

# Using Manipulatives and Animations to Support Students Reasoning on linear Measurement

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# Agenda

- Educational environment
- Math Snacks
- Theories
  - Instructional design
  - Representations
  - Use of manipulatives & instructional animations (multimedia)
  - Trajectories & Realistic Mathematics
  - Understanding of measurement
- Activities
  - Cubes and measurement
  - Discussions based on an instructional animation
  - Broken ruler
  - Paper-based exercises

# Educational Environment

- After school project
- Bilingual school
- 14 fourth grade students (some are ELL students)
- 60-75 minute session
- Once a week during 8 weeks
- Teacher and teacher assistant were present in the classroom

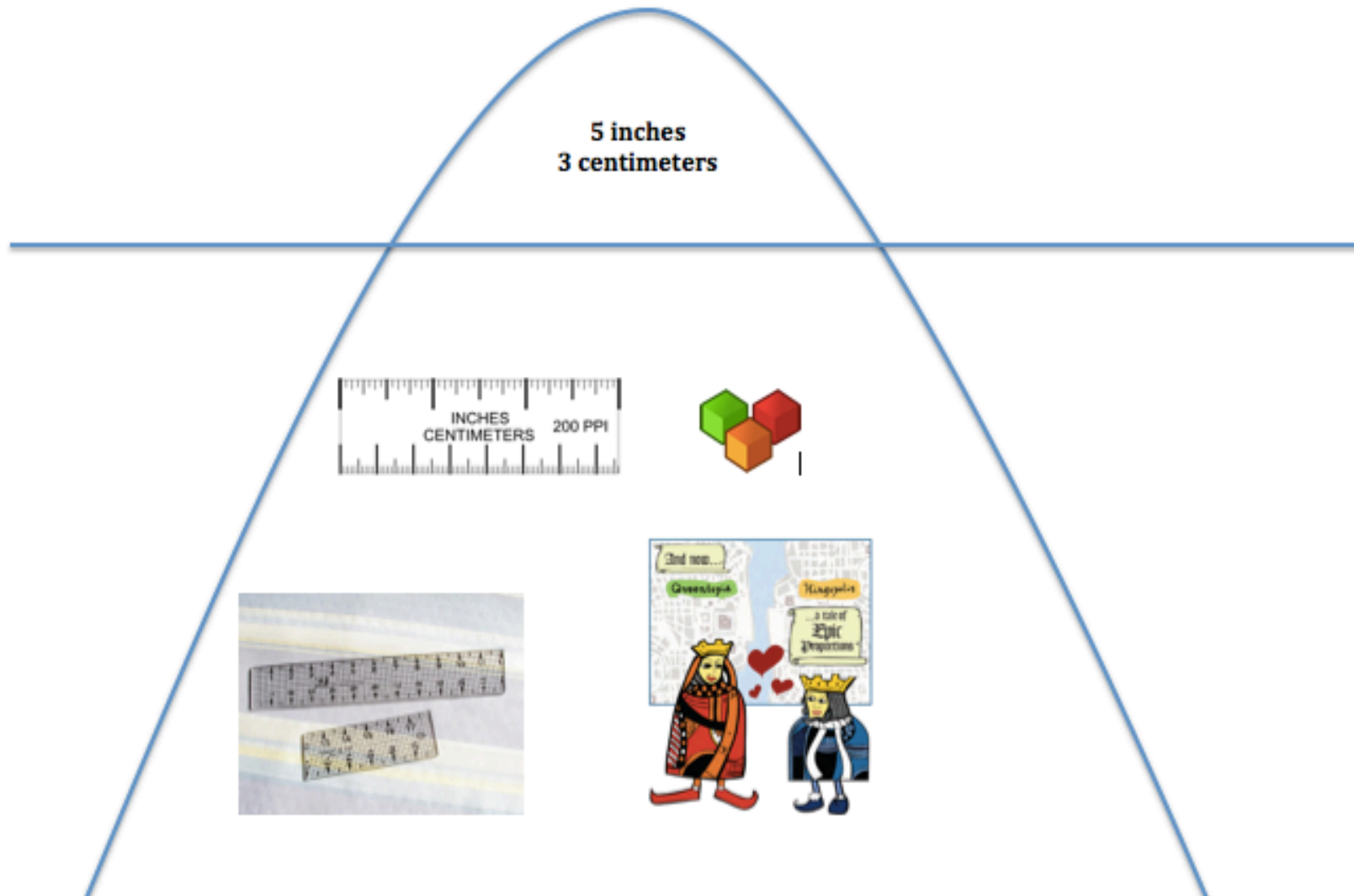
# Math Snacks

Bad Date

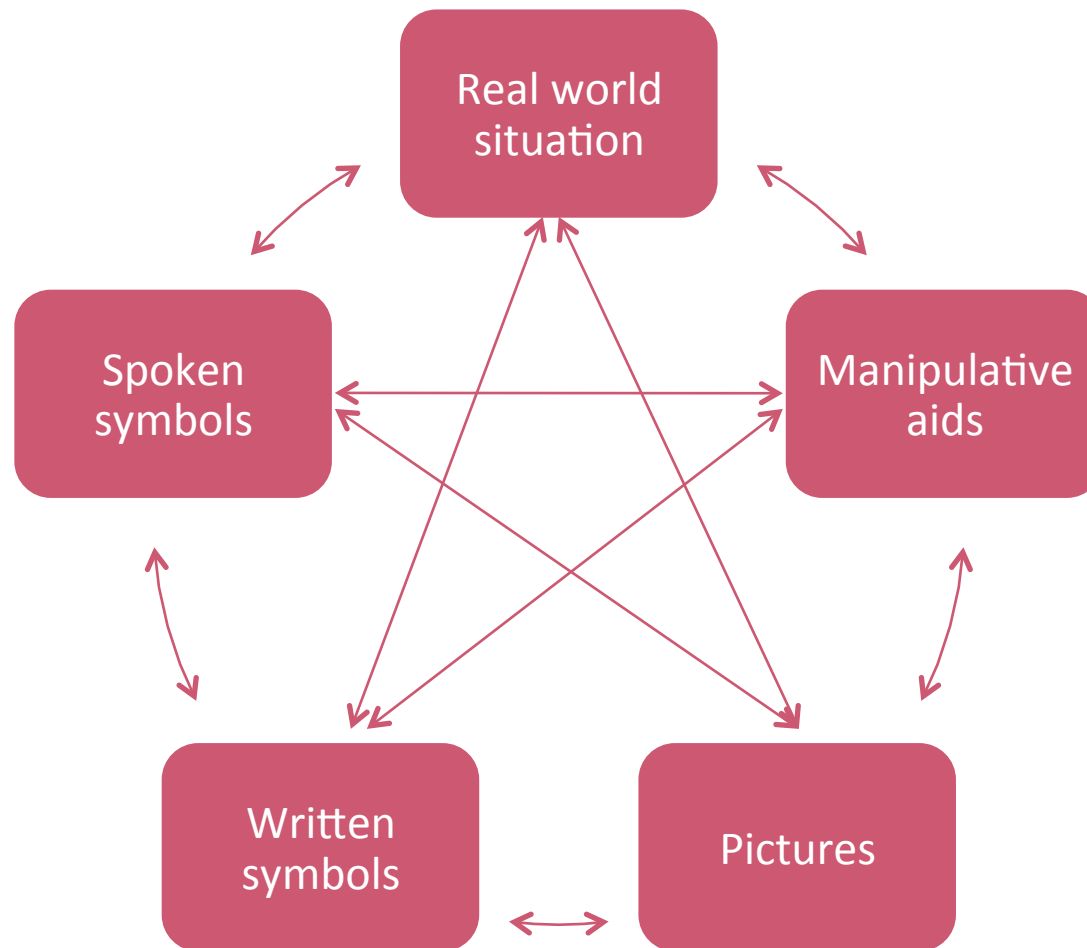
# Instructional Design (ADDIE)

- Analyze
  - Problems, goals, learners, context (learning vs. performance), content, prerequisites, and priorities
- Design
  - Learning outcomes and sequencing, strategies, media and evaluation plan.
- Develop
  - Prototypes, implementation guidelines, adaptation of existing materials.
- Implement
  - Instruction and learning experiences, feedback collection, evaluation and revision tracking
- Evaluate
  - Formative testing and observation, revisions, examination of teamwork

# Iceberg model



# Representations



Lesh, R. (1979a). Mathematical learning disabilities: Considerations for identification, diagnosis, and remediation. In R. Lesh, D. Mierkiewicz, & M. Kantowski (Eds.), *Applied mathematical problem solving*. Columbus, OH: ERIC.

# Multimedia learning

- Cognitive load theory
- Multimedia learning theory
- Recommendations:
  - (1) acquiring sufficient prior knowledge;
  - (2) keeping the information longer on the screen;
  - (3) controlling the pace of the animation;
  - (4) segmenting the animation in parts;
  - (5) presenting statics before animations;
  - (6) increasing interactivity; and
  - (7) predicting situations in the animation.

Ayres, P., Kalyuga, S., Marcus, N., & Sweller, J. (2005). The conditions under which instructional animation may be effective. Paper presented at an International Workshop and Mini-conference, Open University of the Netherlands: Heerlen, The Netherlands.



# Realistic Mathematics

- Reality serves as the source of concept formation and as the area of application
- The students are given the opportunity to actively contribute to their own learning process; they play the part of constructors;
- Attention is especially paid to the production of symbols, diagrams and (visual) models;
- Lines of learning are intertwined
- Instruction is highly interactive

Streefland, L. (1991). *Fractions in realistic mathematics education. A paradigm of developmental research*. The Netherlands: Kluwer.

# Understanding of Measurement

- Grades 3–5 Expectations (NCTM):
  - Understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems
  - Understand that measurements are approximations and how differences in units affect precision
- CCSS (4.MD.A.1):
  - Solve problems involving measurement and conversion of measurements.

# Linear measurement

	Idea	Description
Conceptions of Unit	<ul style="list-style-type: none"><li>- Iteration</li><li>- Identical unit</li><li>- Tiling</li><li>- Partition</li><li>- Additivity</li></ul>	<ul style="list-style-type: none"><li>- A subdivision of a length is translated to obtain a measure.</li><li>- Each subdivision is identical.</li><li>- Units fill the space.</li><li>- Units can be partitioned</li><li>- Measures are additive, so a measure of 10 units can be a composition of 8 and 2.</li></ul>
Conceptions of Scale	<ul style="list-style-type: none"><li>- Zero-point</li><li>- Precision</li></ul>	<ul style="list-style-type: none"><li>- Any point can serve as the origin or zero point on the scale.</li><li>- The choice of units in relation to the object determines the relative precision of the measure. All measurement is inherently approximate.</li></ul>

Lehrer, R., Jaslow, L., Curtis, C. (2003). Developing an understanding of Measurement in the elementary grades. In D. Clements & Bright, G. (Eds.), Learning and Teaching Measurement. 2003 Yearbook. NCTM.

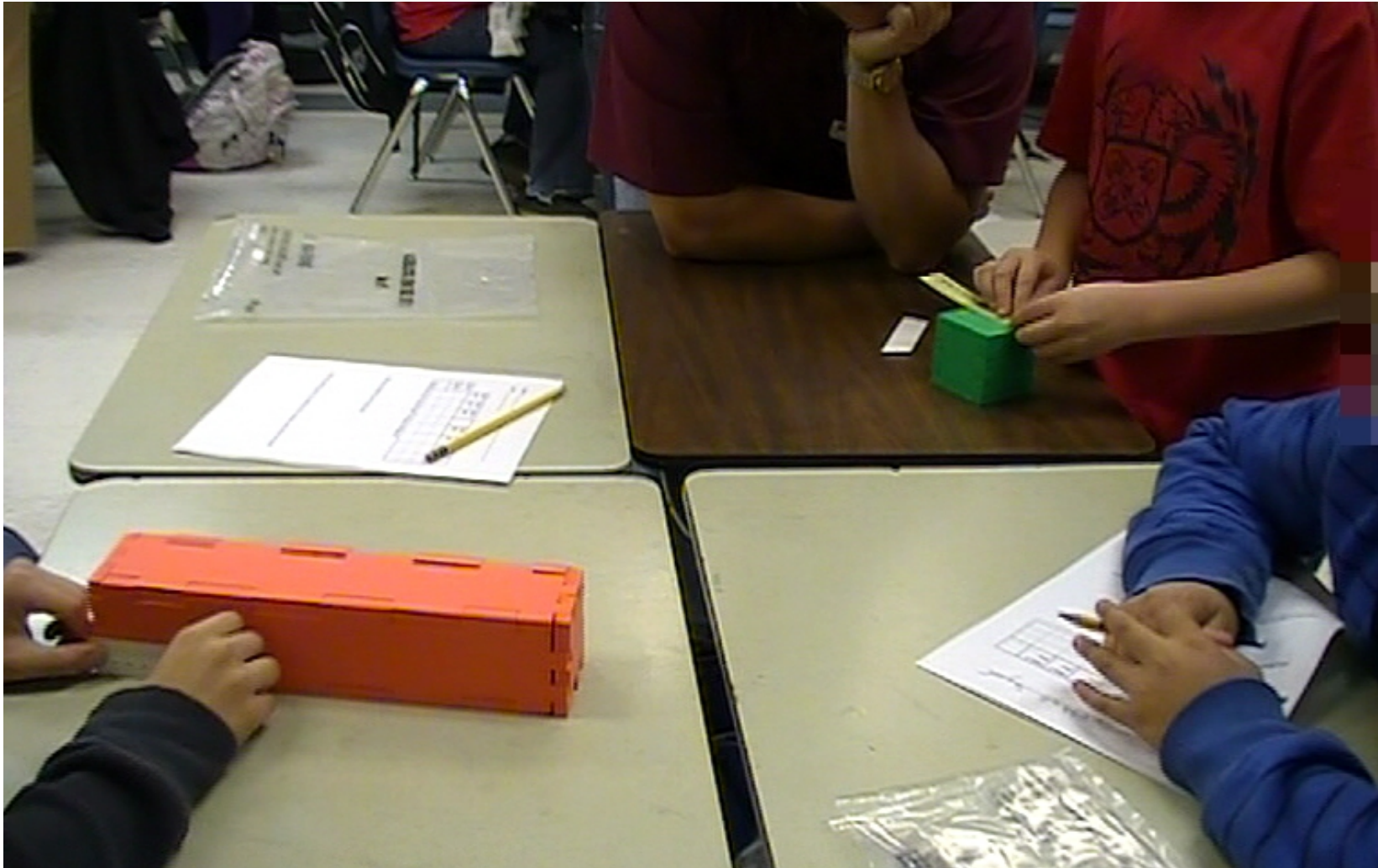
# Activity #1 – boxes & wood pieces



# Activity #2 - Animation

Overruled!

# Activity #3 – Broken ruler



QUESTIONS?

THANK YOU / GRACIAS