

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

Dr. Jacqueline Sack
Dr. Michael Connell

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References

Abramovich, S., & Brasseur, P. (2009). Hidden mathematics curriculum: A positive learning framework for the Learning of Mathematics, 25(1), 12-16, 25.
Connell, M. L. (2001). Actions on objects: A metaphor for technology-enhanced mathematics instruction, Computers in the Schools, 17(1)-23, 143-171.
van Hiele, P. M. (1986). Structure and insight: A theory of mathematics education, Academic Press, Orlando, FL.
<https://sites.google.com/site/matheducation/>

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Research Backdrop

Access to depth and rigor for all



NCTM Process Standards

van Hiele levels (1986)

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



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



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
...



Stellation and duality



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





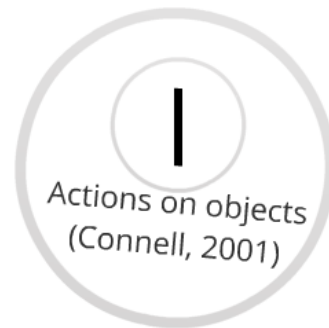
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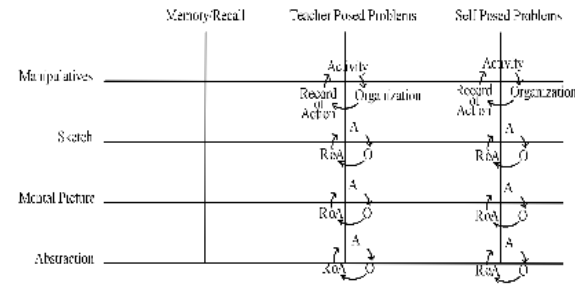
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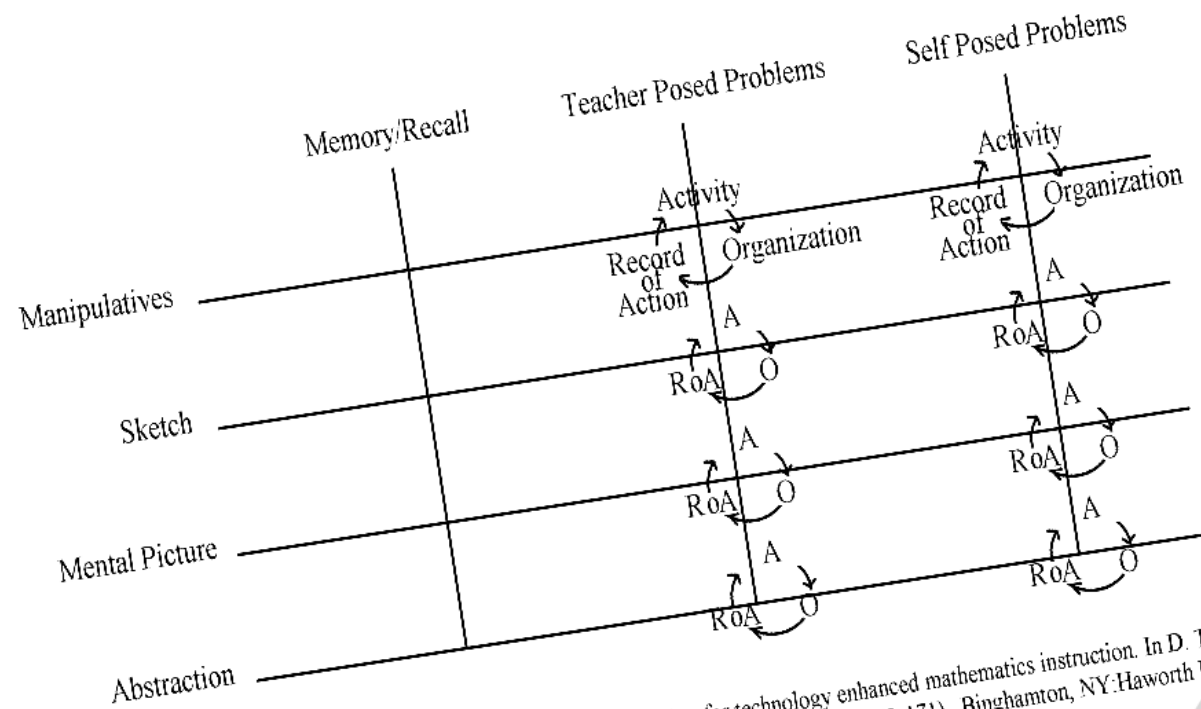
The Actions upon Objects Teaching cycle¹.



¹ Connell, M. L. (2001). Actions upon objects: A metaphor for technology-enhanced mathematics instruction. In D. Teckle & S. Hedderley (Eds.), Using information technology in mathematics (pp. 113-117). Binghamton, NY: Corwin Press.

Actions on objects (Connell, 2001)

The Actions upon Objects Teaching cycle¹.



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.

Access to all

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Action!



Relationships and Analysis

Figure	Vertices	Edges	Faces	Other Topology



Relationships and Analysis

Figure	Vertices	Edges	Faces	Angle Deficiency

Figure	V ertices	E dges	F aces	Angle Deficiency

Other learning trajectories

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2-D geometry

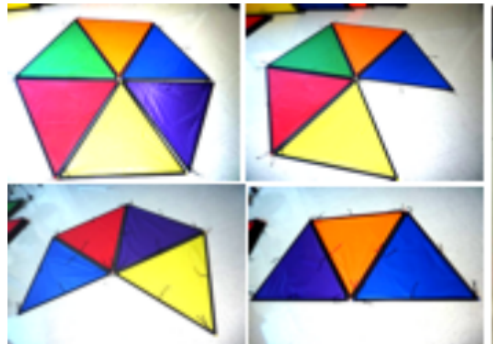
Outline the polygons

Find all diagonals

What shapes are formed?

Measure the angles

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Stella



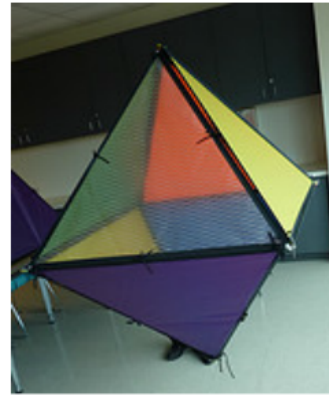
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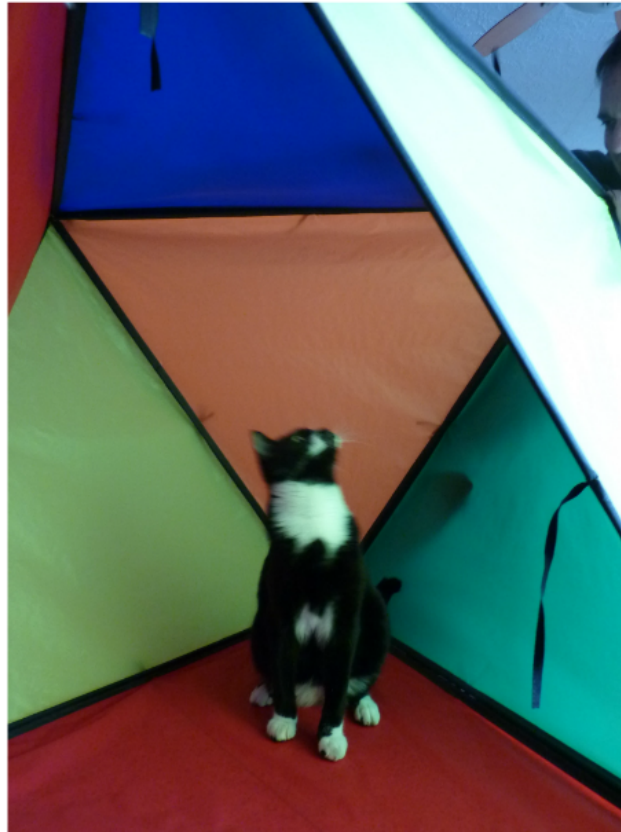
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