DMT INSTITUTE NEWSLETTER

Math Success with DMTI

RATIO TABLES: BUILDING MULTIPLICATIVE REASONING THAT LASTS

In today's edition, we explore:

- **The Classroom Reality:** Why students who know their times tables still fall apart at division, fractions, decimals, and proportions
- **The Structural Why:** How fact-first instruction leaves students without a framework for reasoning about relationships
- **The Instructional Shift:** Teaching ratio tables as a thinking structure, not a fill-in-the-blank activity
- **The Long Game:** How the same structure carries students from Grade 3 multiplication to Grade 7 slope

Educators

- A student fills in a ratio table perfectly — 1, 2, 3, 4 — then completely falls apart when you ask for 37.
- Another adds 4 to every column instead of multiplying: 1→4, 2→6, 3→8. When you ask why, she says it "keeps going up by 4."
- A third can work through a table when every column is given in order, but hands back a blank page when you scramble them.

These are not effort problems. They are the predictable outcome of instruction that taught procedures without building structure. **When multiplication is taught as fact retrieval rather than relational thinking,** students have no framework for scaling, proportional reasoning, or algebra — and a ratio table becomes just another box to fill in.

Our latest **DMT Insight — Ratio Tables: Building Multiplicative and Proportional Reasoning** — explains why these patterns persist and what a more durable instructional path looks like.

The Classroom Reality: Where the Problem Begins

In most classrooms, ratio table instruction looks like this:

- Tables are presented sequentially: students fill in 1, 2, 3, 4 in order, column by column
- The "1 column" is never made explicit as the unit anchor — it is just the first box
- Ratio tables are introduced as a procedure for a specific problem type, not as a generalizable structure
- Students are moved to cross multiplication before they understand proportional relationships

From a student's perspective, the message is clear: a ratio table is a thing you fill in, not a tool you think with.

So students apply the logic their instruction has given them:

- "I add 4 to each column because the pattern keeps going up by 4."
- "I can only do 37 if you tell me 36 first."
- "I need to write every number from 1 to 37 — there is no other way."
- "Fractions don't work in ratio tables — those are different."

The instruction is consistent — even when the mathematics it produces is fragile.

The Structural Why: Facts Without Relationships

Research helps explain why these errors persist. Two instructional patterns work against durable understanding.

The first is fact-first instruction. When students spend years memorizing isolated facts before reasoning about their relationships, they build no framework for scaling. They know 6 × 8 = 48 — but have no structure for 60 × 8 or 6 × 80 without starting over (Sweller, 1988; Hiebert & Carpenter, 1992).

The second is the missing unit anchor. Ratio tables only build multiplicative reasoning when students understand that every column must be checked against **"what does 1 represent?"** Without this anchor, the table is just a grid of numbers — and students pattern-match, add across columns, or give up (Gravemeijer, 1999).

The result: students can fill in a table, but they cannot use one.

The Instructional Shift: Structure Before Speed

The DMT Insight proposes a foundational reframe: before flexible strategies, students need a firm anchor in the unit relationship. This requires a deliberate instructional sequence.

- **Build meaning visually first.** Bar models and double number lines establish what one unit (group) is worth before any table is introduced.
- **Anchor every table to the unit.** The "1 column" is non-negotiable. Every other column must be verifiable against it. This separates multiplicative reasoning from pattern-matching.
- **Develop flexibility explicitly.** Students need prompts — "How can you jump to 10? How can you decompose 7 into parts you know?" — before they discover this themselves. Without them, sequential counting persists into middle school.
- **Delay formal algorithms.** Cross multiplication should follow understanding, not replace it. When students have built tables from the unit relationship, they understand **why** proportional relationships work, not just **how** to compute them.

When teachers ask **"What does 1 represent?"** at every grade level and in every context — students build a mental structure that transfers.

Small questions create large shifts:

- "How can you get to 37 without writing every number from 1 to 37?"
- "How do you know that column is right? What would 1 say?"
- "What would happen to the products if you doubled the multiplier?"

These questions move students from filling in boxes to **reasoning about relationships.**

The Long Game: From Multiplication to Slope

The most powerful insight in the DMT Insight is structural: **ratio tables are not a Grade 3 strategy — they are a structure that spans Grades 3 through 8.**

When students understand that a ratio table encodes a constant multiplicative relationship, they have already grasped the core of proportional reasoning. When they plot table pairs on a graph, they see a straight line. The slope of that line is the constant ratio they have been reasoning about all along.

- **Grade 3:** Ratio tables for whole-number multiplication (1 bag = 3 apples; 7 bags = 21)
- **Grade 5:** Ratio tables extended to decimals and scaling by powers of 10
- **Grade 6–7:** Ratio tables as the representation of proportional relationships and unit rates

The constant in a ratio table is the slope of the line. This makes ratio tables a direct precursor to $y = mx$ — and nothing needs to be unlearned. The structure grows with the student.

Your Turn to Share

We would love to hear from you. **What is one moment when a student's ratio table work revealed something surprising about their reasoning — in either direction?**

Share your thoughts at **contact@dmtinstitute.com**. We will compile and elevate your insights to help advocate for stronger teacher support across districts.

Keep inspiring mathematical minds!

MORE INFORMATION

This newsletter is just a preview—there is much more to explore. For the complete **research overview**, **teacher companion guide**, and **coaches deck**, visit the **DMT Insights** page at **dmtinstitute.com/research**.

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