

Integrating Mathematics and the Visual Arts

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Kindergartners engaged in a literature-based, integrated mathematics-arts activity where they explored and discussed lines, rectangles, and squares and then created a piece of abstract artwork in the spirit of Piet Mondrian.

Introduction

The visual arts present an ideal and unique forum through which students can express their thoughts, ideas, and emotions. More specifically, the visual arts, which range from “drawing, painting, sculpture, and design, to architecture, film, video, and folk arts” (MENC, 1994, p. 33), embody mathematics, as students can explore such interrelated concepts as patterns, line, shape, and form. Given the growing body of evidence which documents that learning in the arts involves principles shared with other academic disciplines (Bransford et al., 2004; Deasy, 2002; Jensen, 2001; Scripp, 2002), it is not surprising that integrating the arts with other content areas is mounting (Efland, 2002; McDonald & Fisher, 2006; Phillips & Bickley-Green, 1998; Walling, 2005; Ward & Muller, 2006). Further, in learning the characteristics of and mathematics embedded in the visual arts, students can collaboratively engage in communicating, reasoning, and investigating -- activities that both the NCTM (1989, 2000) and MENC (1994) strongly advocate.

MENC (1994) has identified as its goal for the *National Standards for Arts Education* to “help students make connections between concepts and across subjects” (p. 13) as the learning tasks defined by these *Standards* serve as “bridges among the arts disciplines, and finally as gateways from the arts to other areas of study” (p. 13). NCTM (2000) echoes these same sentiments and advocates that students’ mathematical experiences at all levels include opportunities for connections to other subject areas and disciplines, especially because mathematics permeates music, art, science and social studies. Additionally, integrating children’s literature into the teaching and learning of mathematics is gaining momentum. In fact, a growing body of research and anecdotal evidence documents the potential and power of using children’s literature in mathematics classrooms (Avery & Avery, 2001; Burns & Sheffield, 2004; Capraro & Capraro, 2006; Carr, Buchanan, Wentz, Weiss, & Brant, 2001; Draper, 2002; Hellwig, Monroe, & Jacobs, 2000; Hunsader, 2004; Johnson & Giorgis, 2001; Leu, Castek, Henry, Coiro, & McMullan, 2004; Monroe & Livingston, 2002; Moss, 2003; Moyer, 2000; Ward, 2003, 2004a, 2004b, 2004c, 2005, 2006a, 2006b; Ward & Muller, 2006; Whitin & Whitin, 2004; Young, 2001).

Because many mathematical ideas and concepts are abstract or symbolic in nature, children’s literature offers teachers the opportunity to present and discuss these ideas and concepts within the context of a story, using illustrations, prose, and more informal, familiar language. This, in turn, can make the learning of mathematics less intimidating and more engaging, especially for students whose first language is not English. Further, using children’s literature to teach mathematics provides students with additional opportunities, encouragement, and support for speaking, writing, reading, and listening in mathematics classes, and many pieces of literature, such as biographies and poetry, can bring the learning of mathematics, as well as other content areas, and the visual arts to life (Ward, 2004a; Ward, 2005; McDonald & Fisher, 2006).

Mathematics-Art Lesson

A class of 22 gifted and talented kindergartners enrolled in an elementary school in southwest Texas participated in this integrated activity. Serving as the focal point of the activity was the artwork of Piet Mondrian, a twentieth century Dutch abstract artist who experimented with lines and the primary colors in his *Composition* series. His intersecting, black, vertical and horizontal lines resulted in rectangular and square regions, some of which he then colored using the primary colors: red, blue, and yellow (see figure 1).

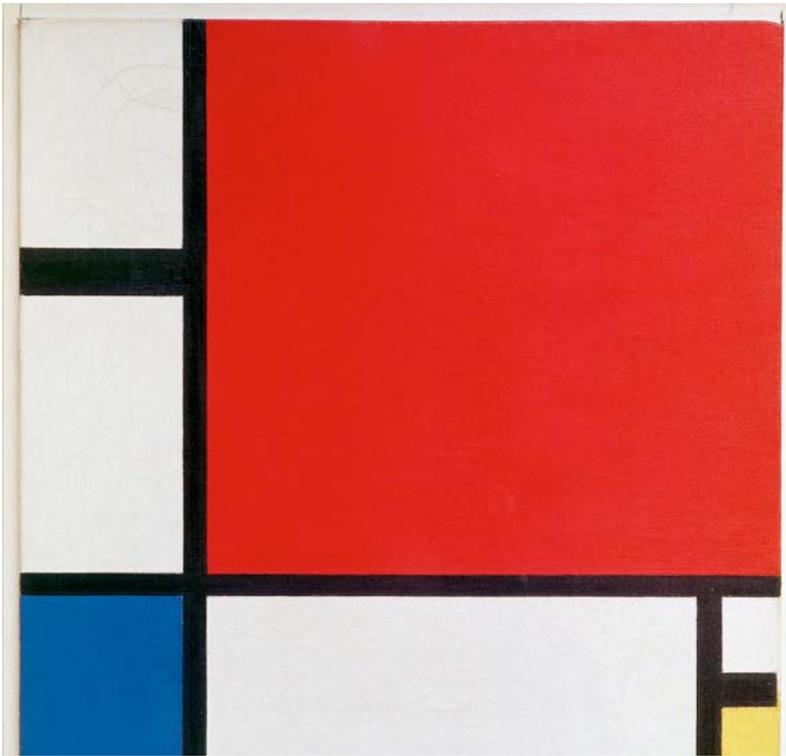


Figure 1. Piet Mondrian's *Composition with Red, Blue, and Yellow* (1930).

Before observing and discussing Mondrian's *Composition* paintings, students, who were seated at tables in groups of 5-6, observed illustrations and photos in select pieces of children's literature. Two tables of students viewed images of rectangles in books by Burke (2000a) and Jones (2006), while the other two tables viewed images of squares in books by Burke (2000b) and Dotlich (1999). Students from each table were then prompted to describe and name the real-life examples of rectangles (e.g., swimming pool, buildings, locker) and squares (e.g., checkerboard, hopscotch, napkin) they recalled seeing in their books.

A two-column chart was created on the front whiteboard on which the teacher recorded students' observations of rectangles and squares. This class

discussion provided students with opportunities to reflect on, compare, and contrast the features and attributes of both shapes, an expectation set for kindergartners as per the *Geometry Standard* defined by NCTM (2000). One female student described a square as having "four sides, just like a rectangle" but further noting that a square has "all even sides. In a rectangle, there are two long and two short sides." A male student commented that a rectangle "looks longer than a square" with another student adding, while pointing to two square books, "If you take those two books and put them together, the two squares will make a rectangle."

Students were then asked to look around the classroom and to identify additional examples of squares and rectangles. Students identified several items as rectangles (e.g., word chart, table, door, whiteboard) and as squares (e.g., computer, window, book). Allowing students to note how shapes appear everywhere in their world is also advocated by NCTM (2000) as per the *Connections and Geometry Standards*, whereby students should "recognize and apply mathematics in contexts outside of mathematics" (p. 402) and "recognize geometric shapes and structures in the environment" (p. 396).

Next, each student was given two precut black strips (1 cm X 27 cm or 8.5" X 11") of black construction paper and students were asked to create something with their two strips. Students created letters such as X, V, and T as well as a "plus sign." Allowing the students to position the strips in various orientations enabled them to use such vocabulary as intersecting, straight, and diagonal. Students were then asked to place the two black strips "across their desks" so that they "were not overlapping or intersecting" (figure 2). Before being able to introduce and define the term *horizontal*, a male student called out, "These are horizontal lines." Students were then given two more black strips of construction paper and asked to place these two new strips "vertically...on top of the horizontal strips." The majority of the students followed, positioning the strips perpendicular to the horizontal strips. After placing her strips vertically, one student announced, "Hey, a rectangle is in the middle!" All students were then asked to observe their arrangement of horizontal and vertical strips and they quickly acknowledged that they had created squares and rectangles, with one student noting that his "looks like a tic-tac-toe game." Students



Figure 2. Students position strips of black construction paper to form horizontal lines.

were encouraged to slide the horizontal strips on their desks up and down and those placed vertically left-to-right in order to create a rectangle and square (appearing in the center of their strips) of varying sizes.

Students then viewed several images of paintings in Mondrian's *Composition* series and were encouraged to articulate the shapes they saw (squares and rectangles) in his work and how the primary colors (red, blue, and yellow) were used. Students were given an 8.5" X 11" piece of white posterboard, gluesticks, as well as additional strips of black construction paper and were asked to create a work of art in the spirit of Mondrian by placing and then gluing horizontal and vertical strips on their posterboard (figure 3) and then deciding which squares and rectangles they should color to make their work of art the most aesthetically pleasing.



Students quickly set to the task, creating their Mondrian-like masterpieces, and then sharing their finished products with the class (figure 4). In a follow-up activity, students then observed and counted the number of square and rectangular regions in their works. The kindergartners' Mondrian masterpieces were mounted in a rectangular array on a classroom wall, reminding students of the integrated mathematics-art activity in which they engaged and how shapes are used in art.

Figure 3. A kindergartner positions strips of black construction paper horizontally and vertically.

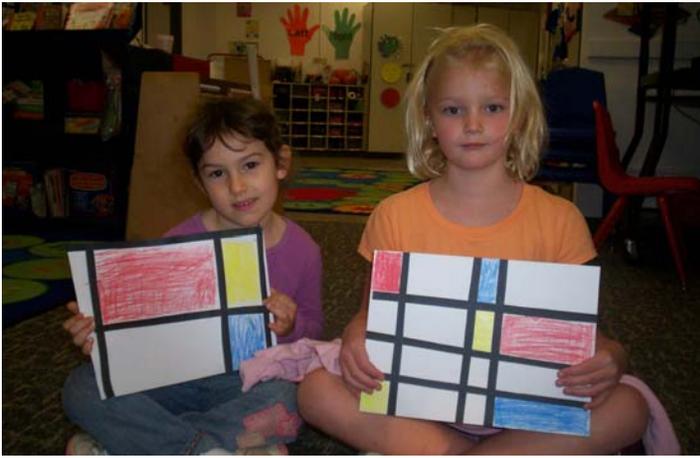


Figure 4. Two students share their Mondrian-like masterpieces.

Implications

The benefits of an integrated curriculum, which recognizes that the subjects within the curriculum are connected to each other and to the real world, have been noted by several educational philosophers, curriculum theorists, as well as others (Bruner, 1977; Dewey, 1933; Drake & Burns, 2004; Gelineau, 2003; Kim, Andrews, & Carr, 2004; McDonald & Fisher, 2006; Schwartz & Pollishuke, 2005; Vars & Beane, 2000). An integrated curriculum engages teachers, stimulates students, and energizes classroom learning environments (Meinbach, Fredericks, & Rothlein, 2000) and also enables teachers and their students to make connections between real life and their classroom learning experiences (Caskey, 2001; Bailey, 2000). Further, in its position statement, the International Reading Association (IRA, 2006) recognizes excellent reading teachers as those who are familiar with children's literature and who include a wide variety of fiction and nonfiction genres in their teaching. By engaging in this literature-based integrated activity, students came to recognize the connections between mathematics and the visual arts, with one student describing that “shapes are in math and art” and another stating, “Patterns and lines are in both.” Further, students experienced how mathematics, in particular, shapes, are everywhere in the world around them. This is the type of rich activity, which embodies the spirit of national education standards for mathematics, language arts, and the arts (NCTM, 2000; NCTE & IRA 1996; MENC, 1994), that teachers should strongly consider implementing in their classrooms.

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