Visual Learning in Elementary Mathematics

How does visual learning help students perform better in mathematics?

Overview

Children are natural visual learners. From the time they are born, they find meaning in the visual images that surround them. In early childhood, they are able to consider and develop conclusions about size and recognize shapes. By the time they are school age, many children can grasp abstract concepts, such as identifying simple patterns and interpreting quantitative data represented in bar graphs. Long before children can read, they are able to assimilate visual information with ease.

Young children are also able to draw and create visual images that communicate information to others. They understand that lines, shapes, forms, and colors convey meaning. And, they willingly express their ideas and creativity visually. Studies have shown that children have the capacity to internalize and find relevancy in what they draw, and they easily make connections to other areas of learning through their image-making.
(Davis, 2005)

While through time, many researchers have addressed the characteristics and benefits of visual learning, the publication of Howard Gardner's seminal work, *The Theory of Multiple Intelligences* (1983), helped to focus the attention of educators on the reality that children learn in different ways. This realization, and its popular acceptance within education communities, initiated the development of new approaches to classroom practice. Regarding visual learning, these approaches involve visualization, color cues, picture metaphors, concept maps, sketches, diagrams, and graphic symbols. (Armstrong, 1994) For those children who are visual learners, these approaches created welcome opportunities for participating more fully in the learning process.

Research has shown that visual learning theory is especially appropriate to the attainment of mathematics skills for a wide range of learners. Understanding abstract math concepts is reliant on the ability to "see" how they work, and children naturally use visual models to solve mathematical problems. They are often able to visualize a problem as a set of images. By creating models, they interact with mathematical concepts, process information, observe changes, reflect on their experiences, modify their thinking, and draw conclusions.
(Rowan & Bourne, 1994)

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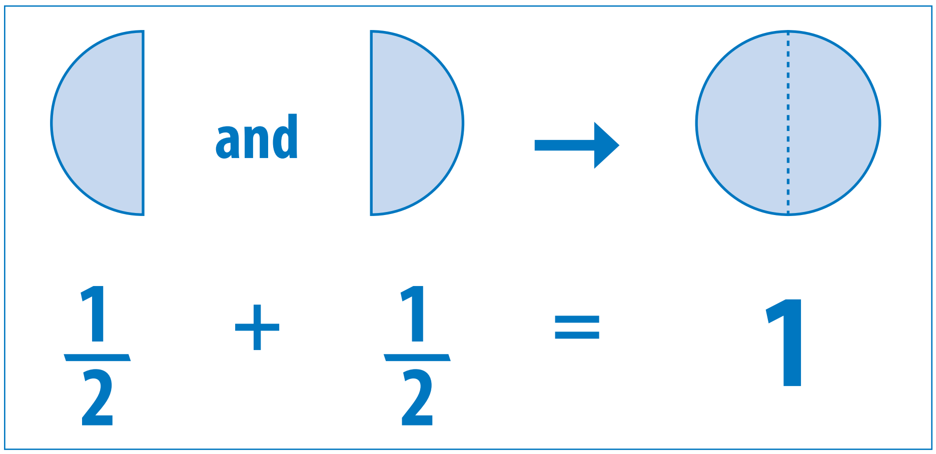
The consideration of relationships and the assessment of size, quantity, distance, position, dimension, and scale all benefit from our ability to visually model these ideas. (Tufte, 1997)

What Is Visual Learning?

Visual learning is about acquiring and communicating information through illustrations, photos, diagrams, graphs, symbols, icons, and other visual representations. It is about making sense of complex data using visual models.

If you try explaining the concept of “half-ness” with words alone, it can be a difficult process. But, if you show an illustration of half of a cookie, or of two equal size piles with about the same number of objects in each, the meaning of half-ness is immediately clear. And once half-ness is understood, it isn’t much of a leap to grasp third-ness, fourth-ness, or even eighty-fifth-ness. The fact is that images express things in ways that words and numbers do not. (Goodman, 1976)

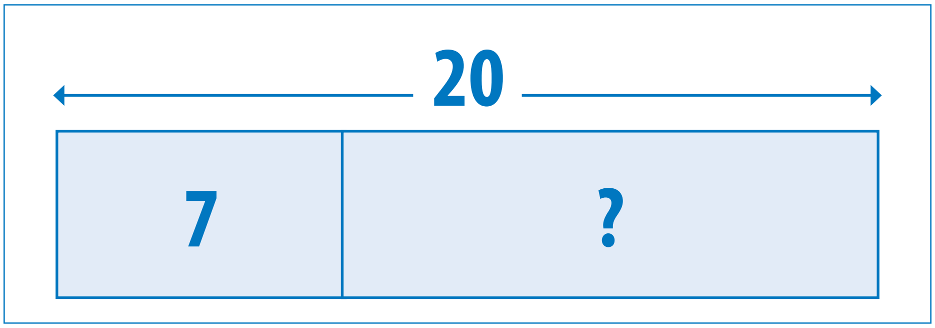
Two sentences describing half-ness.



Visual learning involves a specific set of skills. These include observation, recognition, perception, interpretation, and self-expression or communication. To observe something is to really see it and to examine its attributes. “What is it?” “What makes it that?” Recognition includes visual recall. “That symbol means ‘stop.’” “That’s a triangle because it has three corners and three sides.” Interpreting visual information leads to comprehension and understanding. “What does that model tell me?” “How does it work?” Perception deals with analysis and conjecture. “What will happen next?” And, sketching and image-making are vehicles for exploring ideas, communicating, and expressing creativity.

Visual learning is also about carefully crafting models so that students readily understand them, and consistently using the same models to mean the same things. (Charles, 2006) It’s a visual language.

"What number must be added to 7 to get 20?"



Presenting information visually, verbally, and numerically helps children to truly comprehend complex mathematical information. When ideas are expressed so that the words and the images work together seamlessly, true communication results. (LaSpina, 1998) In the teaching of mathematics, words, numbers, and pictures should come together to clearly demonstrate what's taking place. (Murphy, 2006)

Graphic design plays a critical role in visual learning practice by providing a structure for organizing information and making it accessible. It involves the careful construction and placement of text and images so that the result is clear and considerate of the user. And, it includes the development of models, such as step-by-step sequential diagrams, that will help students better understand processes and procedures. Everything from the choice of colors to the creation of illustrations, from the selection of typefaces to the combining of elements on a page, should work together to make the information easy to "get" and aesthetically pleasing. It is the job of the designer to consider ideas, words, and pictures and fit this material together to make it understandable and engaging. (Rand, 1985) It's about "envisioning information." (Tufte, 1990)

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Visual learning is not about just putting related pictures on a page to illustrate text. It isn't the decoration of ideas that are presented verbally, nor is it the creation of overly busy and confusing displays. Instead, it is the well thought-out and carefully developed visual/verbal co-expression of content.

Visual Learning Strategies

Classroom strategies that support visual learning practice in the teaching of mathematics can take many forms. Teachers can display materials that help to convey ideas, they can encourage students to sketch out problems, and they can ask students to work together to model new concepts.

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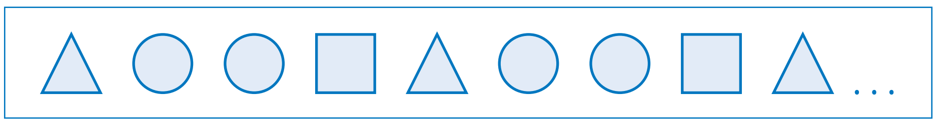
Children can search for rectangles in magazine and catalog photos, outline those rectangles, and bring them to class. Soon, an entire rectangle wall will be on display.

Visuals can be used to show patterns, to model doubles, to represent the numbers in between when counting by fives and tens, and to show the sets within a multiplication example. Models can be created to demonstrate processes such as adding on and rounding to the nearest ten. Students can discuss visual models, how they interpret them, and what they mean.

"What comes next?" "After that?"



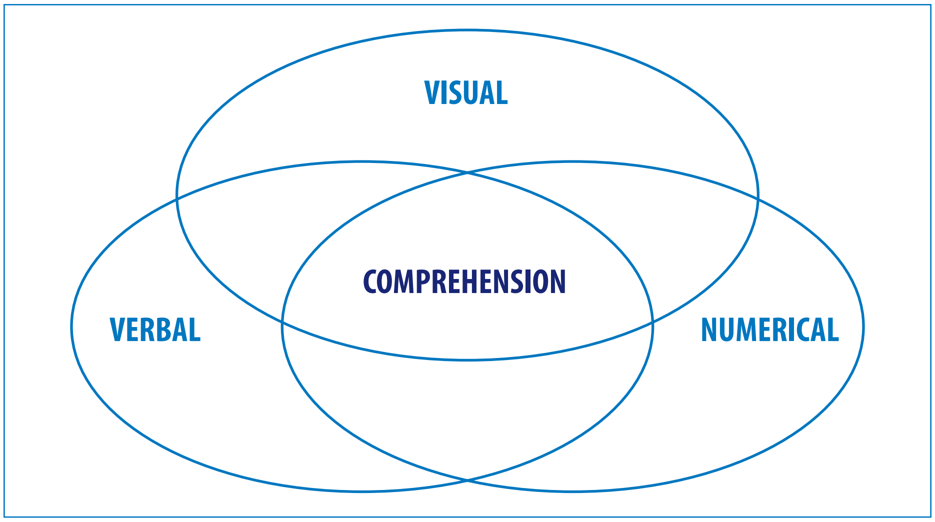
The creation of concept maps of mathematical ideas will help students make critical connections. Time lines can build knowledge about elapsed time. And, diagrams can model estimation and probability examples.

Sketching should be part of a daily math note-taking process. Drawing out a concept and visualizing how it works leads to comprehension. (Armstrong, 1994) A good way to assess understanding is to ask a student to demonstrate a mathematical concept without using words or numbers.

There are many ways to make visual learning part of every student's everyday classroom experience. These result from thinking about math visually and then putting those thoughts into practice. (Arnheim, 1969)

Summary

Through visuals, children are able to compare quantities easily, estimate distances, and figure out which items belong in a set and which don't. They can learn about perimeter and area, dimension and scale, and symmetry. And they can develop strategies for everything from estimating, to counting money and making change, to interpreting quantitative information presented in graphs. Indeed, many important mathematical concepts—concepts such as comparison, scale, dimension, measurement, direction, shape, and perspective—are first experienced visually.



Mathematics has been called a "universal language," transcending cultural and linguistic differences. This in part explains why so many math concepts lend themselves to a visual explanation. As noted by Edward Tufte, "The principles of information design are universal—like mathematics—and are not tied to unique features of a particular language or culture." (1990)

Visual learning strategies can make a profound difference in a student's depth of understanding about mathematics. It is a powerful teaching tool for kids who are natural visual/spatial learners, for children who are English language learners, and for students of all learning modalities. In fact, by using visual learning strategies in the teaching of mathematics, we can increase the learning potential of all children.

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