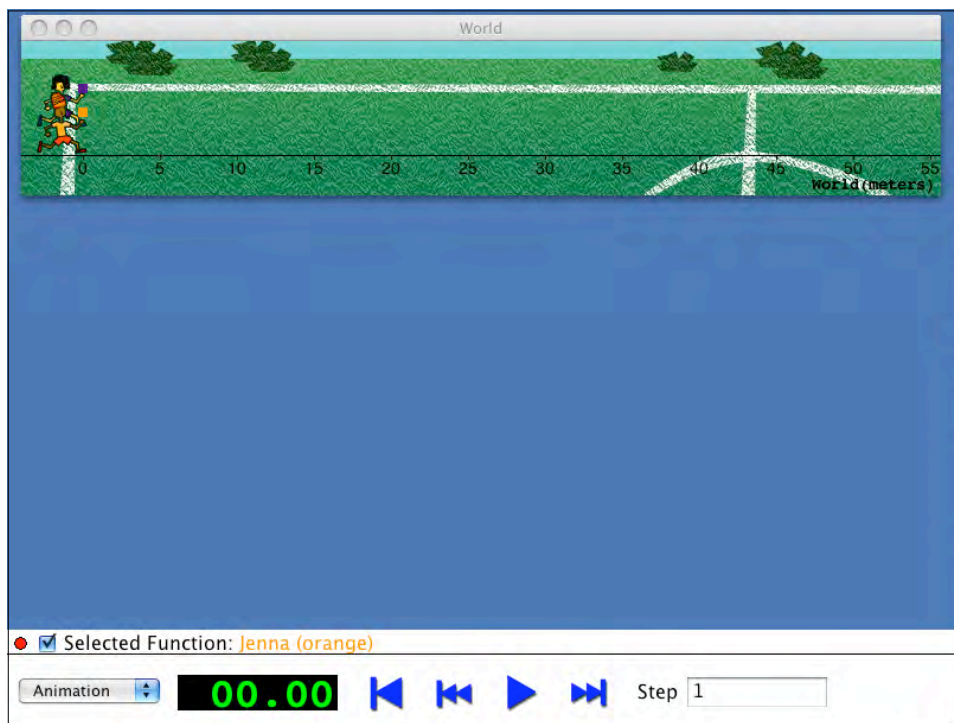
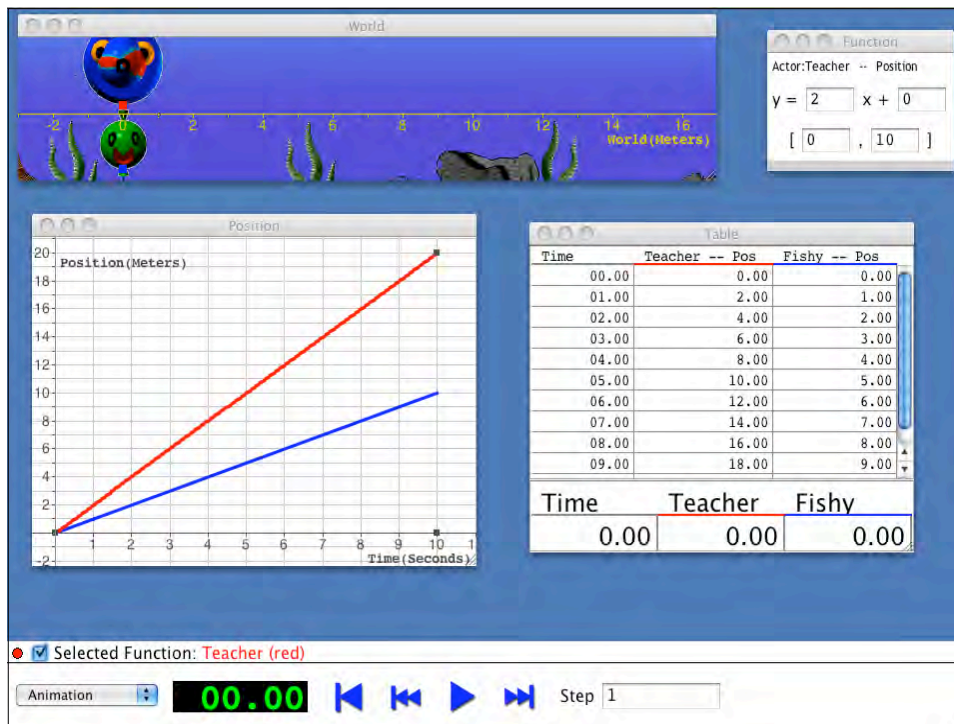
LEAF SIZE OF MAPLE TREES

Tree	Average Length (cm)	Average Width (cm)
1	16.0	9.0
2	10.0	5.0
3	19.0	10.0
4	15.0	8.0

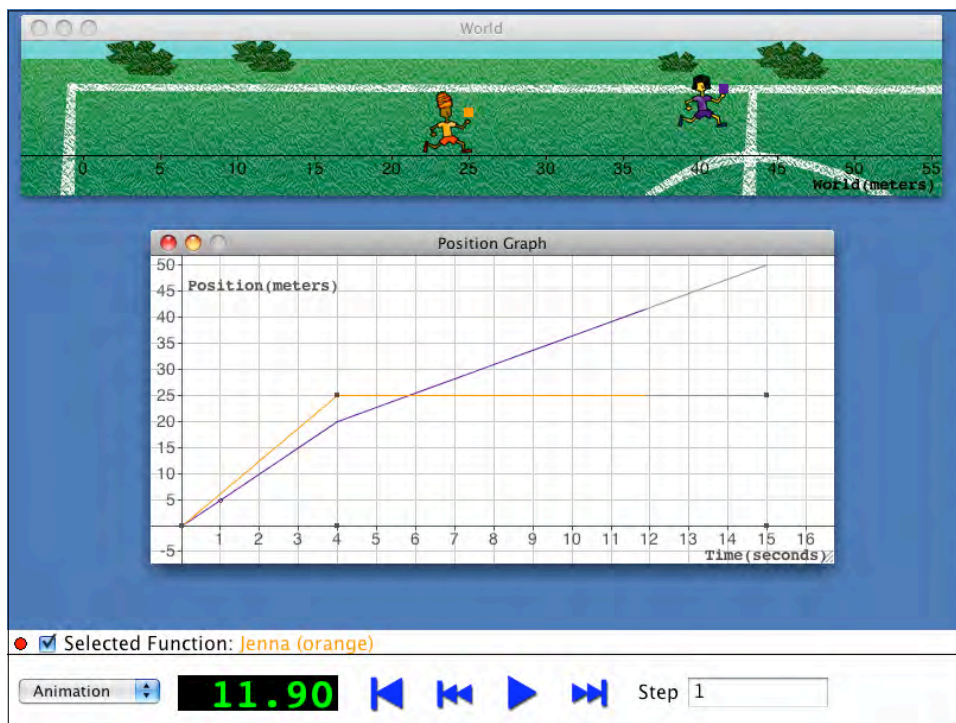


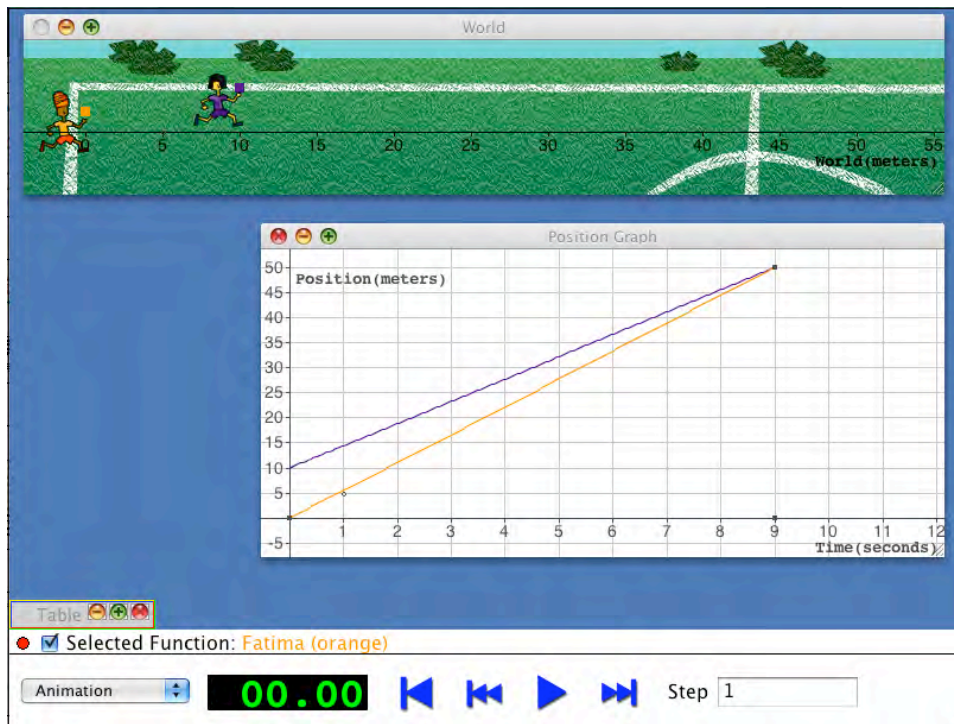


Proportionality includes:
 linearity, rate, function, slope in graphs,
 interpreting tables with an underlying rate









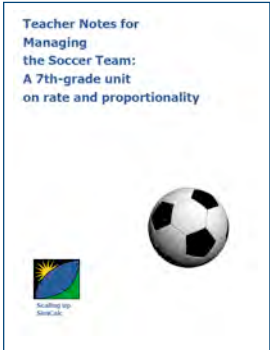
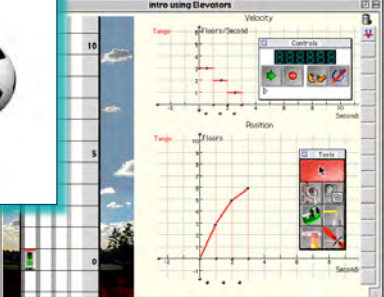


Part II: Description of the program and how it works: Jeremy Roschelle

Switch to video of Jeremy's recent
fellowship award talk at SRI

Part III: Hands on -- Minds on

Demonstration

The image displays a TI-83 Plus calculator on the left with a graph of a downward-opening parabola. In the center is a document titled "Teacher Notes for Managing the Soccer Team: A 7th-grade unit on rate and proportionality" featuring a soccer ball icon. On the right, a Palm OS Emulator shows a graph of a curve. Below the teacher notes is a screenshot of a simulation interface with two graphs: "Velocity" (feet/second vs. second) and "Position" (feet vs. second), both showing a red curve.

What You Need & What We'll Do

- In the set of on-line resources access 7th grade student materials
- Also access the 7th grade teacher materials
- Divide into 4 groups of 6-7
 - 1 “teacher”
 - 5-6 “students”
- Review the lesson materials for the soccer unit (teacher then student)
- We will then run the SimCalc simulations

Reactions to Materials, Program, Examples etc.

Part IV: Scale Up and Evidence of Effects

LEVERAGING TECHNOLOGY TO SCALE OPPORTUNITIES TO LEARN CONCEPTUALLY DIFFICULT MIDDLE SCHOOL MATHEMATICS

SPONSORED BY THE NATIONAL SCIENCE FOUNDATION
Grant # 0437861

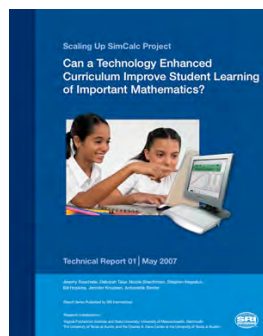
Conducted by



With

Virginia Polytechnic Institute and
State University
University of Massachusetts, Dartmouth
The University of Texas at Austin
The Charles A. Dana Center at The
University of Texas at Austin

This material is based on work supported by the National Science Foundation under Grant No. 0437861. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.



<http://math.sri.com>

The Context

- Interagency Educational Research Initiative (IERI) calls for **scaling up research**

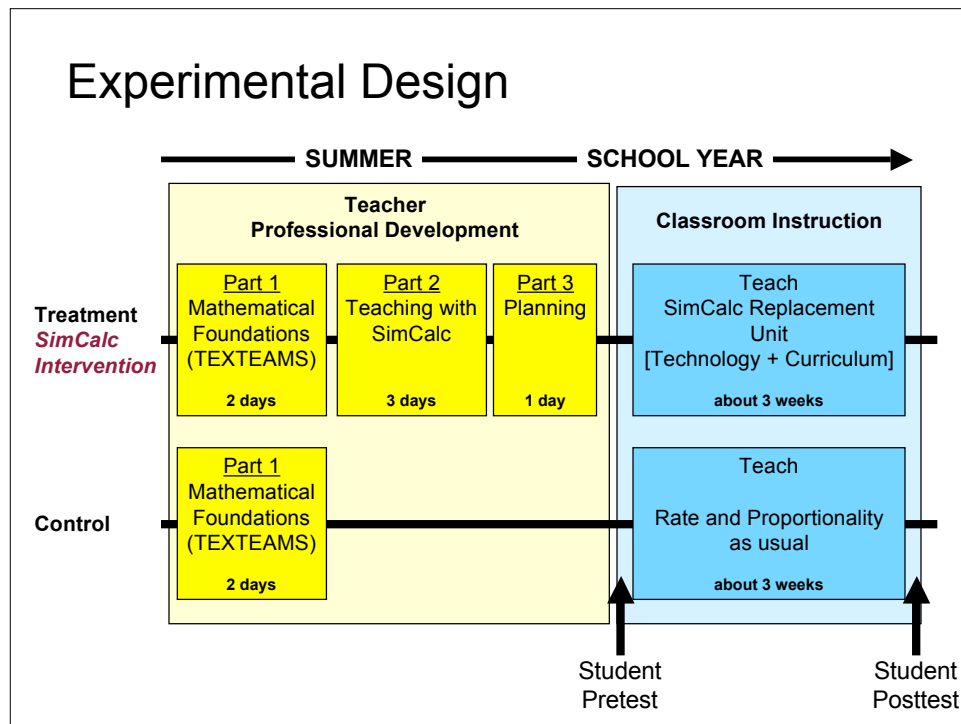
The Third International Mathematics and Science Study (TIMSS), and the TIMSS-Repeat Study ... indicate that U.S. students are less likely to master and/or be taught more complex and conceptually difficult material during their middle and high school years, resulting in lower achievement... IERI projects can help address these serious concerns by scaling up the most powerful and promising approaches to mathematics and science education....

- NCTM “**focal points**” emphasizes 7th grade proportionality
...Students graph proportional relationships and identify the unit rate as the slope of the related line.
- Proportionality is critical to the transition from middle school to high school mathematics and science

Research on Scaling Up

- From 10 students to 10 teachers to 10 schools to 10 regions
- 1621 students,
95 teacher
73 schools

It took MANY research methods to get here!



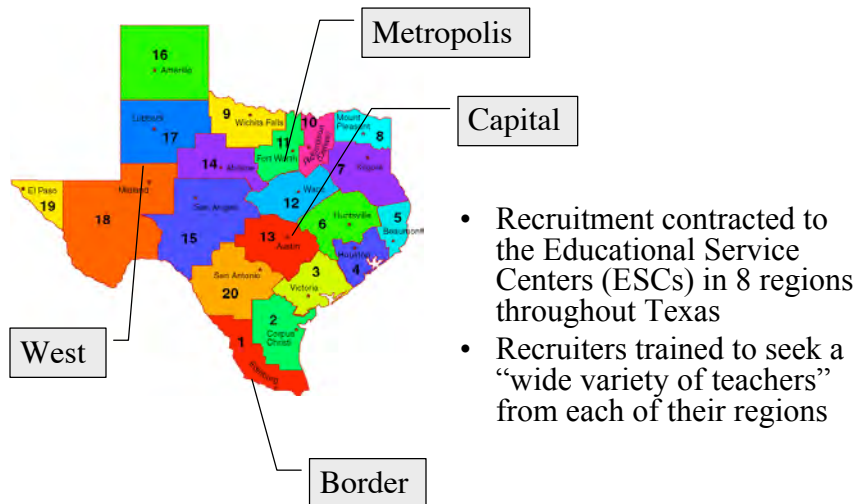
Research Questions

- Does the SimCalc support complex math learning *with a wide variety of teachers and students?*
- Which kinds of variability in classrooms are most important to the effectiveness of the program with students?

Implicit in the way these questions were operationalized was the decision to study the **robustness** of SimCalc effects that can be expected when the approach scales to varied regions, schools, classrooms, teachers and students.

This study attempted to test the robustness of the approach under realistic conditions of scaling up.

Sample & Recruiting

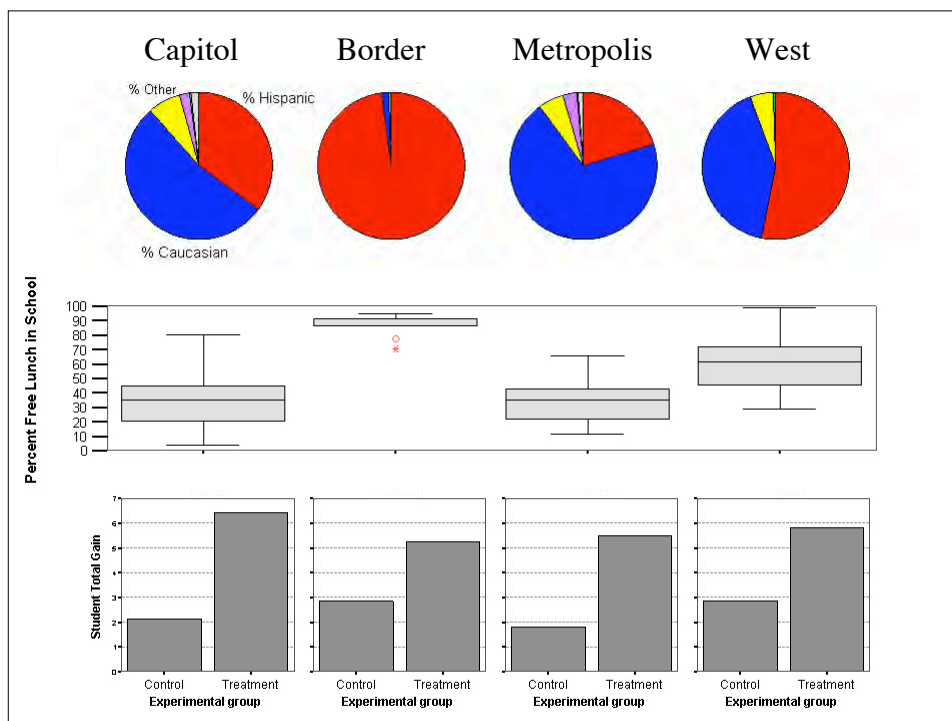
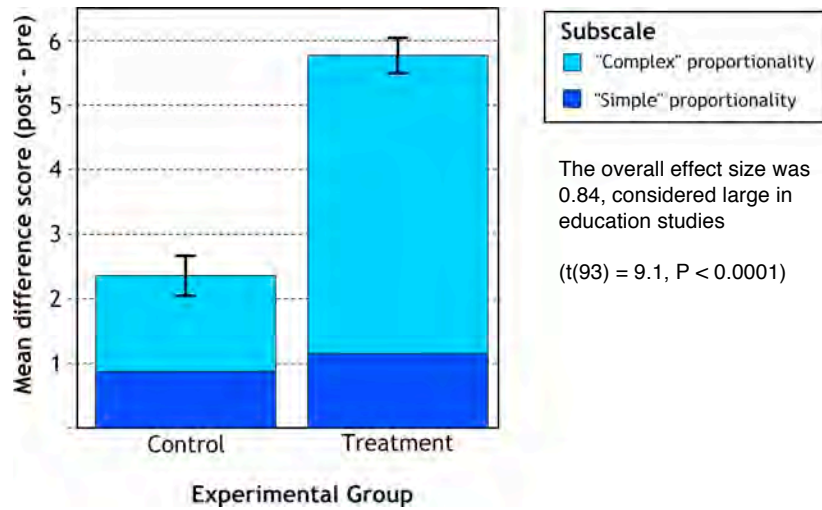


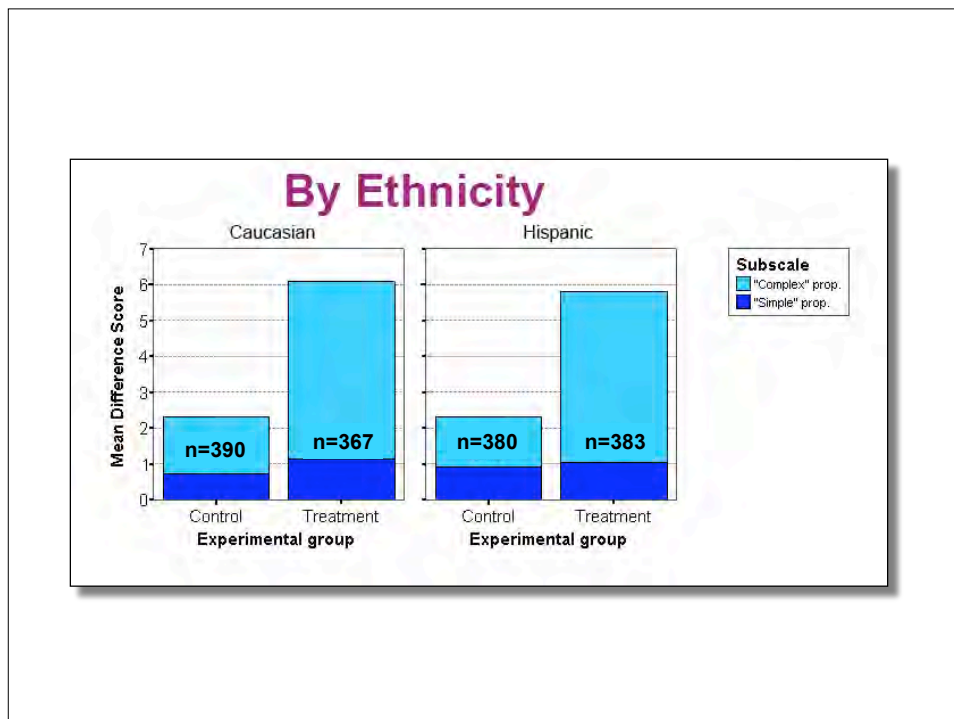
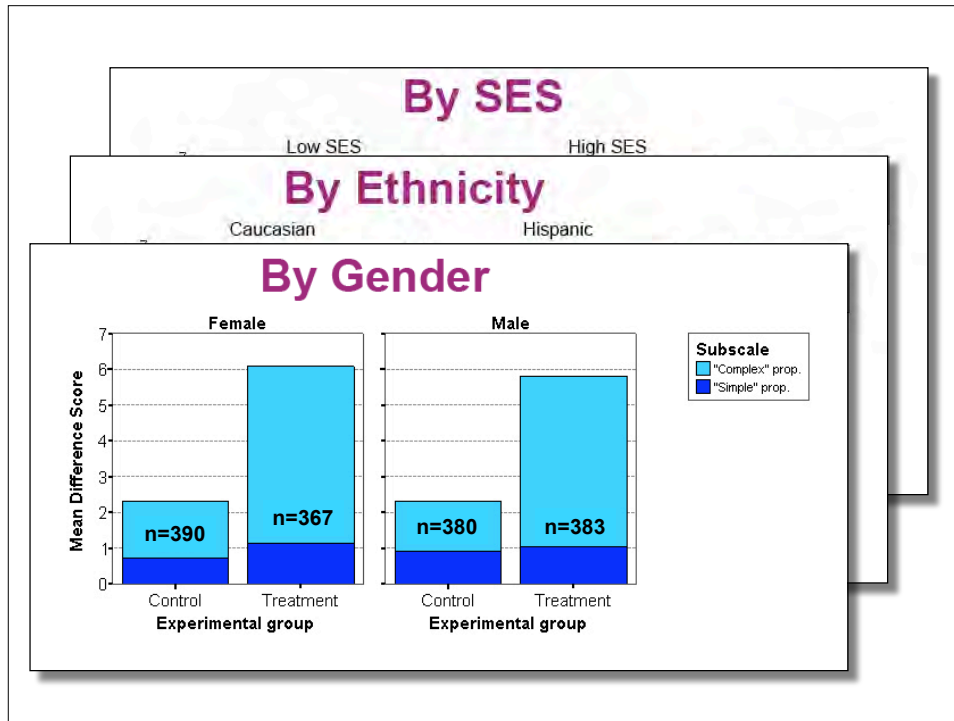
Student Learning Outcome Measure

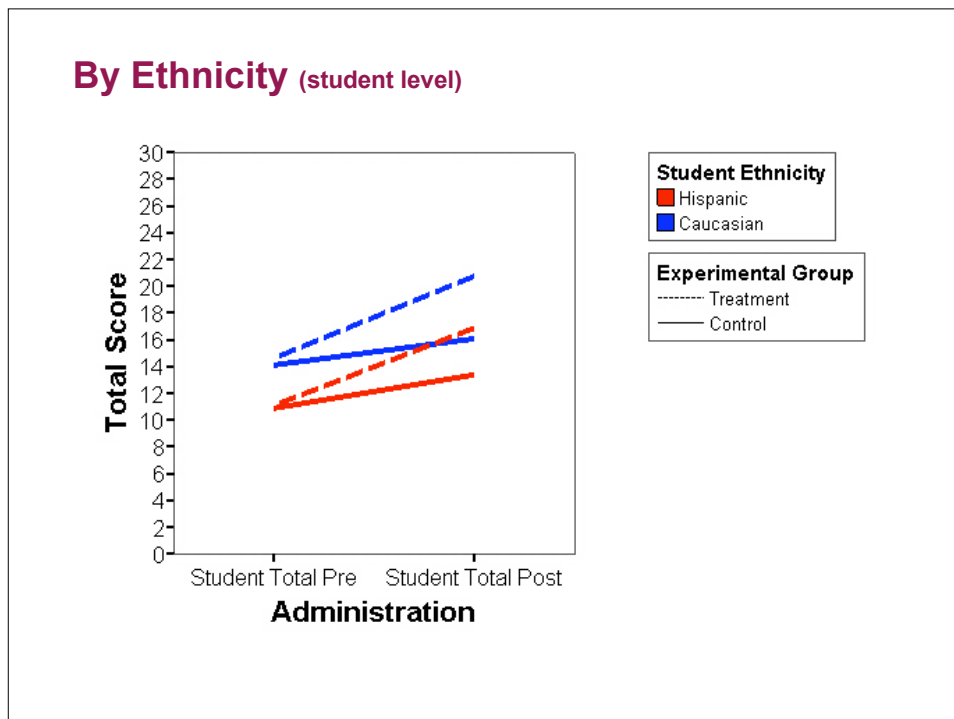
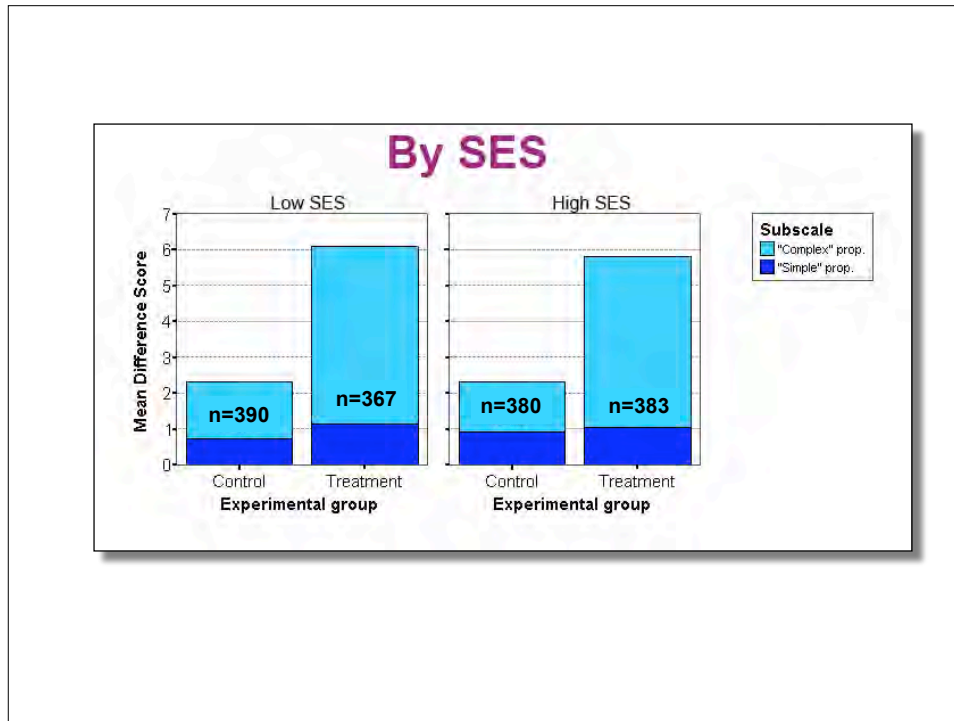
Proportional Reasoning as Preparation for Algebra and Calculus

- “Simple” proportionality
 - Solving for a specific value in $a/b=c/d$ or $y=kx$
 - Reading a specific value in a graph or table
- “Complex” proportionality
 - Solving problems that invoke the function $y=kx$
 - **Function implies a mapping**
 - **Within various representations**
 - **Making connections or comparisons across varying rates, functions, and representations**

SimCalc Students Scored Higher (classroom level)





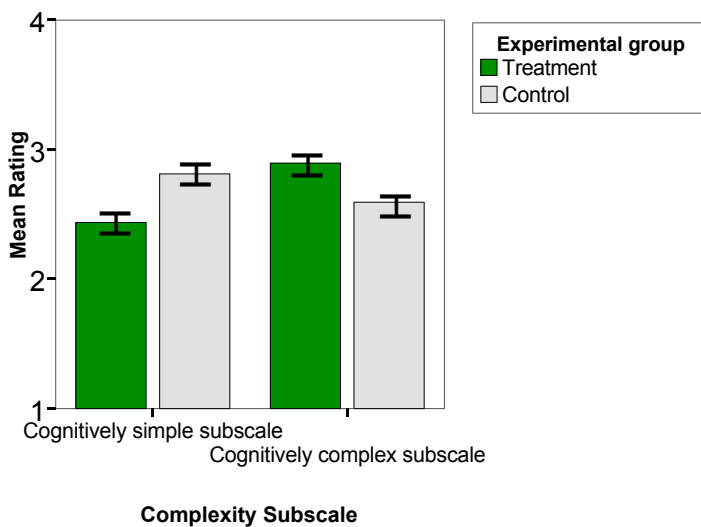


Teacher Log: Complexity of Instructional Goals

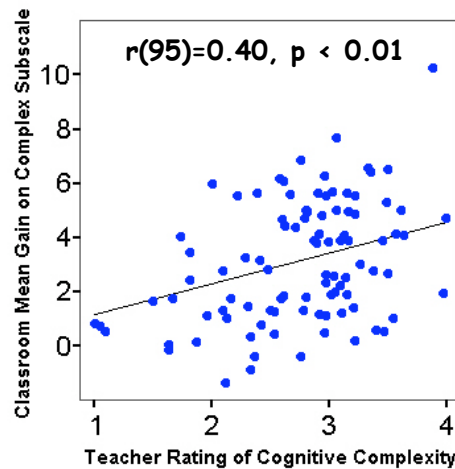
7. To what extent did you and your class focus on the following performance goals for students?

		Not at all		A major focus	
		1	2	3	4
Simple	Memorize facts, definitions, formulas (e.g., students recall traditional skills and knowledge and/or learn computational procedures)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Perform procedures/solve routine problems (e.g., students demonstrate practical competence with skills by using them effectively to accomplish a task)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Complex	Communicate understanding of concepts (e.g., students write or discuss their mathematical understandings)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Solve non-routine problems/make connections (e.g., students solve multi-step or open-ended problems with more than one right answer or solution and/or look for relationships between different topics in mathematics)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	Conjecture, generalize, or prove (e.g., students make, justify, or investigate mathematical conjectures and/or find a mathematical rule to generate a pattern)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Teachers who used SimCalc emphasized complex math



Teachers who reported greater attention to complex math had students who learned more



Points to Remember

- Studied an integration of curriculum, representational tools, and teacher professional development in a replacement unit
- Found robustness of effects across regions, demographics, gender, teacher backgrounds, attitudes, and practices
- Complexity of teaching goals matters (*more modeling later*)
- The next steps are 8th grade replication then longitudinal studies
- We can't expect a single study--no matter the size or design--to provide the final word on all the effects of all uses of learning technologies.

**Part V: Discussion and
Applications to MN**