7

Thinking Maps

A Synthesis Language of Visual Tools

The full range of visual tools has been presented in the last three chapters as patterns for thinking creatively, organizationally, and conceptually. We can see how students are making sense of their own stored knowledge in displayed "visual schemata" and how they accommodate and assimilate new information and concepts through these richly developed visual tools: Brainstorming webs foster creativity, graphic organizers explicitly model more analytical content processes, and mapping tools explicitly focus on deeper conceptual understandings. So it is reasonable—practical really—to consider and question how this wide range of tools could be synthesized, coordinated, and offered to students in a practical and meaningful way so that they could ultimately take control of their own patterns of thinking.

- How could student-centered visual tools be coordinated in ways that they are generative like webs, analytical like organizers, and focused on conceptual learning?
- What would theoretically ground this organization of visual tools? How would we organize and link the visual tools?
- How would this work in practical ways for students, teachers, and school leaders?

These are the questions I asked myself long ago, and this chapter offers an answer drawn from 20 years of theoretical research, demonstrated quantitative and qualitative results, and practical experiences of implementing a common visual language of visual tools called Thinking Maps across whole schools, from preschool to college.

The evidence found in research across educational domains identifies nonlinguistic representations as key to student learning. *Classroom Instruction That Works* (Marzano, Pickering, & Pollack, 2001), *Building the Reading Brain* (Wolfe & Nevills, 2004), and the *Put Reading First* (Armbruster et al., 2001) research all conclude that *nonlinguistic representations* are essential vehicles for improving students' learning. These researchers and others from over 75 years of cognitive studies and the neurosciences also identify *fundamental cognitive patterns* as the foundation to student learning. This nexus of patterns of thinking and nonlinguistic representations is the foundation of Thinking Maps as a language of eight nonlinguistic representations defined by fundamental cognitive skills. This chapter introduces a common visual language for thinking, learning, teaching, and leadership practices that brings together nonlinguistic representations and fundamental cognitive skills in a theoretically sound and classroom-tested language for learning to integrate creative, analytical, and conceptual thinking for all students.

First conceived of in 1986, Thinking Maps* are a language of visual-verbal-spatial cognitive patterning tools that has now been implemented through required professional development training and systematic follow-up coaching in over 5,000 schools across the United States and internationally since 1990 (Hyerle, 1988–1993, 1990, 1993, 1995, 1996; 2000b; Hyerle, Curtis, & Alper, 2004). Teachers, students, and administrators in elementary, middle, and high schools are introduced to this language in the first year of implementation through a professional development process that includes training days, follow-up coaching, and the development of deep applications in reading, writing, mathematics, and technology. The primary outcome of the interactive professional development is that teachers work together over multiple years to *explicitly* teach all their students how to become fluent independent and collaborative users of this language for in-depth content learning and to transfer the same language of thinking across all content areas and grades levels, thus enabling continuous cognitive development for all students.

The effectiveness of Thinking Maps has been established through the scientifically based research cited in this book on nonlinguistic representations and graphic organizers, and extensively documented through test scores and qualitative evidence in academic publications since 1990. Most recently, over a dozen authors from the United States, New Zealand, and Singapore—from high- to low-achieving schools and from inner-city to rural schools—presented the documented results of Thinking Maps implementation in the book *Student Successes With Thinking Maps: School-Based Research, Results and Models for Achievement Using Visual Tools* (Hyerle, Curtis, & Alper, 2004).

In this chapter, we first look at the historical background of Thinking Maps and definition of this language. Then we will look at the implementation rubric for Thinking Maps that shows the development of student, teacher, administrator, and whole-school targets at five levels, as this language becomes a common foundation for learning, teaching, and leadership over multiple years. This will provide the framework for looking at three roles (students, teachers, leaders): student

*The term "Thinking Maps" and the term "Thinking Maps" with the graphic forms of the eight Maps have registered trademarks. No use of the term "Thinking Maps" with or without the graphic forms of the eight Maps may be used in any way without the permission of Thinking Maps, Inc. Specific training is required before Thinking Maps are implemented in the classroom. Inquiries regarding Thinking Maps and training can be made to Thinking Maps, Inc., 1-800-243-9169, www.thinkingmaps.com.

performance in schools with large populations of English-language learning in high-poverty areas; teachers using Thinking Maps for content deep applications through *Mapping the Standards*; and the evolution of a learning community using Thinking Maps for leadership practices. The last chapter of this book reveals the bigger picture of what happens to student and teacher performance when Thinking Maps are implemented for multiple years in a school that is exclusively for students with language and learning disabilities.

A SHORT HISTORY OF THINKING MAPS

The Thinking Maps were created as a language during the generative stages of my writing a student workbook for facilitating thinking skills at the middle school level called *Expand Your Thinking* (Hyerle, 1988–1993). There were four significant experiences that grounded my theoretical and practical development of Thinking Maps as a language for learning, teaching, and leadership.

First, in the early 1980s, I learned from my teaching credential processes and student teaching with the Bay Area Writing Project (University of California, Berkeley) that my students could visually represent their thinking in *every* discipline using brainstorming webs. As shown in Chapter 4, when students surface their conceptions and misconceptions of the content they are learning and writing, we can assess what and how we are connecting content ideas. I taught my students Tony Buzan's Mind Mapping techniques and their writing and thinking improved. Then my students and I hit a wall. Every web started in the center and branched out. The repetitive visual pattern being developed did not reflect a rich range of thinking patterns in the content areas; too much irrelevant information was scattered across a page, with not enough coherence of ideas. I asked myself of brainstorming: What happens after the storm?

In 1983, after attending seminars led by Dr. Arthur Costa, I learned that the direct facilitation of fundamental cognitive skills and habits of mind (then called *intelligent behaviors*) supports student learning at every level of Bloom's taxonomy. I learned from this second experience that it was central to education for teachers to coach these cognitive skills *explicitly*, mediate students' thinking, and ask reflective questions of students so they would become metacognitive, self-assessing, independent learners. If this did not happen, students would be overwhelmed, as they are today, with information and conceptual challenges without conscious tools for thinking on their own. Sometime after these seminars, I was invited to be a part of the newly formed Cognitive Coaching® group led by Drs. Art Costa and Robert Garmston, focused on supervision and coaching in schools. Here I could see that the very same kinds of reflective questions we may ask of each other through supervision, mentoring, and coaching of colleagues reflect the kinds of questions we ask students to facilitate their thinking processes. I also realized that responses to these complex questions could be held in visual maps facilitating metacognition.

A third influential experience occurred during my two years in the early 1980s with the federally funded Teacher Corps, which focused on bringing new teachers into urban education. I was given the opportunity to pilot two comprehensive programs intended to systematically integrate content learning with thinking skills development. One of the programs was called *THINK!* with a scope and sequence that moved from phonemic awareness to full reading comprehension at the eighth-grade level. The second was called *Intuitive Math*, and its scope and sequence moved from basic number identification through eighth-grade math and prealgebra. Both of these programs focused on three outcomes: content learning, basic skills in each area of content, and the explicit teaching of a model of fundamental cognitive skills developed by a relatively unknown semanticist and professor, Dr. Albert Upton. Here I learned that we could *explicitly* teach children cognitive skills *simultaneously* with content knowledge and basic skills and that this *combination* is the key to learning.

Upton's theoretical work *Design for Thinking* (1960) describes six fundamental cognitive skills: defining "things" in context, describing, classifying, part-whole spatial reasoning, sequencing, and analogous thinking. Although these *foundational* thinking processes were well known to all cognitive psychologists and educators, Upton's definitions of these cognitive processes and his capacity to reveal how these skills work independently and interdependently—*along with a few key graphic representations*—showed me that these ways of thinking were at the center of every level of complex thinking from early childhood through adult learning. These cognitive skills work at every level of complexity, and they never go away.

I taught this approach in inner-city Oakland, California, at a Grades 4 to 8 school with a student population that was predominantly African American, most of whom were scoring in the lower two quartiles in reading and mathematics. Within weeks, the students thrived and I could *see* their rich thinking, which was not reflected on their previous test scores. As time went on, these students significantly shifted their test scores upward and began matching the high quality of their thinking with testable performances. This experience in the early 1980s gave me, at a very early stage of my career, an up-close view of the great disparity called the *achievement gap* and the structural inequities of school segregation and inequities of funding, which are still well documented in education today (Kozol, 2005). I also saw the fallacy of the "bell curve" mindset and became an advocate for improving thinking performance for all children. This reframing of the bell curve also led me to reject the culturally narrow framework for the intelligence "deficit model" that presupposed, with blinders on, that African Americans and other racial and ethnic groups were intellectually inferior to the dominant white culture in America. These structural and institutional frames still influence education today, but through my teaching experiences back then, I could see the glimmer of a way through the dire state of many urban classrooms. Students needed explicit tools for thinking through and transforming isolated information into mapped knowledge.

The last experience that captured me occurred while completing doctoral studies at the University of California at Berkeley, through my courses and guidance from Dr. George Lakoff. His research helped me to understand the influence of metaphor, mental models, and "framing" on human cognition. Specifically, frames of reference, whether belief systems, primary discourses in language, or the wealth of culture, directly and deeply influence how each of us as human beings *see* and *think* about the world. Lakoff's cross-cultural research and writings show that fundamental cognitive skills such as categorization, comparison, sequencing, and causality are all framed by our experiential base. This experiential base is found in language, culture, and cognitive structures (Lakoff & Johnson, 1980). The theory of *frame semantics* became a guiding concept for me in learning how cognitive processes and dynamic schemas work together in an often awkward dance to make sense of incoming experiences to the brain and mind.

As described in the following sections, and drawing from Art Costa's insights on metacognition, each cognitive pattern within the model of Thinking Maps is grounded explicitly by the visual rectangular "frame" of reference. After students map content, they may draw the frame around the map and write within the frame any information or experiences that may be influencing their point of view. This establishes a metacognitive stance in relationship to the *thinking* held in each *map*.

The four experiences described above—visual brainstorming, cognitive skills, the link of content learning and literacy to cognitive skills, and metacognition frame theory—all drew together around my interest in improving thinking abilities and learning for *all* students and for providing myself and other teachers with tools to help mediate student thinking.

DEFINING THINKING MAPS AS A LANGUAGE

The language of Thinking Maps is first and foremost based on eight fundamental cognitive skills. These eight cognitive skills, as shown in Figure 7.1, are based on a synthesis of cognitive science research, models of thinking developed for psychological testing and educational programs, and a transformation of Dr. Upton's early work. This model is neither linear nor hierarchical. The eight cognitive skills are defining in context, describing attributes, comparing and contrasting, classification, part-whole spatial reasoning, sequencing, cause-and-effect reasoning, and reasoning by analogy. This language is not a comprehensive view of thinking; it identifies the coherence and interdependency of the eight *fundamental* cognitive skills that ground thinking and learning.

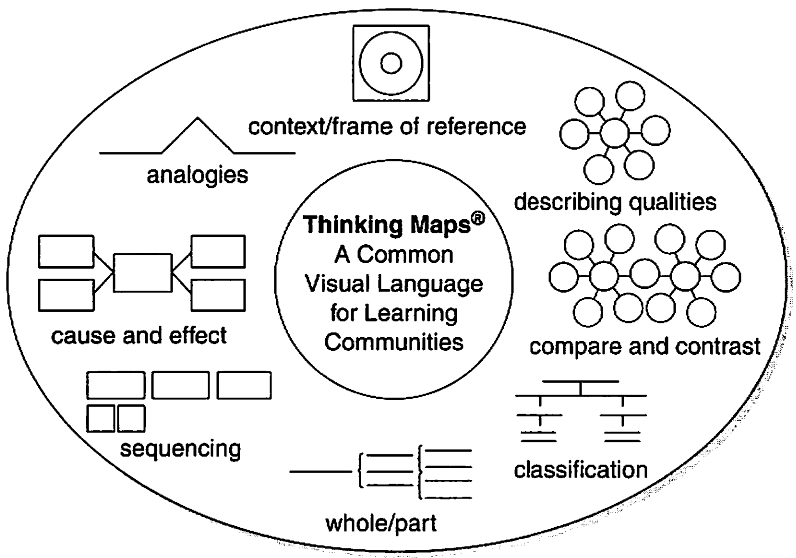
This model is somewhat analogous to the eight parts of speech of the English language, which are used in a unifying way to produce sentences and sonnets and have no hierarchy or linearity in their use. Although it is dangerous to proclaim universals—which may be disrespectful to different cultures, language, and cognitive styles represented around the world—the eight cognitive primitives that ground Thinking Maps have found resonance and relevance as we introduced the tools in places like Singapore, Japan, Mexico, and, of course, in U.S. cities and districts of New York City that work with students speaking at least 150 languages and dialects.

The claim offered here is that around the world, like universal human emotional patterns such as love, joy, and pain, there are also basic universal cognitive processes: Every child born into this world, for example, comes to learn how to *sequence* the day, *categorize* ideas and objects around them, break down objects *whole to parts* and assemble them parts to whole, survive by causal reasoning, and reason by *analogy*. For example, there is no doubt that every human being has a visceral if not always conscious understanding of the causes and effects of actions; we would not survive physically, socially, or emotionally in the world if we did not reflexively and reflectively use cause-and-effect reasoning.

Key to understanding each of the eight cognitive processes is the essential interdependence among them. For example, as we saw in Chapter 2, Robert Marzano and his team have identified *comparing and contrasting* as one of nine strategies that work consistently well in classrooms. When students and teachers become aware of the eight Thinking Maps, including comparing and contrasting, it is clear that to do a high-quality level of comparison, one *must* be able to describe the qualities of the two items being compared. As an extension of this rule, to classify at a higher order rather

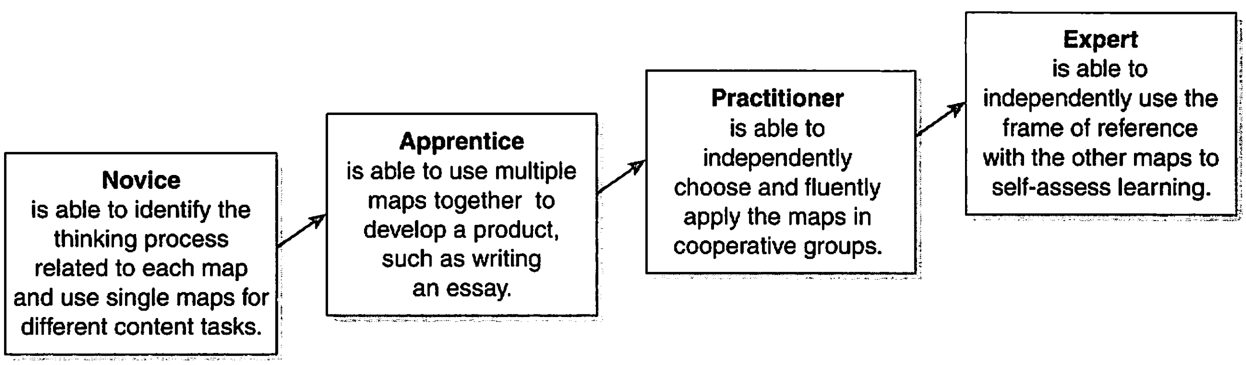
Figure 7.1 Thinking Maps Overview

Background Thinking Maps® is a language, or toolkit, of eight thinking-process maps, developed by David Hyerle. Each map is graphically consistent and flexible so that students may easily expand the map to reflect the content pattern being learned. Thinking Maps® are introduced to students as tools for reading and writing, content-specific learning, and for interdisciplinary investigations. Over time, students learn to use multiple maps together and become fluent in choosing which maps fit the immediate context of learning. Thinking Maps® and Thinking Maps® Software are used in whole schools through faculty training and follow-up.



Basic Techniques

- Begin with an application of each of the maps to a concrete object to be able to understand the relationship between thinking processes and Thinking Maps®.
- Expand each map to show the big picture and then prioritize information by deleting ideas from maps for reading comprehension and writing.
- Use multiple maps together to construct related patterns of learning, and use "frame" to identify frames of reference.



than through one-shot thinking, a student may need to compare items or ideas to determine in which category they belong and for what purpose. This awareness by students of the *interdependency* of thinking skills is, I believe, a missing link in classrooms today. Educators at every level, and psychologists and researchers, simplify these processes by teaching and testing thinking skills in isolation and imply the use of thinking skills rather than explicitly teaching them to students. Thinking is reduced to isolated skill development rather than a complex of cognitive processes that must work together to enable students to think at every level of Bloom's taxonomy. My critique of graphic organizers in Chapter 5—as being often static and isolated, teacher rather than student centered, and task specific rather than transferable—is resolved when teachers teach students how to use and transfer Thinking Maps independently as a language of multiple dynamic cognitive maps across content areas and their educational experience, K–12.

This introduction reveals why the name of this language uses the terms *thinking* and *maps*, in that order and not the reverse: The visual form of each map follows from the cognitive function of each map. *Form follows function.* The eight visual maps are a language of nonlinguistic representations for fundamental cognitive patterns that unite with and explicitly support spoken, written, and numeric representation systems. Each of the graphic primitives that visually define and animate each cognitive process is closely attuned to and reflects the cognitive pattern. Without going into lots of detail on the development of each graphic for each of the eight maps, it is obvious that the Flow Map was derived from flow charting, the Tree Map for classifying came from a traditional diagram for hierarchical reasoning, and the Brace Map for physical analysis of part-whole spatial relationships came from the classic text *Gray's Anatomy*. Each of the other map configurations, as expanded from visual starting points, were derived during my process over many years of developing a graphic primitive that any learner could use from simple to complex applications in every discipline. The main criterion in generating the visual form was that it as closely as possible followed the functioning of the cognitive processes defined by our evolving history of cognition.

As noted earlier, what is important is that each of the cognitive processes is influenced, animated, and transformed by the cultural frames that surround these behaviors. This means that everyone may understand and utilize the cognitive process of categorization, but the categories carry a different language, content, processes for development, and forms within and across cultures. After playing with and rigorously testing the eight maps as individual tools and as a language of interdependent tools, I realized what was missing: a way for learners to name and visually represent what was influencing, or framing, the thinking patterns they had developed using each Thinking Map. Inherent in the metaphor of "frame" was the visual needed for facilitating reflection: Learners could draw a rectangular frame, like a window frame, around any of the maps and thus ask many reflective questions such as:

- What is influencing how I am seeing this information?
- What prior knowledge is helping or getting in the way of my understanding this new content knowledge?
- Why did I choose this Thinking Map?
- Is there another or several other Thinking Maps I should use to understand this idea?

In retrospect, and from what we now know about the effectiveness of Thinking Maps from close to 20 years of implementation in whole schools, the eight cognitive processes grounding the visual representations are most powerful when the learner adds this metacognitive frame of reference around the map being created. This is because we not only want students to be self-assessing and metacognitive, but we want them to understand that other learners in the classroom or school will create different maps of the knowledge. Respecting and having empathy for another person's view of knowledge and frames of reference enhance knowledge creation in classrooms and communication across languages and cultures.

While there are only eight maps—and the "metacognitive" frame that surfaces the culture, belief systems, and perspective of the maps' maker—each map has an infinite number of configurations, much as the English language has only eight parts of speech but a vast number of combinations that create an infinite number of simple to complex variations. Five essential qualities of Thinking Maps are key to their being infinitely expandable and capable of being used simultaneously, as a carpenter uses multiple tools in constructing buildings (Figure 7.2). For example, using the Flow Map as an example, the map is

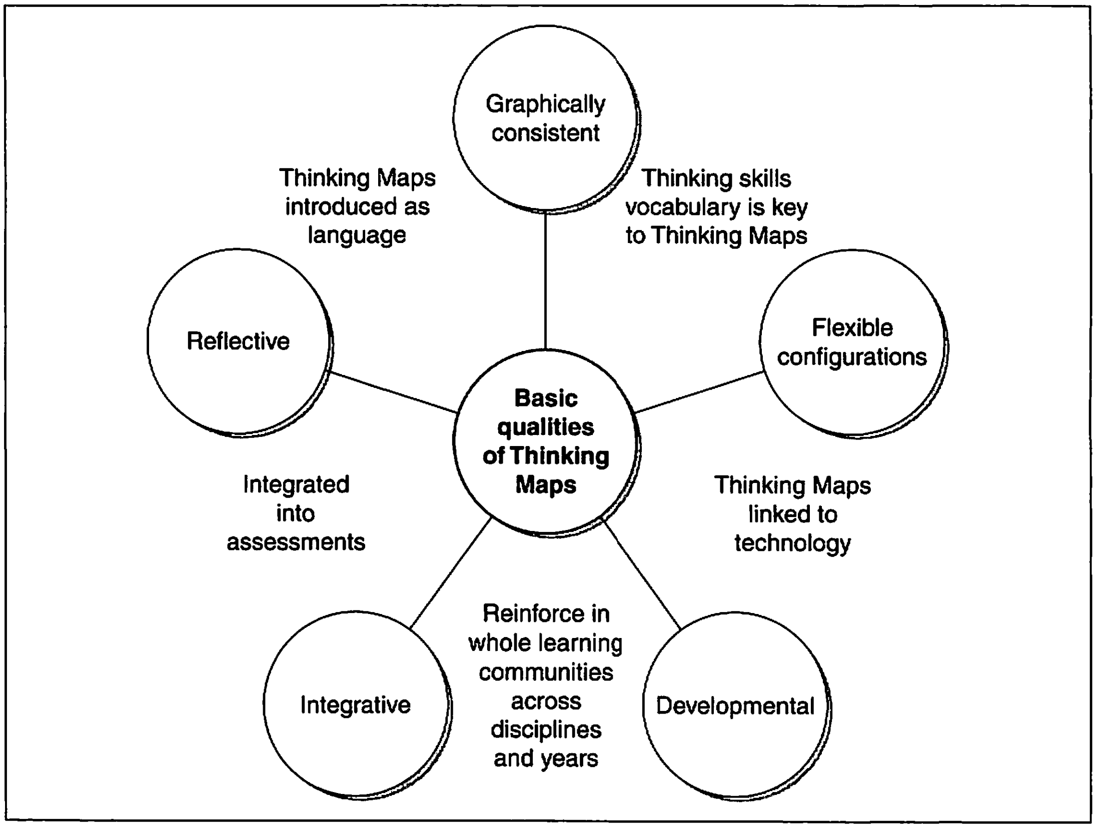
- *graphically consistent*, as the flow is created with boxes and arrows only and can show substages;
- *flexible*, as the graphic primitive expands so the flow can be linear and cyclical, or have multiple parallel flows connected;
- *developmental*, as it can be used at any age level and is responsive to simple to complex applications;
- *integrative*, as it is used across disciplines and for interdisciplinary problem solving; and
- *reflective*, as learners uses it to assess how they are thinking and share and compare the visual representations with one another and teachers.

These qualities of the tools, used individually and together as a language, lead immediately and directly to more complex orders of thinking, such as problem solving involving evaluating, thinking systemically, and thinking analogically. When students are given common graphic starting points, *every* learner is able to detect, construct, and communicate different patterns of thinking about content concepts, as shown in the figure within the frame of reference surrounding the Bubble Map. This is especially true when Thinking Maps are used as a language, keyed to thinking skills vocabulary for learning and assessing, and when they are used with Thinking Maps Software and other technologies, and, most important, when they are reinforced over multiple years across disciplines.

In summary, as a *language* of visual tools, each of the eight Thinking Maps embodies the creative quality of *brainstorming webs*, the organizing and consistent visual structure of *graphic organizers*, and the deep processing capacity and dynamic configurations found in *conceptual maps*. At any time, learners can access this thinking language—on paper or through software—to construct and communicate networks of mental models of linear and nonlinear concepts. As explored in the following sections, using the language of eight graphic primitives, learners and teachers identify the questions and cognitive skills needed to solve a problem, complete a task, answer a question, or write an essay and identify which Thinking Map or most likely *multiple maps* will be useful for the problem before them.

Thinking Maps, as a language of visual tools based on fundamental thinking skills, have been proven as one route for *unifying* content and process instruction and

Figure 7.2 Bubble Map of Five Qualities of Thinking Maps



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assessment of products. As students across whole schools become fluent with Thinking Maps, this array of eight visual tools becomes a common visual language in the classroom for communication, cooperative learning, and facilitating a deep empathy for how others think as well as for the *continuous cognitive development* of every child over a lifespan of learning.

FIVE LEVELS OF THINKING MAPS IMPLEMENTATION

After participating in a Thinking Maps "Day 1 Training" and coaching conducted over a year, teachers and students become independent and cooperative tool users, fluidly linking content knowledge and working together to build maps on the way to final products. Many of these schools integrate Thinking Maps Software® (Hyerle, 2007) into the routines of classroom and computer lab experiences, creating a seamless web connecting the mind of the learner, the content being taught interactively by teachers, and technology.

Thinking Maps are used for reading comprehension and writing across disciplines. The training manual *Thinking Maps: A Language for Learning* (Hyerle, 1995; Hyerle & Yeager, 2007) contains content correlations and examples of Thinking Maps applications to literacy development and mathematics, science, social studies, reading, and writing and the full range of activities in schools from the arts to physical education. As described below, teachers move from novice to expert users of these tools by directly linking the content they are teaching and the questions they are asking to their own local, state, and/or national standards. This occurs through collaboration with outside consultants and their own in-house trainers who have been certified to conduct Thinking Maps follow-up. Though each map is based on a defined thinking process, teachers and students use this correlation to fully integrate the reading, writing, and thinking connection necessary for full comprehension and expression of ideas.

Over the past 15 years, the processes of implementing Thinking Maps over multiple years have surfaced a common evolution across schools and states in which we have worked. Because the implementation model is based on whole-school use over time and the direct involvement of all students, teachers, and administrators, a clearly defined rubric for implementation has been developed as a guideline for long-term implementation (Figure 7.3). As you can see, there is an evolution for students, teachers, administrators, and whole-school development across five levels:

1. Introducing the big-picture concept of Thinking Maps to all participants in the school so that there is a readiness to fully implement the tools
2. Teaching and reinforcing the basic use of Thinking Maps to all participants
3. Horizontal transfer of Thinking Maps as a language across disciplines and communication by teachers and administrators in the school
4. Vertical integration of Thinking Maps and software into students collaborative work and homework as well as within instructional strategies and programs
5. Executive control of Thinking Maps so that all participants are experts in this language and able to independently and collaboratively use the tools for novel applications in any setting

Because Thinking Maps are a visual *language* and is not an add-on program of activities, materials, or worksheets, this rubric is based on the evolution of all participants in a school toward fluency with the tools as applied to what they are already doing in classrooms and in professional meetings. The Concerns Based Adoption Model (CBAM) may be used as a filter for decoding or understanding this innovation across whole schools: participants in the school learn the language, begin to see the implications for the maps for their own work, learn the language from outside experts, develop expertise within their own community of learners, and thus are empowered to more complex and novel applications as they take "executive control" over the content, processes, products, and assessment of the work.

Figure 7.3 Five Levels of Thinking Maps Implementation

	1 Introducing the Knowledge Base	2 Teaching the Skills and Maps	3 Horizontal Transfer Across Disciplines	4 Vertical Integration	5 Executive Control and Assessment
STUDENT	• Is aware of the impending implementation	• Correctly applies and constructs all 8 maps with support • Recognizes maps as teacher applies them in new situations • Identifies appropriate TM in response to prompt or question	• Uses thinking-process vocabulary • Accurate and independent selection of TM for communicating thoughts and ideas in all subject areas • Applies multiple maps to analyze and comprehend information for learning	• Uses TM collaborative group work to expand, revise, and synthesize ideas • Collaborative problem solving • Applies TM to homework, projects, etc., for a variety of purposes and through a variety of technologies, including TM software	• Fluid, independent use of language of TM across disciplines • Uses TM for metacognition, self-reduction, and assessment • Self-selected artifacts for student portfolio of Thinking Maps • Novel applications beyond academic areas
TEACHER	• Has attended Day 1 TM training • Established a plan for systematically introducing TM • Has met with colleagues (grade level, content area) to review plans for implementation • Discussed with students the plan for implementation	• Explicitly introduces and reinforces all 8 maps • Models and applies multiple maps to demonstrate and introduce content and concepts	• Uses TM to guide questioning and responses • Encourages and models thinking-process vocabulary for the transfer across disciplines • Explicitly scaffolds map(s) for improvement of students' thinking abilities	• Uses TM In collaborative work for instruction and assessment • Collaborative problem solving and curriculum planning • Uses TM in and for curriculum planning, cooperative learning, and assessment through a variety of technologies, including TM software • Embeds Thinking Maps in other instructional strategies, structures, and initiatives	• Fluid use of map(s) instruction and assessment • Uses TM for metacognition, self-reflection, and assessment • Self-selected collection and documentation of Thinking Maps integration • Novel application to instructional opportunities beyond academic areas

(Continued)

Figure 7.3 (Continued)

	1 Introducing the Knowledge Base	2 Teaching the Skills and Maps	3 Horizontal Transfer Across Disciplines	4 Vertical Integration	5 Executive Control and Assessment
ADMINISTRATOR	• Has a clearly developed plan to support TM implementation • Uses TM for basic agendas or to display data such as agendas, roles (if leadership training has preceded TM implementation)	• Uses TM to plan and facilitate small- and whole-group meetings • Models multiple maps to introduce and generate information about topics or issues	• Uses TM for coaching and supervision • Uses TM for long-term planning and school improvement • Encourages and models thinking-process vocabulary for transfer across the learning organization	• Uses TM In collaborative work for instruction and assessment • Collaborative problem solving and curriculum planning • Uses TM in and for curriculum planning, cooperative learning, and assessment through a variety of technologies, including TM software • Embeds Thinking Maps in other instructional strategies, structures, and initiatives	• Fluid use of maps in collaborative problem solving, coaching, and supervision, etc. • Uses TM for metacognition, self-reflection, and assessment • Schoolwide documentation of applications across grade levels and disciplines • Novel application to administrative duties
SCHOOL	• Leadership Team, including Trained Trainers, established to guide implementation • All resources and TM software, if acquired, are distributed to faculty • Central area established to share/display TM work	• Displays evidence of student, teacher, and administrator applications • Parents are made aware of the implementation of the maps and opportunities are provided for them to become oriented to their use	• Sharing, discussing, and collecting map applications and media across all grade levels and positions to promote the schoolwide common language • Uses TM for schoolwide data analysis and action planning	• Uses TM in grade-level, department, parent, and volunteer meetings for collaboration problem solving • Integrates TM as a tool within other communication frameworks through a variety of technologies, including TM software	• Fluid use of maps for communication between all members of learning community, parents • TM technology used to facilitate higher-order thinking across school • Schoolwide assessment of implementation indicating patterns of use, growth and next steps • Novel applications outside of school building (in the wider community

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The last cell of the rubric, at the bottom right, is the ultimate goal of implementing Thinking Maps: an evolved capacity for a community of learners to use Thinking Maps as a true language for communication, higher-order thinking, and problem solving, and for assessment at every level of the learning community and thinking organization. Ultimately, as we shall see, this means a leveling or flattening of the typical school hierarchy of empowerment, with the principal at the top, the students at the bottom, and teachers caught in the middle. This is because Thinking Maps offer a common visual language that brings people together around questions, concerns, and problems that reveal patterns from simple to complex and create a visible public space that is cogenerative and not positional (Alper & Hyerle, 2006).

The maps, as shown in the following examples, energize thinking and emotional states by explicitly centering on surfacing and thus honoring the frames of reference of every participant—students, teachers, and administrators—in the processes of learning and leading in schools.

In the first example, principal Stefanie Holzman of Roosevelt Elementary School in Long Beach, California, describes how Thinking Maps have become a "first language" for thinking across the whole school and as a bridge for students between their primary language, Spanish, and their second language, English. This writing is excerpted from Holzman's complete chapter in the book *Student Successes with Thinking Maps* (Chapter 10 in Hyerle, Curtis, & Alper, 2004). In the beginning of the implementation, all teachers and administrators attended Thinking Maps training, and with each year a new cluster of teachers attend a regional, in-depth training of trainers so that expertise is continuously being developed within the school. Roosevelt is now at the highest level of the CBAM model: step into any classroom and you will see, as I did, that teachers are creating novel applications with the tools and are focused on the adaptive and systematic use of Thinking Maps as fully integrated with their complete instructional program, specifically for language development and content learning.

Also, interview almost any student in the school and you will find them fluent with the Thinking Maps for their own learning across disciplines. I interviewed students from one fifth-grade classroom during the 2004 school year, and many stated that they regularly use the maps independently from teacher prompting, that the maps have directly helped their performance—especially in writing—and some even confessed to using the maps at home for working out problems. One student successfully taught the Thinking Maps to his older, high school sister who was having difficulty with writing.

The classroom experiences, transformation of teacher instruction and leadership, and performance results of students at Roosevelt and schools in Los Angeles have led to the in-depth training of over 300 Thinking Maps Trained Trainers in the Language Acquisition Division of the Los Angeles City Schools. Stefanie Holzman's insights offer a window into the idea of differentiated thinking patterns for all students, independent of level of language use, cultural background, and socioeconomic status. The improvement in test scores that she details in the next section—a gain of 182 points over the past three years when the state expectation was 30 points—is highly significant as each year student performance well exceeds state expectations.

Differentiated Thinking Patterns for English-Language Learners, by Stefanie Holzman

Learning content while learning a second language is a complex process. It is frustrating for a child to have ideas, vocabulary, and rich patterns of thinking in one language that are not immediately translated and understood by teachers in the context of the classroom. This is because the acquisition of a second language obviously gets in the way of our thinking and learning. The Thinking Maps become a translator of language and thinking from one language-mind (Spanish) to another (English). Thinking Maps became our first language for thinking, thus supporting the languages, content learning, and cognitive development of our multilingual population. Importantly, Thinking Maps were used to promote critical thinking skills even for students who were still acquiring English.

All students in our school, Roosevelt Elementary, in Grades 1 to 5 were tested on a standardized test in reading and math, and Grades 2 to 5 were also tested on the California standards test. Much of the math section includes reading. The teachers taught students to analyze the type of math question it was (for example, comparison, whole to part/part to whole, relationships, patterns) and the map associated with each. Once the students understood the five kinds of "story problems," they were able to tease out their critical attributes and apply them to the test. For example, in response to a word problem, one first-grade student selected the key information from the problem using a Circle Map and then used the Flow Map to show the steps and the strategies involved in solving the problem based on the information from the initial Circle Map. The change in students' ability to do these problems made a significant difference between last year's and this year's school scores.

Over 85% of the students who enter kindergarten in our school speak Spanish as their primary language. By law, we are required to differentiate the instructional practices based on the level of English-language proficiency of students. Theoretically, differentiation is simple: Teach differently to different students based on their individual needs. Easier said than done. However, one of the differences that Thinking Maps has made at my school is that teachers teach the same content to various groups in their classroom, but they have begun to provide alternative means for students to access content and to show what they know. For example, some teachers expect students to use the Thinking Maps as processes to a final product, whereas others expect students to use the tools as a final product to demonstrate their thinking and comprehension of the content.

In one of the third-grade classes, the students were expected to understand the similarities and differences between two planets. All students were required to complete a Double-Bubble Map comparing and contrasting the two planets, which was the stated outcome of the lesson. However, to differentiate the lesson, students who were fluent in English were also expected to write a report containing this information. Students less fluent in English needed only to create the Double-Bubble Map. The teacher was able to evaluate every student's factual and conceptual learning using either strategy (the map alone or the map and writing). With fluent English speakers, she was also able to evaluate their ability to communicate their learning in writing, something she already knew the less fluent English speakers would not yet be able to do. Of course, it is also essential to have the students who are not fluent in English begin to write from the Thinking Maps, as this provides the bridge from their primary language to the mainstream spoken and written form. As a first language for thinking, the maps became vocabulary builders, visible organizers, and starting points for writing in a second language.

The numbers are in from the standardized tests given in California. The state has a very complicated formula to determine expected growth. Roosevelt School was expected to gain 11 points overall in year 2003. We exceeded that goal with a 60-point gain. Not only did the school as a single unit make improvement, but so did our significant subgroups: Hispanic students, English-language learners, and students of low socioeconomic status as determined by free lunches. In 2003–2004, we gained 18 points on the California assessments and last year we gained another 28 points. We have also been identified as a CA Title 1 Academic Achievement Award winner for 2006. And we are still not satisfied. We've made a total of 182 points on the California assessment system; the expectation was about 30.

The important point here is that the teachers are able to assess content learning and use student maps as data points to see whether or not it is language that is getting in the way of understanding or if there are content misconceptions that need to be retaught. It is often difficult to determine how much limited English-proficient students understand of what is taught. If a teacher wants to know what a second-language learner has learned, does the teacher ask the student to use the second language if the student does not have verbal or written fluency? If assignments require writing what they know, these students often drown in the English language. They have to figure out the vocabulary, the syntax, the spelling, and the punctuation of English and at the same time remember the content they have learned. The results are that teachers often evaluate the students' English skills and sentence construction and not their content knowledge or their reasoning. However, when teachers ask students to use Thinking Maps to demonstrate what they know, then the students do not have to focus on English and can use their mental energies to communicate what they know about the content. They do not even have to use words to convey this information. In most cases, Thinking Maps lend themselves to visuals (e.g., drawings or pictures from magazines) to communicate the content.

ESSENTIAL COGNITIVE QUESTIONS BASED IN STANDARDS

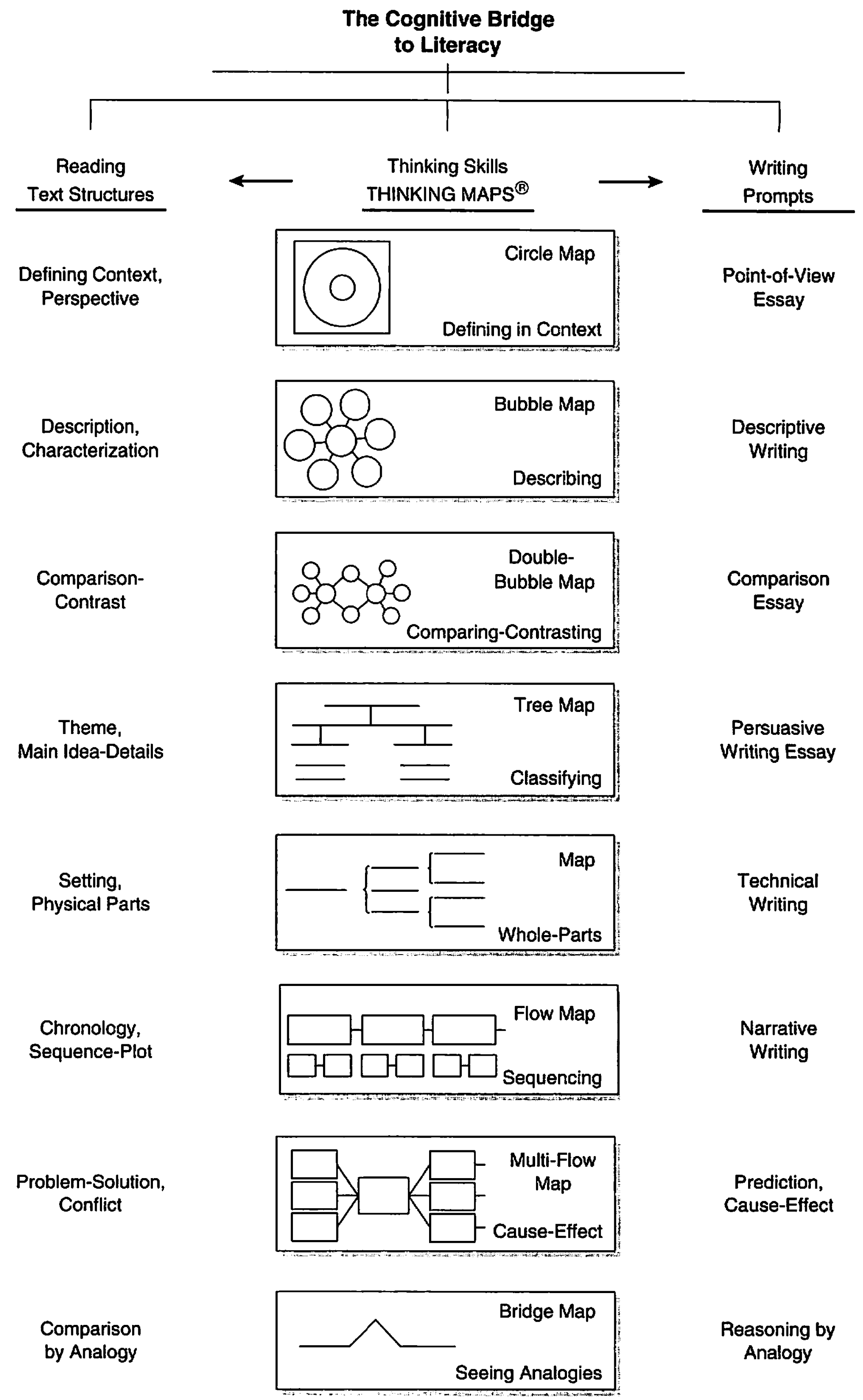
The kind of performance gains documented in Roosevelt School and many more are attained through focusing on essential questions that teachers ask of students on a day-to-day basis in classrooms. These types of questions also show up at the end of chapters in textbooks and in guides for teachers in published programs. These questions, based on fundamental patterns of thinking, are also the basis for questions found in local, state, and national standards.

These questions are also the foundation for Thinking Maps as shown in the following. Like the preceding questions, each Thinking Map—along with the "frame" of reference around them—represents a reflective question:

1. Circle Map: How are you defining this (concept) and in what context?
2. Bubble Map: What are the attributes?
3. Double-Bubble Map: How are these alike and different?
4. Tree Map: How are these grouped together?
5. Brace Map: What are the parts of a physical whole object?
6. Flow Map: What was the sequence of events?
7. Multi-Flow Map: What were the causes and effects?
8. Bridge Map: Is there an analogy between these ideas?

By grounding the Thinking Maps in fundamental cognitive skills, this language becomes the cognitive bridge to literacy between these questions and the reciprocal processes of reading comprehension across disciplines and writing prompts. As shown in Figure 7.4, the Thinking Maps key students and teachers to this bridge.

Figure 7.4 The Cognitive Bridge to Literacy



By linking concrete maps with essential questions and abstract thought processes, students can deal with more complex thinking because they know *what it looks like*. Importantly, they come to know how to link multiple Thinking Maps together in response to the *multiple* essential questions that teachers ask almost every day.

In the following section, Sarah Curtis, former teacher and lead author of the Mapping the Standards project, details how these exemplar lessons guide teachers and students to see how Thinking Maps bridge their own knowledge and skills base with standards-based questions and performances. Of course, it is the student who must perform independently on the gatekeeping tests in our educational system, and Sarah shows how Thinking Maps become the tools not only to meet the cognitive demand for each standard but also to exceed the standards and develop a deeper understanding of content knowledge. This section also reveals how Thinking Maps Software for students, teachers, and administrators offers a seamless connection between classroom practice, higher-order thinking, and this cognitive tool–based technology.

Again, return to the rubric to consider which of the five levels of implementation of Thinking Maps are being attained by integrating these tools into the core learning and teaching practices of a school, when these tools are focused on *meeting the standards by mapping the standards.*

Using Thinking Maps Software to Map the Standards, by Sarah Curtis

Most educators can remember their first attempts to decipher the standards for their grade level or content area. Furrowed brows and signs of exasperation greeted those unappetizing documents that outlined with confounding verbiage what students of a particular age needed to know and be able to do. Perhaps you can recall your own reaction to your state or district standards: anger, rejection, defeat, denial, or overwhelming frustration. Rarely did these documents, intended to provide and promote consistent benchmarks of achievement, leap from the page and into practice across the nation.

Thinking Maps and Thinking Maps Software are useful as tools for instruction and assessment for prioritizing standards across subject areas, and for developing conceptually and cognitively based lessons that address the standards. This provides both teachers and students with a means to translate the complex language of the standards into a tangible form of instruction and assessment for an array of different outcomes, as schools tried to adapt to the standards movement. Thinking Maps offer a vehicle for understanding the standards, constructing meaningful lessons targeting the learning outcomes, and a form of representation of what that learning might actually look like as students progress through their academic careers (Figure 7.5). The Thinking Maps Software provides the technology to archive and distribute these lessons across sites and to document student thinking over time.

When approaching the standards from a thinking-process lens inherent in the design of Thinking Maps, the cognitive processes of the standards emerge to the forefront while the content or topic moves in parallel to the side. Examining the standards in this manner helps shift the focus from an overload of content to be memorized toward a consistent pattern of how to think about content. Continuing to sift through subject matter, this cognitive filter illuminates a new way to see the content. The question changes from "What content needs to be covered?" to "How are the students asked to think about the content, to what degree, and from what angle?"

During the initial professional development day described earlier, when the Thinking Maps are introduced to teachers, teachers spend part of the day analyzing their local and/or state standards by looking at the types of thinking processes that students would use to meet the standard(s). If teachers have acquired Thinking Maps Software, they may begin to map out lesson plans by using this technology. See the example provided of a fifth-grade history lesson in Figure 7.6a–c.

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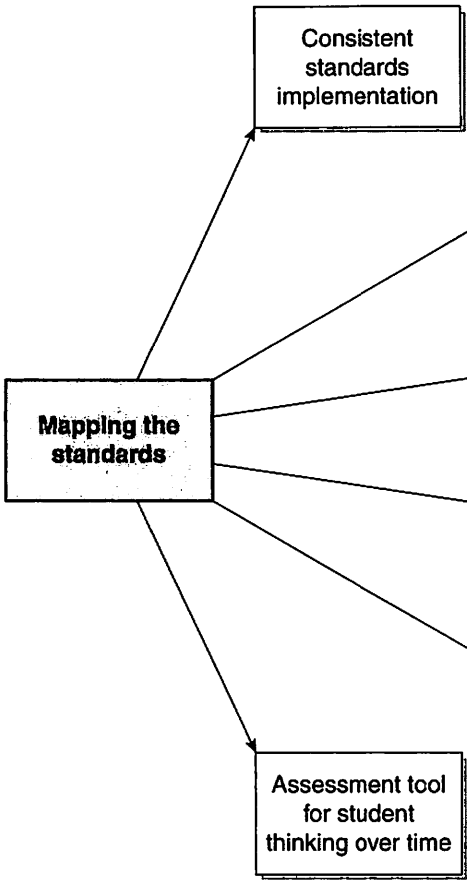
Figure 7.5 Mapping the Standards Outcomes



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Thinking Maps Software shows how the thinking processes embedded in the standards lead to the creation of essential questions and the application of a series of multiple Thinking Maps to develop that understanding. Partially completed Thinking Maps in the Map Window feature possible maps that correspond to the questions during the lesson. These maps may be used for pre- and postassessment and as scaffolds for a final project.

If the final demonstration of understanding is a written assignment, then the Writing Window of the software can be opened next to the Map Windows, and the information can be composed in the Writing Window as a word-processing document. Each lesson may include maps to activate prior knowledge, support student processing, assess content understanding, and extend knowledge. Educators can access the database of standards-based lessons by grade level, content area, or standard and select the lesson that meets their requirements.

In structuring lessons from concept to content—focused on essential questions and the cognitive pattern embedded in the questions—this professional development process aims to provide a model of high-quality instruction for teachers and the explicit pathways for students to exceed the standards. In the history lesson, students are asked to think about the concept of exploration, not just regurgitate names, places, and dates from a random period of time. Presenting this concept invites students to bring their prior knowledge to bear on learning the new information. Most students have some degree of familiarity with exploration, whether they have explored a sibling's room, their neighborhood, or a new landscape in a video game.

Figure 7.6a Mapping the Standards Example

Directions

Grade 5, Social Studies, World History

Knows European Explorers of the 15th and 16th Centuries, Their Reasons for the Expeditions, Results and Information Gathered From Travels

Guiding Questions

Who were some of the explorers of the 15th and 16th centuries?

What are the qualities that explorers exhibit?

Where and why did they explore?

What were the results and implications of their exploration and discoveries?

Activating Prior Knowledge

Explain that students will be studying European exploration from hundreds of years ago so they will understand why explorers explored and what happened as consequences of their exploration. Although this is a time period they may be unfamilar with, they can relate to the concept of exploration. As a whole class, have students construct a Multi-Flow Map capturing from their prior knowledge why they think people explore and the possible outcomes. Explain that students will be updating/revising their thinking as they learn more in the unit.

Activity 1

Tell students that they will be examining an explorer to find out the details about that exploration. As a group, brainstorm, using a Circle Map, the information that they want to know about their explorer. Use the Frame to denote the resources they could use to find the information. Use a Tree Map to classify the information into categories.

Activating Prior Knowledge

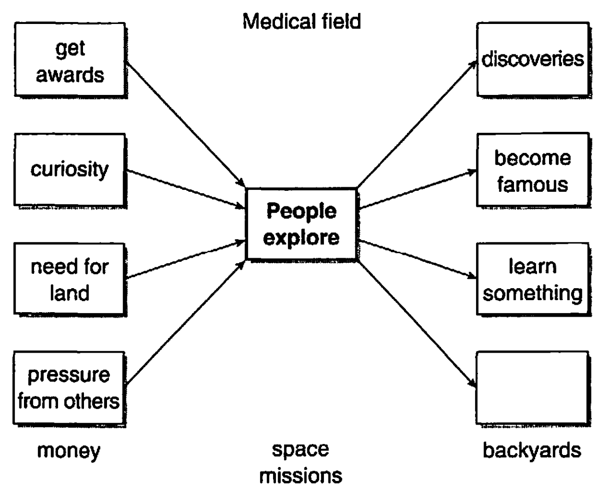

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Figure 7.6b

Directions

Activity 3

Once students understand the basic exploration, students should create a Multi-Flow Map to show the causes and results of this exploration. What happened to the person, the crew, the country, and the natives of that land as a result of this exploration?

Activity 4

Partners could pair with other partners to create a Double-Bubble Map comparing and contrasting their two explorers to find what was similar and different about the explorations. Students should use their Flow and Multi-Flow Maps to help them.

Activity 5

After learning about explorers and sharing information with the class, students should start to see patterns among the explorers. Use a Bridge Map to relate all the explorers in a variety of ways.
Use relating factors like discovered, overcame, and explored to synthesize the information.
Extend to other subject areas besides explorers, such as characters from literature or other figures from history, to extend the concept of exploration and overcoming obstacles.

Extension

Students should write a paragraph about whether they would have liked to have been an explorer or not. They should give examples to support their opinion. Students could use a Tree Map to organize their thinking into paragraphs.

Activity 5

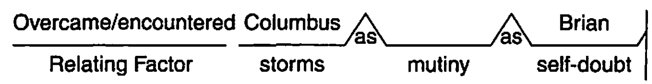

Figure 7.6c

Directions

Activity 4

Partners could pair with other partners to create a Double-Bubble Map comparing and contrasting their two explorers to find what was similar and different about the explorations. Students should use their Flow and Multi-Flow Maps to help them.

Activity 5

After learning about explorers and sharing information with the class, students should start to see patterns among the explorers. Use a Bridge Map to relate all the explorers in a variety of ways. Use relating factors like discovered, overcame, and explored to synthesize the information.

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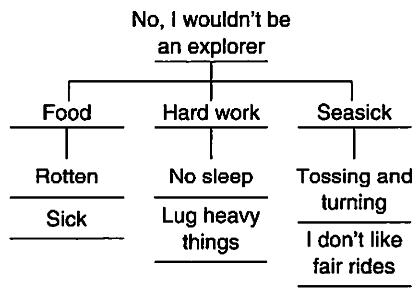

Writing

Turning green, having calluses all over my hands, and listening to my stomach growl are not things I wish to experience. I definitely would not have chosen to be an explorer in the 15th century because of the terrible travel, the hard labor, and the health conditions.

Many expeditions were at sea for months at a time and encountered storm after storm. I can't imagine tossing and turning and being in a constant state of wet from the travel. I can't even handle rides at the amusement parks without getting sick to my stomach.

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The Multi-Flow Map stimulating cause-and-effect reasoning about why people explore and the possible consequences can bridge these thoughts from self (what is known) to historical content (what is unknown). The Bridge Map, used for analogous relationships, deepens the concept from that historical time period to other aspects of history, literature, and science, as demonstrated in Activity 5. The Bridge Map is the concrete visual tool that breathes life into Stephanie Harvey's comprehension strategy of making connections among self, other texts, and the world (Harvey & Goudvis, 2007). In these lessons, explicit interdisciplinary links are offered for students as comprehenders of any subject matter. By focusing on both the cognition and the concept, this process of using Thinking Maps Software not only meets but exceeds the standards.

The Multi-Flow Map highlights some of the key outcomes related to instruction and assessment. From the teaching perspective, this process happens over multiple years in a school or school system as teachers begin to develop, pilot, and distribute the lessons to colleagues at their grade level and within their content area, providing teachers with multiple examples of Thinking Maps embedded into curriculum in meaningful ways, supporting the implementation of both Thinking Maps and standards at a site for teachers at different points in their careers (as new hires, transfers, and veterans). The more comfortable practitioners are with the tool, the more fluent they will be with the language of thinking. The cognitive and conceptual focus provides a model for teaching any content and offers a method for thinking about lesson design. These key questions for uniting standards-based instruction with the language of thinking may serve as guides to streamline the teaching-learning cycle:

1. How are the students asked to think about the content now and over time?
2. What questions, content and cognitive patterns, or links emerge?
3. What concepts or themes are present?
4. How might these patterns, concepts, or themes connect across different disciplines and cultures?

The last question is particularly important as we strive to have students transfer their learning across content and contexts. Teaching for both thinking skills and concept transfer has been the subject of many educational books and articles. The potential for this process described here focuses explicitly on transfer of concepts across content areas and grade levels, but cognitive development over time for each student as well. As students move through school, the topics may change, but the ways in which students are asked to engage in the subject are remarkably similar. The Thinking Maps, as a highly flexible and rigorous language of interdependent visual tools, are easily applied in different content areas and contexts. The recurring use of fundamental cognitive skills as patterns also enables higher-order skill development. For example, the Multi-Flow Map for cause-effect in the Exploration unit, is the same type of thinking necessary for logic problem solving in math, problem solution in literature, and physical change in science. Therefore, this ongoing process of using Thinking Maps and software offers a way to view the standards not only by content or concept but by cognition as well. It is this marriage that makes the potential for teaching for transfer possible.

FROM STUDENTS AND TEACHERS TO LEADERSHIP DEVELOPMENT AND WHOLE-SCHOOL TRANSFORMATIONS

In the preceding two pieces by Stefanie Holzman and Sarah Curtis, the focus is primarily on shifting student performance and teachers' instructional approach. The focus, in both cases, is also on content learning, language development, and the transfer of Thinking Maps across disciplines and conceptual work required in each content area.

In the final section of this chapter, Larry Alper, a former principal and lead author of *Thinking Maps: A Language for Leadership*, shows how these tools are used across a whole school to create and sustain a learning community. Larry and many other principals who have ushered Thinking Maps into their schools and guided their use have done so with hope, belief, and anticipation that the maps would directly improve students' thinking and performance as well as elevate teacher performance to a higher order. What they don't often expect is what Stefanie Holzman describes:

> Ironically, my intent as the instructional leader of Roosevelt School was initially isolated on these tools for a direct and immediate impact on student performance. What I didn't realize and could not foresee were the deeper effects upon the development of teachers across our year-round, multitrack school as a result of the use of Thinking Maps in their classrooms. I discovered that from an administrator's point of view, Thinking Maps did much more than what I had understood from both practical and theoretical points of view.
>
> First, there are changes in how teachers learn and teach and evaluate student work, especially with differentiated processes for our second-language learners.
>
> Second, there have been shifts in the culture and climate of our school, most obvious in the quality of professional conversations that now rise to the surface.
>
> Third, there is a new level of access and discourse in the areas of teacher evaluation and accountability, which has led to a higher quality of teacher decision making. All of these changes—often referenced as keys to school change—will continue to have a long-term positive outcome on the academic achievement of the students at my school beyond the direct application of these tools by students to academic tasks and tests. (Holzman in Hyerle, Curtis, & Alper, 2004)

Let's turn to yet another level of the implementation rubric: administrator leadership and instructional leadership across whole schools. Larry Alper, lead author of *Thinking Maps: Language for Leadership* (Alper & Hyerle, 2006), guides us through an example of multiple maps used to engage in improving parental involvement.

The Role of Thinking Maps in the Process of Becoming a Professional Learning Community, by Larry Alper

The community aspect of learning is a critical dimension of the conceptualization of schools as learning communities. It recognizes that knowledge is as much a social construct as it is an individual one, mediated through the interaction of ideas and experiences shared by people within the community. A unifying feature of communities is the language it speaks. As a common, visual language for thinking, Thinking Maps offers all members of a school community a shared way to elicit, discuss, and examine the individual and collective wisdom within the organization. It provides the community with a common tool for lessening the impulse to arrive too quickly and superficially at a solution before fully surfacing the range of possibilities beyond those immediately evident.

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The phrase *professional learning community* has become common in describing our aspirations as educators for working most effectively on behalf of students. It feels quite natural to apply the act of learning to the work adults within a school environment engage in to address the complex challenges of educating children. However natural the association of this term is to the practices of teaching and leading, too much of what transpires in the professional realm of the school community fails to reflect the qualities of learning. Whether it is because of the pressures of time, or the weight of expectations, or the habits developed from many years of working in hierarchical organizational settings, identifying schools as professional learning communities does not necessarily make them so.

Learning is propelled by curiosity, by the confidence to embrace and enter the unknown and accept ambiguity, and by the willingness to or even the delight in loosening the conventions of one's knowledge and experience to entertain the possibility that there is something new to discover. Frequently, understanding is more about compartmentalizing—associating something new with the familiar and pulling it back toward the established constructs of our thinking or schema, rather than relaxing the boundaries of our ideas to enlarge our field of vision and allow new possibilities to emerge. In professional learning communities, Thinking Maps can provide visual pathways to enter a lush landscape of ideas previously unimagined.

Consider the following selected examples in which a leadership team used multiple Thinking Maps to create an engaging and productive process of inquiry and decision making for improving the involvement of parents in the education of their children and with the larger school community. These examples are excerpted from a new seminar guide for school leadership, *Thinking Maps: A Language for Leadership* (Alper & Hyerle, 2006). Notice how questions were used to guide the process and direct the selection of the particular Thinking Map in response to the thought process reflected in the question. Notice, too, how multiple frames of reference were surfaced to ensure that the fullest possible representation of the topic is presented for consideration.

In the first example (Figure 7.7a), the leadership team began by responding with a partial Multi-Flow Map to the question, What would the outcomes (effects) be if parents were fully involved in their children's education? This question and the ensuing responses allowed the team to surface and clarify its purpose before moving to the next stage in the process (Figure 7.7b).

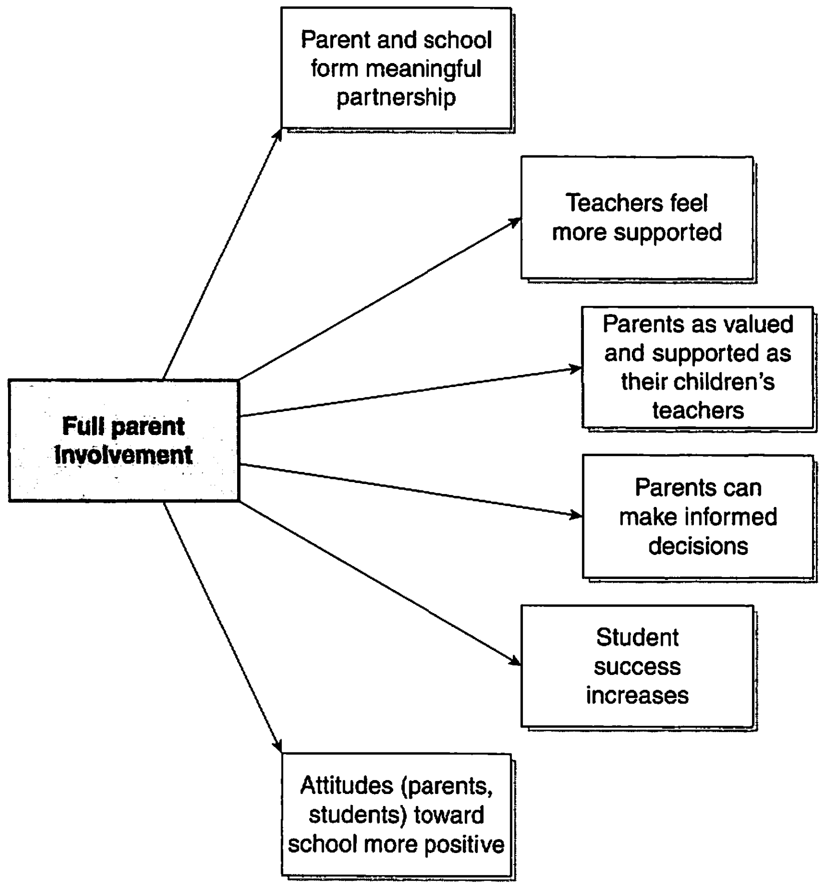
At a later point, recognizing that not all families are the same, the team used a Double-Bubble Map (Figure 7.7c) to examine how some of these family types might be similar and different to identify the prevailing needs of the various families represented in their school community. The question, "In what ways are the needs of grandparents raising grandchildren the same as and different from a single parent?" helped to inform the team's thinking as they prepared to identify meaningful topics and structures for meeting the different needs within the school community.

Recognizing the need to retrieve information directly from the people they wanted to reach, the team chose to use a Circle Map (Figure 7.7d) to generate the questions to be used in a survey and interviews. The Frame of Reference was used by the team to identify the "parents" in the school community and to stimulate more questions with the needs of those people in mind.

Having gathered information from the parents within the school community, the leadership team used a Tree Map (Figure 7.7e) to organize the data and looked for patterns and connections from which to begin to formulate effective action steps. The use of the Tree Map allowed the team to also identify what was missing and to consider the reasons for the absence of these topics.

As shown, Thinking Maps allow for a fundamental shift in the nature of discourse within a community of learners. Rather than expecting people to establish positions and defend or justify them, Thinking Maps invite the members of the organization to identify the multiple ways a topic can be approached to fully understand it, to sift through its complexity, or to simply allow it to reveal itself to us through the nature of its patterns. Thinking Maps inherently place trust in the ability of members of the professional learning community to think deeply about a topic and to arrive at a collective knowing and decision through a process of inquiry. This shift affirms learning as a core value of the school community. It demonstrates and places confidence in the members of the organization to arrive at meaningful and effective solutions through a genuine process of learning. And it does so by establishing a schoolwide language for thinking, uniting all members, children and adults, in this common pursuit.

Figure 7.7a The Effects of Full Parent Involvement



Successful schools not only have the ability to adapt to circumstances, they are able to generate new directions and design novel solutions to complex and changing situations. They not only respond effectively to current realities, they help shape and influence the very circumstances within which they exist in line with their values and beliefs. Thinking Maps help capture and communicate the texture of experiences as they unfold. How we think about a topic, problem, or event shifts as we become fully engaged with constructing meaning and guiding others in a similar process. As tools for learning, Thinking Maps used in combination with each other enable us to enter the varied and shifting landscape of any situation with confidence and the anticipation of discovery. And with adults and children sharing a common language for thinking across an entire school, we create a powerful and compelling culture for learning.

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Figure 7.7b How to Create Parent Involvement and the Effects

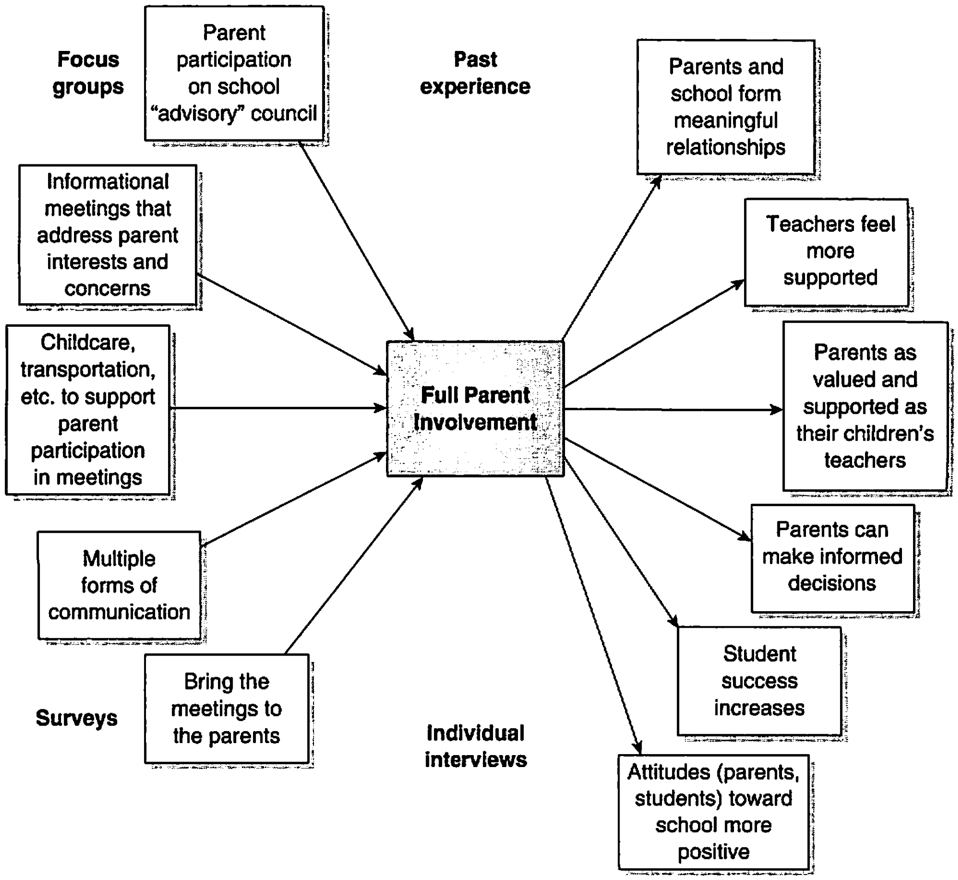

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Figure 7.7c Comparing Single Parents and Grandparents Raising Children

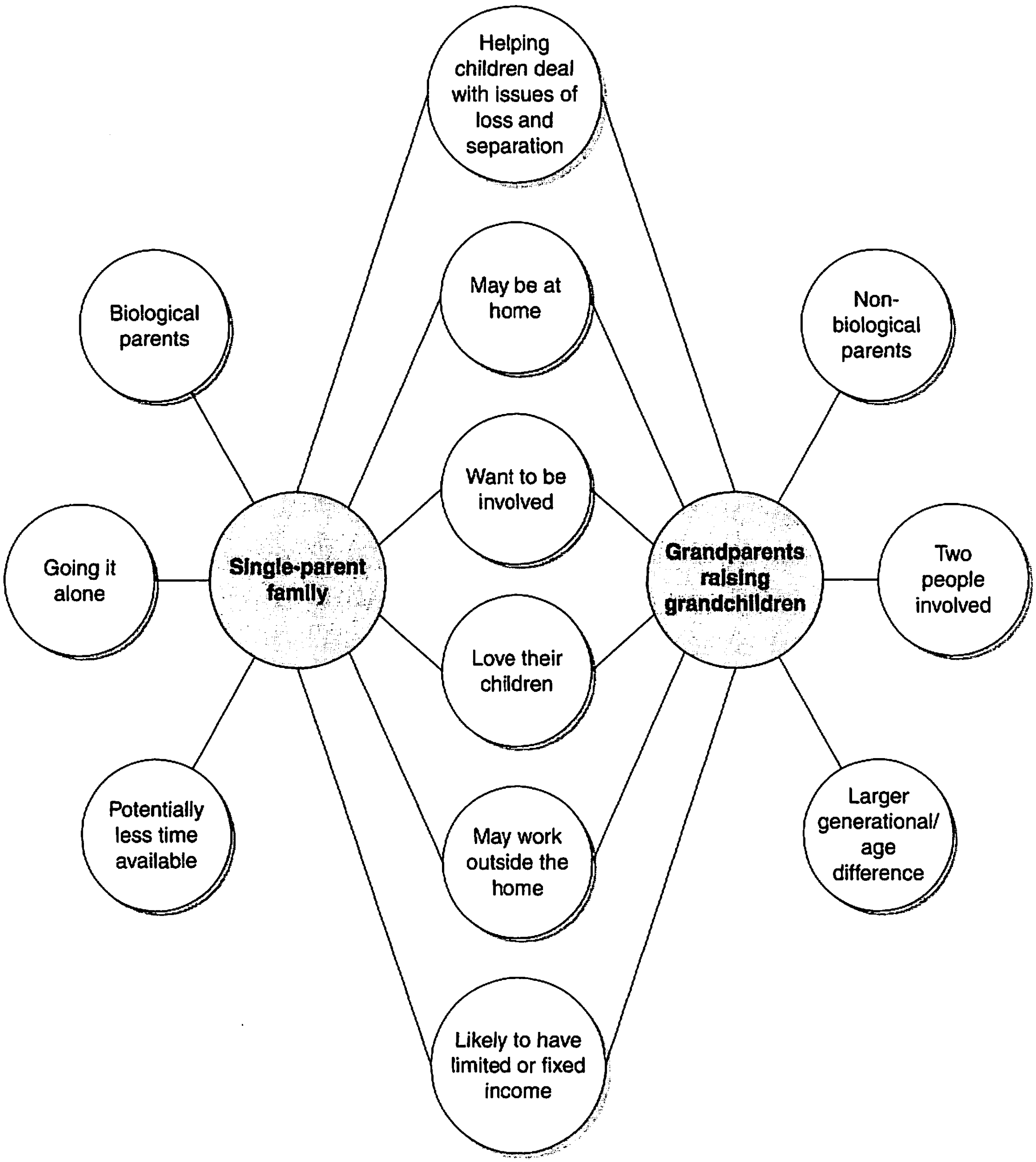

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Figure 7.7d Generating Information Needed From Parents

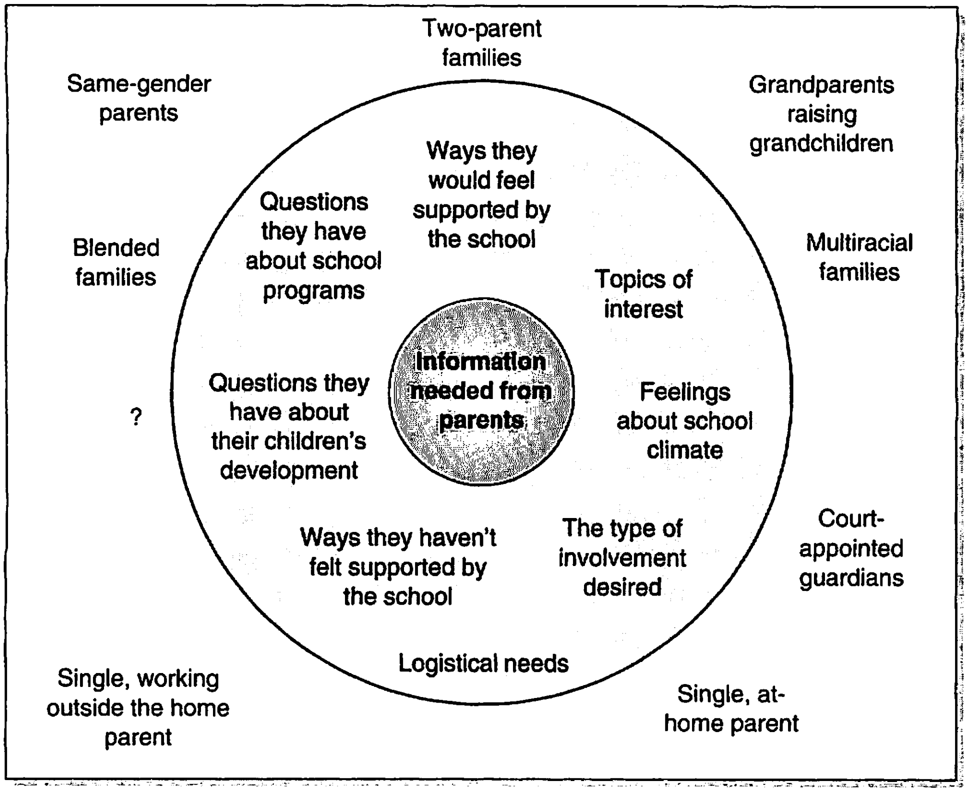

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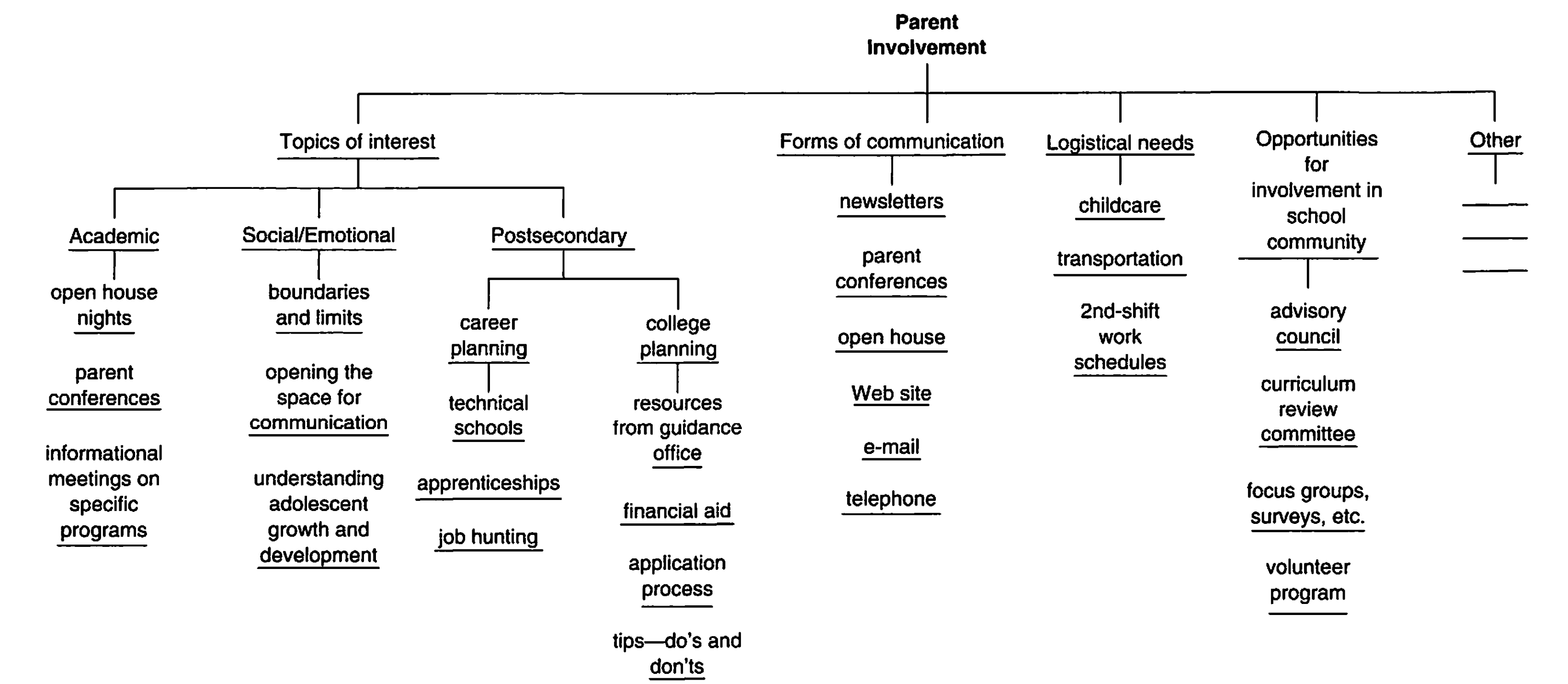
Figure 7.7e Categorizing Parent Involvement Topics and Details



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WHOLE SYSTEM CHANGE

The visual tools and language of Thinking Maps presented in this chapter provide a new avenue for student, teachers, administrators, and the whole community of learners in a school, including parents. In the examples described, we see that students can develop their capacities to be creative and flexible, to persevere and be systematic, and to be reflective and self-aware of cognitive patterns to the degree that they can readily apply these patterns to challenging performance. Yet we also now know that, like the inner working of our brain, our students must continue to grow and adapt over their lifespans. In this chapter, we presented evidence of significant changes in performance for students, in the one case by students, most of whom come from a low socioeconomic area. On entering the school, they also had low levels of English-language usage. But they did not have low cognitive abilities. When we return to the research, we find that the explicit and dynamic blending of nonlinguistic representations and cognition is a vital intersection for students of poverty, in first- and second-language discourses, and their capacities to decode text structures, write in meaningful response to prompts, and problem solve in math and science.

When we look forward to the decades of the 21st century, we realize that explicitly supporting students in their capacities to think and problem solve independently and collaboratively across content areas, languages, and cultures may be the linchpin to an evolution in how they transform information into meaningful knowledge.