Thinking Tools for Innovators: Part 9—Dimensional Thinking

Recent research has shown that we can build innovative thinkers by reinforcing a set of thinking tools, including such skills as observing, abstracting, pattern recognition, modeling, and transforming (among others). As these skills can all be taught, it makes sense that we can help students become the creative thinkers that we will need in the twenty-first century. This lesson plan is the ninth in a series that is focused on using art to enrich instruction in these critical skills. The research on which this information is based can be found in many sources, perhaps best summarized in the book *Sparks of Genius: The Thirteen Thinking Tools of the World's Most Creative People* by Robert and Michele Root-Bernstein.

We see flat images all the time, on our television screens and monitors, as paintings hung in the walls of art museums (or homes). We take a picture with a cell phone and send it to a friend or to a social media page where thousands of others can see it. And yet, we have no problem noting that this flat image actually represents something three dimensional. Dimensional thinking extends this basic understanding and allows us to move comfortably between two dimensions and three dimensions, and back again. There are many skills involved in dimensional thinking, but the basic ones include mapping (the ability to see information in two dimensions and understand it in three); scaling (altering the proportions of an object to better represent it in a different dimension); and dimensional conceptualizing (imagining how something will "turn out" in other dimensions). If you ever folded a paper airplane you used dimensional conceptualizing. After all, how did you know that the folded paper would become a functional glider when unfolded?

Curricular Areas

Mathematics, Visual Arts – Aesthetic Response

Grade Level

Best for middle school, but can be adapted to all grade levels

Common Core Academic Standards

- CCSS.Math.Content.6.G.A.4
- CCSS.Math.Content.7.G.A.1

National Visual Arts Standards

Artistic Process: Responding – Understanding and evaluating how the arts convey meaning

Art Images Required

Click on the titles below to view high-resolution photographs on the Philadelphia Museum of Art website. Images that are also available in the Artstor Digital Library are indicated by an ID number or search phrase.

Perspective View of a Fencing Hall (Vue d'Optique)
Made in Italy
Late 18th century
Philadelphia Museum of Art
Gift of the Young Friends of the Philadelphia Museum of Art, 2009
2009-112-1

- *Perspective View of a Fencing Hall (Vue d'Optique)*, late 18th century, made in Italy

Not available on Artstor

- *Railroad Bridge, Argenteuil*, 1874, by Claude Monet
  Artstor search: Railroad Bridge Monet Philadelphia

- *Virgin and Child Enthroned and Donor, Angels*, c. 1319, by Pietro Lorenzetti
  Artstor search: EW1985-21-1,2

- *Virgin and Child, with Saints Apollonia and Sebastian*, 1490s, by David Ghirlandaio
  Artstor search: Ghirlandaio Philadelphia

Lesson Process

Note to teacher: You may want to preface this lesson with another on the Museum website, *Thinking Space: the Grid in Art and Math*. This math-related lesson follows the process of moving from 2-D to 3-D and back again.

1. Display and examine the painting *Perspective View of a Fencing Hall.* Ask if anyone can explain how the artist gave the impression that this was a three-dimensional scene (i.e., how the artist depicted depth in the painting). What "tricks" can we use if we want to accomplish the same sort of depth when we draw? List these ideas for later reference.

2. Now look more closely at the building in the painting. Even though buildings are made of rectangular surfaces, look for where the artist has depicted diagonal lines. (You can highlight these lines on a smart board or whiteboard, or students can draw them onto a print of the painting.) This is sometimes called the railroad track effect. Can anyone understand why it is called this? More often, this is called one-point perspective, and the point on the horizon where those diagonal lines meet is the vanishing point.

3. On a black piece of paper, mark a dot in the center of the page, about one-third from the top. Then, use a straight edge and connect the dot with a line to one bottom corner, adding another line to the opposite bottom corner to form a triangle. The dot is your vanishing point, and the two lines mark your lines of perspective. Have students mark a second paper in the same way.

4. Use the first paper to create a simple drawing: use the lines as the basis for a roadway, railroad tracks, river, or rows of trees—something vanishing into the distance. Add to the perspective of the drawing by noting that objects farther from the viewer appear smaller. Trees in the distance should be smaller than trees in the foreground. Use additional diagonal lines from the vanishing point to sketch the tops of a row of trees to see how the height changes. Changing the size of an object to represent its distance from the viewer is called *scaling*. A horizontal line through the dot creates a horizon line for the simple drawing.

5. Once students have the idea, use the second paper for something more creative. Some students may draw something that wavers from the line, like a winding stream. Some may turn the page sideways and use the perspective lines as architectural lines on the side of a building (similar to the *Fencing Hall* image).

6. View *Virgin and Child Enthroned* by Pietro Lorenzetti. After a discussion of what students see, display *Virgin and Child, with Saints Apollonia and Sebastian* by David Ghirlandaio. Note: if there is a way to display both side-by-side, that would be ideal. If not, perhaps a few 8x10" prints would be helpful. Lorenzetti's painting was created around 1319, while Ghirlandaio's was created in the 1490s. Compare

these paintings, particularly the use (or lack) of one-point perspective. In the Ghirlandaio painting, where is the vanishing point? (Answer: the hand of Jesus, giving the sign of a blessing.) Why might this be a significant location?

Assessment

1. View the image, *Railroad Bridge, Argenteuil*. In a brief essay, describe Monet's use of perspective and explain its effect on the viewer of the artwork.

2. Have students (perhaps in pairs) gather a group of art images—half of which show clear perspective and half of which do not. Look for images of similar topics so that they can be compared side-by-side.

Enrichment

1. How did artists discover the "secret" of perspective? Research this topic and present a summary to the class ,highlighting both the artistic and the mathematical aspects of this development.

2. Once an artist understands perspective, he/she can "play" with it. Research drawings by M. C. Escher that play with perspective. Present some of these to the class, discussing how he has altered perspective to create interesting images.