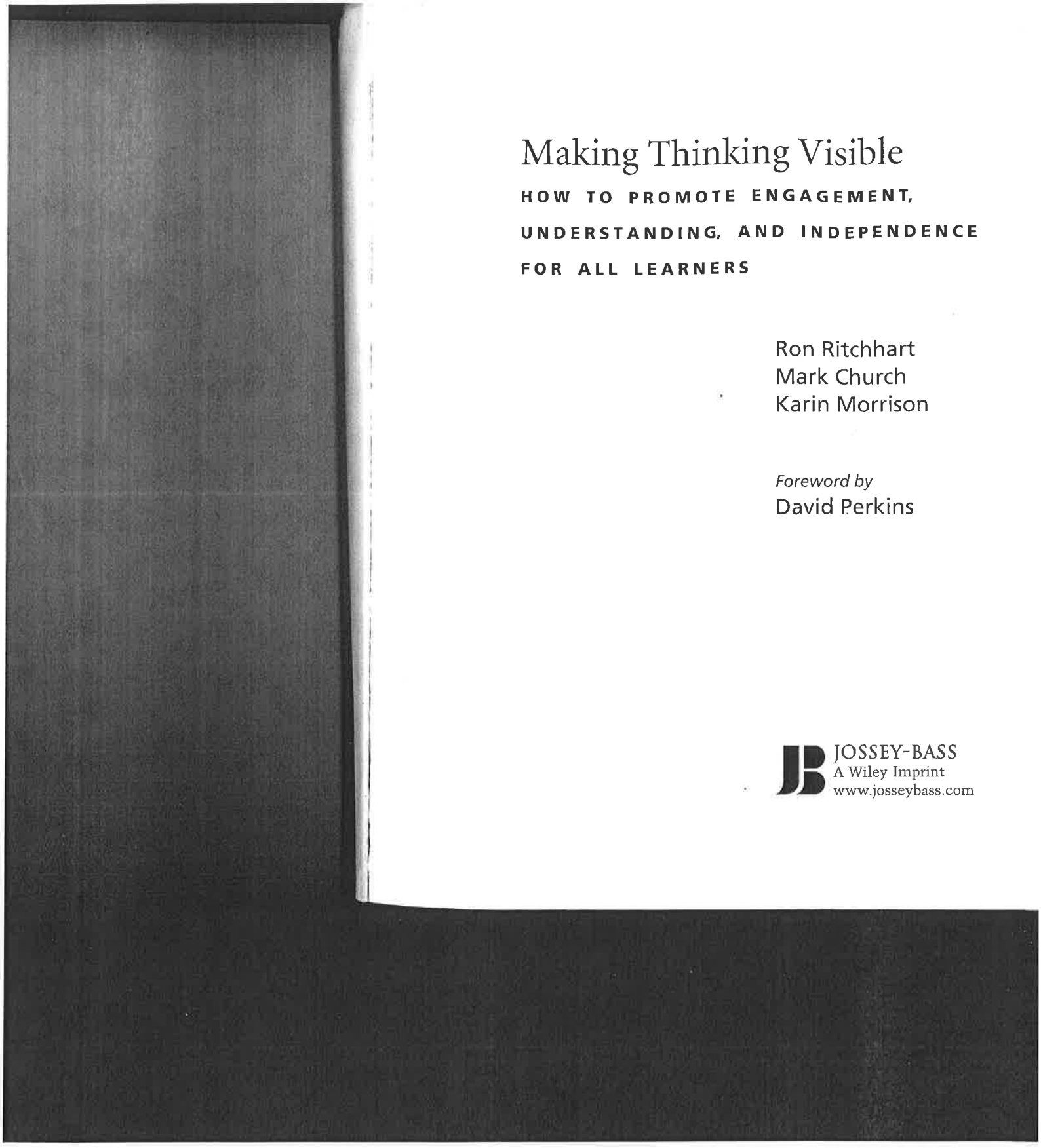

Making Thinking Visible

HOW TO PROMOTE ENGAGEMENT, UNDERSTANDING, AND INDEPENDENCE FOR ALL LEARNERS

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CHAPTER 1

Unpacking Thinking

According to the *Oxford English Dictionary*, there are somewhere in the neighborhood of a quarter of a million distinct words in the English language—if one uses a somewhat strict definition of distinct words, that is ("Facts About Language," 2009). Of course, of this vast number of linguistic options, we use only a small percentage on a regular basis. It is estimated that a mere 7,000 words account for 90 percent of our day-to-day usage. With these numbers in mind, where do you imagine the word *think* resides in terms of frequency of use? That is, with what relative incidence do you believe you use, hear, or read the word *think* each day? What rank does it hold in our average use? Does it make the top 1,000 or is it much further down the list?

Drawing on information from several lists, *think* as a word ranks somewhere around the top 125 to 136 in terms of frequency in print (Fry, Kress, & Fountoukidis, 2000). If one considers just verbs, *Oxford English Dictionary* rates the word *think* as the twelfth most used verb in the English language! Clearly the word *think* plays an astonishingly prominent role in our speech and writing, but for all this usage, how well do we understand what it actually means to think? When we use the word *think*, what meaning do those listening to us infer? When we tell someone we are thinking, what is it we are actually doing? Although no data is available, one might expect the word *think* to occur even more frequently in classrooms. When teachers use it, what do they intend? When students hear it, how do they interpret it? Does it lead to any actions on their part?

If we want to support students in learning, *and* we believe that learning is a product of thinking, then we need to be clear about what it is we are trying to support. What kinds of mental activity are we trying to encourage in our students, colleagues, and friends? When we ask teachers in workshops, "What kinds of thinking do you value and want to promote in your classroom?" or, "What kinds of thinking does that lesson force students to do?" a large percentage of teachers are stumped. They simply haven't been asked to look at their teaching through the lens of thinking before. They ask their students to think all the time, but they have never stepped back to consider just what it is they specifically want their students to do mentally. However, if we are going to make thinking visible in our classrooms, then the first step will be for us as teachers to make the various forms, dimensions, and processes of thinking visible to ourselves.

BEYOND BLOOM

When we ask teachers to identify the thinking required in their lessons, we frequently get the response, "Do you mean Bloom's taxonomy? Is that what you're after?" Most teachers have learned about Benjamin Bloom in their teaching training courses. Although his taxonomy focused on three domains—affective, psychomotor, and cognitive—it is the cognitive domain that most teachers remember. Bloom identified a sequence of six learning objectives that he felt moved from lower-order to higher-order thinking: knowledge, comprehension, application, analysis, synthesis, and evaluation. However, these ideas were just a theory and were not based on research on learning. Nonetheless, they have become codified into the way many teachers are taught to think about thinking. Teachers are often admonished to make sure some of their questions or lessons require the "higher levels" of thinking, though generally this is taken to mean anything above comprehension.

Although Bloom's categories capture types of mental activity and thus are useful as a starting point for thinking about thinking, the idea that thinking is sequential or hierarchical is problematic. Bloom suggests that knowledge precedes comprehension, which precedes application, and so on. However, we can all find examples from our own lives where this is not the case. A young child painting is working largely in application mode. Suddenly a surprise color appears on the paper and she analyzes what just happened. What if she does it again but in a different place? She tries and evaluates the results as unpleasing. Continuing this back and forth of experimentation and reflection, she finishes her work of art. When her dad picks her up from school, she tells him about the new knowledge of painting she gained that day. In this way, there is a constant back and forth between ways of thinking that interact in a very dynamic way to produce learning.

In the 1990s, two of Bloom's former students revised his taxonomy, and a new list was published using verbs rather than nouns. However, the idea of a sequence was kept. Moving from lower- to higher-order skills, Anderson and Krathwohl (2001) identified remembering, understanding, applying, analyzing, evaluating, and creating. Once again a potentially useful list, but it remains problematic if one takes it as a set sequence to guide instruction for learning. Looking at the thinking actions that Anderson and Krathwohl associated with these six, one might question whether the "testing" they say is involved in evaluating is really more difficult or higher order than the "describing" they list under remembering. For instance, looking carefully to notice and fully describe what one sees can be an extremely complex and engaging task. Such close observation is at the heart of both science and art. Analysis and speculation depend on careful noticing.

Our colleague Steve Seidel (1998) has written about both the importance and challenge of description when looking at student work. Because the mind is designed to detect patterns and make interpretations, slowing it down to fully notice and just describe can be extremely challenging. In contrast, one can test the ability of a paper airplane to fly, the accuracy of a proposed mathematical algorithm, or the strength of a toothpick bridge pretty quickly and easily.

What these examples illustrate is that it makes little sense to talk about thinking divorced from context and purpose. Furthermore, the idea of levels might best be considered with regard to the thinking itself. Rather than concerning ourselves with levels among different types of thinking, we would do better to focus our attention on the levels or quality within a single type of thinking. For instance, one can describe at a very high and detailed level or at a superficial level. Likewise, one can simply test something out to determine if it will fail, or one can fully test the limits and conditions of that failure. Analysis can be deep and penetrating or deal with only a few readily apparent features. Watch any major television news show and contrast it to the more in-depth stories one might hear on radio and see in print, and you will see different levels of analysis at play.

One can argue that there is a bit of category confusion in both of the Bloom's lists as well, since not all items seem to operate at the same level. This can most readily be seen in the way "understanding" is framed. Since the 1970s, many researchers and educational theorists have focused on the complexities of teaching and learning for understanding, as opposed to just knowledge retention (Bruner, 1973; Gardner, 1983, 1991; Skemp, 1976; Wiske, 1997). Some researchers have made the distinction between deep and surface learning (J. B. Biggs, 1987; Craik & Lockhart, 1972; Marton & Saljo, 1976). Surface learning focuses on memorization of knowledge and facts, often through rote practices, whereas deep learning has a focus on developing understanding through more active and constructive processes. Today, most educators would argue that understanding is indeed a very deep, or at least complex, endeavor and not in any way a lower-order skill as the revised taxonomy suggests (Blythe & Associates, 1998; E. O. Keene, 2008; Wiggins & McTighe, 1998). Indeed, understanding is often put forward as a primary goal of teaching.

Research into understanding, much of it conducted with our colleagues at Project Zero, indicates that understanding is not a precursor to application, analysis, evaluating, and creating but a result of it (Wiske, 1997). Recall the brief illustration of the young girl painting mentioned earlier. The understanding or insight she develops into painting are the direct result of much and varied activities and the associated thinking that went

along with those activities. Thus, we might consider understanding not to be a type of thinking at all but an outcome of thinking. After all, one cannot simply tell oneself to understand something or direct one's attention to understanding versus some other activity. Ellin Keene (2008) writes about the complexity of the process of understanding in the process of reading and the need to develop explicit thinking strategies to support those efforts. Likewise, James Hiebert et al. (1997) write about how learning mathematics for understanding is fundamentally a different task than memorizing procedures.

The same argument put forth about understanding—that it is a goal of thinking rather than a type of thinking—applies equally well to the process of creating. How does one go about the process of creating anything? It is not necessarily a single direct act but a compilation of activities and associated thinking. Decisions are made and problems are solved as part of this process. Ideas are tested, results analyzed, prior learning brought to bear, and ideas synthesized into something that is novel, at least for the creator. This creation can be simplistic in nature, as with the child creating a new color; useful, as in the invention of a new iPhone app; or profound, such as new methods of producing energy from never before used materials.

As these brief critiques point out, the idea of levels is problematic when it comes to parsing thinking and ultimately less useful than one might hope. Thinking doesn't happen in a lockstep, sequential manner, systematically progressing from one level to the next. It is much messier, complex, dynamic, and interconnected than that. Thinking is intricately connected to content; and for every type or act of thinking, we can discern levels or performance. Perhaps a better place to start is with the purposes of thinking. Why is it that we want students to think? When is thinking useful? What purposes does it serve? We pick up on these issues in the following section of the chapter.

BEYOND MEMORIZATION, WORK, AND ACTIVITY

In the preceding discussion of Bloom's taxonomy, we made the argument that understanding isn't a type of thinking one does but is in fact a chief goal of thinking. As most teachers are aware, understanding is one of the major thrusts of current educational practices. The Teaching for Understanding (TfU) framework (Blythe & Associates, 1998) and Understanding by Design (UBD) (Wiggins & McTighe, 1998) are two current curricular planning tools that help teachers focus on understanding. It would be nice if we could merely take for granted that all teachers adopt this goal and strive to teach for understanding, but we all know that the reality of most schools and classrooms is quite different. Within the high-stakes testing environments in which educators today operate,

there is often pressure to cover the curriculum and to prepare for the test (Ravitch, 2010). Although lip service may be paid to the idea of teaching for understanding, there are pressures that work against it. These pressures aren't necessarily anything new. Schools, having been built on an industrial model, have long focused on imparting skills and knowledge as their chief goal.

In most school settings, educators have focused more on the completion of work and assignments than on a true development of understanding. Although this work can, if designed well, help to foster understanding, more often than not its focus is on the replication of skills and knowledge, some new and some old. Classrooms are too often places of "tell and practice." The teacher tells the students what is important to know or do and then has them practice that skill or knowledge. In such classrooms, little thinking is happening. Teachers in such classrooms are rightly stumped when asked to identify the kinds of thinking they want students to do because there isn't any to be found in much of the work they give students. Retention of information through rote practice isn't learning; it is training.

The opposite side of this same coin is a classroom that is all about activity. In the often misunderstood notion of experiential or inquiry-based learning, students are sometimes provided with lots of activities. Again, if designed well some of these activities can lead to understanding, but too often the thinking that is required to turn activity into learning is left to chance. Other times, the activity itself is little more than a more palatable form of practice. Playing a version of *Jeopardy* to review for a test may be more fun than doing a worksheet, but it is still unlikely to develop understanding.

At the heart of this view of teaching is the notion that curriculum is something that teachers deliver to students and good teachers are those most effective at that delivery. Reflecting on his own evolution as a teacher, Mark Church recounts how prevalent this view was in his own teaching:

> In my early years of teaching I was "the fun teacher" bursting with confidence and more than a bit of hubris. I kept my students entertained. They liked me. They liked my class. Whatever was to be covered became an object of knowledge that I, as the expert, would deliver by way of gimmicks and glamour to my students. Consequently, I judged my teaching by the ease with which I was able to transmit information along a linear, one-way path of knowing. My idea of good teaching was to focus on the creation and delivery of palatable, hands-on, though not necessarily minds-on, activities. Becoming a good teacher meant mastering a set of delivery techniques and knowing all the answers to my students' questions. In those years it had not yet occurred to me that good teaching hinged upon what I knew and understood about

the learners themselves and about how learning happens. However, it was not until I really examined the issue of what is understanding and how does it develop that I actually began the process of becoming a teacher. Only then did I recognize that work and activity are not synonymous with learning.

Let's return to the key question with which we began this chapter: "What kinds of thinking do you value and want to promote in your classroom?" And the associated question, "What kinds of thinking does this lesson force students to do?" When classrooms are about activity or work, teachers tend to focus on what they want their students to do in order to complete the assignments. These physical steps and actions can be identified, but the thinking component is missing. When this happens, the learning is likely to be missing as well.

Here's a quick exercise to help you identify the possible discrepancy between students' classroom activity and teaching that is likely to lead to understanding. Begin by making a list of all the actions and activities with which your students are engaged in the subject you teach (if you are an elementary school teacher, pick a single subject to focus on, such as math, reading, or writing). You might want to brainstorm this list with a couple of colleagues or teammates. Now, working from this list, create three new lists:

1. The actions students in your class spend most of their time doing. What actions account for 75 percent of what students do in your class on a regular basis?
2. The actions most authentic to the discipline, that is, those things that real scientists, writers, artists, and so on actually do as they go about their work.
3. The actions you remember doing yourself from a time when you were actively engaged in developing some new understanding of something within the discipline or subject area.

To the extent your first list—what students spend the bulk of their time doing—matches the other two lists, your class activity is aligned with understanding. If the three lists seem to be disconnected from one another, students may be more focused on work and activity than understanding. They may be doing more learning *about* the subject than learning *to do* the subject. To develop understanding of a subject area, one has to engage in authentic intellectual activity. That means solving problems, making decisions, and developing new understanding using the methods and tools of the discipline. We need to be aware of the kinds of thinking that are important for scientists (making and testing hypotheses, observing closely, building explanations . . .), mathematicians (looking for patterns, making conjectures, forming

generalizations, constructing arguments . . .), readers (making interpretations, connections, predictions . . .), historians (considering different perspectives, reasoning with evidence, building explanations . . .), and so on, and make these kinds of thinking the center of the opportunities we create for students. Furthermore, these kinds of thinking need to be among the primary expectations we hold for students: that they can and that they will engage in the kinds of thinking necessary to build disciplinary understanding.

A MAP OF THINKING INVOLVED IN UNDERSTANDING

In the preceding section we listed a few types of thinking that were central to different subject areas, such as making and testing hypotheses in science or considering different perspectives in history, but are there particular kinds of thinking that serve understanding across all the disciplines? Types of thinking that are particularly useful when we are trying to understand new concepts, ideas, or events? When you thought about the kinds of thinking you did to develop your own disciplinary understanding, you probably identified some of these. Ron Ritchhart and colleagues David Perkins, Shari Tishman, and Patricia Palmer set themselves the task of trying to identify a short list of high-leverage thinking moves that serve understanding well. Their goal was not to come up with all the different kinds of thinking that were involved in understanding but to identify those kinds of thinking that are essential in aiding our understanding. They wanted to identify those thinking moves that are integral to understanding and without which it would be difficult to say we had developed understanding. They came up with the following six:

1. Observing closely and describing what's there
2. Building explanations and interpretations
3. Reasoning with evidence
4. Making connections
5. Considering different viewpoints and perspectives
6. Capturing the heart and forming conclusions

We feel that these six all play important roles in fostering understanding of new ideas. If we are trying to understand something, we have to notice its parts and features, being able to describe it fully and in detail. Identifying and breaking something down into its parts and features is also a key aspect of analysis. The process of understanding is integrally linked to our building explanations and interpretations. In science, we label

these as *theories* and *hypotheses*. In mathematics, we sometimes call them *conjectures* or *generalizations*. In building these explanations, we draw on and reason with evidence to support our positions and try to arrive at fair and accurate positions that can be supported. When we encounter anything new, we make connections between the new and known, drawing on our past experience. These connections help us to link ideas and find where the new ideas fit within the subject area and out. Our connections might also be about application and where the new ideas or skills are used. All of these connections aid our retrieval of information and help ensure that new information is not static or inert (Whitehead, 1929). If one were only to look at new ideas or situations from a single perspective, we would say that one's understanding was limited and sometimes even biased. Awareness of the different perspectives or takes on an idea gives us a more robust understanding. Capturing the heart or core of a concept, procedure, event, or work ensures that we understand its essence, what it is really all about. We want to make sure we haven't lost the forest for the trees and that we notice the big ideas in play.

These types of thinking are by no means exhaustive of all the kinds of thinking we want to make visible in classrooms. However, they do provide a good and useful list with which to begin. Many teachers working to make thinking valued and visible in their classrooms have found that posting these thinking moves in their classrooms can be extremely useful. The list helps draw students' attention to what they will be doing to learn. To help ensure that work and activity don't swamp students' learning, teachers often pause class either before or after an assignment to discuss the types of thinking that will be or were involved in the assignment. As students become more aware of their own thinking and the strategies and processes they use to think, they become more metacognitive (Ritchhart, Turner, & Hadar, 2009a).

Since all of these thinking moves directly support the development of understanding, this list can be useful to teachers in planning units. Over the course of a unit of study, students should be engaged in all of these types of thinking on more than one occasion to help them develop their understanding. If students haven't been actively engaged in building explanations, reasoning with evidence, making connections, or having the opportunity to look at things from more than one perspective, then there would likely be significant holes or gaps in their developing understanding. Just as the six thinking moves can help to develop understanding, they can also be useful in assessing understanding. Fredrik Pettersson, a secondary history teacher at Lemshaga Akademi in Sweden, found that the six thinking moves were exactly the qualities he was looking for in a historical essay and decided to use them as an assessment rubric that he gave to his students. The sixth grade team at the International School of Amsterdam decided that if they were

really trying to make thinking visible in their classrooms, then students should focus on their thinking and not only their performance on tests and quizzes. All sixth graders were charged with creating a visible thinking portfolio in which they collected samples that demonstrated where and when they had engaged in each of the six thinking moves. These portfolios were then presented to parents as part of a student-led conference at the end of the year.

Since identification of the six thinking moves that support understanding, what we sometimes call the "understanding map," we have added two additional thinking moves:

7. Wondering and asking questions
8. Uncovering complexity and going below the surface of things

The importance of curiosity and questioning in propelling learning is easily seen in our experience as learners. We know that when our curiosity is sparked and we have a desire to know and learn something, our engagement is heightened. Many teachers are familiar with the use of essential questions as vehicles to propel students' learning. However, questions are also an ongoing part of developing understanding. The questions we ask at the outset of a learning journey change, morph, and develop as that journey moves forward. Even after extensive efforts to develop understanding, we find that we may be left with more questions than when we started. These new questions reflect our depth of understanding. This depth and our ability to go below the surface of things is a vital part of our ongoing development of understanding. Rather than look for or accept the easy answers, we push to identify the complexity in the events, stories, and ideas before us. In this complexity lay the richness, intrigue, and mystery that engage us as learners.

While these eight represent high-leverage moves, it is important to once again stress that they are by no means exhaustive. We offer up this list as a useful starting place, and no more. You can probably think of other kinds of thinking that are useful, such as visualization, taking stock of what you understand, looking for cause-and-effect relationships, and others. Furthermore, you can probably identify many thinking moves that further flesh out the key eight in ways that are useful. For instance, comparing and contrasting ideas is a specific type of connection making, as is thinking metaphorically. Classifying extends our description and noticing. We've chosen the broad terms of explanation and interpretation, but these are certainly related to inferring, explaining, and predicting. You might well ask, Where is reflection? Structured reflection has been shown to be a way to enhance understanding and problem solving (Eyleer & Giles, 1999).

The answer is that a structured reflection—that is, reflection that goes beyond voicing one's opinion or feelings—involves describing the object of reflection and noticing its key features, connecting what is new to what one already knows, and examination of the event or object of reflection through various lenses or frames, which is perspective taking (Colby, Beaumont, Ehrlich, & Corngold, 2009).

OTHER KINDS OF THINKING

Of course, understanding is not the sole goal of thinking. We also think to solve problems, make decisions, and form judgments. Many of the eight key thinking moves come in handy when we are doing those activities as well. Looking at things from new perspectives, identifying the parts, and reasoning with evidence certainly play a role. Making connections to our prior knowledge so that we can draw on it and use it effectively is useful as well. Forming conclusions and identifying the essence are also important. Some additional types of thinking we haven't mentioned that seem useful in the areas of problem solving, decision making, and forming judgments include:

1. Identifying patterns and making generalizations
2. Generating possibilities and alternatives
3. Evaluating evidence, arguments, and actions
4. Formulating plans and monitoring actions
5. Identifying claims, assumptions, and bias
6. Clarifying priorities, conditions, and what is known

Again, these six are not meant to be exhaustive, merely useful moves in terms of directing our mental activity and planning our instruction. Each of the six could be further elaborated with associated kinds of thinking. For instance, brainstorming is a useful strategy to help one generate possibilities and alternatives, and taking stock would be a part of clarifying priorities, conditions, and what is known. Formulating plans and actions connects with the idea of being strategic just as evaluating evidence is a part of being skeptical. Reviewing this list, one might get the impression of a very thoughtful mathematics or science classroom in which problem solving plays a central role. In learning mathematics and science actively, it is important that one gets used to looking closely, noticing patterns, and generalizing from those patterns to create procedures, algorithms, and theories. Of course, these theories and conjectures must be carefully evaluated and tested.

The preceding list might also give one the impression of a civics class in which students are exploring current political, social, or ethical issues. In these situations, getting clear about priorities, conditions, and what is known and unknown is an important starting place. Being sensitive to assumptions and bias that might be clouding our perception is also crucial. Of course, in such situations one must also look at things from a variety of perspectives, drawing on one of the kinds of thinking discussed in the understanding map. Depending on the situation, one might also find oneself generating possibilities and alternative takes on the situation and/or making plans to carry out and monitor.

The combination of the preceding list with the eight thinking moves in the map of understanding goes a long way to helping us unpack what we mean by thinking. By being clearer in our own minds as teachers about the kinds of thinking we want our students to do, we can be more effective in our instructional planning. We can create opportunities for the kinds of thinking we value and want to make an expectation in our classrooms. Being clear about the thinking students need to do to develop understanding or to solve problems effectively allows us to target and promote those kinds of thinking in our questioning and interaction with students. Now that we are clearer about what we mean by thinking, we turn our attention toward how we can make students' thinking about thinking visible.

UNCOVERING STUDENTS' THINKING ABOUT THINKING

When schools take on the mission of cultivating students' thinking and enculturating the habits of mind and dispositions that can support lifelong learning, the issue of how students construe thinking and their general metacognitive awareness comes to the fore. It's one thing for us as teachers to articulate the kinds of thinking we are seeking to promote; it is another for students to develop a greater awareness of the significant role that thinking plays in cultivating their own understanding. The important function of this awareness is highlighted by Biggs (J. B. Biggs, 1987), who stated, "To be properly metacognitive, then, students have to be realistically *aware* of their own cognitive resources in relation to the task demands, and then to plan, monitor, and control those resources" (p. 75). Biggs refers to this awareness of one's own learning processes and one's control over them as "meta-learning," a subcomponent of metacognition. Others have labeled it "meta-strategic knowledge," that is, knowledge about the strategies one has at one's disposal to facilitate and direct one's own learning (Zohar & David, 2008). As you have been reading through this chapter, your own meta-strategic knowledge has most certainly come to the foreground as you have thought about the processes one uses to think and learn.

As a part of the Cultures of Thinking project at Bialik College, the research team of David Perkins, Terri Turner, Linor Hadar, and this book's authors was interested in exploring students' explicit awareness of the process of thinking and how these conceptions of thinking might change as their teachers worked to make thinking more visible in their classrooms. Specifically, the team was interested in uncovering students' awareness of thinking moves they might undertake that could facilitate their learning, problem solving, decision making, and judgment. Although this includes study skills and the recognition of memorization and knowledge retrieval strategies, it goes beyond them to look at students' awareness of those thinking strategies that can build understanding, such as looking at material from a different perspective, making connections with one's prior knowledge, generating alternative hypotheses, and so on. But, how does one uncover students' thinking about thinking? How does one unearth their conceptions of what thinking is and the mental moves it encompasses? How can this be done in an open way that captures individual responses and growth over time rather than constraining students' responses to a predetermined set of categories?

Our research team developed a methodology using concept maps that teachers across a variety of grade levels could use in their classrooms as a platform for launching a discussion about what thinking is and the kinds of thinking that would be emphasized in their classrooms. Our prompt for the map was purposely general in an attempt to support and not inhibit students' responses. It asked students, "What is thinking? When you tell someone you are thinking, what kind of things might actually be going on in your head?" Two examples were given: "Making a mental picture of things" and "Comparing one thing with another." The term *thinking* was written in the middle of the page, and students were asked to record their ideas about thinking. We specifically chose the phrasing, "What is going on in your head?" as opposed to "What are you doing?" to focus students on cognitive actions rather than physical ones. We chose two specific examples that likely would be familiar to students in order to further promote a focus on cognitive acts.

As both educators and researchers, we found this technique and prompt readily accessible to students. As such, it is something you might like to try yourself in your classroom. Teachers in our study generally allowed between 5 and 10 minutes for students to complete their maps and then followed up with some sort of discussion of the maps. One way some teachers did this was to have students form small groups and create a joint concept map on thinking, drawing from their individual maps. This allowed students who struggled with the map construction to hear the ideas of others. In other classrooms, teachers made a concept map as a whole class after students had

completed their individual ones. This allowed the teachers to engage students in a discussion of which ideas might group together and was particularly effective at focusing in on thinking rather than some of the peripheral ideas that emerged on students' maps. However it was debriefed and built upon, teachers found looking at students' conceptions of thinking as revealed through these maps fascinating. In every classroom there was a huge range and variety of responses. Examples of a fourth grade, sixth grade, and tenth grade map are provided in Figures 1.1, 1.2, and 1.3.

Looking through hundreds of maps from students in grades 3–11, the research team identified four main response types: associative, emotional, meta, and strategic. *Associative responses* are those associated with thinking but do not describe or identify the act of thinking. Comments such as "in math class," "when I'm traveling," and "what will happen next" spoke to the when or where of thinking, as well as "what I am thinking about." These comments did not describe actual thinking processes or the nature of thinking but rather people, places, and things. Other associative remarks included very general comments about "what I think with," or "how I think," such as "thoughts in my mind" or "brainwaves." Likewise, *emotional responses*, those comments revealing an affective connection to thinking, were not strictly about thinking either. Frequently students included affective words and phrases such as *unsure*, *joy*, and *hard when there is time pressure.*

When researchers first administered the concept map task at the beginning of our work, we found elementary students' responses were frequently 70 percent associative and 10 percent emotional. Even middle and high school students' maps were close to 50 percent associative and 10 percent emotional. The point here is that students don't have much knowledge of the strategies they might employ to facilitate and direct their thinking. Without this knowledge, they are likely to be less effective, less independent, less engaged, and less metacognitive as learners. You can read more about this study and the findings in "Uncovering Students' Thinking About Thinking Using Concept Maps," *Metacognition and Learning* (Ritchhart, Turner, & Hadar, 2009b). If you do this activity with your own students and notice a high level of associative or emotional responses in their maps, don't be alarmed or worry that they aren't responding to the prompt accurately. People can only deliver those things they know and have access to, and rather than being incorrect, these responses reveal that an awareness of thinking simply hasn't been developed for these particular students.

There were a few responses on students' concept maps that spoke to a greater awareness of the nature of thinking, though not strictly about the thinking process. These were labeled *meta responses*. Rather than specifying an action, these comments focused

on epistemology, the nature of understanding, and conceptualizations of building knowledge. This meta type of response included comments such as "There is always more to learn," "You can't ever fully understand something," and "Remembering helps to develop creativity." Look for these in your own students' maps as partial indicators of a greater awareness of the purpose and complexity of thinking, learning, and understanding.

Of course, the type of responses we as teachers would like to see students deliver are *strategic responses*. However, even here not all strategies are equal. As was discussed earlier in this chapter, people have thinking moves that can be directed at knowledge retention and memorization as well as those that can be used to help one understand. The Cultures of Thinking research team identified four categories into which students' strategic responses might be grouped:

1. *Memory and knowledge-based strategies.* These related to surface learning and focus on storage and retrieval of information, such as "Look in books" or "Practice it over and over again."
2. *General and nonspecific strategies.* These stood out as a category due to their very general nature. Items in this category often sounded good but did not reflect specific actions one could take. For example, "Think logically" is clearly related to thinking but it is ambiguous in terms of its actions when coming from a fifth grader. So too are items like "Problem solve," "Metacognition," or "Understand."
3. *Self-regulation and motivation strategies.* This category of responses reflected students' understanding that thinking needs to be motivated and managed, and included responses such as "Clear your mind of all other worries" and "Tell myself I can do it."
4. *Specific thinking strategies and processes.* This category relates to deep or constructive approaches to learning that are about making meaning, building understanding, solving problems, and making decisions. These included such responses as "Consider different perspectives" or "Expand on other questions that may arise from the previous one."

In this book, when we talk about making thinking visible, we are generally referring to those specific thinking strategies and processes students use to build deeper understanding. These are the processes that need to live at the center of classroom activity, directing the work of both teachers and students. As we make thinking—our own as well as that of our students—visible, we draw attention to the mechanisms by which

individuals construct their understanding. To the extent that students can develop a greater awareness of thinking processes, they become more independent learners capable of directing and managing their own cognitive actions. But, how likely is it that just making thinking visible through the various strategies discussed in the following chapters will enhance students' awareness of thinking processes and strategies? In our concept map research done at the outset of the Cultures of Thinking Project, we found that on average students at every grade level made statistically significant gains in their reporting of specific thinking strategies on the concept map task, from a 250 percent increase in responses for the younger students to 65 percent for high school students. On average, all students in the sample made gains that exceeded normally developmental projections by more than 68 percent.

One major goal of making thinking visible is to facilitate greater understanding among students. Another aim is to enhance students' engagement and independence. This second goal is accomplished, at least in part, through the development of students' meta-strategic or meta-learning knowledge. As this research shows, the tools presented in this book clearly have an impact on students' learning about learning and their thinking about thinking. The Pictures of Practice woven throughout the book to illustrate the use of strategies provide evidence of the types of understanding that can be elicited through the use of thinking routines and effective questioning. As you work with these ideas yourself, keep these goals in mind and continually look for ways your own students are demonstrating greater understanding, becoming more engaged, and displaying their independence as learners.