NEWSLETTER

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WHEN A SQUARE BECOMES A "DIAMOND"

Why Mathematical Language and Defining Properties Matter

In today's edition, we explore:

- **The rotated square:** why it is still a square
- **Why familiar examples matter:** prototypes and concept images
- **Classroom tips:** four things teachers can do
- **The research:** how students' geometric reasoning develops

Educators!

A student looks at a square that has been rotated and calls it a "diamond." Another says a square cannot be a rectangle because rectangles are longer.

These responses are familiar, but they raise an important question about how we teach geometry. Are students identifying shapes by their appearance, or are they examining the properties that define them?

A "diamond" is not a separate mathematical category of shape. A square remains a square no matter how you rotate it. In schools, we should use correct mathematical terminology and help students understand why a figure belongs to a particular category.

Our latest DMT Insight examines research on geometric thinking, familiar examples, and the development of reasoning about properties and relationships.

Why Familiar Examples Influence Classification

Children often organize shape categories around familiar examples, or prototypes: upright triangles, long rectangles, and symmetric shapes. Researchers distinguish a student's concept image, the examples and pictures associated with a concept, from the concept definition, the properties that specify it (Tall & Vinner, 1981). A student may know a shape's definition but still rely on a familiar image when deciding whether a figure belongs to that category.

Without varied examples, students may form rules such as "Triangles must point up," "Rectangles must be long," or "Rotation changes the shape."

Help students investigate the straight sides, vertices, angles, and relationships that define polygons and their categories. A square remains a square when rotated because its four congruent sides and four right angles do not change. It is also a rectangle and a rhombus because it has all the defining properties of each.

Classroom Tips

1. **Use correct mathematical terms.** A rotated square is still a square. Do not teach “diamond” as a separate category of shape.
2. **Vary the examples.** Include rotated, irregular, and unfamiliar figures so students examine defining properties.
3. **Ask students to explain.** What properties make this a square, rectangle, triangle, or other polygon?
4. **Examine relationships.** Help students explain why a square is also a rectangle and a rhombus.

Varying examples and asking students to examine defining properties can help them classify shapes without relying on orientation or familiar appearance.

What Does the Research Say?

In a study of 82 five- and six-year-olds, most children identified a familiar triangle, but about half had difficulty identifying triangles of other sizes, types, and orientations (Dağlı & Halat, 2016). van Hiele (1986) described geometric thinking as moving from recognizing shapes as wholes to analyzing their properties and reasoning about relationships among categories.

Keep developing mathematical thinkers.

More Information

This is a quick overview. To read DMT Insight 41, watch the video, and download the Companion, go to DMT Insights at mathsuccess.io/dmtinsights.

What shape do your students most often classify by appearance? What happens when you ask them to explain which properties define it? Share it with us at contact@dmtinstitute.com.

For more information on professional development and curricular resources, visit mathsuccess.io.

