Giant Polyhedra, Inside and Out: Hands-On Development of 3-D Concepts

Dr. Jacqueline Sack
Dr. Michael Connell

University of Houston Downtown

NCTM Annual Meeting, Philadelphia, April 2012

Research Backdrop

- Hidden mathematics framework (Abramovich & Brouwer, 2006)
- Access to depth and rigor for all
- Actions on objects (Connell, 2001)
- NCTM Process Standards
- van Hiele levels (1986)

References

Abramovich, S., & Brouwer, P. (2006). Hidden mathematics curriculum: A positive learning framework. For the Learning of Mathematics, 26(1), 12-16, 25.

Connell, M. L. (2001). Actions on objects: A metaphor for technology-enhanced mathematics instruction. Computers in the Schools, 17(1-2), 143-171.

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https://sites.google.com/site/mathematicsrigor/

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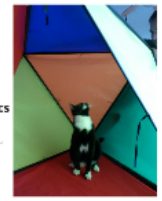
Rigorous Mathematics for All



Action!

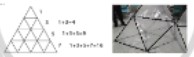
Relationships and Analysis

Other learning trajectories

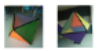
2-D geometry
Outline the polygons
Find all diagonals
What shapes are formed?
Measure the angles
...

Measurement
Surface area and volume
Indirect measurements of figures using scale drawings, similar figures, Pythagorean Theorem, and basic trigonometry

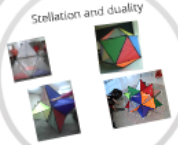
Dilations
How many triangles if the edges are doubled?
How many unit tetrahedra will fill the larger figure?
Can you tessellate space with regular tetrahedra?
Number relationships in scaling
...



Symmetry and transformations
Planes of symmetry
Rotational symmetry
Use symmetry to enumerate



Stellation and duality



Curvature
What if each vertex must have more than 6 triangular faces?

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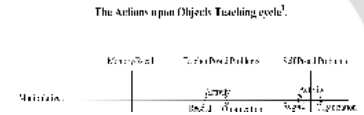

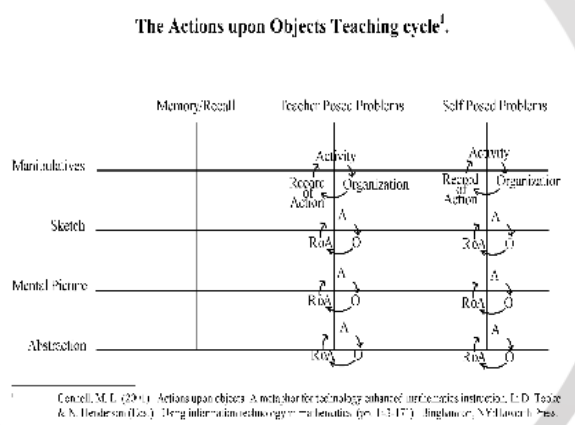

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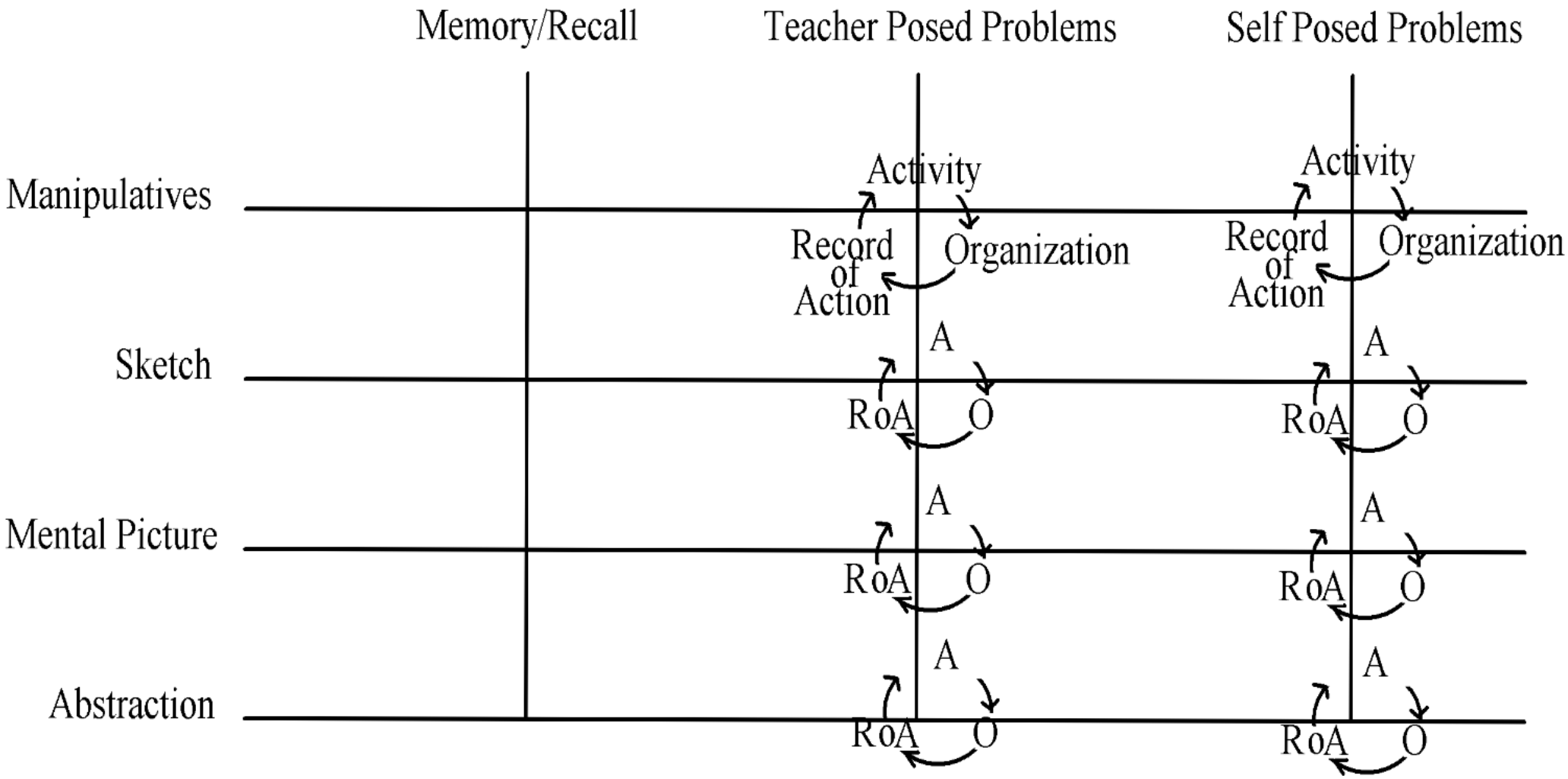
The Actions upon Objects Teaching cycle[1].



[1] Connell, M. L (2001). Actions upon objects: A metaphor for technology enhanced mathematics instruction. In D. Tooke & N. Henderson (Eds.). Using information technology in mathematics. (pp. 143-171). Binghamton, NY:Haworth Press.

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Relationships and Analysis

Figure	$V_{vertices}$	E_{edges}	F_{faces}	Angle Deficiency

Relationships and Analysis

Figure	Vertices	Edges	Faces	Angle Deficiency

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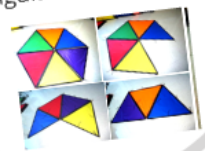

2-D geometry

Outline the polygons

Find all diagonals

What shapes are formed?

Measure the angles

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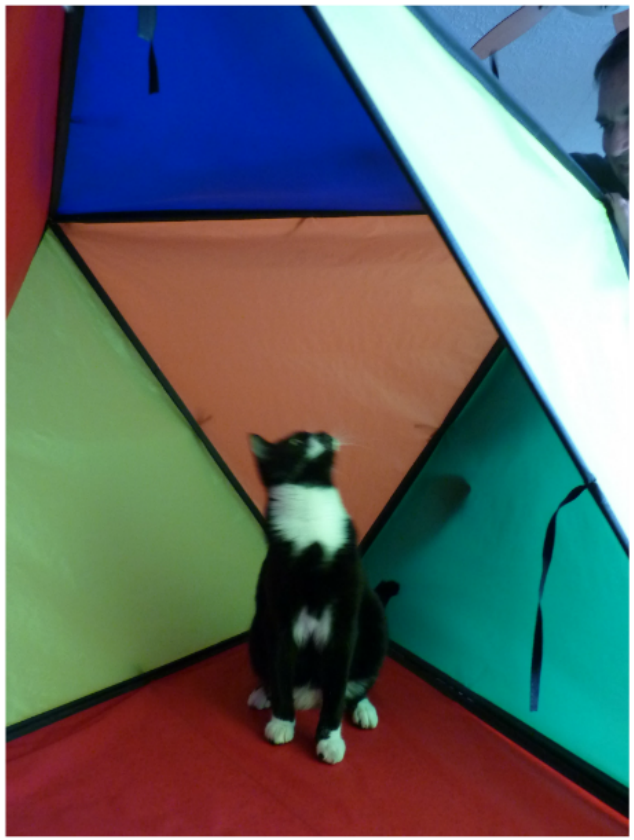

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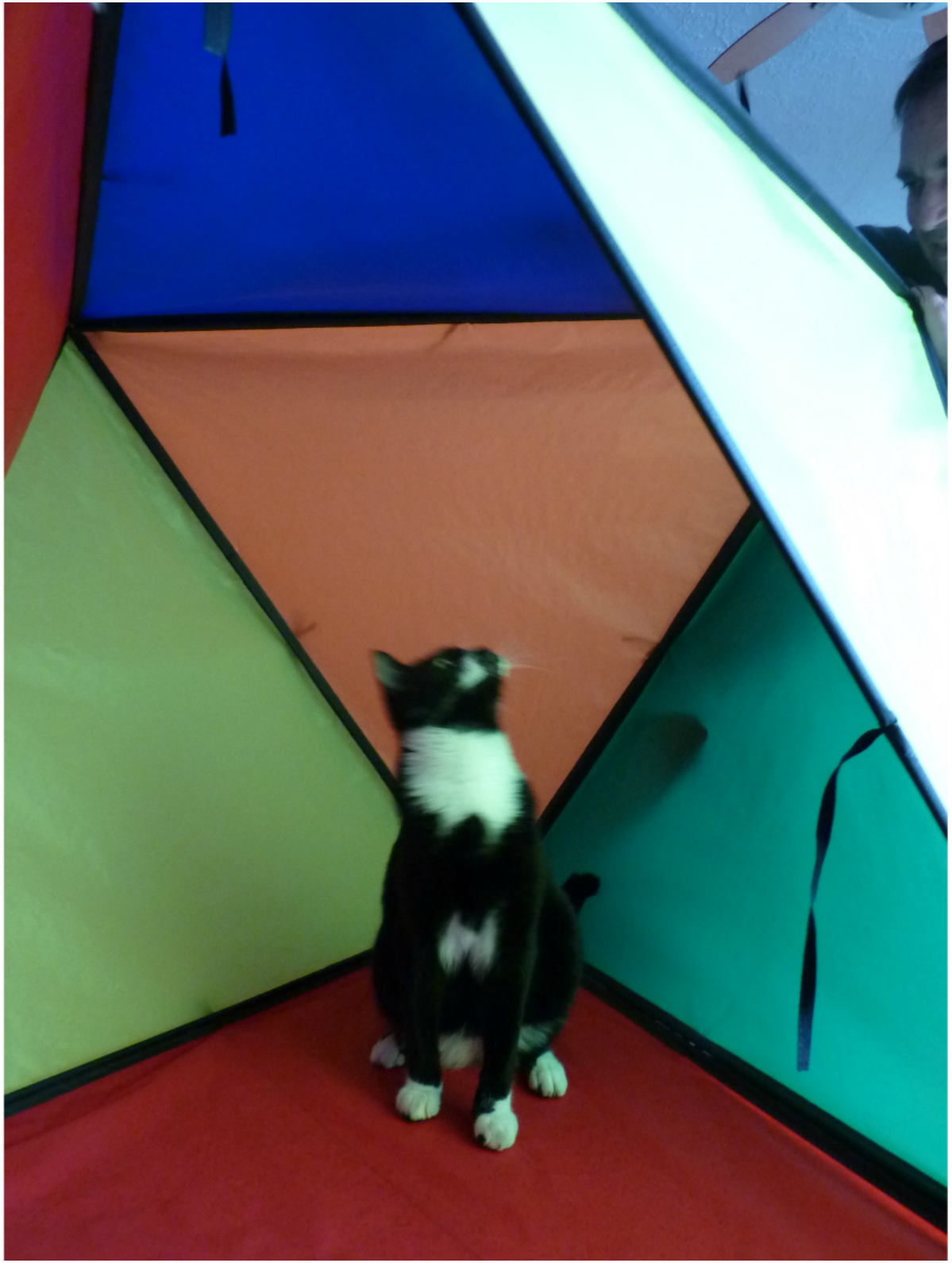

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