CHAPTER

9

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COMPLEX COGNITIVE PROCESSES

WHAT WOULD YOU DO?

TEACHERS' CASEBOOK: Uncritical Thinking

This year's class is worse than any you've ever had. You assigned a research paper and you find more and more students are using the web for their information. In itself, using the web is okay, but the students appear to be completely uncritical about what they find. "If it is on the web, it must be right" seems to be their attitude. Their first drafts are filled with quotes that seem very biased to you, and there are no sources cited or listed. It is not just that students don't know how to reference their work. You are more concerned that they cannot critically evaluate what they are reading. And all they are reading is information on the web!

CRITICAL THINKING

- How would you help your students evaluate the information they are finding on the web?
- Beyond this immediate issue, how will you help students think more critically about the subjects you are teaching?
- How will you take into account the cultural beliefs and values of your students as you support their critical thinking?

OVERVIEW AND OBJECTIVES

In the previous chapter we focused on how knowledge develops—how people make sense of and remember information and ideas. In this chapter, we consider complex cognitive processes that lead to understanding. Understanding is more than memorizing. It is more than retelling in your own words. Understanding involves appropriately transforming and using knowledge, skills, and ideas. These understandings are considered "higher-level cognitive objectives" in a commonly used system of educational objectives (Anderson & Krathwohl, 2001; Bloom, Engelhart, Frost, Hill, & Krathwohl, 1956). We will focus on implications of cognitive theories for the day-to-day practice of teaching.

Because the cognitive perspective is a philosophical orientation and not a unified theoretical model, teaching methods derived from it are varied. In this chapter, we will first examine the complex cognitive process of metacognition—using knowledge and skills about learning, motivation, and yourself to plan and regulate your own learning. Next we explore four important areas in which cognitive theorists have made suggestions for learning and teaching: learning strategies, problem solving, creativity, and critical thinking, including argumentation. Finally, we will consider the question of how to encourage the transfer of learning from one situation to another to make learning more useful.

When you have completed this chapter, you should be able to:

9.1 Discuss roles of metacognition in learning and remembering.

9.2 Describe several learning and study strategies that help students develop their metacognitive abilities.

9.3 Explain processes involved in problem solving and factors that can interfere with successful problem solving.

9.4 Explain how creativity is defined, assessed, and encouraged in the classroom.

9.5 Identify factors that influence students' abilities to think critically and to form and support arguments.

9.6 Discuss how, why, and when knowledge learned in one situation might be applied to new situations and problems.

METACOGNITION

Watch
Metacognitive Knowledge and Regulation

In Chapter 8 we examined **executive control processes**, including attention, rehearsal, organization, imagery, and elaboration. These executive control processes are sometimes called *metacognitive* skills, because they can be intentionally used to regulate cognitive activities like encoding, and storing and retrieving information from memory.

Metacognitive Knowledge and Regulation

Donald Meichenbaum, professor emeritus at the University of Waterloo, and his colleagues described **metacognition** as people's "awareness of their own cognitive machinery and how the machinery works" (Meichenbaum, Burland, Gruson, & Cameron, 1985, p. 5). Metacognition literally means cognition about cognition—or thinking about thinking—something William James wrote about over 100 years ago (although he did not give it that name). The term was introduced into discussions of child development by John Flavell and his colleagues in the early 1970s. Metacognition is higher-order knowledge about your own thinking as well as your ability to use this knowledge to manage your own cognitive processes such as comprehending and problem solving (Bruning, Schraw, & Norby, 2011). People differ in how well and how quickly they learn partly because they differ in their metacognitive knowledge and skills.

Executive control processes Processes such as selective attention, rehearsal, elaboration, and organization that influence encoding, storage, and retrieval of information in memory.

Metacognition Knowledge about our own thinking processes.

Anthony Magnacca/Merrill

METACOGNITION Metacognition sets the stage for choosing the best way to approach a learning task. Students with well-developed metacognitive skills set goals, organize their activities, select among various approaches to learning, and change strategies if needed.

Metacognition involves all three kinds of knowledge we discussed earlier: (1) *declarative knowledge* about yourself as a learner, factors that influence your learning and memory, and skills, strategies, and resources you need to perform a task—*knowing what* to do; (2) *procedural knowledge* or *knowing how* to use the strategies; and (3) *self-regulatory knowledge* to ensure the completion of the task—*knowing the conditions*, when and why, to apply the procedures and strategies (Bruning, Schraw, & Norby, 2011). Metacognition is strategically applying this declarative, procedural, and self-regulatory knowledge to accomplish goals and solve problems (Schunk, 2012). Metacognition also includes knowledge about the value of applying cognitive strategies in learning (Pressley & Harris, 2006).

Metacognition regulates thinking and learning (Brown, 1987; Nelson, 1996). There are three essential skills: *planning*, *monitoring*, and *evaluating*. *Planning* involves deciding how much time to give to a task, which strategies to use, how to start, which resources to gather, what order to follow, what to skim and what to give intense attention to, and so on. *Monitoring* is the real-time awareness of "How I'm doing." Monitoring is asking questions like, "Is this making sense? Am I trying to work too fast? Have I studied enough?" *Evaluating* involves making judgments about the processes and outcomes of thinking and learning. "Should I change strategies? Get help? Give up for now? Is this paper (painting, model, poem, plan . . .) finished?" The notion of *reflection* in teaching—thinking back on what happened in class and why, and thinking forward to what you might do next time—is really metacognition about teaching (Sawyer, 2006).

Of course, we don't have to be metacognitive all the time. Some actions become routine or automatic. Metacognition is most useful when tasks are challenging, but not too difficult. And even when we are planning, monitoring, and evaluating, these processes are not necessarily conscious, especially in adults. We may use them without being aware of our efforts (Perner, 2000). Experts in a particular field plan, monitor, and evaluate as second nature; they have difficulty describing their metacognitive knowledge and skills (Pressley & Harris, 2006; Reder, 1996).

Individual Differences in Metacognition

Some differences in metacognitive abilities are the result of development. Younger children, for example, may not be aware of the purpose of a lesson—they may think the point is simply to finish. They also may not be good at gauging the difficulty of a task—they may think reading for fun and reading a science book are the same (Gredler, 2009). As children grow older, they are more able to exercise executive control over strategies. For example, they are more able to determine if they have understood instructions or if they have studied enough to remember a set of items. Metacognitive abilities begin to develop around ages 5 to 7 and improve throughout school (Flavell, Green, & Flavell, 1995; Woolfolk & Perry, 2012).

Not all differences in metacognitive abilities have to do with age or maturation. Some individual differences in metacognitive abilities are probably caused by differences in biology or learning experiences. In fact, many students diagnosed as having learning disabilities have problems monitoring their attention (Hallahan & Kauffman, 2006), particularly in long tasks. Working to improve metacognitive skills can be especially important for students who often have trouble in school (Schunk, 2012; Swanson, 1990).

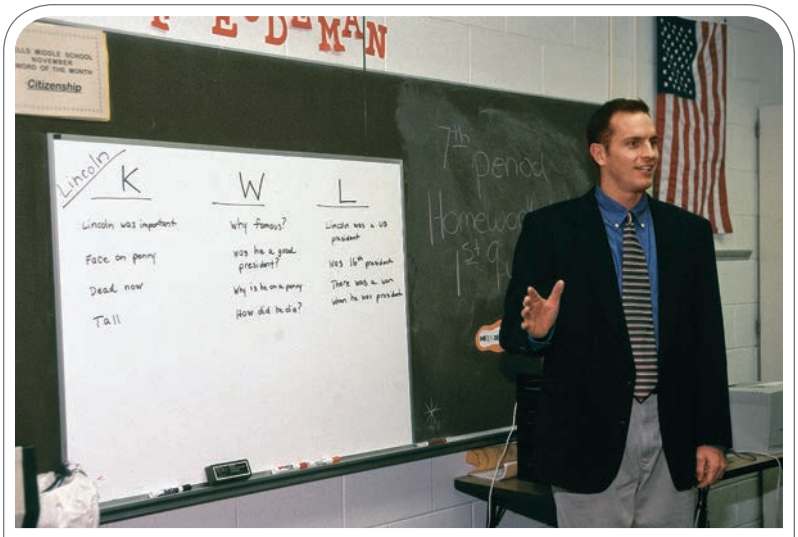
Lessons for Teachers: Developing Metacognition

Like any knowledge or skill, metacognitive knowledge and skills can be learned and improved.

METACOGNITIVE DEVELOPMENT FOR YOUNGER STUDENTS. In his grade 2 classroom, Daric Desautel (2009) worked with mostly Latino/a and Asian students. As part of

teaching literacy, Desautel decided to focus on student metacognitive knowledge and skills such as setting goals, planning, evaluating achievements, and self-reflection. He wanted to help students develop the habit of "looking in" at their own thinking. He also included self-reflections to help students evaluate their writing and gain insight into themselves as readers and writers. For example, one self-reflection activity included a checklist asking:

- Did you pick a topic that you know all about?
- Did you write a special beginning that makes the reader want more?
- Did you organize your thoughts and make a table of contents?
- Did you pick the right kind of paper and illustrate your book clearly?
- Did you re-read your work to check for *sound*, *sense*, *order*, and *goofs*?



Anthony Magnacca/Merrill

KWL One cooperative learning strategy used by many teachers to guide reading and inquiry is called KWL: What do I know? What do I want to know? What have I learned?

Desautel was successful in helping all his students, not just the most verbal and advanced, develop metacognitive knowledge. One student noted in his reflection, "I worked hard and did my best to make this book. I like nonfiction books better than stories. Next time, I would write about a different sport."

In her work with grade 1 and 2 students, Nancy found that asking students two questions helped them become more metacognitive. The questions were "What did you learn about yourself as a reader/writer today?" and "What did you learn that you can do again and again and again?" When teachers regularly asked these questions during class, even young students demonstrated fairly sophisticated levels of metacognitive understanding and action (Perry, VandeKamp, Mercer, & Norby, 2000).

Many of the cooperating teachers we work with use a strategy called **KWL** to guide reading and inquiry in general. It can be used with most grade levels. The steps are:

K What do I already *know* about this subject?
W What do I *want* to know?
L At the end of the reading or inquiry, what have I *learned*?

The KWL strategy encourages students to "look within" and identify what they bring to each learning situation, where they want to go, and what they actually achieved. It's a very metacognitive approach to learning. Marilyn Friend and William Bursuck (2002, pp. 362–363) describe how one teacher used modelling and discussion to teach the KWL strategy. After reviewing the steps, the teacher models an example and a nonexample of using KWL to learn about "crayons."

> **Teacher:** What do we do now that we have a passage assigned to read? First, I brainstorm, which means I try to think of anything I already know about the topic and write it down.

The teacher writes on the board or overhead known qualities of crayons, such as "made of wax," "come in many colours," "can be sharpened," "several different brands."

> **Teacher:** I then take this information I already know and put it into categories, like "what crayons are made of" and "crayon colours." Next, I write down any questions I would like to have answered during my reading, such as "Who invented crayons? When were they invented? How are crayons made? Where are they made?" At this point, I'm ready to read, so I read the passage on crayons. Now I must write down what I learned from this passage. I must include any information that answers the questions I wrote down before I read and any additional information. For example, I learned that coloured crayons were first made in the United States in 1903 by Edwin Binney and E. Harold Smith. I also learned that the Crayola Company owns the company that made the original magic markers. Last, I must organize this information into a map so I can see the different main points and any supporting points.

KWL A strategy to guide reading and inquiry: Before—What do I already *know*? What do I *want* to know? After—What have I *learned*?

At this point, the teacher draws a map on the chalkboard or overhead.

> **Teacher:** Let's talk about the steps I used and what I did before and after I read the passage.

A class discussion follows.

> **Teacher:** Now I'm going to read the passage again, and I want you to evaluate my textbook reading skills based on the KWL Plus strategy we've learned.

The teacher then proceeds to demonstrate the strategy *incorrectly*.

> **Teacher:** The passage is about crayons. Well, how much can there really be to know about crayons besides there are hundreds of colours and they always seem to break in the middle? Crayons are for little kids, and I'm in junior high so I don't need to know that much about them. I'll just skim the passage and go ahead and answer the question. Okay, how well did I use the strategy steps?

The class discusses the teacher's inappropriate use of the strategy. Notice how the teacher provides both an *example* and a *nonexample*—good teaching.

METACOGNITIVE DEVELOPMENT FOR SECONDARY AND UNIVERSITY STUDENTS (LIKE YOU). For older students, teachers can include metacognitive questions into their lessons, lectures, and assignments. For example, David Jonassen (2011) suggests that instructional designers incorporate these questions into hypermedia learning environments to help students be more self-reflective:

- What are my intellectual strengths and weaknesses?
- How can I motivate myself to learn when I need to?
- How good am I at judging how well I understand something?
- How can I focus on the meaning and significance of new information?
- How can I set specific goals before I begin a task?
- What questions should I ask about the material before I begin?
- How well have I accomplished my goals once I'm finished?
- Have I learned as much as I could have once I finish a task?
- Have I considered all options after I solve a problem?

Metacognition includes knowledge about using many strategies in learning—our next topic.

Learning Strategies

Most teachers will tell you that they want their students to "learn how to learn." Years of research indicate that using effective learning strategies helps students learn and that these strategies can be taught (Hamman, Berthelot, Saia, & Crowley, 2000; Pressley & Harris, 2006). But were you taught "how to learn"? Powerful and sophisticated learning strategies and study skills are seldom taught directly until high school or even university, so most students have little practice with them (Winne, 2013). In contrast, early on, students usually discover repetition and rote learning on their own, so they have extensive practice with these strategies. Unfortunately, some teachers think memorizing is learning (Beghetto, 2008; Woolfolk Hoy & Murphy, 2001). This may explain why many students cling to flash cards and memorizing—they don't know what else to do (Willoughby, Porter, Belsito, & Yearsley, 1999).

As we saw in Chapter 9, the way something is learned in the first place greatly influences how readily we remember the information and how appropriately we can apply the knowledge later. First, students must be *cognitively engaged* to learn—they have to *focus attention* on relevant or important aspects of the material. Second, to think and *process deeply,* they have to *invest effort*, make connections, elaborate, translate, invent, organize, and reorganize—the greater the practice and processing, the stronger the learning. Finally, students must *regulate and monitor* their learning—keep track of what is making sense

and noticing when a new approach is needed, That is, they must be *metacognitive*. The emphasis today is on helping students develop effective learning strategies that focus attention and effort, process information deeply, and monitor understanding.

Being Strategic About Learning

Learning strategies are flexible kinds of procedural knowledge—*knowing how* to do something. There are thousands of strategies. Some are general and taught in school, such as summarizing or outlining. Others are specific to a subject, such as using a mnemonic to remember the order of the planets: "My Very Educated Mother Just Served Us Nachos" for Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Other strategies may be unique, invented by an individual to learn Chinese characters, for example. Learning strategies can be cognitive (summarizing, identifying the main idea), metacognitive (monitoring comprehension—Do I understand?), or behavioural (using an internet dictionary, setting a timer to work till time's up) (Cantrell, Almasi, Carter, Rintamaa, & Madden, 2010). All are ways of accomplishing a learning task that are intentionally applied when usual methods have not worked and strategic effort is needed (Harris, Alexander, & Graham, 2008). Over time, as you become more expert at using strategies, less intentional effort is needed. Ultimately you may become more automatic in applying the strategies; in other words, the strategies will become your usual way of accomplishing that kind of task, until they don't work and new strategies are needed.

Skilled learners have a wide range of learning strategies they can apply fairly automatically. Using learning strategies and study skills is related to modestly higher GPAs in high school and persistence in university (Robbins et al., 2004; Winne, 2013). Researchers have identified several important principles:

1. Students should be exposed to a number of different strategies, not only general learning strategies but also very specific strategies for particular subjects, such as the graphic strategies described later in this section.
2. Students should be taught conditional knowledge about when, where, and why to use various strategies. Although this may seem obvious, teachers often neglect this step. A strategy is more likely to be maintained and employed if students know when, where, and why to use it.
3. Students may know when and how to use a strategy, but unless they also develop the desire to employ these skills, general learning ability will not improve. Several learning strategy programs include a motivational training component.
4. Students need to believe that they can learn new strategies, that the effort will pay off, and that they can "get smarter" by applying these strategies.
5. Students need some background knowledge and useful schemas in the area being studied to make sense of learning materials. It will be difficult to find the main idea in a paragraph about ichthyology, for example, if you don't know much about fish. So students may need direct instruction in schematic (content) knowledge along with strategy training. Table 9.1 summarizes several learning strategies.

DECIDING WHAT IS IMPORTANT. You can see from the first entry in Table 9.1 that learning begins with focusing attention—deciding what is important. But distinguishing the main idea from less important information is not always easy. Often students focus on the "seductive details" or the concrete examples, perhaps because these are more interesting (Gardner, Brown, Sanders, & Menke, 1992). You may have had the experience of remembering a joke or an intriguing example from a lecture, but not being clear about the larger point the professor was presenting. Finding the central idea is especially difficult if you lack knowledge in an area and the amount of new information provided is extensive. Teachers can give students practice in identifying and using signals in texts such as headings, bold words, outlines, or other indicators to identify key concepts and main ideas (Lorch, Lorch, Ritchey, McGovern, & Coleman, 2001).

Learning strategies A special kind of procedural knowledge—*knowing how* to approach learning tasks.

SUMMARIES. Creating summaries can help students learn, but students have to be taught how to summarize (Byrnes, 1996; Palincsar & Brown, 1984). Jeanne Ormrod

TABLE 9.1 • **Examples of Learning Strategies**

	EXAMPLES
Planning and Focusing Attention	Setting goals and timetables
	Underlining and highlighting
	Skimming, looking for headings and topic sentences
Organizing and Remembering	Making organizational charts
	Creating flowcharts, Venn diagrams
	Using mnemonics, imagery
Comprehension	Concept mapping, webs
	Summarizing, outlining and note-taking
	Creating examples
	Explaining to a peer
Cognitive Monitoring	Making predictions
	Self-questioning and self-testing
	Identifying what doesn't make sense
Practice	Using part practice
	Using whole practice

(2004) summarizes these suggestions for helping students create summaries. Ask students to:

- Find or write a topic sentence for each paragraph or section.
- Identify big ideas that cover several specific points.
- Find some supporting information for each big idea.
- Delete any redundant information or unnecessary details.

Begin by doing summaries of short, easy, well-organized readings. Introduce longer, less organized, and more difficult passages gradually. Ask students to compare their summaries and discuss what ideas they thought were important and why—what's their evidence?

Two other study strategies that are based on identifying key ideas are underlining texts and taking notes.

STOP & THINK How do you make notes as you read? Look back over the past several pages of this chapter. Are any words highlighted yellow or pink? Are there marks or drawings in the margins and if so, do the notes pertain to the chapter content or are they grocery lists and doodles? •

UNDERLINING AND HIGHLIGHTING. Do you underline or highlight key phrases in textbooks? Underlining and note-taking are probably two of the most frequent but ineffectively used strategies among post-secondary students. One common problem is that students underline or highlight too much. It is better to be selective. In studies that limit how much students can underline—for example, only one sentence per paragraph—learning has improved (Snowman, 1984). In addition to being selective, you also should actively transform the information into your own words as you underline or take notes. Don't rely on the words of the book. Note connections between what you are reading and other things you already know. Draw diagrams to illustrate

relationships. Finally, look for organizational patterns in the material and use them to guide your underlining or note-taking.

TAKING NOTES. Taking good lecture notes is not easy. You have to hold the lecture information in working memory; select, organize, and transform the important ideas and themes before the information "falls off" your working memory workbench; and write down the ideas and themes—all while you are still following the lecture (Peverly et al., 2007). As you fill your notebook with words and try to keep up with a lecturer, you may wonder if taking notes makes a difference. It does, if the strategy is used well.

- Taking notes focuses attention during class. Of course, if taking notes interferes with actually listening to and making sense of the lecture, then note-taking may not be effective (Kiewra, 1989, 2002; Van Meter, Yokoi, & Pressley, 1994).
- Taking notes makes you construct meaning from what you are hearing, seeing, or reading, so you elaborate, translate into your own words, and remember (Armbruster, 2000). Even if students don't review notes before a test, taking them in the first place appears to aid learning, especially for those who lack prior knowledge in an area.
- Notes provide extended external storage that allows you to return and review. Students who use their notes to study tend to perform better on tests, especially if they take many high-quality notes—more is better as long as you are capturing key ideas, concepts, and relationships, not just intriguing details (Kiewra, 1985, 1989; Peverly, Brobst, Graham, & Shaw, 2003).
- Expert students match notes to their anticipated use and modify strategies after tests or assignments; use personal codes to flag material that is unfamiliar or difficult; fill in holes by consulting relevant sources (including other students in the class); and record information verbatim only when a verbatim response will be required. In other words, they are *strategic* about taking and using notes (Van Meter, Yokoi, & Pressley, 1994).

Even though taking notes is valuable from middle school through graduate school, students with learning disabilities often have trouble (Boyle, 2010a, 2010b). Middle school and high school students with learning disabilities who used a strategic note-taking form recalled and understood significantly more key ideas from science lectures than students in control groups who used conventional note-taking methods (Boyle, 2010b; Boyle & Weishaar, 2001). For an example of this kind of form see www.ldonline.org/article/6210. Figure 9.1 is a general form that can be used in many note-taking situations. Dividing up the page is an idea from Cornell notes, described in Pauk's classic guide, *How to Study in College*. It is still available (Pauk & Owens, 2010). This form could be useful for any student who needs extra guidance in note-taking,

Visual Tools for Organizing

To use underlining and note-taking effectively, you must identify main ideas. In addition, you must understand the organization of the text or lecture—the connections and relationships among ideas. Some visual strategies have been developed to help students with this key organizational element (Van Meter, 2001). A **concept map** is a drawing that charts the relations among ideas, as shown in Figure 9.2, which is a concept map describing a website for creating concept maps! You may have referred to these interconnected ideas as *webs*.

In a review of 55 studies with students from grade 4 to graduate school and subjects ranging from science to statistics to nursing, John Nesbit and Olusola Adesope (2006) of Simon Fraser University concluded that, "in comparison with activities such as reading text passages, attending lectures, and participating in class discussions, concept mapping activities are more effective for attaining knowledge retention and transfer" (p. 434). "Mapping" relationships by noting causal connections, comparison/contrast connections, and examples improves recall. Anita's students use **Cmaps**, the free downloadable tools from the website shown in Figure 9.2, that are used for creating concept maps. One student even planned his dissertation and organized all the reading for his doctoral examinations with tools from the website. Computer Cmaps can be linked to the internet, and

Concept map A drawing that charts the relationships among ideas.

Cmaps Tools for concept mapping developed by the Institute for Human and Machine Cognition that are connected to many knowledge maps and other resources on the internet.

FIGURE 9.1

A FORM FOR TAKING NOTES STRATEGICALLY

Topic:	What do I already know about this topic?
Key Points/ Key Terms	Notes
Summaries: Write 3 to 5 sentences that capture the main ideas. 1. 2. 3. 4. 5.	
Questions: What is still confusing or unclear?	

Source: Based on ideas from Pauk, W., Owens, R. J. Q. (2010) [1962]. How to Study in College *(10th ed.). Florence, KY: Cengage Learning; http://academic.cuesta.edu/acasupp/as/618.htm; and www.ldonline.org/article/6210.*

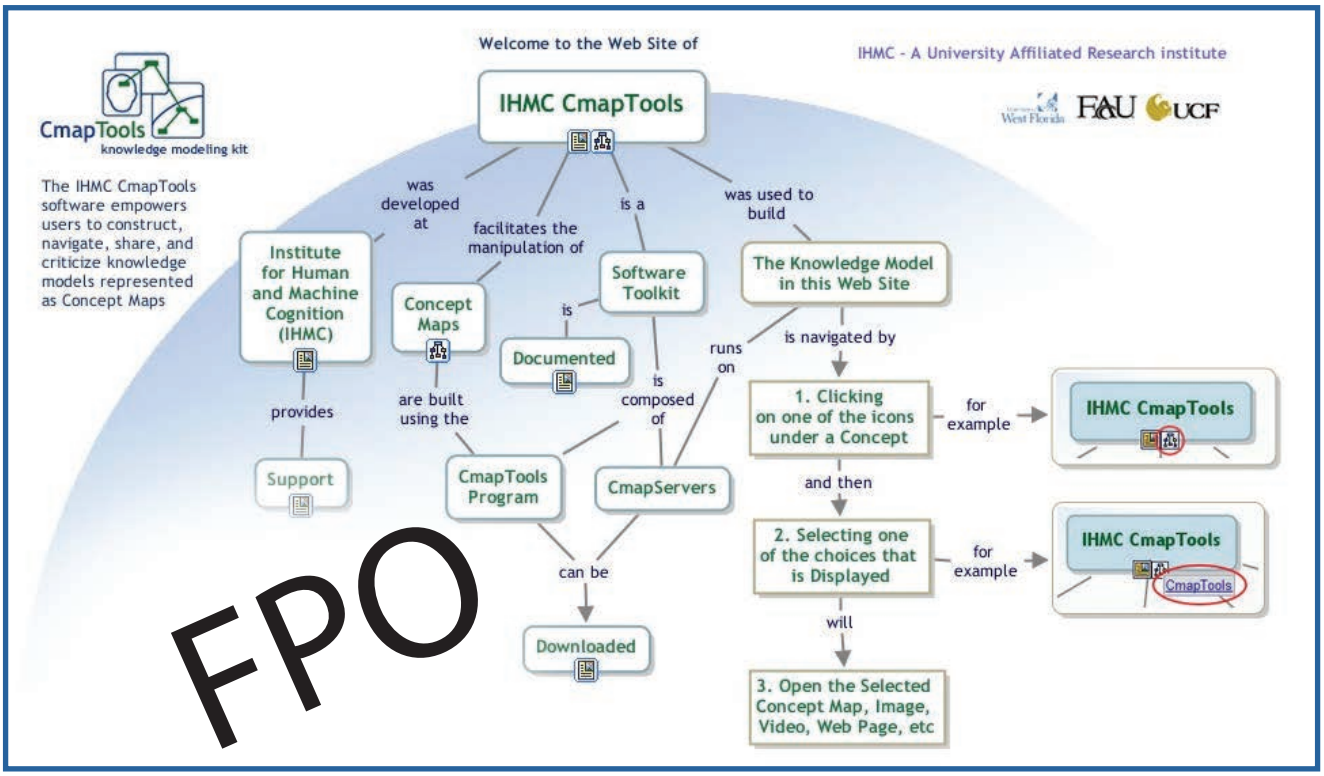
students in different classrooms and schools all over the world can collaborate on them. Students should compare their filled-in "maps" and discuss the differences in their thinking with each other.

There are other ways to visualize organization, such as Venn diagrams, which show how ideas or concepts overlap, and tree diagrams, which show how ideas branch off each other. Time lines organize information in sequence and are useful in classes such as history or geology.

FIGURE 9.2

THE WEBSITE FOR THE INSTITUTE FOR HUMAN AND MACHINE COGNITION CMAP TOOLS AT HTTP://CMAP.IHMC.US

At this site, you can download concept mapping tools to construct, share, and criticize knowledge on any subject.



Source: Institute for Human and Machine Cognition Cmap Tools home page. http://cmap.ihmc.us. Reprinted with permission from the IHMC.

Reading Strategies

As we saw earlier, effective learning strategies should help students *focus attention*, invest effort (connect, elaborate, translate, organize, summarize) so they *process information deeply*, and *monitor* their understanding. There are a number of strategies that support these processes in reading. Many use mnemonics to help students remember the steps involved. For example, one strategy that can be used for any grade above later elementary is the five-step **READS**:

R Review headings and subheadings.
E Examine boldface words.
A Ask, "What do I expect to learn?"
D Do it—Read!
S Summarize in your own words. (Friend & Bursuck, 2012)

A strategy that can be used in reading literature is **CAPS**:

C Who are the characters?
A What is the aim of the story?
P What problem happens?
S How is the problem solved?

There are several reasons why strategies like the ones we've described are effective. First, following the steps makes students more aware of the organization of a given chapter. How often have you skipped reading headings entirely and thus missed major clues about the way the information was organized? Next, these steps require students to study the chapter in sections instead of trying to learn all the information at once. This makes use of *distributed practice*. Answering questions about the material forces students to process the information more deeply and with greater elaboration.

No matter what strategies you use, students have to be taught how to use them. *Direct teaching, explanation, modelling*, and *practice with feedback* are necessary and are especially important for students with learning challenges and students whose first language is not English. For an example of direct teaching of strategies with explanations, modelling, and practice with feedback, see the KWL discussion earlier in this chapter.

Applying Learning Strategies

One of the most common findings in research on learning strategies is a phenomenon known as **production deficiencies**, where students learn strategies, but do not apply them when they could or should (Pressley & Harris, 2006). This is especially a problem for students with learning disabilities. For these students, control of metacognitive strategies such as planning, organizing, monitoring progress, and making adaptations often is underdeveloped (Kirk, Gallagher, Anastasiow, & Colemen, 2006). It makes sense to teach these strategies directly. To ensure that students actually use the strategies they learn, several conditions must be met.

APPROPRIATE TASKS. First, of course, the learning task must be *appropriate*. Why would students use more complex learning strategies when the task the teacher set is to "learn and return" the exact words of the text or lecture? With these tasks, memorizing will be rewarded and the best strategies involve distributed practice and perhaps mnemonics (described in Chapter 9). But we hope that there are few of these kinds of tasks in contemporary teaching, so if the task is *understanding*, not memorizing, what else is necessary?

VALUING LEARNING. The second condition for using sophisticated strategies is that students must *care* about learning and understanding. They must have goals that can be reached using effective strategies (Zimmerman & Schunk, 2001). Anita was reminded of this in her educational psychology class one semester when she enthusiastically shared a magazine article about study skills. The gist of the article was that students should continually revise and rewrite their notes from a course, so that by the end, all their understanding could be captured in one or two pages. Of course, the majority of the knowledge at that point would be reorganized and connected well with other knowledge. "See," she told the class, "these ideas are real—not just trapped in texts. They can help you study smarter." After a heated discussion, one of the best students said in exasperation, "I'm carrying 18 hours—I don't have time to *learn* this stuff!" She did not believe that her goal—to survive the overloaded semester—could be reached by using time-consuming study strategies.

EFFORT AND EFFICACY. This student also was concerned about effort. The third condition for applying learning strategies is that students must believe the effort and investment required to apply the strategies are reasonable, given the likely return (Winne, 2001). And students must believe they are capable of using the strategies; that is, they must have self-efficacy for using the strategies to learn the material in question (Schunk, 2012). This is related to another condition: Students must have a base of knowledge and/or experience in the area. No learning strategies can help students accomplish tasks that are completely beyond their current understandings.

The *Guidelines* provide a summary of ideas for you and your students.

Production deficiencies Failing to activate a learning strategy—a production—when it is appropriate and useful to use the strategy.

GUIDELINES

Becoming an Expert Student

Make sure you have the necessary declarative knowledge (facts, concepts, ideas) to understand new information.
Examples

1. Keep definitions of key vocabulary available as you study.
2. Review required facts and concepts before attempting new material.

Find out what type of test the teacher will give (essay, short answer), and study the material with that in mind.
Examples

1. For a test with detailed questions, practise writing answers to possible questions.
2. For a multiple-choice test, use mnemonics to remember definitions of key terms.

Make sure you are familiar with the organization of the materials to be learned.
Examples

1. Preview the headings, introductions, topic sentences, and summaries of the text.
2. Be alert for words and phrases that signal relationships, such as *on the other hand, because, first, second, however, since.*

Know your own cognitive skills and use them deliberately.
Examples

1. Use examples and analogies to relate new material to something you care about and understand well, such as sports, hobbies, or films.
2. If one study technique is not working, try another—the goal is to stay involved, not to use any particular strategy.

Study the right information in a productive way.
Examples

1. Be sure you know exactly what topics and readings the test will cover.
2. Spend your time on the important, difficult, and unfamiliar material that will be required for the test or assignment.
3. Keep a list of the parts of the text that give you trouble, and spend more time on those pages.
4. Process the important information thoroughly by using mnemonics, forming images, creating examples, answering questions, making notes in your own words, and elaborating on the text. Do not try to memorize the author's words—use your own.

Monitor your own comprehension.
Examples

1. Use questioning to check your understanding.
2. When reading speed slows down, decide if the information in the passage is important. If it is, note the problem so you can reread or get help to understand. If it is not important, ignore it.
3. Check your understanding by working with a friend and quizzing one another.

For more resources on studying, see http://www.ucc.vt.edu/stdysk/stdyhlp.html or http://www.d.umn.edu/student/loon/acad/strat.

Reaching Every Student: Learning Strategies for Struggling Students

Reading is key in all learning. Strategy instruction can help many struggling readers. As you have seen, some approaches make use of mnemonics to help students remember the steps. For example, Susan Cantrell (2010) and her colleagues identified 862 students in grades 6 to 9 who were at least two years behind in reading. The students were from 23 different schools. Students were randomly assigned to either a Learning Strategies Curriculum (Deshler & Schumaker, 2005) or the traditional curriculum. The Learning Strategies Curriculum focused on six strategies: word identification, visual imagery, self-questioning, LINCS vocabulary strategy, sentence writing, and paraphrasing. The **LINCS Vocabulary Strategy** uses stories and imagery to help students learn how to identify, organize, define, and remember words, which increases their ownership of their learning. The LINCS steps are:

L "List the parts." Identify the vocabulary word and key information.
I "Identify a reminding word." Pick a known word that reminds them of the vocabulary word.

LINCS Vocabulary Strategy A strategy that uses stories and imagery to help students learn how to identify, organize, define, and remember words and their meanings.