In Tribute to Prof. Miriam Ben-Peretz

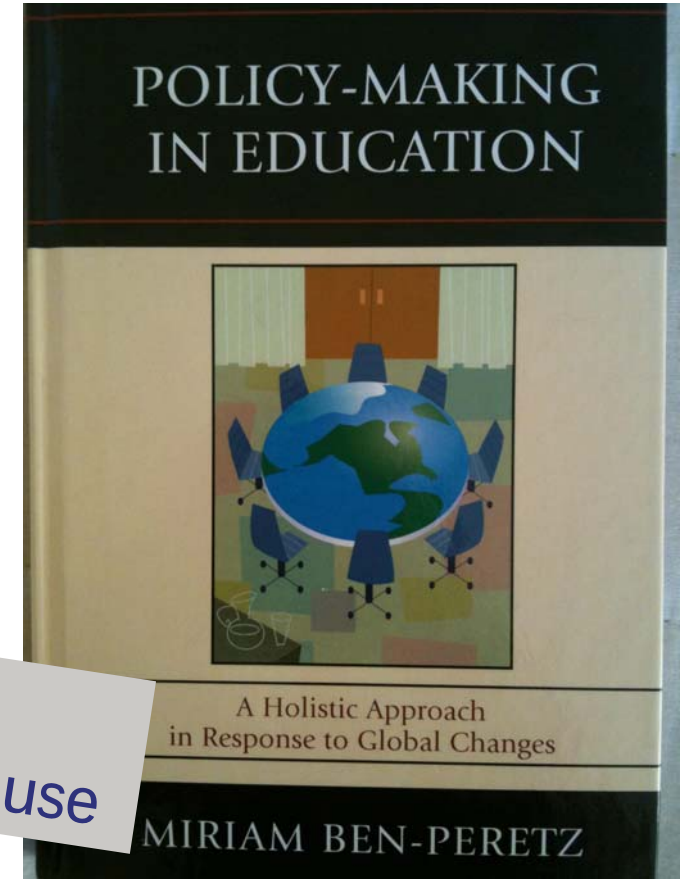
teachers as curriculum designers

the teacher-curriculum encounter

curriculum potential

teachers, students, and society as stakeholders and agents in curriculum use

understanding education holistically in a diverse and changing world



SCHOOL OF EDUCATION UNIVERSITY OF MICHIGAN

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

The potential of curriculum to effect educational improvement by . . .

1. Promoting equity
2. Supporting teachers' practice
3. Strengthening teacher education
4. Building professional knowledge and community

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

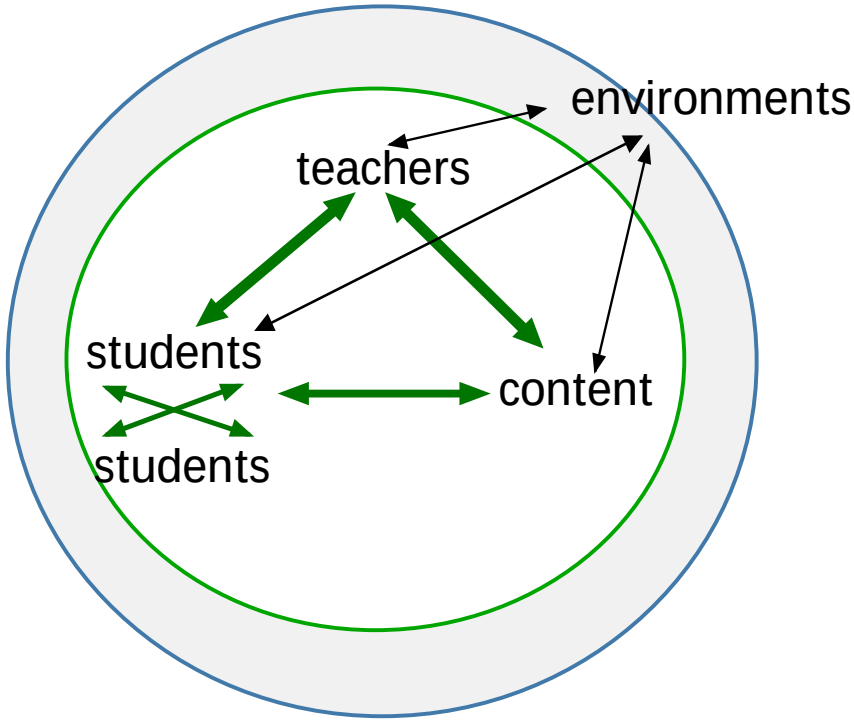
The past overpromise of curriculum as a lever for change

- Curriculum frameworks, curriculum materials
- Frequent use as a policy tool
- Policymakers' faith in curriculum as determinant of students' learning
- Repeated disappointments in the efficacy of curriculum as a lever for change

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

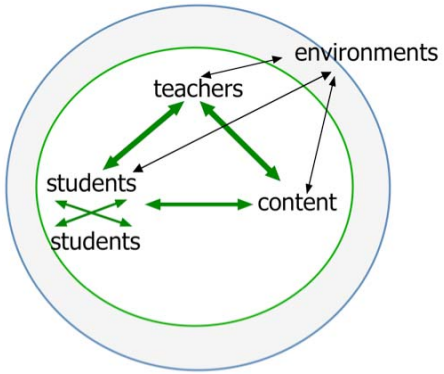
What is “instruction”?

- **Instruction** is what is co-produced by students and teachers in contexts, around specific content and curriculum, in environments, over time.



Cohen, Raudenbush, & Ball (2003); Lampert (2001); Lee (2007)

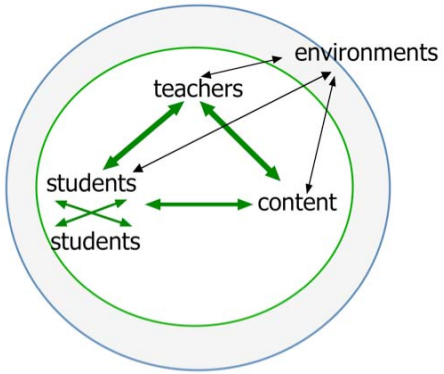
This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu



Instruction, outcomes, and curriculum

1. Students learn all the time, everywhere, in formal and non-formal settings.
2. Teachers have unique responsibility to ensure that students learn specific valued content and skills.
3. Curriculum can help provide common goals, and tools for attaining them.

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu



How are instruction and curriculum related?

1. Curriculum specifies the goals of instruction.
2. Curriculum is a resource and set of tools for instruction.
3. Curriculum is produced through the dynamics of instruction.

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

1. A close look at the "teacher-curriculum encounter"

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

Grade 6 class

Addition and subtraction of integers

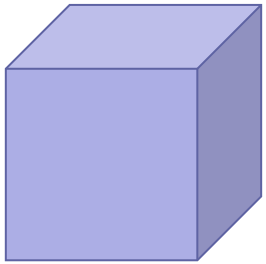
-2 + 5

-1 – (-3)

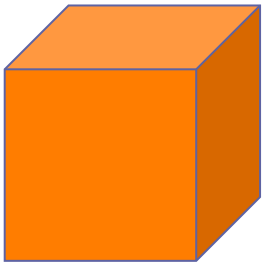
This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

Chip model: "Positive" and "negative" cubes

positive



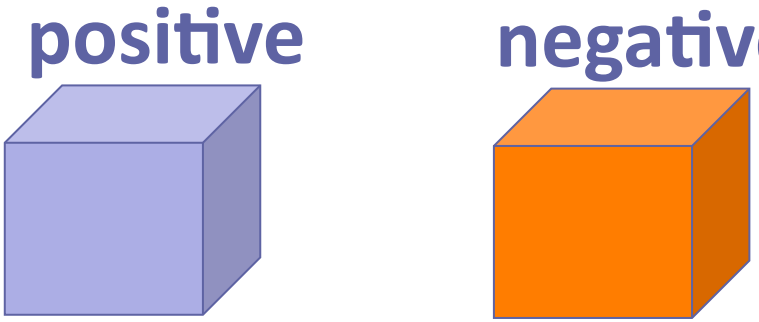
negative



- Advantage: Represents negative numbers physically
- Needed: Rules and language to make these materials work to represent integer addition and subtraction; careful use mapped to symbolic form and meaning

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

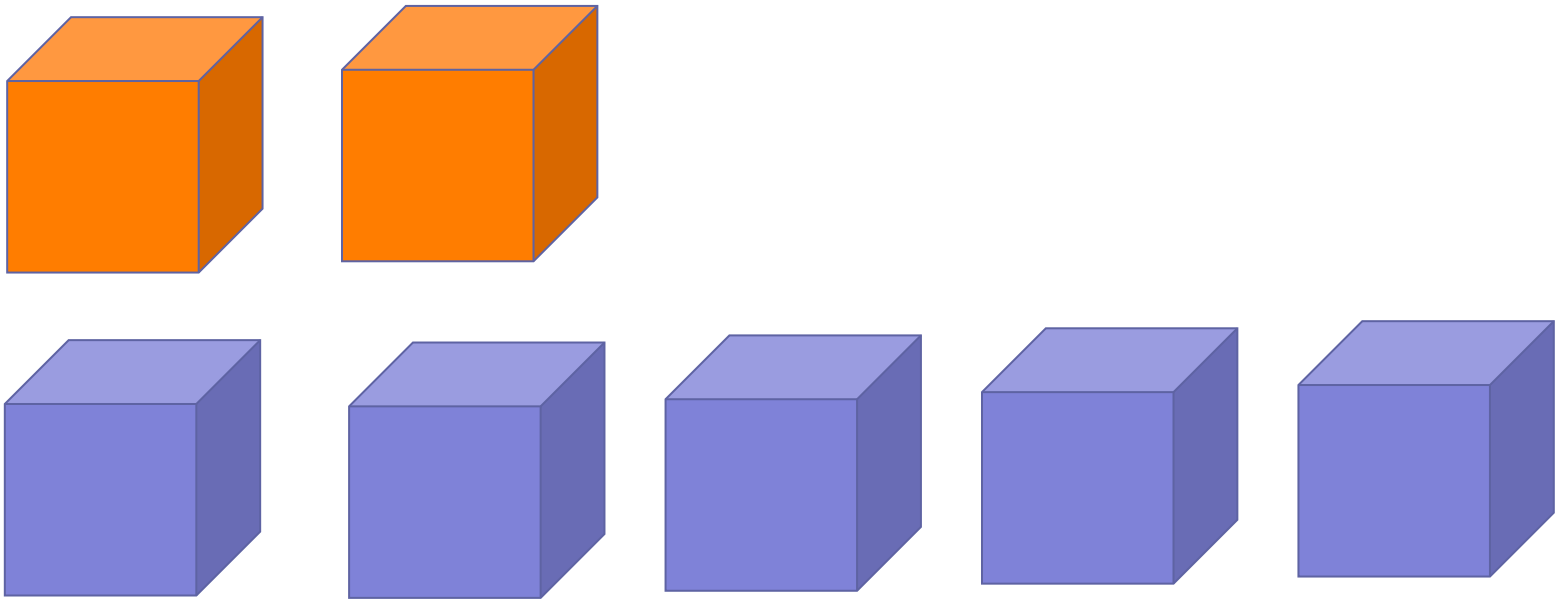
Rules and language for using the representation



- Addition: combining two sets of cubes
- Subtraction: taking away cubes from a set
- A positive and negative cube cancel each other (a + (-a) = 0

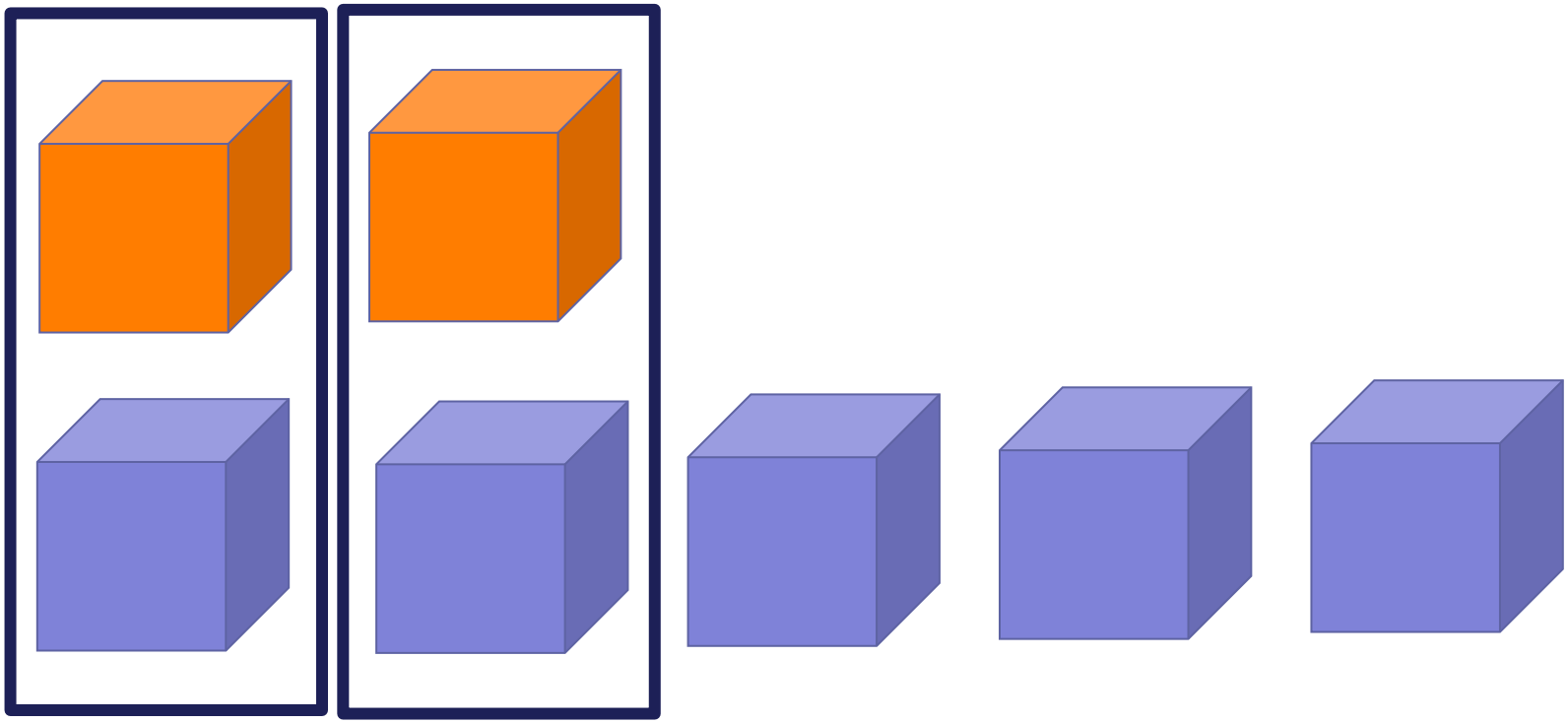
This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

First problem: -2 + 5



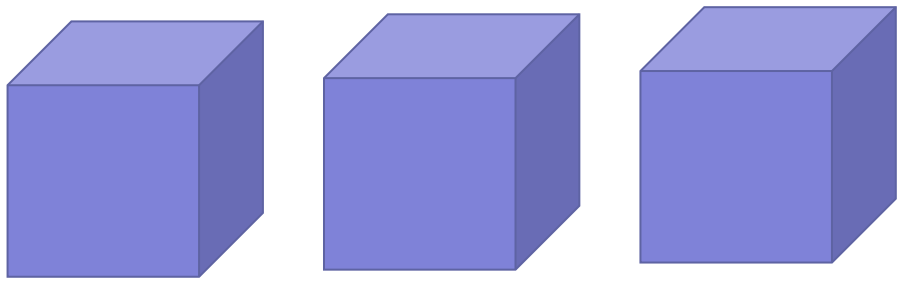
This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

-2 + 5



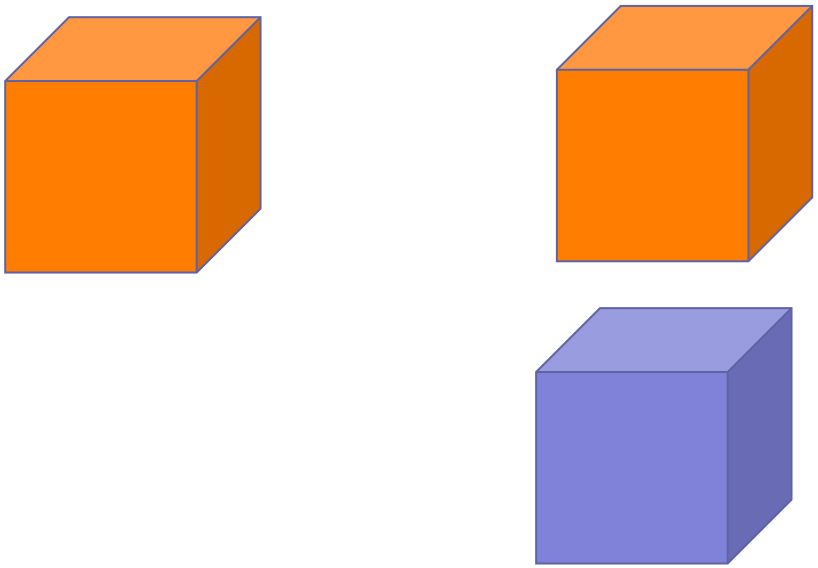
This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

-2 + 5 = 3



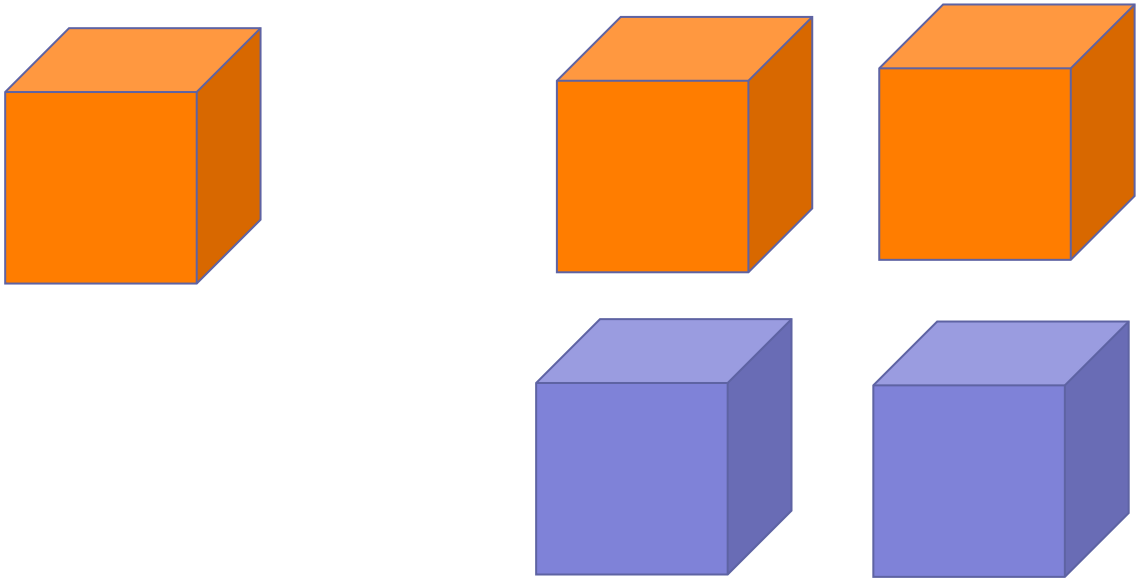
This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

Second problem: -1 - (-3)



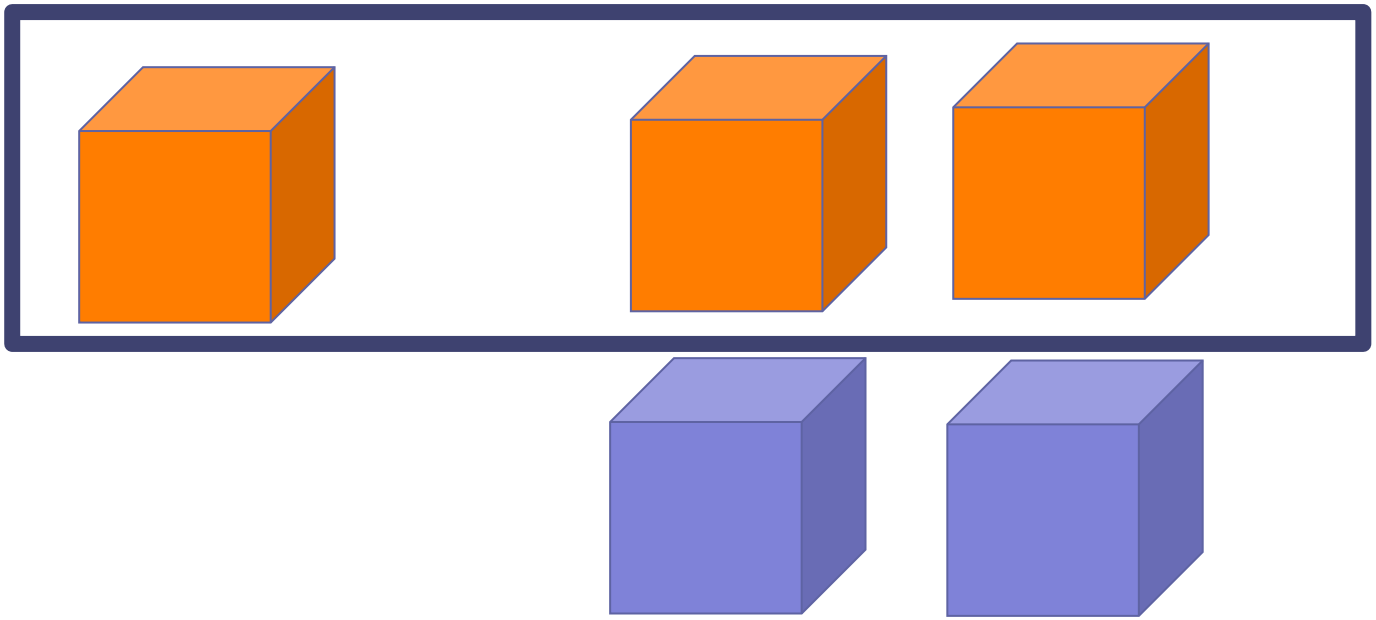
This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

-1 - (-3)



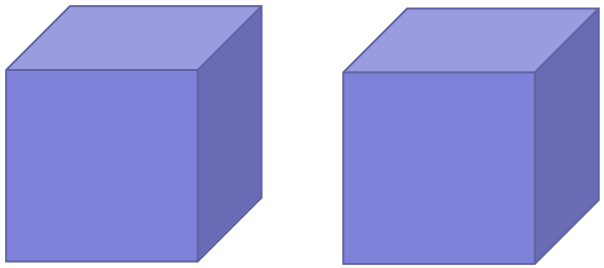
This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

-1 - (-3)



This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

$$-1 - (-3) = 2$$



This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu



This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

What is specified by the curriculum material in this segment?

- The goal (proficiency with integer arithmetic)
- Choice of representational context to use in lesson (chip model)
- Specific numerical problems and their sequencing

  -2 + 5; -1 - (-3)

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

What is left to the teacher's discretion by the curriculum material?

- Why those examples were chosen, and why that order
- Exactly how to coordinate between the model, the symbolic form, the meaning, and the answer
- What to emphasize and precisely what language to use in talking
- How to structure the dynamic of the interactions
- Additional examples
- What are the key mathematical ideas?
- Why this representational model, and pros and cons of others

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

What are the key mathematical ideas?

1. Integers

- Every integer is either a whole number or it is negative.
- Negative integers are the opposites of whole numbers, including that -(-a) = a
- A number has a sign and a magnitude.

2. Addition and subtraction

- Addition: Combining two quantities; Incrementing one quantity resulting in a second
- Subtraction: Taking away one quantity from another; comparison of two quantities, or difference between two quantities

3. Integer addition and subtraction: $a + (-b) = a - b$

Consequences: $a + (-a) = 0$ $a - (-b) = a + [-(-b)] = a + b$

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

Two possible representational "families"

- Chip models: Discrete modeling of negative and positive numbers
- Number line models: Continuous modeling

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

Chip model: Money version

- 5 + (-2)

  Miriam has $5 but she also owes Lily $2.

  Result: She has, net, $3.
- Mathematically appropriate
- But — young learners often do not have a "net worth" orientation and do not feel drawn to reconcile positive with negative quantities

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

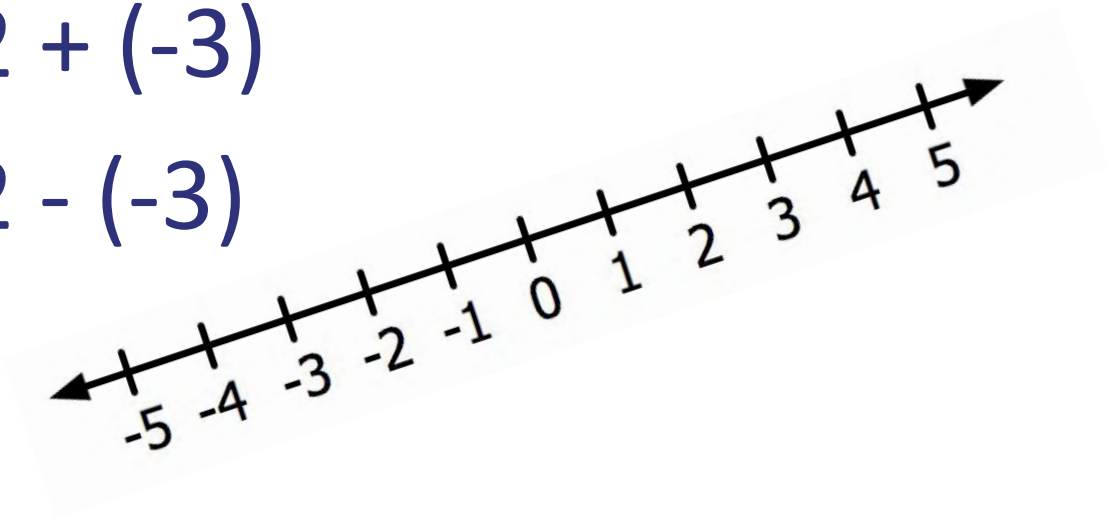
Number line models

2 + 3

2 - 3

2 + (-3)

2 - (-3)



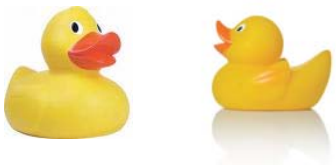
This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

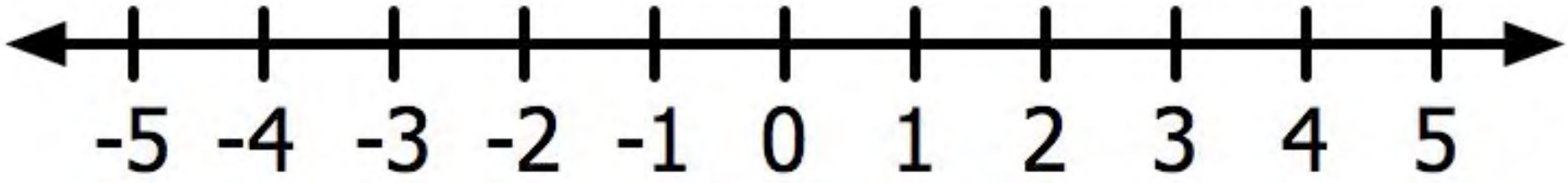
$$2 + 3$$

$$2 - 3$$

$$2 + (-3)$$

$$2 - (-3)$$





This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

2. A revised view of instructional practice

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

An underdeveloped conception of teaching practice

- Lack of attention to teaching
  - Value-added measurement that fails to investigate variation in teaching practices
  - Orientation to "constructivist" or "student-centered" classrooms s
  - Belief in teaching as highly unspecifiable
- A confounded view of "professionalism"
  - Agreement on the complexity of practice
  - Disdain for "prescriptiveness" and detail: "de-skilling" teaching (an irony)

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

The need for a new view of the practice of teaching

1. Teaching is intricate and deliberate work.
2. Teaching entails highly predictable routine practice as well as "thinking on your feet."
3. Teaching requires acts that are unnatural in everyday life, and do not depend on commonsense (Ball, 2007).

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

From negative views of "prescription" to sensible views on *specification*[2]

- If teaching is detailed work, then" its improvement depends on wise specification
  - The realities of scale
  - Shared commitment and responsibility to students
  - The importance of professional knowledge for improvement
- Not *whether*, but *what* and *how* to specify

[2]Cohen & Ball, 1999, 2000, 2009

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

What *could* be specified?

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu



This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

What could be specified?

- Details about the content and detailed aspects of it for teaching:: e.g., importance of re-representing -1 in in -1 – (-3)
- Clear specification of the mathematical point of the lesson: e.g., is it to learn how the model works, to get right answers to problems, to understand specific aspects of adding and subtracting with integers?)
- Predictable student responses, thinking, difficulties: meaning of subtracting a negative
- Clear explanations of choices of specific numbers, sequencing, use of representations (e.g., why not the number line? What is the point with the cubes?)
- Details of deployment: Ways to use the overhead, comparison with using whiteboard
- Questions, wording for ways to say or frame things (e.g., be careful to distinguish uses of "minus," "take away," "subtract." "negative
- Timing, pacing, types of time uses
- In-lesson assessment tools and support for interpreting results

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

3. How could curriculum be a more effective lever for improvement in educational outcomes?

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

The potential of curriculum to effect educational improvement by . . .

1. Promoting equity
   - Common content across teachers, schools, contexts (Anyon, 1981)
2. Supporting teachers' practice
   - Knowledge for teaching
   - Guidance for teaching
3. Strengthening teacher education
   - Common content to learn to teach
4. Building professional knowledge and community (Hiebert, Gallimore, &Stigler, 2007)
   - Distributing shared knowledge

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

What could be the role of curriculum materials in teacher learning and educational reform?[1]

Concept of **"educative curriculum"**:

- Shifts conception of who are "users" of curriculum
- Could serve as a manual to guide skilled practice
- Could provide more professional knowledge and insight, preparation for predictable *and* uncertain outcomes
- Could include "textbook cases" and ways to respond to them

[1]Ball & Cohen (1996), *Educational Researcher*

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

"Textbook cases"

- Highly predictable student responses or difficulties
- Explanations of their roots
- Two or three alternative responses or "instructional treatments," their rationales, and differences among them

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

What *can't* curriculum support?

- Real time enactment: Carrying out the specific treatments
- Highly unusual and unpredictable student responses or difficulties

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

Obstacles to curriculum as a lever for improvement in educational outcomes

- Romantic views of teaching
- Inattention to learning to use curriculum in teacher education
- History of “teacher-proof” curricula
- Lack of sufficient knowledge base about instructional practice
- Lack of knowledge for how to design usable educative curriculum: avoiding swollen and complex teachers’ guides

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

Toward a view of curriculum as a partner in educational improvement

- Providing resources for practice
- Designed for teachers as users
  - Appropriate guidance for the content and for the work of instruction
  - Intended for teachers' learning
  - Tool for distributing common professional knowledge

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

Implications for curriculum development

- Multiple kinds of expertise
  - Content
  - Student thinking
  - Instruction
- Testing in practice to learn about implementation and use

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

Questions about the role of curriculum in improving educational outcomes

1. **The continuum of teacher development**: Do teachers need different sorts of support at different points in their practice?
2. **Subject-specific differences**: Are there qualitatively and conceptually significant differences in the guidance needed in different fields or levels?
3. **Contextual differences:** Are there differences based on professional, societal, and cultural factors (within and across countries)?

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu

תודה

Thank you!

To obtain slides, please Google “Deborah Ball”

This work is licensed under the Creative Commons Attribution-Noncommercial-No Derivative Works Version 3.0 United States License: http://creativecommons.org/licenses/by-nc-nd/3.0/us/
© 2010 Mathematics Teaching and Learning to Teach • School of Education • University of Michigan • Ann Arbor, MI 48109 • mtlt@umich.edu