



Little Lone Peak from Lone Peak, Alpine, Utah.

Balanced Mathematics

What is it?

Context

- International comparisons - US ranks in the low range of mediocre
- 67% Math Phobic (Burns)
- Mathematics-related graduate work - international students
- Math Wars



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Our Secret Weapon . . . Teacher Character

- The vast majority of teachers are among the most unselfish people on earth.
- Teachers are always interested in changing their practice when they become convinced that change will help them reach more children.



Pendulum Swings . . . Going to Extremes

*Darling I don't know why I go to extremes.
Too high or too low there ain't no in-betweens.
And if I stand or I fall,
It's all or nothing at all
Darling I don't know why I go to extremes.*

-- Billy Joel



Balance

- A reaction to the pendulum swings that characterized reading instruction for decades resulted in Balanced Literacy.
- Can a similar reaction to the pendulum swings that now characterize mathematics instruction result in “Balanced Numeracy?”



So, what are we balancing?

- Type of math learned
- Type of teaching
- Type of outcome
- Number of strategies
- Type of assessments
- Pattern of interaction
- Nature of practice
- Role of application
- Type of grouping configurations
- Concepts ----- Procedures
- Inquiry ----- Direct
- Process ----- Product
- Multiple ways --- One right way
- Alternative ----- Traditional
- Discourse ----- One-way
- During discourse ----- Isolation
- Context ----- After learning
- Flexible ----- Whole class

What beliefs characterize a traditional approach to math teaching?

- Mathematics is a set of rules to be learned rather than a body of interrelated concepts.
- Teaching mathematics is tantamount to telling students how to follow procedures rather than supporting students as they make sense of mathematics for themselves.
- Learning mathematics is a process of practicing and memorizing rather than a process of reasoning and sense-making.
- In other words . . . Don't ask me why.
- (Ernest, 89)



From the mouth of babes . . .

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are needed to see this picture.

What does the NCTM *Principles & Standards* say about the BALANCE that should exist between learning procedures (how to do math) and learning concepts (why math works)?

- Learning mathematics *without* understanding has long been a common outcome of school mathematics instruction. In fact, learning without understanding has been a persistent problem since at least the 30's. (20-1)
- Students who memorize facts or procedures without understanding often are not sure when or how to use what they know, and such learning is often quite fragile. (20-3)
- Being **proficient** in a complex domain such as mathematics entails the ability to use knowledge flexibly, applying what is learned in one setting appropriately in another. One of the most robust findings of research is that conceptual understanding is an important component of **proficiency**, along with factual knowledge and procedural facility. (20-2)
- The alliance of factual knowledge, procedural proficiency, and conceptual understanding makes all three components usable in powerful ways. (20-3)

What beliefs about how children learn math characterize a more BALANCED approach to teaching math?

- Mathematics is a web of interrelated concepts and procedures.
- One's knowledge of how to apply mathematical procedures does not necessarily go with understanding of the underlying concepts. That is, students or adults may know a procedure they do not understand.
- Understanding mathematical concepts is more powerful and more generative than remembering mathematical procedures.
- If students learn mathematical concepts before they learn procedures, they are more likely to understand the procedures when they learn them. If they learn the procedures first, they are less likely ever to learn the concepts.
- (Philipp, 2006)

Concepts & Procedures

- Systems  Rules
(e.g., Number Sense Reading Numbers)
- Operations  Basic Facts
(e.g., Multiplication Sense . . . Times Tables)
- Algorithms  Computation
(e.g., Number Sense/Multiplication Sense . . .
Multiplication Procedure)

Related Issues in Balanced Literacy (Pinnell & Fountas)

- In the arguments about what constitutes effective instruction, two issues often arise:
- Should instruction be explicit or *implicit*, that is, embedded in the processes of reading and writing?
- Should we teach children directly or allow them to discover or generalize essential concepts for themselves?



Related Issues (con't)

- In the tug-of-war between direct teaching and discovery, going to extremes can be dangerous.
- Leaving everything to discovery will almost surely mean that many children will not attend to or acquire the understanding they need.
- Yet assuming that children learn only through direct teaching may lead us to neglect the power of the learning brain, that is, the excitement that makes learning real.



Deborah Loewenberg Ball

- At the heart of teaching well is the core challenge of getting learners engaged in productive work.
- This may occur through listening to a finely-designed lecture, participating in well-orchestrated discussion, working collaboratively with a few peers, or thinking intently on one's own.
- Implementing Standards-Based Mathematics Instruction, 2000

What other beliefs about the ways children learn characterize a balanced math classroom and what are their implications?

- Children can solve problems in novel ways before being taught how to solve such problems. Children in primary grades generally understand more mathematics and have more flexible solution strategies than their teachers, or even their parents, expect. (Inquiry Teaching)
- The ways children think about mathematics are generally different from the ways adults would expect them to think about mathematics. That is, real-world contexts support children's initial thinking whereas symbols do not. (Application Context)
- During interactions related to the learning of mathematics, the teacher should allow the children to do as much of the thinking as possible. (Discourse)
- (Philipp, 2006)

Inquiry Lesson (in part)

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Fundamental Inquiry

- Launch - present the task (problem)
- Explore - invite children to solve on their own in multiple ways
- Discuss - engage children in mathematical discourse in which they share and “argue” about their problem-solving strategies

Inquiry Lesson Model

1. Review and assess relevant prior knowledge
2. Present a worthwhile math task, inviting students to solve it in multiple ways of their own choosing (circulate and assess)
3. Engage students in small group discourse (circulate and assess)
4. Engage students in whole class discourse
5. Repeat steps 2-4 for practice purposes using a similar task
6. Present a third similar task for evaluation purposes

Process Standards - How Children do Math

- Problem Solving - solving real-life problems in multiple ways
- Communicating - explaining problem-solving strategies
- Reasoning & Proof - justifying those strategies
- Representing - showing math concepts in multiple ways
- Connecting - telling how representations, strategies, or previous and current math relate to each other

Process Standards Exemplified

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Questions, Comments