Using Art To Develop Girls' Measurement Skills

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National Council of Teachers of Mathematics
94th Annual Meeting and Exposition
San Francisco, April 2016

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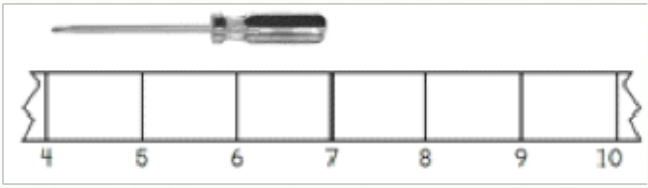
Some Benefits of Creating Art
- Motivation
- Different learning mode and expression
- Enhanced learning in other subjects (e.g., geometric reasoning)
- Perspective-taking (expanded thinking; diversity education)
- Particular benefits for low-income students

Visual Arts & Math
- Require ongoing problem solving
- Involve reflective thinking
- Use exploration and creativity
- Convey information

Measurement: Meaning & Use
- "Assignment of a numerical value to an attribute of an object [e.g., length, area]" (NCTM *Standards*, 2000, p. 44)
- Subdivision of defined space into appropriate same-sized units that are counted
- "Serves as a foundation for much of the sciences, and is one of the most widely used applications of mathematics in everyday life" (Vasilyeva et al., 2009, p. 401).

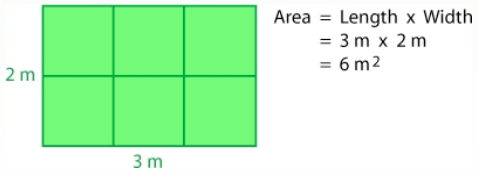
Measurement of Space
Length; area; perimeter; volume; surface area; amount of opening (of an angle)

Measurement: Challenging for Students
- Lack of understanding about properties being measured
- Lack of understanding about units and their use (appropriate unit for attribute, inverse between unit size and number of units, unit iteration procedure)
- Overemphasis on numerical cues (e.g., "broken ruler")



Females' Performance in Measurement

- Weak overall in relation to boys
- Gap larger among lower achievers and low-income students; widens over time
- Boys stronger on spatial/conceptual measurement, girls on formula-based measurement



- Influenced by females' lower spatial skills

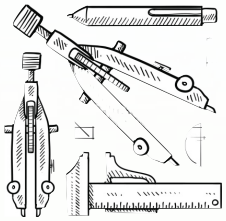
Sources: National Assessment of Educational Progress (various years); Ngware et al. (2012); Vasilyeva et al. (2009)

Some Art-Math Quotes

- "Creating *aesthetically-rich* mathematical classrooms requires *untidying* the mathematical experiences of students" (Dietiker, 2015, p. 3).
- "Designing mathematically inspired art projects has the potential to disrupt the belief some students have that mathematics is not a creative subject, but one reducible to systems of rules and procedures" (Ernest & Nemirovsky, 2015, p. 17).
- "Visual art offers a pathway to deep mathematical understanding" (Holtzman & Susholtz, 2011, p. 2).

Art Elements & Design Principles

• Space	• Value	• Balance	• Rhythm
• Line	• Texture	• Proportion	• Unity
• Shape	• Color	• Contrast	• Emphasis
• Form		• Movement	



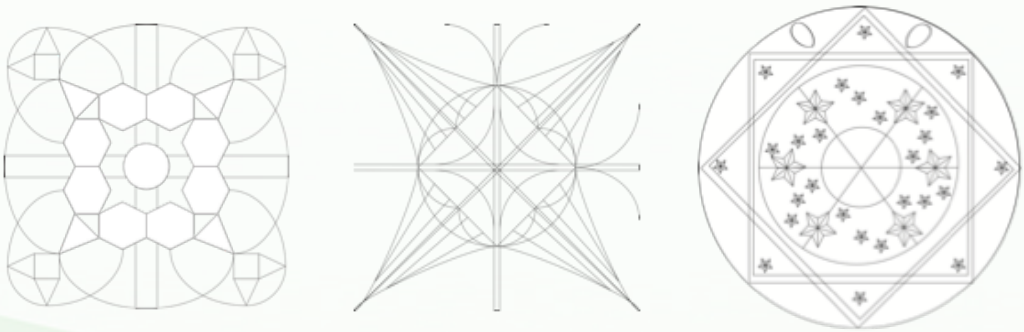
Example Art-Measurement Projects (pen-to-paper, graphic design, digital design)

Mandala; cyborg; sundial; creation of a brochure; packaging design (including flaps); mosaic projects; proportional drawings

Mandala

In common use, "mandala" has become a generic term for any diagram, chart or geometric pattern that represents the cosmos metaphysically or symbolically; a microcosm of the universe.

Measure from the center (origin) and work outward in all directions. Use lines and shapes to create a symmetrical and visually pleasing design.



Cyborg

The objective of this project is to design a blueprint and create a three-dimensional Cyborg, which is part organic and part machine. Design a Cyborg showing four different views: front, side, back and internal. The drawings are to include the dimensions (l-w-h), ratio between the organic and mechanical surfaces, texture and color. Using the drawings as a blueprint, create a three-dimensional model of the Cyborg.

Selected Resources

- ArtSciMath: Integrated Art Lessons: artscimath.com
- Holtzman, C., & Susholtz, L. (2011). *Object lessons: Teaching math through the visual arts, K-5*. Portland, ME: Stenhouse.
- Sousa, D. A., & Pilecki, T. (2013). *From STEM to STEAM: Using brain-compatible strategies to integrate the arts*. Thousand Oaks, CA: Corwin.
- STEM to STEAM: stemtosteam.org

References

- Dietiker, L. (2015). What mathematics education can learn from art: The assumptions, values, and vision of mathematics education. *Journal of Education*, *195*(1), 1-10.
- Ernest, J. B., & Nemirovsky, R. (2015). Arguments for integrating the arts: Artistic engagement in an undergraduate foundations of geometry course. *PRIMUS*. DOI: 10.1080/10511970.2015.1123784
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- National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics*. Reston, VA: NCTM.
- Ngware et al. (2012). What explains gender gaps in maths achievement in primary schools in Kenya? *London Review of Education*, *10*(1), 55-73.
- Vasilyeva et al. (2009). Measurement skills in low-income elementary school students: Exploring the nature of gender differences. *Cognition and Instruction*, *27*(4), 401-428.