Guest Editorial

Minds, Models, and Maps

By Kenneth Wesson

"Every child is an artist. The problem is how to remain an artist once he grows up."

— Pablo Picasso

The solar system is too large to bring to school. Mammalian life cycles stretch well beyond the academic year, and tiny organisms are too small to examine closely. Prehistoric animals are, well, "prehistoric." However, the forever fascinating world of science from the massive to the minute, of today and of years long gone, opens immediately to all students by way of sketches, models, simulations, maps, and other visual learning devices. Collectively, they allow young learners to make cognitive leaps from the intangible to the comprehensible.

We say that we "see" with our eyes, although vision is more accurately accomplished by specialized brain cells that effortlessly convert the external world into the neural language of the brain for encoding, processing, storage, and retrieval. Beginning at birth, the eyes and the brain undergo a daily training regimen for understanding models, maps, and images well before the first day of formal education. For millions of years, vision has been our species' primary method of experiential data collection. Nearly 80% of the information entering our conscious sensory world does so by way of the eyes, making sight our major pathway to discovery, learning, and knowledge.

When the human brain processes an object in the external world, the same neural systems in the visual cortex are reactivated when the brain later "recreates" that object as an internal ("mind's eye") representation of the original object (Pinker 1998) or experience. A learner can only retrieve from memory that which has been properly stored earlier.

The ability to bring to mind mental representations or images is a powerful determiner of both attention and comprehension—the linchpins to learning. To promote the initial mental imagery formation, no children's book is complete without an abundance of illustrations. The direct engagement of the visual cortex is essential to all human learning. Once we "recognize" an object, separating image from name and the name from function becomes next to impossible. Vision is so central to factual certainty that our initial sensory impressions, and eventually our overall cognition, are validated by our eyesight. As we so often hear, children assure others that "I saw it with my own eyes!" underscoring a pinnacle in experiential confidence that cannot be humanly exceeded.

Visualizing is integral to reading for comprehension. To understand what they read, students must rely heavily on the "picture-making" mechanisms in the visual cortex in order to extract meaning from the text. The association cortex is charged with the task of making sense of the incoming visual information. Learners can only make sense of abstract information based on preexisting internal mental models.

Teaching visual-spatial thinking skills helps in the construction and the recreation of mental pictures. Not only do models, illustrations, and maps give students a "second way of knowing," they bring those objects, processes, cycles, systems, and events literally within arm's reach of the learner. This key facet of learning would otherwise remain outside the impenetrable borders of time, space, and normal perception. For many children, new words alone foster a shallow conceptual understanding at best, because the children are unable to generate the intended images inside the mind's eye with vivid accuracy. Text-relevant illustrations, hands-on models, and visual aids produce precise mental pictures that would be inaccessible solely by means of the printed word.

Children receiving formal instruction on (1) how to form mental images on their own, and (2) paying attention to illustrations in text, significantly outperform their counterparts on tests of comprehension and recall (Presley 1976). Particularly taking time to provide opportunities for young girls and students from linguistically diverse backgrounds to develop visual–spatial thinking skills will enhance both the process and the results of learning in science.

Young learners need regular opportunities to develop abstract thinking by "downloading" their ideas onto paper with illustrations, maps, and models. These mental meanderings have inspired great works of art, serendipitous discoveries in every field of medicine and every academic discipline, every invention in science, and every "aha" moment in the classroom when a student screams, "I got it!" The dynamic back-and-forth process of shifting images from the mind's eye to paper and to tangible models is when children make their most creative and memorable connections. Whether the topic is atoms or architecture, planetary systems or brain structures, working with images and models is compulsory to the learning process. A paucity of opportunities to create and translate illustrations, maps, and models into personal knowledge can impede conceptual development as well as creativity in the classroom.

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References

Marzano, R., D. Pickering, and J. Pollock. 2001. *Classroom instruction that works: Research-based strategies for increasing student achievement.* Alexandria, VA: ASCD.

Pinker, S. 1998. *How the mind works.* New York: William Morrow.

Presley, G. 1976. Mental imagery helps eight-year-olds remember what they read. *Journal of Educational Psychology* 68 (3): 355–359.

Easy-to-implement strategies for incorporating illustrations, models, and maps.

I. For elementary students, plan the following:

1. Introduce a "big idea" by inviting students to discuss and draw a picture of what they think they will learn based on the title or a description of the topic that will be under investigation.
2. Share their predictions with classmates or in small groups.
3. Engage students in an active science investigation.
4. Maintain a "mind-map"* recording the vocabulary, what they see, hear, and do.
5. Record the sequence of steps in the investigation and what occurred at each. (Once on paper, there is less ambiguity in their ideas.)
6. Discuss the sequence of their steps and any early outcomes they begin to notice.
7. Ask "what if" questions. ("What would happen to ____, if we changed _____?")
8. Draw a picture of the concept learned, its connections, and the related vocabulary (an informal assessment of comprehension giving students a "safe" venue to connect images, pictures, symbols and words that are linked with the student-developed pictures).
9. Orally describe (or report) how their picture explains the concept and represents the significant aspects of the activity/investigation. Compare their findings and conclusions.

When an experiment or science investigation is deliberately left incomplete, ask students to illustrate how they think the investigation will end. Students can describe their predictions orally. This informal assessment can serve as another check for conceptual understanding.

II. Students compare and discuss their drawings, illustrations, maps, and models:

1. Students receive immediate and ongoing feedback (informal peer-reviewed assessment) promoting new opportunities for idea elaboration and/or revision.
2. Feedback is given on their representations and perceptions through academically relevant social interactions as peers analyze their symbolic information.
3. Student drawings are not crafted with photographic fidelity. Instead, students interpret reality through their models and illustrations. The learning goals are self-expression and cognitive development, not "gallery-quality" products.

*Mind-maps and other thinking tools allow drawings to converge with words and short phrases to create a mental summary of a concept complete with vivid imagery. When practiced regularly, a 27 percentile gain can be the expected outcome (Marzano, Pickering, and Pollock 2001).