DMT INSTITUTE NEWSLETTER

Math Success with DMTI

WHY COMMON SHAPE MATERIALS CREATE PREDICTABLE MISCONCEPTIONS: AND WHAT TO DO INSTEAD

In today's edition, we explore:

- **The Classroom Reality:** Why students insist a rotated square is a "diamond"
- **The Cognitive Why:** How posters and worksheets quietly train picture-based thinking
- **The Instructional Shift:** How teaching shapes as intersecting lines builds durable understanding
- **The Materials Question:** What to audit, remove, and replace in K–8 geometry resources

Educators

A student looks at a square drawn on a corner and says, *"That's a diamond."* Another insists, *"Squares aren't rectangles—rectangles are the long ones."*

These are not careless mistakes. They are **logical conclusions drawn from the materials students see every day**.

Posters, worksheets, anchor charts, and online resources often teach shapes as **pictures to recognize** rather than **structures defined by properties**. Over time, students learn a "folk geometry" where orientation, symmetry, and cultural labels matter more than straight sides, closure, and invariant relationships.

Our latest **DMT Insight—*The Diamond Problem: How Everyday Language Undermines Geometric Thinking*** explains why these misunderstandings are so persistent and how a small but powerful instructional shift can prevent them.

The Classroom Reality: Where the "Diamond" Comes From

Many classrooms display shape charts that list:

> Circle, Square, Rectangle, Triangle, Oval, **Diamond**

The message is subtle but powerful**: a diamond is a basic shape category**.

Students quickly infer the rule:

- Square on a side = square
- Square on a vertex = diamond

From the student's perspective, this makes perfect sense. The materials are consistent—even when the mathematics is not.

Research in mathematics education and cognitive psychology shows that **students build shape categories from**

repeated examples rather than from formal definitions alone. When those examples emphasize appearance and orientation, misconceptions become stable and resistant to correction.

The Cognitive Why: Pictures Before Properties

Children naturally organize geometric ideas around **prototypes**—upright triangles, long rectangles, and symmetric shapes. These visual shortcuts are efficient, but they narrow what "counts" as a shape.

Without deliberate variation and precise language, students form internal rules like:

- "Triangles must point up."
- "Rectangles must be long."
- "Rotation changes the shape."

This is not a lack of effort or intelligence. It is a predictable outcome of **prototype-heavy instruction**.

The Instructional Shift: Shapes as Intersecting Lines

Our research overview proposes a simple reframe: **Teach shapes as systems of intersecting straight lines—not pictures to name.**

From this perspective:

- **Vertices** are points where lines intersect
- **Sides** are straight segments between intersections
- A **polygon exists only when those segments are closed**

Only after straightness, closure, and the number of vertices are established do **properties** (right angles, equal sides, parallelism) determine *which* polygon it is.

This shift:

- Makes orientation irrelevant
- Clarifies why squares are rectangles
- Eliminates "diamond" as a mathematical category
- Connects early geometry to later work in area, similarity, and proof

The Materials Question: What to Remove, Replace, and Redesign

If students are consistently confused, the issue may not be instruction—it may be the **training set**.

High-impact moves include:

- Removing posters that list "diamond" as a basic shape
- Replacing definitions like "rectangles are long" with property-based language
- Auditing example spaces for overuse of upright, regular, and symmetric figures

- Intentionally including rotated, irregular, and non-prototypical examples

Small changes in materials can produce **large changes in student reasoning**.

A Question Worth Asking

If students learned geometry **only** from your posters, worksheets, and examples:

- **What theory of "what makes a shape a shape" would they construct?**
- That theory is being built every day—whether intentionally or not.

Your Turn to Share

We would love to hear from you. **What is one form of support that would genuinely help you teach math more effectively?** More time to collaborate? More demonstrations? Deeper content learning? Better coaching?

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

Keep inspiring mathematical minds!

MORE INFORMATION

This newsletter is just a preview—there is more to explore! For the complete research overview and additional videos, visit the "DMT Insights" page at dmtinstitute.com/research. You will find deeper insights, classroom strategies, downloadable resources, and more ways to expand your math teaching.

Have a classroom story, tip, or question to share? We love featuring educator voices and ideas. Email us at mathsuccess@dmtinstitute.com to contribute a teaching tip or share your experience—your story could be in our next newsletter!

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