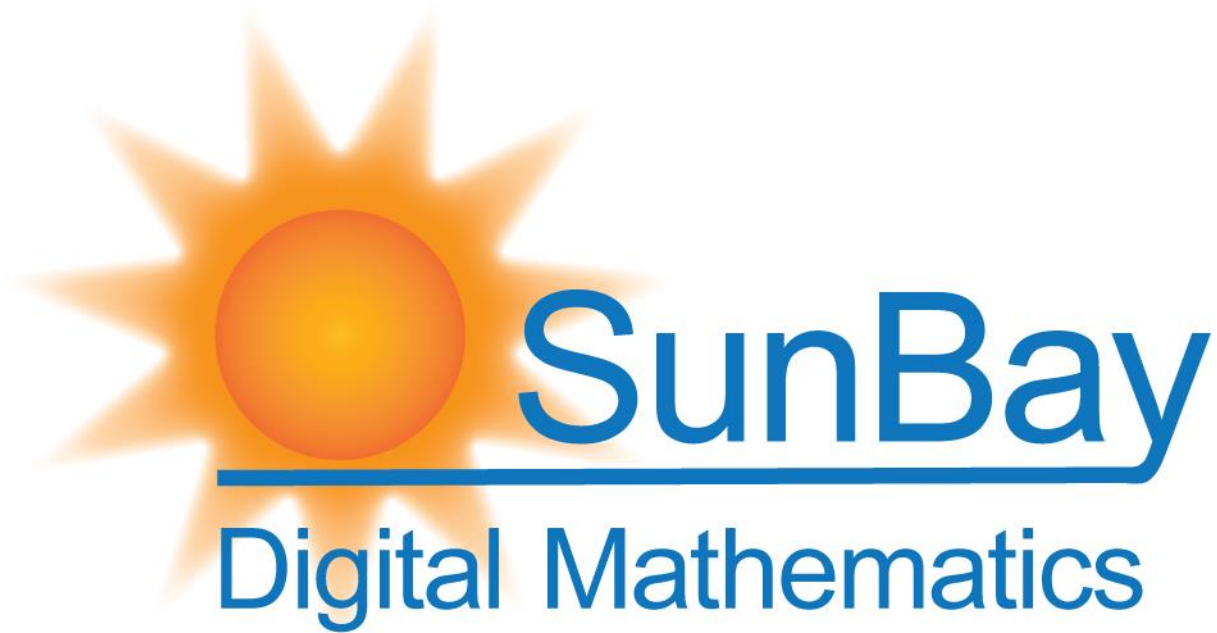


The SunBay Digital Mathematics Project: An Infrastructural and Capacity-Based Approach to Improving Mathematics Teaching and Learning at Scale

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SunBay

Digital Mathematics

How do we raise the quality of
middle school mathematics
at scale?

Infrastructure: Teacher tools used to deliver instruction

(Kaput & Hegedus, 2007;
Roschelle, Tatar, & Kaput, 2008)

Capacity:
The human and organizational
resources that enable school
professionals to use these tools
skillfully

(Cohen & Ball, 1999; Fishman, 2006;
Massell, 2000)

Managing the Soccer Team (MST) (Knudsen, de Frondeveille, & Rafanan, 2003)

- Uses dynamic simulations from SimCalc MathWorlds (Kaput & Schorr, 2008; Roschelle, Tatar, Shechtman, & Knudsen, 2008)
- Organized through a paper workbook intended to change the system of instruction at scale (Roschelle, Knudsen, & Hegedus, 2009)


MST Workbook Sample: On the Road

3. The trip from St. Petersburg to Palm Bay two years ago went fairly well.

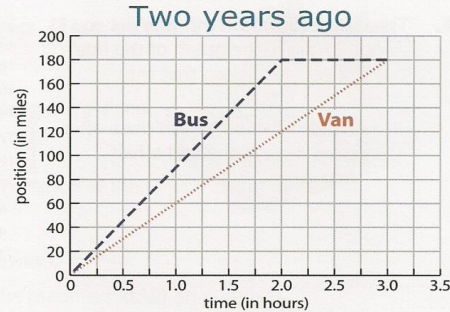
a. Looking at the graph, *predict* which vehicle arrived first.

b. How long did it take each vehicle to make the trip?

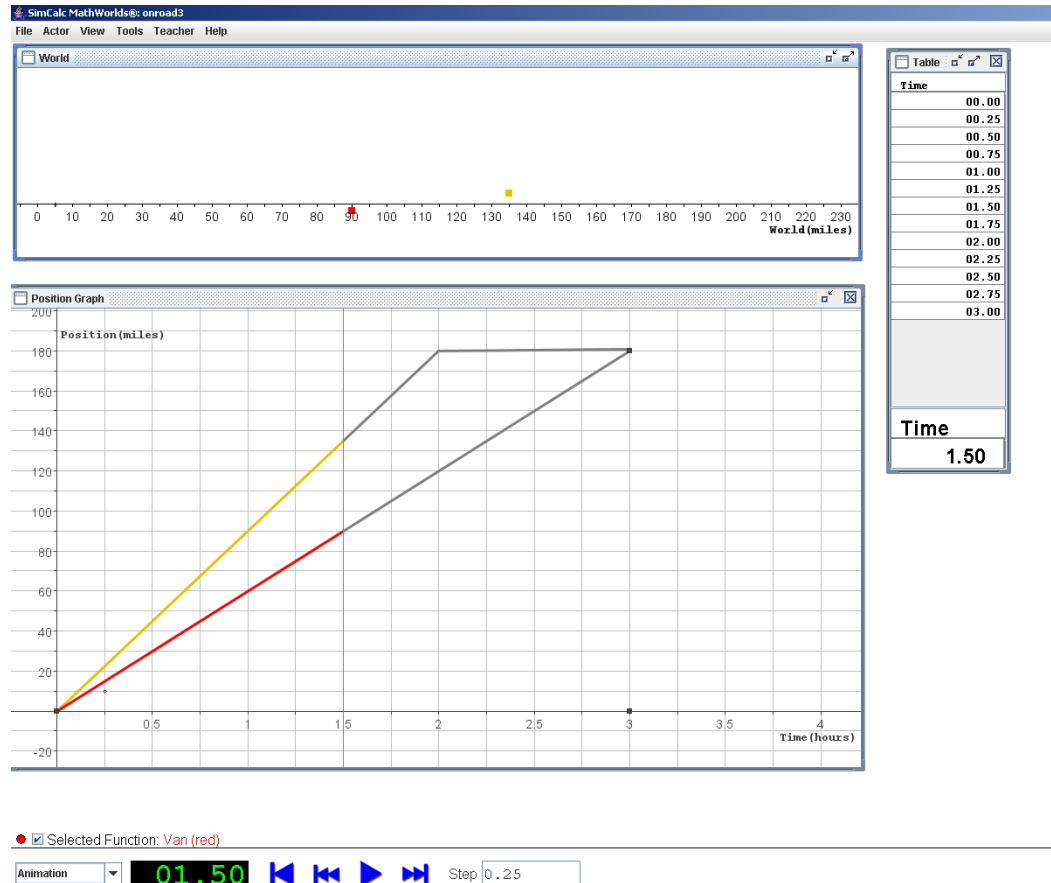
c. How do you know the time it took each vehicle to complete the trip?

d.  Run the simulation in the file *onroad3.2mw*. Were your predictions right? Explain any differences.

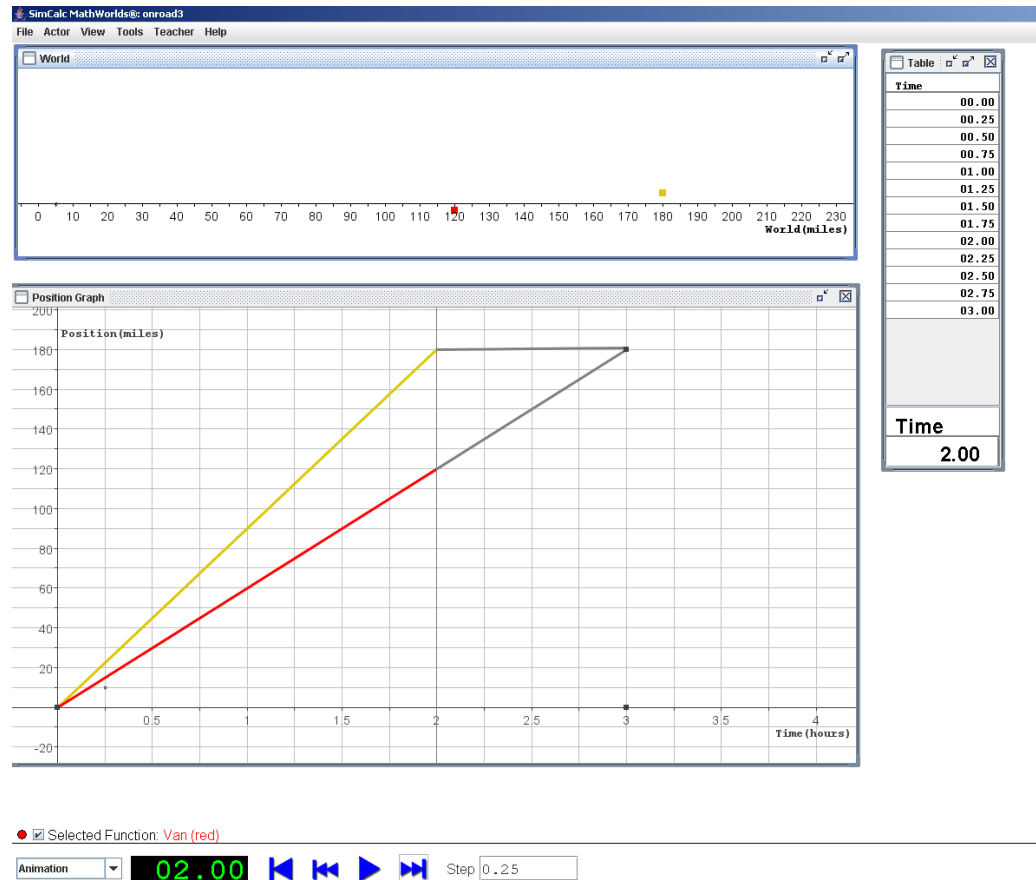
e. Tell a story that could go along with the graph of the trip of two years ago. Make sure to include what speeds the bus and the van traveled. Also, explain how you determined the bus' and van's speeds.



SimCalc MathWorlds Simulation: On the Road



SimCalc MathWorlds Simulation: On the Road



MST

- Shown to be effective and robust in field trials
 - Raises student achievement in cognitively demanding mathematics without sacrificing student growth in basic skills (Roschelle et al., 2010; Tatar et al., 2008)
 - Girls, Hispanic students, free lunch students all tend to achieve high gains (Vahey, Lara-Meloy, & Knudsen, 2009)

How do we raise the quality of
middle school mathematics
at scale?

SunBay Math Digital Mathematics

- Collaboration among a K-12 school district, college of education and nonprofit.
- Large urban district with 21,000 middle school students in more than 20 middle schools
- 54% of district's students live in poverty
- 40% are members of minority groups

Strategic Planning: June-August 2009

- MST selected as first curriculum replacement unit
- Florida experts evaluated MST's alignment to the Florida NGSSS and recommended minor, cosmetic changes.
 - Unit comparable to version in Texas randomized trial discussed in Roschelle, et al. (2010)
- MST put in a specific place on the district's pacing guide.

Recruitment: June-August 2009

- 15 7th grade teachers at 7 schools, ~2 per school
- Ages ranged from 26-51 years
- Years of experience ranged from 2-24 years
- All certified to teach mathematics, many certified through alternative routes, some with experience in private sector
- Some were mathematics leaders in their schools and others said they were “volunteered” for the program

Professional Development: August 2009

3-day PD similar to Roschelle et al. (2010).

- Teachers learn the unit by working through workbook problems and running the simulations as learners.
- Organized around 3 norms discussed in Roy, Vanover, Fueyo, and Vahey (2012)
 - Do the math.
 - Make bold conjectures.
 - Think about your classrooms.
- Teachers report high levels of satisfaction
 - Average 4.6/5 on items probing pacing, organization, readiness to teach the materials

“You have a hard time teaching children why is the slope like this, or why is the slope like that. Now, you can say what ‘that’ means.”

“I’ve been to a lot trainings where I couldn’t see it. [SunBay Math] helped me do it. I could see what I was doing and could imagine what I might do in my classroom.”

“Good thinking and communication.”

Teacher comments at August 2009, SunBay Math PD

Fall 2009: Monthly Professional Development

- 3 hour PD session once a month focused on MST
- Both mathematics and implementation emphasized
- Teachers report high levels of satisfaction
 - Average 4.4/5 on items probing pacing, organization, readiness to teach the materials

“I liked seeing where was the unit coming from. Going deeper with questioning strategies.”

“I liked the fact that they were...opening us up to ideas and strategies that I had forgotten or never learned. I didn't learn stuff just about SimCalc, but something about being a better teacher.”

Teachers discussing Fall 2009 trainings in phone interviews

Implementation of MST

- 13/15 PD teachers implemented MST
- 150 hours of University staff time for technical logistics (e.g., managing computer access issues, installing software, troubleshooting)
- Availability/usability of computers a problem for teachers implementing MST
- Teachers reported difficulty fitting unit into schedule even with a place on the district's pacing guide

Video Observations of MST Lesson On the Road

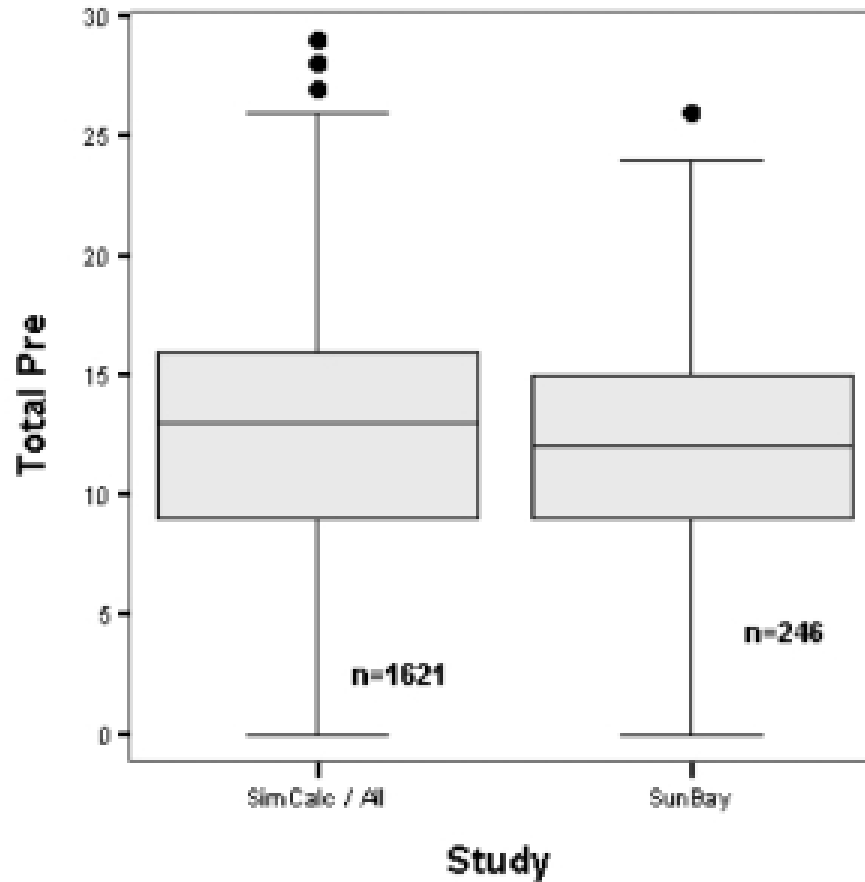
Variation within a Theme

- All teachers used the workbook to guide instruction
- All followed workbook activities in order
- Variation in
 - Pre-workbook activities
 - Technology usage
 - Classroom organization
 - Pacing
- Technology did not determine the organization of the lesson
 - Inquiry-oriented whole class discussions organized around a single laptop and video projector
 - Highly directed lessons organized in rooms where pairs of students had their own computers.

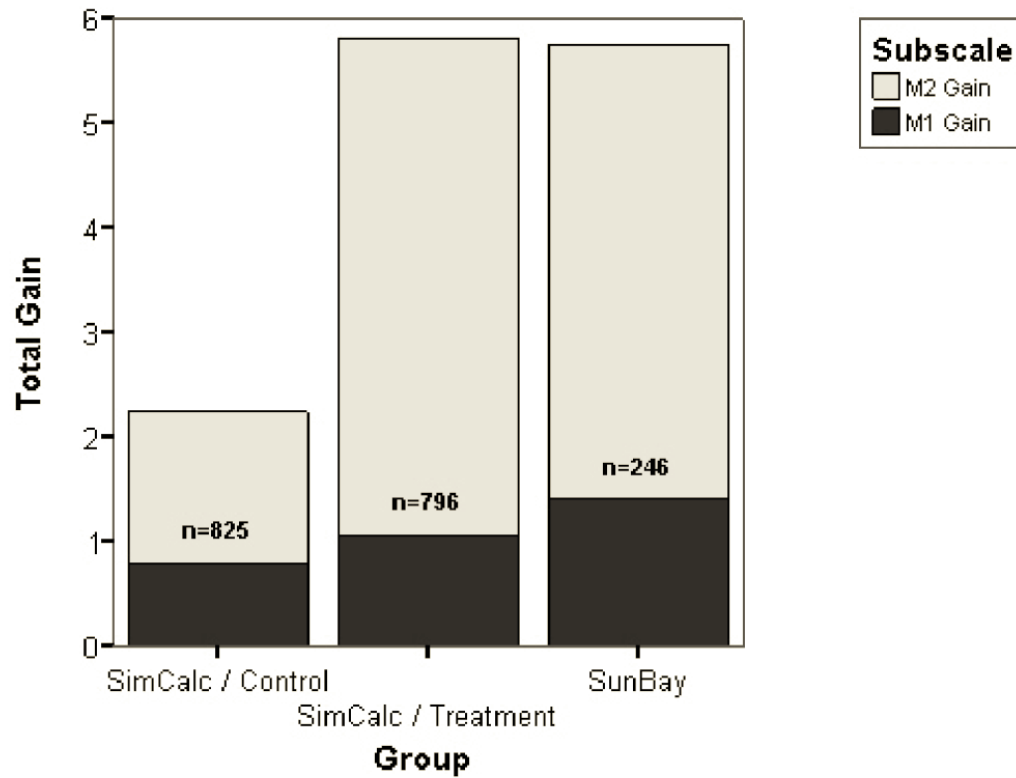
Pre-Post Unit Assessments of MST

- Compared gains generated by control and treatment teachers in the Texas randomized experiment discussed in Roschelle et al. (2010)
 - In Texas 825 students received MST
 - SunBay Math provided 246 students with MST
 - 795 Texas control students enrolled in a delayed treatment design

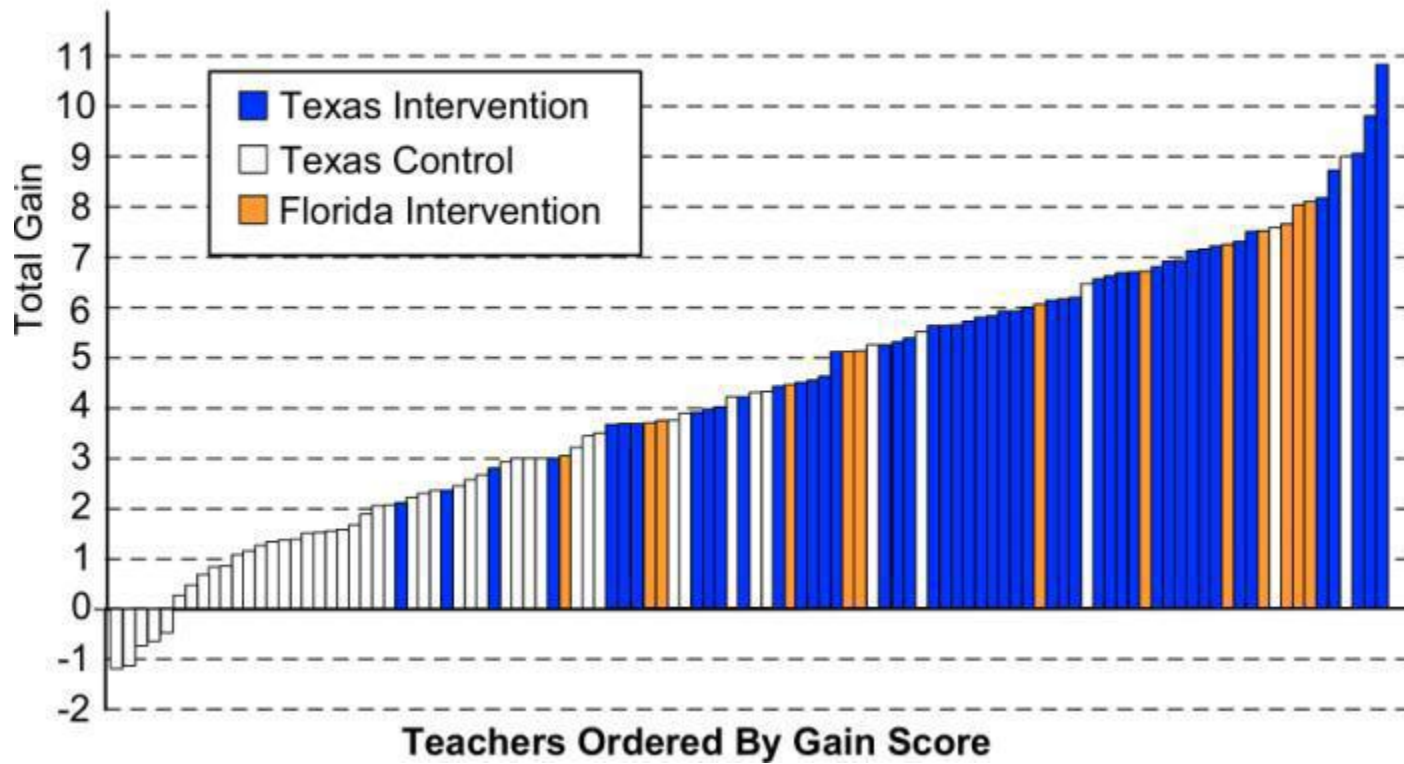
Pre- Unit Assessment Findings: Texas vs. SunBay Math



Post-Unit Assessment Findings: Control vs. Texas MST vs. SunBay MST



Post-Unit assessment Findings: Control vs. Texas MST vs. SunBay MST



Moderate Resource Demands= High Gains

- Moderate resources
 - 3 days summer PD
 - 3 evening trainings
 - Technical assistance focused on technology implementation
- High gains
 - The lowest SunBay Math teacher out-performed 62% of Texas controls
 - 6 SunBay Math teachers outperformed 99% of Texas controls

Lessons Learned

- In line with Fishman et al. (2009), efforts to align MST to Florida standards critical to successful implementation.
- Teachers had difficulty finding time to do the unit, despite it having a specific place in the district pacing guide.
- District technology implementation capacity lower than anticipated, even though numbers and type of computers increasing

Infrastructure First!

SunBay Math used infrastructure
from SimCalc MathWorlds
and a replacement unit developed by
SRI to build district capacity one
cohort at a time

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