5
Expand Your Thinking

David Hyerle

The mind of man is capable of anything—because everything is in it, all the past as well as all the future.
—Joseph Conrad

Applying Thinking Skills to Content Learning to Use Graphic Organizers

Important ideas and relationships often go unseen by students because verbal tools alone do not clearly communicate the overall patterns of how people are thinking.

For example, I was recently working with a social studies teacher in a middle school classroom. The teacher took me aside and said, "Look, I have written everything out on the board, even the main idea, and I have told students over and over again what I mean. Why can't they understand?" With her permission, I went to the board and began, with the class, to visually map out the relationships between concepts, using classification "trees" and other maps for showing the pattern of her main idea, supporting propositions, and specific details. These visual representations created a connected, whole picture of what the teacher had tried to verbally communicate to students. The maps thus helped students to translate the *sequence* of her spoken and written sentences into the pattern of her thinking. Students could then *see* what she meant.

Over the past decade, educators have taken positive steps toward teaching for and about thinking by investigating different views of thinking, defining thinking skills, focusing on teacher questioning, and asking students to verbalize and reflect on their thinking. Yet a core question remains: How can we help students—on their own—to flexibly apply thinking skills to content learning?

Let me suggest one response: Connected, graphic representations can supplement the use of verbal and numeric symbols for communicating our thinking in the classroom. All participants in the classroom can use practical visual tools—graphic organizers—for applying abstract thinking skills to content learning and teaching. Students can learn how to visually represent and connect information in linear, holistic, and analogical patterns. Students then have the additional tools for reflecting on the pathways of their thinking and for improving their thinking abilities. Graphic representations also enable teachers to see and assess students' maps of prior knowledge, to present new content information in connected ways, and to evaluate students' content learning by seeing the development of students' thinking over the course of instruction.

Expand Your Thinking (Hyerle 1989b) is a program that introduces students to these graphic tools for applying thinking skills in content learning. Students work through the program in cooperative pairs to learn how thinking maps can be used to organize, communicate, and share their thinking. They are shown that "expanding your thinking" means both applying "thinking maps" to content learning and sharing their thinking with other students. Teachers are supported by a guide that shows how they can expand their teaching repertoire by using thinking maps *and* by practicing "teaching for thinking" strategies, which are an integrated part of the directions for each student activity.

Together, students and teachers can use *Expand Your Thinking* as a starting point for using thinking maps to create different mental models of the same content information. They can efficiently share these differences and at the same time make connections between similar thoughts. As Jones, Pierce, and Hunter (1988) state: "A good graphic representation can show at a glance the key parts of a whole and their relations, thereby allowing a holistic understanding that words alone cannot convey" (p. 21).

Drawing the Lines: Toward a Connective View of Knowledge and Thinking

Students who work through the *Expand Your Thinking* program use thinking maps to draw the lines that represent specific thinking skills and patterns of thought. They also question, in a fundamental way, how they make sense of things by connecting and creating patterns of content information. This practical use of thinking-skills maps is based on an underlying, theoretical view of knowledge and thinking as *the active making of mental connections.* It is also through this connective view of knowledge that the so-called "lower order" or "micro-logical" thinking skills, such as classification, are presented to students.

A recent challenge for educators is trying to describe the relationship between lower- and higher-order thinking. On one side, educators who reject the direct teaching of discrete lower-order thinking skills. On another side are those who cringe when higher-order content questions are asked of the students who have not shown proficiency with "lower-order" thinking skills. What is the problematic line between lower- and higher-order thinking? The problem, as I see it, is that the "lower-order" skills are being presented to students as primarily rote, analytic tools for processing "given" information and not for deeply questioning how knowledge is being made through these processes. The outcome is that these skills are often taught in isolation as disconnected, strictly analytic tools for thinking, to the near exclusion of holistic thinking.

One reason for the overemphasis on analysis has been the influence of a traditional view of knowledge, called "logico-deductive." In this theory of knowledge, skills such as labeling and classification are seen as atomistic processes. Words and numbers are understood as unquestioned labels that correspond unambiguously to things in the world, and each thing represented understood as fitting into a preexisting, "natural" category that has a clearly defined boundary. Yet, as biologist Stephen Jay Gould points out, *applying* the skill of classification is of a higher order:

> Taxonomy is a fundamental and dynamic science dedicated to exploring the causes of relationships and similarities among organisms. Classifications are theories about the basis of natural order, not dull categories compiled only to avoid chaos (Gould 1989, p. 98).

Despite the dynamism revealed by Gould, the processes of classification and many other such analytical skills are found at the bottom of nearly all models of thinking skills. Because these skills are presented as low level, the understanding of the skills is not often richly developed by students nor applied in connected, holistic ways. Research released over the last ten years by leaders in the fields of biology (Gould 1981; Mayr 1989), psychology (Gardner 1983), cognitive linguistics (Lakoff 1989; Lakoff and Johnson 1980), moral development (Gilligan 1982), philosophy (Putnam 1988), and education (Perkins 1986) reveals that the logico-deductive view of knowledge, though important and useful, is not the only view of knowing and thinking. These researchers and educators point toward other ways to conceive of knowledge and the processes of thinking.

One view of knowledge may be called "connectivism" (Hyerle 1989a) and is based on a perspective that knowledge is actively constructed as people represent and *connect* a variety of forms of sensory information. Through this process, knowledge is "remade" between human beings and remains open to reinterpretation. Knowledge viewed as connective is patterns of information—

- linked together by unclear mental boundaries, such as boundaries between categories;
- constructed through communication in a social context;
- represented by a range of signs, symbols, and images and by idealized mental models and theories; and
- supported by conceptual metaphors.

Through connectivism, we attempt to see the complexity of a problem in context, while honoring different points of view and learning from them. Though we may draw on past regularities for information, we recognize that knowledge is not given: Knowledge is made. Knowledge viewed as connective is an interpretive process of thinking about the mental relationships we create between things. In a most fundamental way, it is from a connectivist view that we begin to deeply investigate these "things" we call boundaries and relations.

> What do we mean when we say that boundaries and relations are things? Are not the water's edge and the land's end one and the same? Is the shoreline a part of the land or of the sea, or is it a line in its own right? . . . *A person must draw that line somewhere.* . . . The world is really a dynamic operation; only by means of symbols can the mind deal with it "as if" it were a static structure (Upton 1961, p. 31).

This insight, by the late Albert Upton, Professor Emeritus at Whittier College, shows that we are constantly using word symbols to represent "things," making distinctions between and connecting these symbols, and thereby creating mental boundary lines. An essential benefit of using graphic organizers as tools for improving students' thinking abilities is that we are asking students to *draw that line*, then to see and question the connections they are making between things. These lines connect things as we creatively analyze relationships, such as between categories, between parts of whole objects, or between sequences in an event. The boundary lines that students establish between things—first in their

minds and then on a page—are mental models of how they think.

What is "higher-order" and "critical" about these lower-order connections is that once students begin to investigate seemingly simple mental boundaries they will be more likely to see greater complexity, dissolve hardened opinions and idealized dichotomies, and open up to different points of view. For example, if a young student attempts to draw a line between night and day, the student may see that the lines are fuzzy areas we call sunrise and dusk. Similarly, another student may see people in the world as either "good" or "bad"; but drawing the line and fully investigating each classification may reveal a deeper understanding of humankind. In reality, relationships between things and people are often fuzzy and complex. In our minds, all too often, even the most fundamental connections between things are idealized as clear and absolute; thus, the complex nature of mental relationships remains hidden from sight.

A Connective Model of Thinking Skills and Maps

Expand Your Thinking builds toward a view of knowledge as connective and is based on a practical model of thinking processes and maps described in the following pages. This model was initially developed by Upton, who viewed the cognitive act of thinking as a dynamic union of the analytical "taking apart" and the creative "synthesis" of things—through representations. His first book for students, *Creative Analysis* (Upton and Samson 1963) is based on this model. By using *Creative Analysis*, Upton's students at Whittier College learned about basic patterns of thought and how to verbalize and graphically organize these patterns. Though Upton was relatively uninterested in IQ scores, *all* of the 280 students who went through his freshman course over an eight-month period gained in their scores using a standardized intelligence test as the pre-post measure. The average IQ score increased 10.5 points. This statistically significant change in IQ scores was reported in the *New York Times* (Hechinger 1960) at a time when there were few alternative definitions of "intelligence."

The Upton model is neither hierarchical nor process oriented in its theory or application. Unlike most models, this is not a set of procedures for problem solving, but rather a view of patterns of thinking processes that are related—and a corresponding set of maps. Upton's model is most useful when perceived as a set of tools for thinking and when used in response to the needs and objectives of students. The model, which is presented in *Expand Your Thinking*, includes six thinking processes:

- Thing-making
- Qualification
- Classification
- Structure analysis
- Operation analysis
- Seeing analogies

Thing-Making

As a semanticist, Upton stressed the importance of having students become aware of how we represent physical or mental "things" using signs, symbols, and images in context. Most of the time we use symbols such as words or numbers—and, now, computer languages. Upton and his colleague, Richard Samson, called this symbolizing process *Thing-making*. Often this process is understood as lower order and mechanical. It is usually called "naming" or "labeling," using nouns. Yet one of the higher order challenges that our students face is to develop a dynamic view of symbols—what I call *symboliteracy*—through which they must actively remake and interpret things in context using symbols. Consider how we continually ask students to "put" some "thing" in context, such as a vocabulary word, to find the meaning.

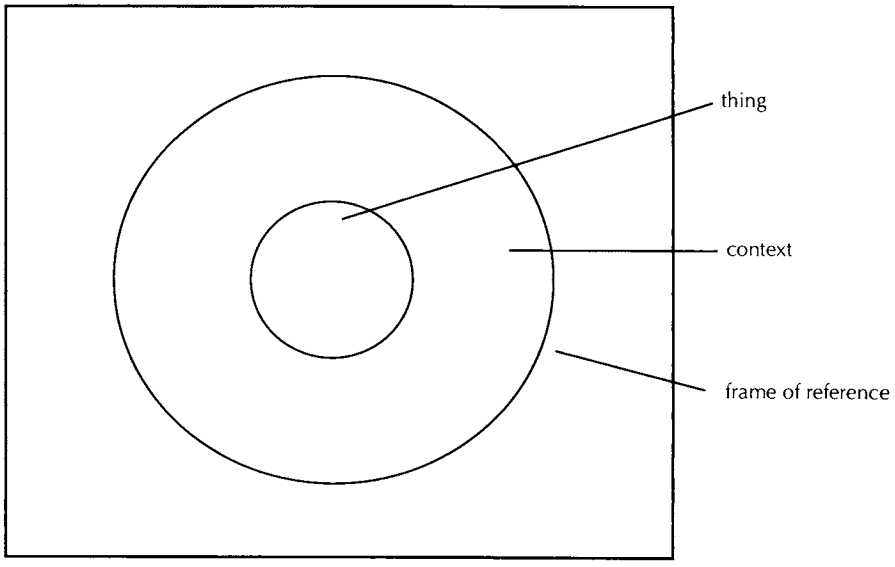
The Circle Map in Figure 1, my recent addition to Upton's model, is used as a visual tool for putting things in context. The "thing" represented is written or drawn in the center circle and contextual information is shown in the outside circle. Each circle represents how we create mental boundaries when we try to define something. This basic map can be expanded by drawing a frame around the outside of the two circles, to represent the frame of reference for defining something in context. The visual frame and the circles provide reflective tools for asking: What is your cultural background, and what are your life experiences and your religious, political, social, and emotional points of view that influence how you make sense of something in context? Using this map helps students to see that *how* they represent and define something is influenced by context and their own background experiences.

Qualification

When we are trying to define and make sense of something, we are drawing on our sensations of the world. Upton called this process *Qualification*. When describing a person, a character in a story, or a naturally occurring element, we draw on our five senses—and our emotions—to project or attribute qualities to things, and to abstract qualities from things. Some qualities are more tangible, such as sensory qualities of hot and cold, whereas other qualities are less tangible, such as the emotive quality of sculpture. The Bubble Map in Figure 2 is used to represent the process of

FIGURE 1

Circle Map for Thinking-Making

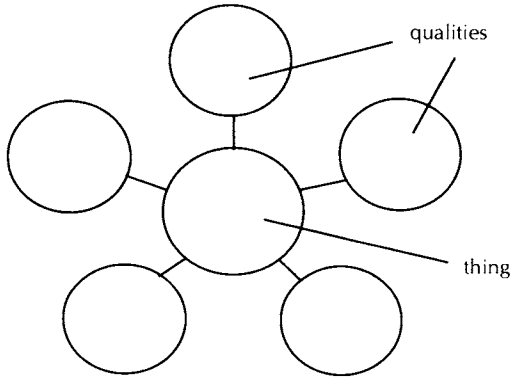


abstracting from and projecting qualities onto things, and to identify sensory, logical, and emotional qualifications we are making. Notice that the circle in the middle is the thing being qualified. The lines extending outward each represent the abstraction/projection process, and the outside circles are used as abstracted place holders for adjectives and phrases.

This map can be expanded for the process of comparing and contrasting the qualities of two things using the Double-Bubble Map (Figure 3). The middle circles are the perceived common qualities of the two things being compared, while the outside circles describe the unique qualities of the two things, respectively.

FIGURE 2

Bubble Map for Qualification

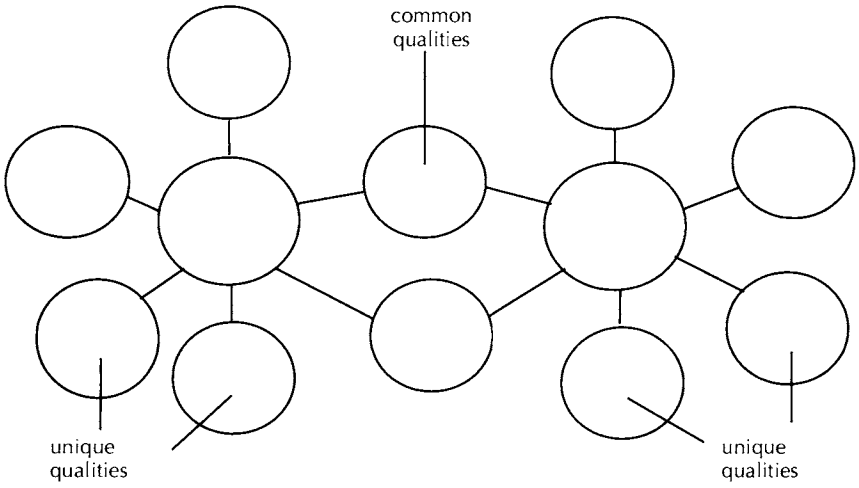


Classification

Because we are constantly making sense of things in context, we also investigate relationships between multiple things and qualities that we perceive. We try to see the connected mental webs, or patterns of relationships that create "context" and support our inferences. Upton drew from the work of those who closely study our physical world—such as biologists—to identify three patterns of thinking. These scientists create taxonomies or classifications of things, study the anatomy or physical structures of things, and interpret the physiology or operation of things.

FIGURE 3

Double-Bubble Map for Comparing and Contrasting

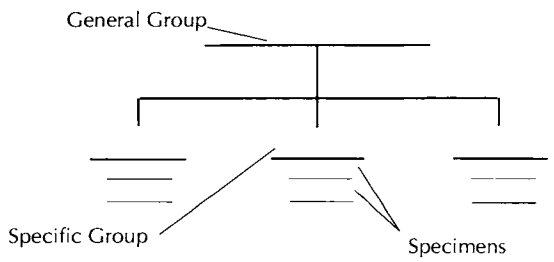


We use the process of *Classification* in the classroom as a way to see the main idea and supporting details of a reading passage, to study cultural groups in the world, to organize writing, to sort information in computers, and to create taxonomies in the sciences. What is interesting about this process is that things rarely exist in absolute categories, and not all classification systems are hierarchical. Not all things in a group necessarily share all of the same qualities. There are gray areas and overlapping categories. Classification systems, then, are created by and between humans through our perceptions, actions, and communication in the world.

The familiar Tree Map (Figure 4), is just one of the maps used for applying the skill of classification. This map represents a top-down pattern for sorting information, with the general term on the top, and specific groups and specimens below.

FIGURE 4

Tree Map for Classification



Structure Analysis

Another way of seeing patterns is by noticing the physical boundaries between things, or part-whole relationships, such as in Upton's "shoreline" example cited previously. Upton called this process *Structure Analysis.* We use this process to understand spatial relationships, such as the setting of a play, the dimensions of geometric figures, the parts of the human body, even the geopolitical landscape. Much in the same way that categories do not exist absolutely in the world, Upton also believed that boundaries are represented by humans when we freeze an otherwise dynamic world.

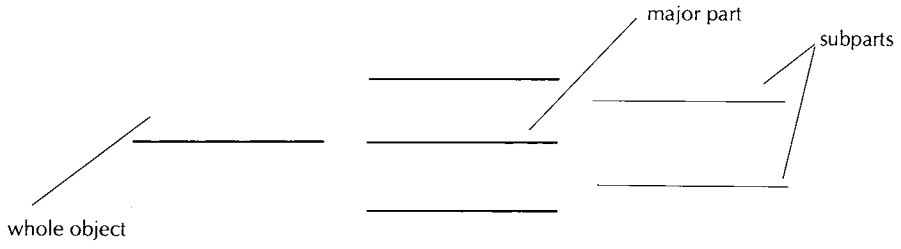
The Brace Map (Figure 5) is used for looking for part-whole relationships. On the left side, the "whole" thing is drawn or written above the line. The braces represent the physical joints between parts, and the lines are the placeholders for major "parts," followed by the subparts. This map can be expanded infinitely to smaller (atomic) or larger (universal) parts of the whole.

Operation Analysis

If the world is a dynamic operation, then the process Upton called *Operation Analysis* is an expression of this view. Operation Analysis is the process of interpreting changes or sequences. We ask our students to interpret such things as directions, sequences in math or computer programs, timelines in history, and the plot lines of literature. The familiar Flowchart Map (Figure 6) is a useful starting point for thinking about different kinds of operations. This basic flowchart shows that an operation may have many

FIGURE 5

Brace Map for Structure Analysis



stages and substages. When students draw the rectangles, they create a juncture between one stage and another, depending on their point of view. As the operations are seen to be more complex, feedback loops can be added through a "systems" approach (Roberts 1983).

A flowchart can be expanded into the Cause-Effect Map (Figure 7), useful for investigating cause-effect patterns of thinking. Of course, when students examine human interactions in the social sciences, the changes in history or of characters in a novel, and physical changes, they discover that each discipline has different cause-effect dimensions that can be thought about and displayed using different forms of this basic map.

Seeing Analogies

Central to Upton's model is a process of thinking that shows connections between representing and qualifying things, as well as relationships and interactions. It is the process of seeing similarities between relationships, what Upton called *Seeing Analogies*. Through our ability to create analogies, we are able to transfer information from one "body" of "knowledge" to another. This also enables us to communicate abstract ideas—such as in science and politics—by using conceptual metaphors. Metaphors are commonly thought of as poetic tools, yet this form of analogical thinking is one of the foundations for the human conceptual system (Lakoff and Johnson 1980).

FIGURE 6

Flowchart Map for Operation Analysis

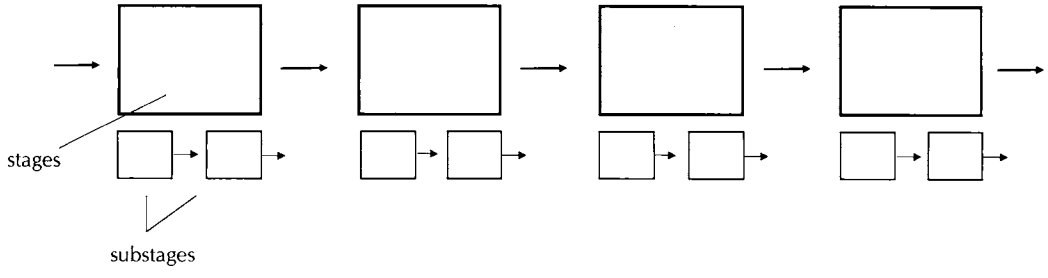
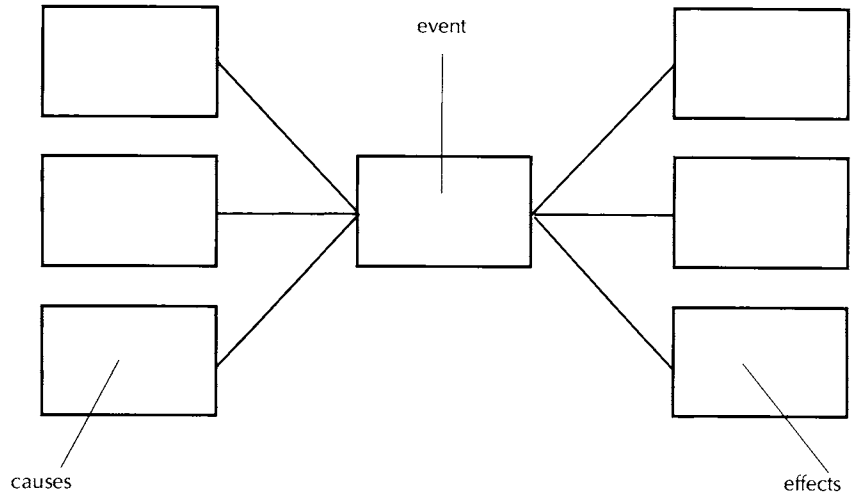


FIGURE 7

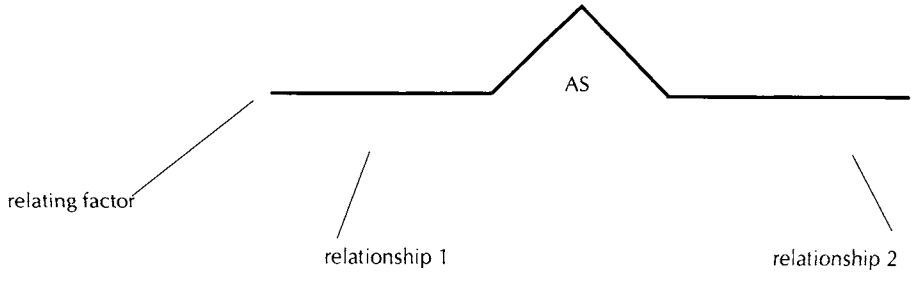
Multi-Flow Map for Cause-Effect



The Bridge Map (Figure 8) represents the pattern of Seeing Analogies: The line of the bridge represents the "relating factor" that is transferred across relationships. The relating factor is the common relationship that a student finds to exist between two or more pairs of things. Students can expand this map to create multilevel analogies and to investigate conceptual metaphors.

FIGURE 8

Bridge Map for Seeing Analogies



Each line, circle, or square of these thinking maps represents a relationship or boundary; such graphics provide a consistent visual vocabulary for creating maps and for thinking on a high order about fundamental acts of cognition. In addition, the pattern and name for each map together create a key image for using the skill: circles for representing things in context, bubbles for intangible qualifying, trees for top-down classifying, braces for structuring, flowchart arrows for operating, and bridges for making analogies. These visual-verbal maps are metacognitive tools: By drawing that line or circle between words, and questioning the type of boundaries being drawn, students are displaying and applying connected ways of thinking and knowing.

Expand Your Thinking

A Student Resource

The purpose of the *Expand Your Thinking* program is to introduce upper elementary and middle schools students to the six thinking processes and corresponding maps and then to apply this model to content learning. The program consists of a resource workbook for students and an extensive teacher's guide. The activities in this program help teachers to:

- Introduce students to thinking skills using thinking maps;
- Show how the skills can be applied to content learning using the thinking maps; and
- Structure the learning environment in a cooperative format.

The student workbook is called a *resource* for several reasons. First, the text is written directly to students so that they can read and reread important information without having to depend on the teacher. Second, clear definitions of maps and skills are highlighted within each chapter, and a one-page summary of the six skills and maps is provided as a reference. Third, instructions are provided to students, showing how to construct each thinking map. Finally, activities showing how to apply these maps to specific content areas are clearly designated according to disciplines. Ideally, the workbook is used as a resource by students throughout the year.

The *Expand Your Thinking* program takes approximately 40 class periods to complete. There are eight parts to the student workbook: introductory chapter for defining and applying the model to thinking about a concrete object, one chapter each of the six skills and maps, and a concluding chapter for applying the model to creating a new use for a common object. Each chapter provides about seven activities.

Figure 9 presents an overview of the "Qualification" chapter, an example of a typical chapter sequence. The activities are usually one page in length, and range in completion time from 20 minutes to two full periods of class time—much more time if the additional applications are completed.

FIGURE 9

Overview of Sample Chapter Activities

Chapter 2: Qualification Using the Bubble Map

Activity	Title	Description
A	What is the Skill of Qualification?	Introducing and defining Qualifications using the Bubble Map to describe an apple; students also create their own Bubble Map.
B	Making Sense of the World	Practice qualifying objects from daily life using the Bubble Map to organize sensory impressions.
C	Character Traits	Applying the Bubble Map to the analysis of two character descriptions (language arts).
D	Comparing and Contrasting	Applying the Double-Bubble Map to compare and contrast two characters, followed by a creative writing assignment.
E	Qualities and Subjects	Practice using the Double-Bubble Map by comparing and contrasting information (science, geography, and mathematics).
F	What Are the Reasons For Your Opinions	Applying the Double-Bubble Map to thinking about personal reasons for liking and disliking things; topic: television vs. reading.
G	The Science of Snack Food	Applying the Bubble Map to creating a nutritional snack food, followed by a writing assignment (science).

Each chapter of *Expand Your Thinking* has activities devoted to practice using the maps across multiple disciplines (as in activity E in Figure 9). Other activities focus on in-depth applications in one content area (as in activities C, D, and G). Content applications from the other chapters include: using the Circle Map for reading comprehension, using the Tree Map for organizing information in science, using the Brace Map for identifying geographic boundaries between countries, creating a Flowchart Map for showing how a law is made, and using a multilevel Bridge Map to connect historical information.

Most activities ask students to discuss and add to their maps while in cooperative pairs. Asking students to use visual thinking maps to think about information, and then to verbalize their thinking in pairs helps to create an environment in the classroom through which students are individually expanding their thinking abilities while learning from each other.

A Teacher's Guide to Creating a Thinking Classroom

There are many ways for teachers to promote the improvement of students' thinking. The design of the teacher's guide for *Expand Your Thinking* directly supports teachers in three of these areas by showing how to:

- Introduce thinking skills to students through the use of thinking maps;
- Integrate thinking skills instruction into content teaching; and
- Integrate ten interactive teaching strategies into classroom practice.

Each student page is reproduced in the teacher's guide, with suggested responses showing how each map may be completed. For every student activity there are instructions for the teacher that include a statement of purpose, directions and procedures, and applications to content area teaching.

The heart of this teacher's guide is a section called "Creating a Thinking Classroom." This section includes the ten "teaching for thinking" strategies that teachers can use to facilitate students' thinking, as classified using the Tree Map (Figure 10). These ten strategies are fully described, and then embedded within the teacher's guide for each student activity. As an example, for an activity using a Tree Map to classify different types of transportation vehicles for a social studies report, students are asked to draw maps showing different ways the information could be organized. The objective of this activity is to reveal that their purpose for writing influences how they may classify and therefore organize information. Included in the teacher's directions are three of the strategies for facilitating students' thinking: wait time, metacognitive questions, and justifying your answer. Teachers are also advised to frequently describe these teaching strategies to their students before, during, or after use. This repetition helps students to become conscious of facilitation skills that they can use with each other, and the strategies support the creation of a thinking classroom.

Beyond Expand Your Thinking: Staff Development Through Curriculum Redesign

Expand Your Thinking can be implemented without a major commitment to staff development, yet with an introductory workshop, the foundation is set for long-term staff development based on the redesign of curriculum materials.

An introductory, half- or full-day workshop is suggested, though not required. The focus during this introduction is on applying thinking skills using the maps and teaching strategies. Extensive training is not required; with the detailed lesson plans and the visual support of mapping, teachers are not in the position of immediately having to create lessons that bridge between an abstract thinking-skill activity and a content application.

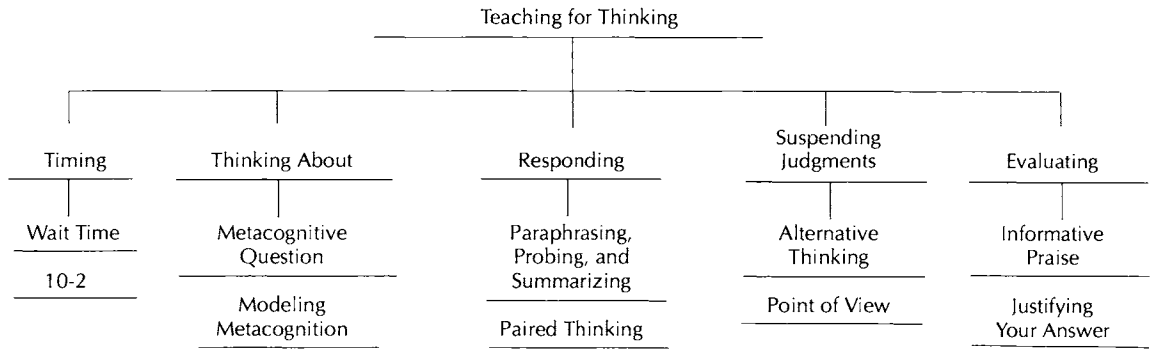
Applying Thinking Skills

Beyond the *Expand Your Thinking* materials are staff-development opportunities at three levels. (These three levels, with minor modification, are also available for teachers in schools and districts who want to learn how to use thinking maps for applying thinking skills to content learning independent of published materials.) The umbrella name for the staff development offerings is "Applying Thinking Skills." These training sessions are structured so that teachers work together in small working groups to focus on applying thinking skills and maps in their classrooms—in all three levels of Applying Thinking Skills, as follows:

- *Tools for Thinking* (1 day): This introduction can be attended by teachers who are going to implement *Expand Your Thinking* or by teachers who want a basic-level training in the use of thinking maps. While the focus is introductory, by the end of the day teachers have created materials for use in the classroom.
- *Thinking Skills and Content Area Teaching* (3 days): By the end of this seminar, teachers in working groups have created a series of lessons for immediate use in the classroom. These lessons are based on using thinking maps and the ten "teaching for thinking" strategies. All of the transformed curriculum materials created by the groups are reviewed, and feedback suggestions are provided.
- *Curriculum Design for Teaching Thinking* (5 days): This institute is an extended version of the Seminar design.

FIGURE 10

Ten Teaching for Thinking Strategies



By the last session, teachers in working groups have redesigned a complete curriculum unit and some of the materials have been piloted. These units integrate the use of thinking maps; teaching strategies; and, when appropriate, assessment tools using maps. These rough-draft units are then reviewed and feedback suggestions provided.

The emphasis shifts from how to use thinking maps and teaching strategies in the classroom in the introductory training, toward the redesign of curriculum materials, including basals, in the 3- and 5-day sessions. A school or district can initiate a staff development program at any of these levels, with or without implementing *Expand Your Thinking*.

Teachers as Authors of Curriculum

Teachers come to staff development days with the expectation of taking something new back to the classroom that they can use. As shown in the three levels of staff development, the key to each session is that teachers use the thinking skills maps to renew their own curriculum materials and add to their teaching repertoire. In the seminar and institute settings, teachers are asked to bring materials that they will be using with their students so they have the opportunity to take renewed materials back to the classroom. As a follow-up to the institute, an additional option is available for finalizing the redesigned materials. The materials can be edited, printed, and compiled in a *Teacher's Resource Manual*. This material can be duplicated and shared within a school and disseminated across a district. This finished product of staff development is a resource that supports the long-term commitment to teaching for and about thinking, provides practical materials for use by teachers, and honors those groups of teachers who have worked together to expand their teaching repertoire.

* * *

Expand Your Thinking is a program primarily used for teaching students how to apply thinking skills to content learning, using thinking maps. The long-term goal is to enable students to work together as they consciously apply thinking maps to learning. With the addition of staff development in "Applying Thinking Skills," a second long-term goal is set to enable teachers to work together as they learn to use thinking maps in their daily teaching by redesigning the materials they already use in their classrooms. Through these programs, students and teachers are seeing how to connect and express their thinking, using maps and strategies; and teachers have the opportunity to transform how *and* what they teach.

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Expand Your Thinking

Developer:	David Hyerle (based on the work of Albert Upton)
Goals:	Training students to use graphic organizers as tools for applying thinking skills to content learning through working in cooperative pairs.
Sample skills:	Using flowcharts for sequencing and cause/effect reasoning, classification tree maps for main idea and supporting evidence, bubble maps for descriptions and comparison/contrast, bridge map for seeing analogies, circle map for defining things in context, brace map for seeing structural relationships.
Assumptions:	• Knowledge is connected, patterned information that often is linked together by unclear mental boundaries and mental models. • Thinking (creative and analytical) and learning are facilitated by having students use graphic organizers to visually connect and represent information. • Communication of thinking is facilitated when students cooperatively share their thinking with others, using graphic organizers.
Intended audience:	Regular program: grades 5–7.
Process:	Students work in cooperative pairs throughout most of the program. Students are introduced to an integrated model of six fundamental thinking processes and correstponding graphic organizers for applying each process. Within each skill chapter, students first apply each "thinking map" to common, everyday information; then to basic information from different content areas; and, finally, in greater depth within a specific content area activity.
Resource:	*Expand Your Thinking*, by David Hyerle (1989).
Time:	Varies with individual schedules; one period per week is suggested.
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