Virtual Manipulatives and Dynamic Representations in Length and Area Measurement

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Strengthening Tomorrow’s Education in Measurement (STEM) Project

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Introductions

**Eryn** – 2\(^{nd}\) year PhD student at MSU – and 2\(^{nd}\) year with STEM, taught mathematics at the university level for 4 years, taught pre-service elementary teachers.

**Kelli** – ??
Session Goals

• **Sources** of Virtual Manipulatives and Dynamic Simulations for Measurement
  – NCTM,
  – MSU STEM project
  – Others...

• **Decision-making** – which tools to use and why
Session Overview

- Who We Are and What We Do
- Tools and Technology
- An Activity in Three Acts
- Potential Affordances of Dynamic Simulations
- Exploring the Potential of Our Measurement Simulations
The STEM Project

Goals & Activities (Spring 2007 – present)

- Examine the curricular contributions to poor performance in spatial measurement (length, area, volume)
  - Do current US elementary mathematics provide sufficient “opportunity to learn” (OTL) spatial measurement?
- Putting to use what we have learned
  - Professional Development with PD facilitators from around the state of Michigan who work with elementary school teachers in their districts
  - Lesson Study with Pre-service Teacher Elementary school Teachers
  - Communication with Curriculum Authors
STEM – Three Curricula

We produced a fine-grained analysis of:

- Scott Foresman-Addison Wesley Mathematics
- UCSMP’s Everyday Mathematics
- Saxon Math
We found that for across all textbooks

- the content was heavily procedural for length (greater than 75%) and area (greater than 88% procedural)
- the conceptual knowledge that was there was weakly attend to
- Very few dynamic representations or activities

You can’t really learn measurement from a book. Students need to be actively involved and out and about doing stuff. It is hard to get that on a written page.

-Author of one of the curricula we analyzed
Tools and Technology

• Small group discussion:
  – What are three affordances of measurement applets?
  – Star the most important

• Whole group discussion:
  – One from each group and why
An Activity in Three Acts

Act 1

Which shapes have the same area?

Which strategies and methods did you use?

What learning (concepts/procedures) would this support?
An Activity in Three Acts

Act 2

Did you use the same strategies and methods from Act 1?

How are these tasks similar or different?

What learning (concepts/procedures) would this support?
An Activity in Three Acts
Act 3

How many different parallelograms can you build that have an area of 88 square units?

An Activity in Three Acts

Act 3

How was this third task similar or different from the first two tasks?

How did the use of technology enhance or detract from your experience?

Learning goals?

Potential Affordances of Simulations

Promotes “Messing Around”

Use the green blocks to measure the length of the pencil!
Potential Affordances of Simulations

“Seeing” things that are not easy to “see”

Watch how the paint roller creates a rectangular area. Use the arrows on the right to change the size of the roller.

Start

Demonstrates the creation of a rectangular area and highlights the continuous nature of area.
Potential Affordances of Simulations

“Seeing” things that are not easy to “see”

What is the area of the gray shape?

Highlights why the formula for finding the area of a parallelogram is the same as the area of a rectangle (b*h)
Potential Affordances of Simulations
“Seeing” things that are not easy to “see”

Highlights why the formula for finding the area of a triangle is the same as the formula for finding the area of a rectangle ÷ 2
Exploring the Use of Our Measurement Simulations

How might you use the simulation(s) in a lesson with your students?

For example, how might you use:

- a particular simulation
- a group of related simulations

What learning goals?
Thank you!

We want to thank the National Science Foundation for funding this work

We want to thank you for coming!

For more information: http://www.msu.edu/~stemproj

If you have any questions please e-mail us at: stemproj@msu.edu