

Using Frayer Diagrams to Support Understanding of Shapes

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NCTM Regional Conference

November 29-30, 2012

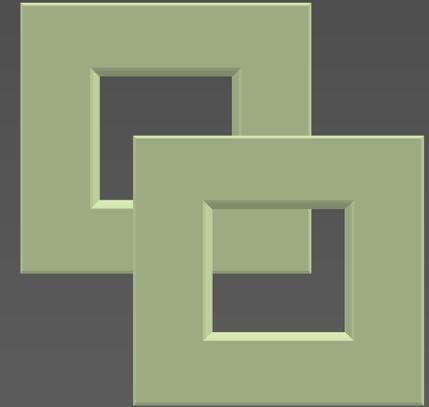
Chicago, Illinois

Levels of Geometric Thought

van Heili, 1999

- Visual
- Descriptive
- Informal Deductive
- Formal Deductive

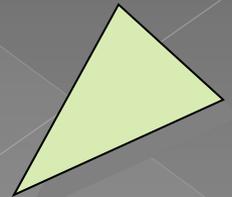
Level 1: Visualization



- Non-verbal thinking
- Figures are judged by appearance
- “It’s a square because I see it is.”
- “It’s a rectangle because it looks like a door.”

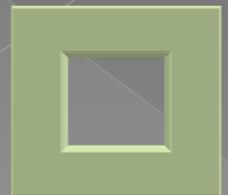
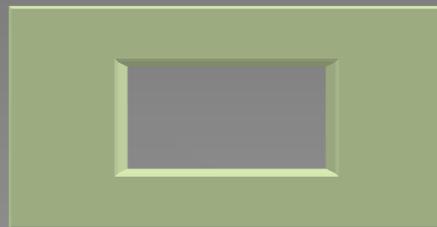
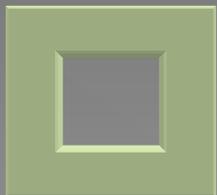
Level 2: Description (Analysis)

- ◉ Figures are judged by their properties
- ◉ Language is used to describe shapes, yet properties are not logically ordered
- ◉ “An equilateral triangle has...3 sides, all sides are equal, 3 equal angles, line symmetry, rotational symmetry”



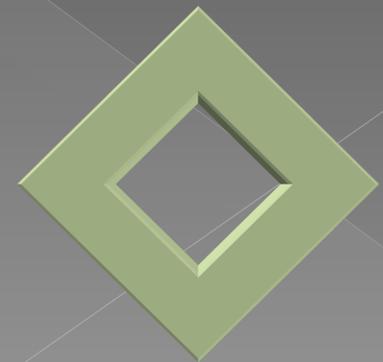
Level 3: Informal Deduction

- Students see that shapes have properties that can be logically ordered or deduced from each other.
- Students use properties to justify relationships
- “A square is also a rectangle because it has all the properties of rectangles.”



Level 4: Formal Deduction

- ◉ Students can understand that a minimal number of properties can define a shape
- ◉ Students' make deductions based on definitions, theorems, and axioms.



Triangle Task – Part 1

Individually complete the triangle task

- It isn't necessary for you to write the type of complete answers you would like to see from students.
- **What key attributes of each shape helped you to make a decision?**
- **What attributes would you like your students to notice as they complete the task?**

Triangle Task – Part 2

With a small group, analyze student work. Use post-it notes to label each paper with a level of geometric thought (i.e., 1-4)

- **What evidence of levels of geometric thinking are available in students' answers?**

Phases for Teaching

(van Heili, 1999)

- **Inquiry** – guided exploration to discover structures
- **Direct Orientation** – sequence of tasks where characteristic structures gradually appear
- **Explicitation** – teacher introduces terminology and encourages its use

Phases for Teaching (cont.)

- **Free Orientation** – tasks that can be completed in a variety of ways; tasks allow students to construct deep conceptual knowledge
- **Integration** – tasks that require students to pull together what they know



Is it a polygon?

- Study the examples of polygons and non-polygons on page 167.
- Use the attributes of the examples to decide if the 12 shapes on p. 162 are polygons or non-polygons
- In silence, participants will draw one of the shapes from p. 162 on the board in the appropriate category
- Discussion...

Polygon Definition Posters

- Polygons must have...
- Polygons must not have...

Lesson Steps

- ◉ Sort polygons according to number of sides
 - > Explicitly label types of polygons (teacher)
- ◉ Create poster for “All triangles have...”
- ◉ Sort triangles into three piles
- ◉ Create poster for “Some triangles have...”
 - > Explicitly label types of triangles
- ◉ Create Frayer diagrams for triangles