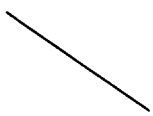
CHAPTER 2

A COGNITIVE DOMAIN EXAMPLE: READING

Table 2.1. Taxonomy of the Cognitive Domain

Process Requirements  **Knowledge Domains**	**Acquisition** Learning elements of a new knowledge domain (e.g., acquiring nomenclature).	**Automaticity** Integrating and applying elements and procedures through extensive repetition (i.e., automating skills)	**Transfer: Near term** Developing ability to generalize- apply principles, and strategies (e.g., heuristics) within a domain	**Transfer: Far term** Learning to discover new principles in a domain (e.g., creative thinking, problem finding, meta-cognition) and applying them across domains
COGNITIVE *decision making *problem solving *logical thinking *critical thinking	Rote learning (e.g., learning alphabet); Part task learning; Learning new procedures of a domain	Applying a known procedure to a known category of problem (e.g., decoding words, adding numbers, and automating through repetitive practice)	Solving new problems in the domain, conceptual thinking, strategic learning, transfer learning (e.g., self-generating a definition, proving a theorem)	Extending knowledge of a domain (creative thinking) to other domains (e.g. applying schemas of reading acquired in science to math, social studies, etc.

In this Chapter we will be highlighting the following learning heuristics as they apply to the developing reader:

- *Operant principles of minimizing errors, using small steps, and providing immediate reinforcement for acquisition of initial elements of domain knowledge;*
- *Advanced organizers to facilitate integrative skill acquisition and capitalize on prior knowledge;*
- *Continual use of active learning in functional context;*
- *Part-task training to break up complex tasks into manageable chunks;*
- *Providing multiple-context environments to facilitate positive transfer within and across domains.*

INTRODUCTION

In this chapter, we cover the four learning processes as they relate to the Cognitive domain. The Cognitive example we have chosen to illustrate our approach in this chapter is Reading. When we teach people to read, we are trying to enhance or facilitate their ability to manipulate a symbol system, we call it language. The purpose this serves is to help the learner to better organize his world. Therefore, we are aiding the development of thinking and reasoning, the abstract representation and manipulation of a symbol system. We would submit that Reading represents the primordial ooze of such a complex, cognitive process and is essential for all future abstract manipulations (see Whorf, 1956, on language and thought).

Perceptually, the gestalt psychologists, working in the visual domain, helped us to note that certain primary structures exist from birth and then are built upon later; e.g., the curve, the line, etc. (Köhler, 1947). When we teach our children early on we give them concrete manipulanda and attach abstract names to them. This facilitates organizing the primary, perceptual structures into higher order categories or groupings, for example, trees, dogs, cats, cars, etc. Developmentally, we note the success in such categorizations by use of the term "perceptual constancies." The research on brightness, shape, size, and color constancies indicate that their appearance occurs respectively at chronologically increasing ages (brightness first at a few months, next shape, size, and lastly, color, the last at about eight to nine years of age; See Woodworth & Schlosberg, 1955). Note also that while we are teaching our children to attach names to objects, we are also providing motivation, emotional involvement, and motor involvement as we smile, clap our hands and in other ways with our body language show approval for what the child is accomplishing. In turn the child smiles back, points to or manipulates the object, and may even mimic the approval-making applause. This example illustrates that the interrelatedness, therefore, of all our domains is reinforced from the child's earliest learnings.

The point of this discussion is to emphasize that in instruction we capitalize on the developmental sequence by moving from the concrete to the abstract, simple to complex, and provide multiple examples for the learner to aid the organizational process. Language learning facilitated by listening, reading, and writing is the primary means by which we gain the basis for our learning increasingly abstract

organization and symbol manipulation for thinking and reasoning. Learning to read by its very nature, manipulating an abstract symbol system, represents the learning of an ill-structured domain, an open task if you will, and is the epitome of a complex, cognitive ability. This is especially so in the learning of the English language with its many rules, exceptions to rules, and irregular characteristics. Moreover, the fruits of this learning are felt in every other domain and subject matter. In their research on memory, comparing novices to experts, Ericsson, Patel, and Kintsch (2000) provide additional support for our selection of Reading as a cognitive domain example. They note, "It is necessary to keep large amounts of information accessible in WM [working memory] during text comprehension and expert performance in domains such as chess and medicine." Furthermore they assert "... that the same type of memory mechanisms mediate the comprehension of texts, chess, and medical diagnosis" (pp. 582-83).

The value of choosing Reading as our example of the Cognitive domain is that it is the clearest illustration of learning to transfer principles or schemas across all other areas of human learning. We call this, as noted above, Far Term Transfer. In education, or training, transfer might otherwise be called teaching or instructing for understanding. The schemas for grammatical construction, sentence or paragraph comprehension, application of cognitive strategies in reading, etc. are not learned typically as ends in themselves. Rather, their meaning is attained when we apply them to learning other cognitive examples, such as math, science, etc. as well as learning skills in other domains: psychomotor, affective, and interpersonal. Thus, learning to read for understanding means learning the verbal skills and the schemas necessary to learning other domain skills, such as, playing the piano, typing, playing sports, solving a physics problem or describing a historical event, and expressing ourselves emotionally and socially. Becoming expert in these skills would be severely limited, if not impossible, without the ability to read.

The limitations of Reading in serving far term transfer result from the fact that we encode our experiences in a number of ways. First, in the visual domain we encode verbally and pictorially (Pavio, 1986). We also encode with multiple channels (Broadbent, 1952a, 1952b; Mayer & Moreno, 2003), such as the mix of auditory and visual information. In training with simulations, especially in virtual reality, the military is experimenting with including the haptic sense (feel, touch) as well (Bakker, Werkhoven, & Passenier, 1999; Dupont, Schulteis, Millman, & Howe, 1999). Nevertheless, our world is heavily visual, and reading to do something or act on something to understand our world is one of the first and most important cognitive skills we learn.

The format of the chapter will be two sections following the Introduction. First, we suggest possible strategies or guidance that the developer might apply to the targeted training or educational materials under consideration for this domain. Secondly, we provide the research and theoretical support from the literature. The reader may wish only to use Section I without reading the backup material. The value of Section II is to provide a more comprehensive basis for the practical suggestions given first; but it is not necessary in order to apply the recommended strategies.

Acquisition

The process of learning all the elements of the domain (in this case, Reading), regardless of specific theorist descriptions, we are calling: Acquisition. As the chart above illustrates, this would include rote learning of such items as the alphabet among others in order to develop a basic skill set from which further instruction in reading can progress.

When children move into reading, they shift from visual cue processing of words to phonetic cue processing. The phonetic processing requires familiarity with letters and their names or sounds and knowledge of how letters symbolize phonetic units detected in the pronunciation. It also entails recognizing and remembering associations between letters in spellings and sounds in pronunciations and explains how children first become able to read single words reliably. At this stage, the emerging reader (from approximately birth to age 5) is learning the alphabet, becoming familiar with storybook reading, and building important letter-sound relationships (Chall, 1983/1996).

Automaticity

Reading is a complex skill that requires a great deal of attention and integrates many processes in a short period of time. The Automaticity Phase requires integrating the basic elements and automating the earlier processes. Reading is also a continuously developed skill and the instructional materials should match the changing abilities and skills of the reader. Initial skills such as word decoding, learning letter-sound relationships, and using contextual cues are ones that beginning readers use as they begin to become familiar with print and the processes of reading (Chall, 1993/1996). Word recognition becomes automatic at a fairly early level of reading development. The processing of words takes only a few seconds for the fluent reader but there are many who do not succeed in becoming fluent readers although they may quickly and easily understand speech (LaBerge & Samuels, 1974). When these basic skills are automatized, little attention is needed to perform these skills. This allows the readers' full attention to focus on the comprehension of the text. As readers develop and become more proficient, their learning shifts to more complex tasks, such as the development of cognitive schemas, which require higher-order constructive, cognitive processes including the use of complex reading strategies.

Transfer: Near Term

As the reading task gets more complex, it requires conceptual thinking and strategic learning. It involves developing the ability to interpret and generalize (i.e., to transfer principles). The reader interprets what he or she reads, associates it with past experiences, and projects beyond it in terms of ideas, relations, and categorizations. Chall (1983/1996) categorizes this stage of reading as *learning the new*. The supporting research for near term transfer is classified in broad Reading categories of strategic reading and conceptual learning from text. The reader can be

aided in his or her quest for developing such transfer capabilities by competent authors. "In a well written text, the author facilitates the integration of new sentences with earlier presented information through the organization of the text and the use of explicit and implicit references. For example, when a skilled reader encounters the words 'that all policemen' in a sentence, then these words provide a semantically based retrieval cue to relevant information about the associated character in the text that the reader generated during the prior reading of the text" (Ericcson, Patel, & Kintsch, 2000, p. 583).

Transfer: Far Term

The key to far term transfer is developing strategies that apply beyond the domain one is currently learning, in this case techniques for learning how to read better that might apply to other curricula, say, math or social studies (Bransford & Stein, 1993). It may include, for example, such strategies as meta-cognitive strategy use, comprehension monitoring and decision-making. The supporting research for far term transfer includes reading engagement, reading in multi-text environments and amount and breadth of reading. These will be discussed further in Section II.

SECTION I:

INSTRUCTIONAL GUIDANCE

Acquisition Process

Table 2.2. Acquisition Process of the Cognitive Domain

Process Requirements	**Acquisition**	**Automaticity**	**Transfer: Near term**	**Transfer: Far term**
COGNITIVE *decision making *problem solving *logical thinking *critical thinking	Rote learning (e.g., learning alphabet); Part task learning; Learning new procedures of a domain	Applying a known procedure to a known category of problem (e.g., decoding words, adding numbers, and automating through repetitive practice)	Solving new problems in the domain, conceptual thinking, strategic learning, transfer learning (e.g., self-generating a definition, proving a theorem)	Extending knowledge of a domain (creative thinking) to other domains (e.g. applying schemas of reading acquired in science to math, social studies, etc.

In order to maximize performance during the Acquisition phase of early reading, the following strategies will apply:

- **Exposure to storybook reading;**
- **Practice in sound and letter recognition;**
- **Teach word-decoding skills and help develop vocabulary words;**
- **Teach word recognition and sight reading skills.**

Exposure to Storybook Reading

Preschool children who are read to consistently usually associate reading with pleasure and enjoyment and learn to read more easily once they reach the kindergarten and first grade age (Whitehurst et al., 1994). Activities such as storybook reading, storytelling, object and picture identification, practice with the alphabet and rhyming games confer skills that are essential to the reading process. Through these learning activities, emerging readers begin to understand important associations between the spoken and written language. Importantly, research indicates that the quality of the reading experience is essential to reading development (Heath, 1983). How parents and teachers mediate the reading process with regard to positive social interactions surrounding the book reading is as important as the reading itself. Some milestones for the emerging reader occur when she or he begins to recognize commercial establishment signs such as "McDonald's" or when she or he can recognize his or her own name in print. It also involves learning that: (1) Reading proceeds from left to right and from the top of the page to the bottom; (2) Spoken language is represented in a consistent fashion in the written language; (3) Each letter of the alphabet is associated with one or more sounds in spoken language. Studies in emergent literacy have focused on the following points (Sulzby & Teale, 1991):

1. The presence of people who read and write in the child's environment is vital to emergent literacy. This includes social interactions with parents and caretakers in activities that integrate reading and writing.
2. Create a routine to foster storybook reading. Being read to daily (or as often as possible) is crucial in the development of reading in children. Routine in dialogue creates a predictable atmosphere, which helps children learn how to participate in the reading event.
3. When print is present, children begin to take an interest in reading and writing, so one should introduce storybooks as early as infancy. There are "soft fabric" books and sturdy cardboard books that they can begin to play with and manipulate on their own.
4. Reading and writing reinforce one another and develop simultaneously rather than sequentially so one should provide reading and writing materials (e.g. books, coloring books, crayons, and plain writing paper) in the play area so that they will be viewed as exciting activities.

5. Have children reenact their favorite stories and read familiar stories in unconventional ways in order to create independence with reading.
6. Allow children to create, write and retell their own stories in order to reinforce the connection between the spoken and written word.
7. Watch *Sesame Street* or television with captioning to improve readiness (Pressley, 2002).
8. Create a positive social interaction around reading. Tell children how the story relates to their own personal experiences.

Practice Sound and Letter Recognition

Instruction in reading begins when the student is able to recognize each letter of the alphabet and its corresponding sound(s). The student should also be able to distinguish letters of the alphabet in uppercase and lowercase forms. Students should be versed in hearing phonemes that are the distinct sounds within a spoken word. Phonemic awareness refers to the ability to recognize units of sounds or phonemes in words, and to manipulate individual sounds in words. When children have the understanding that words are made up of phonemes, their reading improves significantly (Adams, 1990; Ball & Blachman, 1991; Pressley, 1998; Stahl & Murray, 1994). The initial emphasis is placed on auditory recognition because 1) the auditory processing of language helps differentiate sounds in words, and 2) often, words that sound the same do not share visually similar characteristics, such as words "friend" and "mend." The following exercises can assist children in being skilled in the beginning stages of reading:

1. Explicitly teach skills for phonemic awareness. Help children practice the skill of isolating the initial letter in the sound of a word.
2. Ask children to identify words all beginning with the same sound. Initial letter isolation differs from the ability to produce words that have the same beginning sound, as it requires the child to separate the initial sound of a word from a whole word as opposed to producing words that begin with the same sound, which is a more difficult skill.
3. Say several words and/or show pictures of several objects and ask children to choose the one that begins and/or ends with a different sound from the others.
4. Play games that incorporate words that rhyme and words that have the same beginning sounds.
5. Read alphabet books embedded with individual letters in colorful pictures and meaningful stories. Have children practice writing letters, first by tracing, then copying, and eventually retrieving them from memory.

Teach Word-Decoding Skills

Students should be taught how particular letters and letter combinations are pronounced (Stanovich, 1991). Word decoding involves identifying the sounds associated with the word's letters and blending them together to determine the word. The letters used to spell a word often give some indication of the way in

which the word is pronounced. However, the English language is not always reliable because it does not have one concrete correspondence between sounds and symbols. To assist students in learning to read words:

1. Focus on spelling patterns. Help the reader become familiar with riming clusters and repeating patterns in letters (e.g., ate).
2. Clap out the syllables of new words to help students hear and pronounce all of the sounds in the word.
3. Teach the rules of reading words that apply most of the time (e.g., the *e* at the end of a word is usually silent).
4. Show patterns in similarly spelled and pronounced words (e.g., the *end* in *bend, mend, send*).
5. Have students create nonsense words using common letter combinations (e.g., *brip, shwing*).
6. Give students a lot of practice sounding out unfamiliar words.
7. Teach students how to spell the words they are learning to read.

Using Examples and Non-examples to Reinforce Decoding of Words

This type of part-task training presents contrasting examples that are accurate representations with those that are "non-examples." Non-examples help to refine definitions of concepts being understood by a learner. The contrast between examples and non-examples helps to develop learners' representation of knowledge (Montague, 1987). In teaching a student to read, this approach can be easily applied. First, provide examples of how the task should be accomplished; Start off simple and proceed to the more difficult task at hand. Next provide the contrasting non-example to reinforce the concept or word being learned.

With regard to word decoding, if you are teaching a student to read the word *placemat*, first present the child with each syllable of the compound word starting with *place* and then *mat*. Complete the instruction with sounding the whole word out. The letter "c" can be pronounced differently depending upon its placement in a word. The teacher can present to the student a non-example of the word's pronunciation. The letter "c" is sometimes pronounced like "k" making the word *plakemat*. Explain why this is not the correct way to pronounce "c" in this context; in turn, the non-example further defines how to read *placemat*.

Importantly, the use of examples and non-examples applies not only to word decoding, but also is useful in other phases of learning (e.g., conceptual development, near term transfer).

Automaticity Process

Table 2.3. Automaticity Process of the Cognitive Domain

Process Requirements	**Acquisition**	**Automaticity**	**Transfer: Near term**	**Transfer: Far term**
COGNITIVE *decision making *problem solving *logical thinking *critical thinking	Rote learning (e.g., learning alphabet); Part task learning; Learning new procedures of a domain	Applying a known procedure to a known category of problem (e.g., decoding words, adding numbers, and automating through repetitive practice)	Solving new problems in the domain, conceptual thinking, strategic learning, transfer learning (e.g., self-generating a definition, proving a theorem)	Extending knowledge of a domain (creative thinking) to other domains (e.g. applying schemas of reading acquired in science to math, social studies, etc.

In order to maximize performance during the Automaticity stage, the following strategies will apply:

- **Teach word recognition and vocabulary;**
- **Use oral and expressive reading to develop fluency;**
- **Practice with appropriate levels of familiar texts;**
- **Maximize time spent reading.**

Teach Word Recognition and Vocabulary

Word recognition must become automatic in two ways. First students should be able to sight-read words quickly and automatically, without having to decode them letter-by-letter. Secondly, they should be able to retrieve the meanings of words immediately. Importantly, research shows that any one process of reading, like Automaticity, need not develop incrementally (Stanovich, 1991); rather, students can simultaneously gain meaning from text while developing automatic word decoding skills. Also, students need to expand their repertoire of word meanings through the development of an extensive vocabulary. Automaticity in word recognition develops through constant practice:

1. Utilize activities that incorporate environmental print such as logos, cereal boxes, household products, etc that can support emerging control over the conventions of print.
2. Provide many opportunities for the students to write to help them see connections among speech, sounds in words, and written words.
3. Use flashcards of individual words to promote more automatic word recognition.

Emphasize vocabulary development through:

1. Teaching the meanings of words through explicit vocabulary lessons;
2. Helping students activate their prior knowledge and experiences when encountering new words;
3. Providing word-building activities that pay attention to spelling, prefixes and suffixes;
4. Using both definitions and contextual examples when introducing new words;
5. Practicing the use of new words in several contexts and through two or three sensory modes;
6. Using semantic mapping for vocabulary expansion that extends knowledge of how words are related to one another (see also Near Term Transfer Section for more discussion and guidance);
7. Using analogies to portray the meaning of a word through comparisons that show its relationship to other words;
8. Encouraging students to read a variety of texts and materials as often as possible.

Use of Context to Facilitate Word Recognition

Word order is important in understanding the relationship between language and reading. The syntactic patterns in language are the same patterns followed in reading and writing. Words are recognized more easily when seen within the context of a sentence than when seen in isolation. Both the syntax and the overall meaning of the sentence provide context clues that help. Context is especially important for beginning readers who are not familiar with the new words or who have not fully developed automaticity. Some instructional techniques for effectively using context are listed below. An important caveat for the reading teacher is to provide multiple contexts of word representation. In this way, the beginning reader does not restrict the meaning of a word to a specific graphic representation (for further explanation see Stanovich, 2000).

1. Reading stories aloud provide opportunities to hear sounds in words within the context of the connected text.

2. When the student comes to an unknown word, instruct them to complete the sentence and then come back to the unknown word to figure it out.
3. Present the reader with a sentence in which one word has been omitted but the initial consonant is present.
4. Present a sentence with a blank that could be filled with just one word and no other.
5. Use exercises in which the vowels are absent from a word in the sentence and the student relies upon meanings, language cues and consonant cues in order to decipher the word.
6. Provide incomplete sentences in which the missing word can be identified among a group of words.

Use Oral and Expressive Reading to Develop Fluency

Students can gain oral fluency and expressiveness in reading through daily practice with familiar text. Fluency involves: (1) the rate and accuracy with which students recognize words (LaBerge & Samuels, 1974); and (2) the intonation, tone, and expressiveness of reading. Advanced readers are fluent, in the sense that they can read isolated words rapidly and accurately. They can read a whole passage aloud to communicate its meaning by adjusting their inflection, rate, and speed to match the intended meaning of the author. There are a number of variants of reading aloud to gain fluency including:

- Repeated readings—reading the same material more than once;
- Paired readings—pairs read orally to one another;
- Choral readings—a group of students read together simultaneously;
- Expressive readings—students dramatize oral readings through assuming roles in books or choosing favorite passages to read aloud. Books with rhyming patterns or ones that use two voices are very good for this type of reading (e.g., *Joyful Noise: Poems for Two Voices* by Paul Fleischman (1988) or *Under One Rock: Bugs, Slugs, and other Ughs* by Anthony D. Fredericks (2001) would be good selections to use).

Practice with Appropriate Levels of Interesting Texts and Maximize Time Spent Reading

Book access is an especially crucial aspect of early reading development (Pressley, 2002). Readers should have access to multiple levels and genres of text (see also Davis & Tonks, 2004; Guthrie & Cox, 1998). Guthrie and Cox (1998) recommend:

- Provide an ample supply of books about a theme of instruction;
- Provide books that are culturally responsive to students;
- Provide time for self-selected reading;
- Balance self-selected reading with guided reading.

Transfer Process: Near Term

Table 2.4. Near Term Transfer Process of the Cognitive Domain

Process Requirements	Acquisition	Automaticity	Transfer: Near term	Transfer: Far term
COGNITIVE *decision making *problem solving *logical thinking *critical thinking	Rote learning (e.g., learning alphabet); Part task learning; Learning new procedures of a domain	Applying a known procedure to a known category of problem (e.g., decoding words, adding numbers, and automating through repetitive practice)	Solving new problems in the domain, conceptual thinking, strategic learning, transfer learning (e.g., self-generating a definition, proving a theorem)	Extending knowledge of a domain (creative thinking) to other domains (e.g. applying schemas of reading acquired in science to math, social studies, etc.

In order to maximize performance during the Near Term Transfer stage, the following strategies will apply:

- **Teach reading comprehension strategies, such as activating background knowledge, questioning, searching, summarizing, and graphic organizing, text structure, and story grammar, among others;**
- **Use tasks that help readers transform their knowledge, including metaphorical reasoning;**
- **Integrate reading and writing whenever possible.**

Teach Reading Comprehension Strategies

Since reading is a constructive process in which readers identify main ideas, draw inferences, and usually go beyond the words in order to construct authors' intended meanings, reading strategy instruction is essential. *Reading Strategy Instruction* refers to the explicit teaching of strategic behaviors in reading. The National Reading Panel (2000) reviewed the current reading research in comprehension strategy instruction and concluded that several reading strategies are beneficial to students' meaning construction. These include: activating background knowledge, questioning, searching, summarizing, self-explanation, and graphic organizing, etc. that enable students to acquire relevant knowledge from text. Instruction using

teacher modeling, scaffolding, and coaching, with direct explanation for why strategies are valuable, and how and when to use them, is important for strategy use to develop. Other researchers (e.g., Meichenbaum & Biemiller, 1998) similarly point to the importance of a variety of instructional strategies to nurture learning. According to Meichenbaum and Biemiller (1998), it is important for teachers to use explicit direct instruction with clear instructional goals, modeling, independent practice, and appropriate feedback (see pp. 124-130 for more detail). Taboada and Guthrie (2004) have created benchmarks for strategy learning in the elementary grades and explicated the necessary components of competence, awareness, and self-initiation when teaching comprehension strategies. Guthrie, Wigfield, and Perencevich (2004) offer the following instructional recommendations:

- **Activating background knowledge**—Effective meaning instruction is enhanced by the amount of knowledge the reader already has about the topic (Alexander & Jetton, 1996; van Dijk & Kintsch, 1983).
  1. When first teaching activation, use books with the following qualities in order to reduce cognitive load:
     - Familiar topics relating to personal experiences,
     - Pictures that relate to students' experiences,
     - Title matched to content,
     - Vivid pictures,
     - Minimal text,
     - Situationally interesting,
     - Avoid topics about which students have many misconceptions.
  2. Later, the topics should be slightly unfamiliar; so that students can identify a number of new ideas they learned.
  3. The teacher can lead a discussion based on a book walk, previewing the text and illustrations and helping students to recall their knowledge about the topic.
  4. The teacher can use photographs, videos, demonstrations, props, hands-on activities, or even a field trip *before* reading to help students activate their knowledge.
  5. After reading, students can identify something new and important that they learned but did not express in prior knowledge statements. That is, they can revise and update their prior knowledge to include new knowledge learned after reading.
- **Question answering** – Students answer questions posed by the teacher and receive immediate feedback.
- **Self-questioning** – Students ask themselves questions about various aspects of an informational text or story.
  1. Specific instruction on how to ask questions needs to be provided by the teacher.
  2. When first teaching self-questioning, books with the following qualities will help students ask "good" questions:

- Visually enticing/vivid pictures,
- Concept-rich texts with related details,
- High quality text features such as, headings, sub-headings, captions, and
- Title, heading, and sub-headings matched to content.

3. In the initial stages of questioning, the teacher can first give one-half a question and have the students finish it. Or teacher can also provide a question word and have students finish the question. Students can also do these in pairs finishing each other's questions.
4. The teacher should highlight the difference between factual questions and conceptual questions. Teacher can emphasize that higher-order questions request *explanations* rather than facts. Taboada and Guthrie (2004) have developed a very useful questioning rubric for teachers and instructors to utilize.
5. Teachers can model questioning both before and during reading.
6. After reading (amount of text to be decided by teacher), teacher and students identify which questions were answered and which were not. Questions that could not be answered by the text can be reformulated or search for answers can be extended across multiple texts.
7. Be aware of individual differences, including students' personal characteristics, and social factors (Van Der Meij, 1994) when having students complete this task.

- **Searching** – Students are taught how to search for information in the text (i.e. table of contents, headings, index, etc.) (see also Dreher, 1993; Guthrie, Weber, & Kimmerly, 1993).
  1. When first teaching search, choose books with the following qualities:
     - High quality text features such as, headings, sub-headings, captions;
     - Title, heading, and sub-headings matched to content.
  2. Give students the choice of which book to search for information (Reynolds & Symons, 2001; Symons, McLatchy-Gaudet, & Stone, 2001).
  3. When first teaching search, introduce students to text features, such as table of contents (TOC), index, glossary, bolded words, captions, illustrations, boxed text, etc., and have the students practice finding answers to questions using various text features.
  4. Teach the students how to identify indexed terms, skim the text carefully, and monitor how well extracted information fulfills the search goal (Symons et al., 2001).
  5. When first teaching the use of index, select a book with simple index and choose straightforward search terms where the student does not have to figure out synonyms. Later, students can build a "synonym journal" and have insert synonyms about re-occurring topics to help with finding terms in the index.

6. Discuss with students why captions and pictures go together. To help students become aware of the use of bold in headings, ask them to provide alternative titles or headings. Similarly, ask students to develop better captions for text illustrations.
7. Have students compare two books with different search features and have them evaluate how books differ in their text features and which books are more conducive to searching.
8. Give learners a worked example as a high scaffold for searching. For example, students can be given a research question, a list with books, and the search processes used to elicit the book selection. Students can identify the quality of the book selection and search processes utilized (van Merrienboer, Kirschner, & Kester, 2003).
9. Give learners a ½ worked example and have students complete the search process. For example, students can be given a research question, a list of books, and students can complete the search task by reducing the number of books to a predefined number (van Merrienboer, Kirschner, & Kester, 2003).
10. Present the task in an appealing format to arouse the student's interest (Reynolds & Symons, 2001).

- **Explanation and elaborative interrogation** – Students are taught to explain information to themselves and others and ask *why* questions about text material.
    1. Have pairs of students read a text selection silently. Next have one student read a sentence aloud. Have the partner ask a why question, such as, "Why would that be true?" or "Why is that important? to which the reader responds by connecting text ideas.
    2. Both partners can gain information from the process. The reader should think deeply to connect text information and the *why* question asker should choose an appropriate question to ask that makes sense in the context of the text information.
    3. Have students explain text material aloud to ensure comprehension (Chi et al., 1994).
    4. Have readers use think-alouds wherein they talk out loud about hurdles they face during reading. Also teachers can think-aloud to model their thinking processes about how to fix difficulties that might arise during the reading process (Afflerbach, & Pressley, 1995).
- **Summarizing** – Students are taught to integrate ideas and generalize from the text information (see also Brown & Day, 1983).
    1. Books for teaching summarizing should have the following qualities:
        - Concept information that is contained in one page or one section of text,
        - Section organized with main idea and supporting details,
        - Concept-related rather than fact-based (e.g., Eyewitness books are already summarized for the reader),
        - Familiar content.

2. The teacher can tell students about a movie he or she recently saw, using a detailed, long, description with irrelevant details. Next, the teacher can summarize what the movie was about in 2 to 3 sentences. Discuss the differences between the 2 statements in order for students to understand the purpose of a summary.
3. To summarize, have students identify and circle the main idea, underline all of the supporting details, and cross out all of the unimportant details (Brown & Day, 1983).
4. Have students highlight key words and then use those words to write a summary sentence.
5. Partners can trade summaries and verbally explain to summary-writer what the book was about.

- **Using Graphic and Semantic Organizers** – Students make graphic representations of the material.
  1. Have students identify clusters of related words within lists and then arrange word clusters and build a concept map.
  2. Teachers can provide a list of the main words (e.g. word-cards or word-slips with the main-idea word(s)) and supporting-detail words. Students can read a section of text and then build a class concept map with the words provided by the teacher. Discussion of word choice and word organization should be a central part of the direct instruction process (e.g. Why do we put this word in the center? Which words should branch out from the main idea? etc.). When students decide on the organization of words and provide their rationales for word organization they should be able to back up their concept-maps organization with text information.
  3. Concept maps should have a hierarchical form. Each level should express a similar level of generality and inclusiveness; however, as the student moves from top to bottom, the information should get progressively more specific and less inclusive of the specific context (Novak & Musonda, 1991).
  4. There should be consecutive map revisions by the students with the assistance of the tech to increase clarification of the concepts being learned and the connections between them (Starr & Krajcik, 1990).
- **Teaching "Story grammar"** (i.e. story structure) – Students learn how to use the structure of the story texts (morals, plot, obstacles, etc.) as a means of helping them recall story content in narratives (Baumann, & Bergeron, 1993; Meyer, 1984). Narrative texts have different purposes than expository texts. Expository text is intended to present information. Narrative texts, on the other hand, explore literary themes emphasizing character development and plot occurrences. Students need to be aware of these differences between genres in order to use strategies appropriate for each text type (see also Guthrie, Wigfield, & Perencevich, 2004).

1. Have students think about the crafting of the plot: *What is the author's purpose for writing this? What is the author trying to say?* Have students generate questions to help them develop awareness of the plot's progression and understanding of what is happening in the story and why.
2. Students can search for evidence of characters' main motivations and obstacles facing the main characters. Students can make predictions on how the obstacles could be handled by the characters based on what they found about the character's motivations.
3. To build cognitive flexibility, expose students to literary texts, which can support multiple interpretations, and have students search for multiple, possible themes and develop arguments to substantiate their positions. (see Spiro, et al., 1989, 1990, 1995).

Transfer Process: Far Term

Table 2.4. Far Term Transfer Process of the Cognitive Domain

Process Requirements	**Acquisition**	**Automaticity**	**Transfer: Near term**	**Transfer: Far term**
COGNITIVE *decision making *problem solving *logical thinking *critical thinking	Rote learning (e.g., learning alphabet); Part task learning; Learning new procedures of a domain	Applying a known procedure to a known category of problem (e.g., decoding words, adding numbers, and automating through repetitive practice)	Solving new problems in the domain, conceptual thinking, strategic learning, transfer learning (e.g., self-generating a definition, proving a theorem)	Extending knowledge of a domain (creative thinking) to other domains (e.g. applying schemas of reading acquired in science to math, social studies, etc.

At this level of transfer processes, multiple-contexts are applied in an even broader application of the principle.

- **Reading is presented as a context in itself as an example of structure.**
- **Positive far term transfer is expected across domains; e.g., with history, from attending to concepts of form and meta-cognitive awareness,**
- **Self-initiation of strategy use, and**

- **Strategies that integrate reading and writing.**

Metacognitive Awareness

Metacognitive awareness refers to the ability of the reader to recognize that reading is a construct in itself as well as a conveyor of information about ideas and events in the physical world. Many metacognitive strategies, such as elaborating and comprehension monitoring, are important in reading. Good readers spend a great deal more time on parts of a passage that are likely to be critical to their overall understanding (Afflerbach & Pressley, 1995; Garner, 1987; Palincsar & Brown, 1984). Good readers often set goals for their reading and ask themselves questions that they hope to answer as they read (Baker & Brown, 1984; Webb & Palincsar, 1996). Metacognitive processes in reading can be encouraged in readers through:

1. Utilizing activities that require the reader to attend to the structure, form, and or semantic character of words or sentences to develop skills in attention to critical detail or to important cue words or phrases.
2. Deleting trivial and redundant information.
3. Identifying general ideas that incorporate several more specific ideas (Bean & Steenwyk, 1984).
4. Instructing students to make predictions as they read.
5. Providing opportunities for group discussions of material (Gambrell & Almasi, 1996).
6. Asking students to give a verbal retelling of why what they read is important to increase the sophistication of the beginner/novice reader; i.e. elaborative interrogation (Willoughby et al., 1994; Willoughby et al., 1999, Woloshyn et al., 1994).

Generalizing these techniques to other cognitive domains is illustrated by Meichenbaum and Biemiller (1998). They suggest six useful strategies for self-instructional guidance, including: "defining the problem, accessing and summarizing relevant information, focusing attention and planning, self-monitoring (e.g., evaluating performance, catching and correcting errors), using coping self-statements, and self-reinforcing [statements]" (p. 131).

Comprehension Monitoring

Students learn how to be aware of their understanding of their reading material. Instructing by using metaphors can be helpful here. Metaphorical reasoning uses a schema-based approach for comprehension of the subject at hand. Using schemas to construct meaning during reading involves the reader's use of prior knowledge, context, and other linguistic cues (Kincade, 1991). Through this interaction, each reader constructs an individualized interpretation of the material read by integrating both explicitly and implicitly stated information. An example of the use of the skills in metaphorical reasoning in Reading would be figurative language such as sentence metaphors. The individual uses abstract problem-solving strategies to successfully

comprehend a methaphorical text. In other words, a problem or concept is presented to an individual that they cannot understand. For comprehension, the problem is put into metaphorical terms using prior knowledge or schemas already developed by the individual. This way, the individual learns new material by understanding it in other comprehensible terms.

1. Teach students detection cues for when a breakdown in understanding occurs. For example, during reading students can ask themselves, "does this make sense? or "what did the paragraph say?" After reading, students can explain the meaning of the text to a peer or identify the main ideas of the passage. If this cannot be accomplished, students need to use fix-up strategies.
2. Comprehension monitoring occurs at various levels, including the word, sentence, paragraph, page, and book levels. Therefore, students must have a repertoire of fix-up strategies at each level where a breakdown occurs. Word and sentence meaning fix up strategies include, rereading the sentence, using context clues, consulting an expert (e.g., glossary, dictionary, other person). Higher level fix up strategies include, summarizing the text, drawing illustrations or graphic organizers, or explaining the meaning of the text to another person.
3. Teach students text structures (e.g., compare/contrast, problem/solution, and persuasion for information texts and poetry or legends for narrative). Prompt these text structures to help students recognize patterns that authors often use.
4. Remind students of the ideas they already know about the reading topic.
5. Give students' specific training in drawing inferences from reading material (see suggestions above for developing cognitive flexibility in Near Term Transfer).
6. Relate events in a story or information in an expository text to students' own lives.
7. Ask students to form mental images of the people or events depicted in a reading passage.
8. Ask students to retell, elaborate, or summarize what they have read after each sentence, paragraph, or section to foster concept learning.
9. Remind students to use reading strategies, such as elaborative interrogation, graphic organizing, drawing pictures, creating mental images, or questioning, to overcome hurdles in the comprehension process.

Reading with Technology: Reducing Cognitive Load

When teaching for fluency or comprehension skills, use as many familiar contexts as you can. Make the text easily accessible, i.e. simple vocabulary, recognizable spelling, and patterns. Otherwise, a cognitive overload could prevent an individual from taking in, processing, or integrating new information. Below, we suggest some

guidance when using multimedia learning supported by learning research principles (see Section II for a discussion of cognitive overload) to avoid this from happening:

1. *When presenting new information to an individual on a computer, instead of overusing one channel, such as the visual channel, use two channels to spread out the cognitive processing to prevent overload.* (e.g., Sweller's split-attention effect, 1999). For example (Mayer & Moreno, 2003), an individual wants to learn about lightning. On the screen appears an animation depicting the steps in lightning formation. Instead of presenting on-screen text describing the steps of lightning formation, a narrative can be sounded. This way the visual channel is not overloaded by watching the animation as well as reading the text.
2. *When organizing the information being presented, use illustrations* (Foshay, Silber, & Stelnicki, 2003). When presented with a picture/illustration, people actually code them twice. They 1) assign meaning to them and 2) interpret the visual image. This is referred to as dual coding and makes it easier for the individual to store and retrieve information in long term memory as well as prevent cognitive overload.
3. *To avoid both channels being overloaded, the information presented to the individual could be broken up into parts divided by breaks in time* (Mayer & Moreno, 2003). This way, the individual can process all the information presented to them before moving on to new information. Use principles of part-task training and distributed practice (discussed in more detail in Chapter 3).
4. *Another way of avoiding overload in both channels, is pre-training the individual on the information that will be presented to them* (Mayer & Moreno, 2003). If they have a background on the components, when the information is presented in full, the student will not try to understand each component and the causal links between them.
5. *Unnecessary information must be weeded out that may cause overload* (Mayer & Moreno, 2003; Sweller et al., 1998). For instance, with the lightning example, an instructional developer might want to include extra features in the presentation of information, such as background music, distracting graphics, etc. This additional information may just overload either channel; therefore, to avoid this, don't include any unnecessary additional information. Training examples are: 1) training pilots to recognize landing info on carriers, black and white outline figures better (or at least as good as) than full color 3-D pictures). 2) training Army helicopter pilots on cockpit procedures with cardboard mockups superior to use of copter itself (Prophet & Boyd, 1970). In addition to being better for the learner, such procedures are less costly.
6. *If this unnecessary information cannot be weeded out, then something should be done do draw attention to the information that is necessary* (Mayer & Moreno, 2003). In the lightning example, this can include putting words in bold, adding arrows to the animation, stressing words in the

narration, or organizing images by adding a map showing which of the parts of the lesson was being presented, using the principle of saliency.

7. *Make sure that you are not displaying the information in a confusing manner that would cause cognitive overload* (Mayer & Moreno, 2003). For example, pictures are on one screen and the words to go with them are displayed on another screen. This would require the individual to go back and forth to integrate all the information. Instead, present pictures and corresponding words/explanations together in an integrated presentation.
8. *Do not be redundant in presenting information* (Mayer & Moreno, 2003). You do not need a narration, animation, and test for presenting one piece of information. Too many things to listen to and look at may cause an overload in processing. In this situation, one should also take into account individual differences. Some persons' needs may warrant redundancy (novices) and others (experts) may not depending on their experience and level of education (Kalyuga et al., 2003).
9. The learner sometimes will have to hold onto the material previously presented to them to understand the next set of information presented. "Cognitive capacity must be used to hold a representation in working memory, thus depleting the learner's capacity for engaging in the cognitive processes of selecting, organizing and integrating" (Mayer & Moreno, 2003, p. 50). *In order to minimize the amount of material required to be held in working memory, the recommendation is to synchronize the material.* Present both pieces of material at the same time without presenting too much, (Foshay et al., 2003; also Miller's 1956, 5 to 7 items, maximum capacity for short-term memory), which may cause an overload. For example, present the narration and the animation of the steps of the lightning at the same time. Do not present the animation, than afterwards present a narrative explanation. The learner may have to jump back to the animation in order to integrate all of the information, which may result in confusion and time lost. If this suggestion is not possible, then training in holding mental representations in memory can be done.

Foster Far Term Transfer through Reading Engagement

Our engagement perspective on reading focuses on the mutual functioning of motivation, cognitive skills, strategy use, and knowledge during reading (see also Guthrie & Wigfield, 2000). Because reading is an effortful activity that often involves choice, motivation is crucial to reading engagement (see Chapter 4 in this volume for further discussion of motivation as task-oriented focus of energy). Even the reader with the strongest cognitive skills may not spend much time reading if she or he is not motivated to read. This discussion offers instructional recommendations that answer the question, how do you increase long-term reading engagement in and outside the classroom? We and other researchers suggest using the following motivational practices to foster engagement in reading (Guthrie & Cox, 2001; Guthrie, Wigfield, & Perencevich, 2004).

- *Learning and Knowledge Goals* – construct instructional goals that emphasize conceptual understanding in a specific topic within a knowledge domain (Ames, 1992; Ames & Archer, 1988).
  - For example, within a unit on life sciences for elementary school students, a conceptual theme may be "adaptation". There are many subtopics within this theme, such as physical body features of animals, their behavioral functions, and species-biome relationships.
- *Hands on experience* – provide a sensory interaction (e.g., seeing, hearing, feeling, or smelling) with tangible objects or events as they appear in their natural environment to increase curiosity in a topic, which in turn, evokes intrinsically motivated behaviors (Paris, Yambor, & Packard, 1998).
  - For example, in science, real-world interactions consist of inquiry science activities such as observing predatory beetles or conducting experiments with guppies. In history, real-world interactions may consist of reenacting a historical event or visiting the American History Museum.
- *Interesting texts* – provide an ample supply of texts that are relevant to the learning and knowledge goals being studied as well as matched to the cognitive competence of the learners (Davis & Tonks, 2004)
- *Autonomy support* – give the students opportunities for choices and control over their learning (see also Cordova & Lepper, 1996; Deci & Ryan, 1987; Stefanou, Perencevich, DiCintio, & Turner, 2004; also see discussion on self-regulation in Chapter 4 of this volume).
  - For example, to provide support for student choice, allow students to select a subtopic as their learning goal and allow students to identify texts that they believe will be informative and understandable for them.
- *Collaboration in instruction* – provide structures for social interchange around learning the content (Meichenbaum & Biemiller, 1998; Turner, 1995; also discussed under Strategies Section in Chapter 5).
  - For example, work in teams to learn. In learning about adaptation in mammals, different students may elect the subtopics of feeding, defense, shelter, and reproduction. As students integrate their diverse information, they form higher-order principles about the topic. Students can choose who to work with on specific learning tasks and how to distribute their expertise.
  - For example, students may consult with others in the classroom in a variety of ways, including, tutoring, think-pair-share, idea circles (Perencevich, 2004), or reciprocal teaching (see also Meichenbaum & Biemiller, 1998).

Concept Instruction with Text

This topic refers to three central aspects of instruction that foster in-depth conceptual learning of expository text (informational text). Concept instruction with text is defined as providing extensive opportunities for students to interact with

multi-layered knowledge, to transform meaning by manipulating information, and to experience optimal challenge during reading. Conceptual learning from text occurs when students have formed a mental representation consisting of four schematic elements. Those elements include: (a) basic propositions about the domain (e.g., facts), (b) relations among the propositions, (c) concepts or generalizations that broadly relate propositions (facts) to each other, and (d) a network of concepts. Students with conceptual knowledge can use this schema network flexibly to solve problems or serve as an analogy for new learning. This flexible schema and all its parts constitute an explanatory understanding of the domain (network of interrelated concepts and rules that serve as a critical component in a discipline of knowledge). To acquire a domain of richly elaborated knowledge, students should encounter and interact with all these levels of knowledge. To improve concept learning, Cox and Guthrie (2001) recommend:

- Teachers rely on texts that contain all levels of knowledge (e.g., propositional, relational, and conceptual levels).
- Students read, discuss, and write about such texts in a setting in which this material is relevant and useful.
- Use hands-on activities to provide concrete referents for the basic propositions and to create opportunities for spontaneous questioning.
- Have students create new representations of text, such as concept mapping, constructing projects, building models or drawing graphical representations so that they rely on deep structural knowledge of a domain.
- Use optimally challenging reading activities to heighten conceptual learning from text
- Help students meet increasingly difficult goals and see concrete evidence of their growth.
- Expose students to multiple texts with multiple perspectives on a topic or theme.

Time Spent in Multiple Contexts

The teacher should provide learners with multiple contexts (i.e. different topics, different subject matters) and reading opportunities in which the learner can practice the development of comprehension strategies. The more variety of example contexts and content that the learner practices, the greater the likelihood of developing domain independent strategies. In Far Term Transfer, this translates into greater "time on task" where the task is to develop cross-domain schemas. This theme will be noted repeatedly throughout the book because we feel it is of paramount importance for all higher-order, schematic learning, or transfer. Stanovich (2000) compared this idea of time on task to the "rich get richer effect", which translates into the more you read the better you get. The amount that students read for enjoyment and for school strongly contributes to students' reading achievement and knowledge of the world (Cipielewski & Stanovich, 1992; Cox & Guthrie, 2001; Guthrie & Wigfield, 2000).

More than simply time on task however, it is essential that the quality of the material and the instruction permit and encourage the development of multiple interpretations when the learner is faced with complex contexts. Spiro et al. (1989, 1990, 1995) advocate the use of a hypertext-learning environment as especially useful when the learner is trying to read and understand complex concepts, which can take on different meanings dependent upon the context (i.e., in ill-structured domains). In an extension of this discussion, Feltovich, Spiro, and Coulson (1993) point to the need for using techniques of multiple representation (including analogies) as opposed to a single isolated and oversimplified perspective in order to teach complex learning, especially in ill structured domains. We would submit that in teaching Reading, it is quite clear that word meaning is dependent on the semantic context of a story, implied in a sentence. For example, "He caught the fly," at the very least could mean a baseball or an insect. Instruction involving our proposed functional context spiral can certainly help avoid the oversimplification and isolated concept problems. Spiro and his associates cite as one of their prime domain examples the field of "medical education, [which] has traditionally had separated 'basic science' and clinical parts..." with the clinical parts occurring much later in the program (Feltovich, Spiro, & Coulson, 1993, p. 204) We would submit that following Sticht's early work on functional literacy (1975), it became quite clear to those teaching Reading that it suffered from the same problems. Since Reading involves the basic symbol system by which we learn early on to encode and build transfer schemas, it is our position, as stated earlier in Chapter 1, that it is fundamental as an example of learning in the cognitive domain.

Therefore:

- Provide a wide array of texts in multiple levels & genres for students to read, and
- Give supplementary guidance about the way meanings can vary in particular situations.
- Provide extensive time for students, to read and then in class, to discuss alternative interpretations.

Classroom Environment

An integral part of Reading education is a conducive learning environment, indeed, it is for all learning, as we discuss in Chapter 4. In the Reading context, Pressley et al. (2001) suggest:

- The teacher should emphasize a positive, reinforcing, cooperative setting.
- Instructors should set high but realistic expectations, and make accomplishing these expectations accessible to them by providing and encouraging more challenging tasks.
- Books of all contexts and subject matters should be readily available to the students along with the time (long, uninterrupted periods) to read them. This

time as well as organization and work habits should be self-monitored by the students.

- Finally the teacher should make their rules and expectations clear to the student and meaningfully engage assistants in assisting in these tasks.

SECTION II:

SUPPORTING RESEARCH

Gray (1950) describes reading as consisting of four processes: word recognition, comprehension, reaction, and assimilation. Robinson (1966) expanded the model to include rate of reading. Beginning readers need a wide range of skills and abilities for making sense of text at the word and sentence levels (Adams, 1990). A reader should first learn how to recognize individual sounds and letters, use word-decoding skills, recognize words automatically, use of context clues to facilitate word recognition, and develop meanings of vocabulary words for story comprehension (Adams, 1990; Ehri, 1991; Stanovich, 1991; Sulzby, & Teale, 1991).

More advanced readers can use high-order reading strategies to develop an understanding of the writer's intended meaning and metacognitively regulate the reading process (Meyer, 1984; National Reading Research Panel, 2000). Some of these skills include: activating background knowledge, questioning, searching, summarizing, organizing graphically, structuring story grammars, and monitoring comprehension. Along with these cognitive skills, readers use self-regulatory and motivational strategies to persist in the effortful task of reading. Following is a review of the skills, abilities, and cognitive and motivational strategies necessary for reading to develop.

Research Supporting Acquisition and Automaticity

One common observation in reading research is that the beginning reader must rely on visual information much more than the advanced reader, who is able to use both visual and non-visual sources of information, both syntactic and semantic. Beginning readers typically deduce meaning from the surface structure or the visual array of letters on the page. Often the beginning reader becomes so absorbed with the mechanical aspects of reading, specifically word identification and pronunciation, that comprehension becomes problematic. The advanced reader on the other hand, attends selectively to the more important words in the text and uses other strategies to comprehend the text effectively. In the Instructional Guidance section of this chapter, we described exercises to facilitate this transition between beginning and advanced reading (e.g., practice in efficient methods for decoding written words and using context cues).

Ehri (1991, 1994) synthesized strategy development in word reading, and revealed that development occurs in three phases: logographic, alphabetic, and orthographic. The first phase, logographic, refers to the visual features of a word that are nonphonemic, contextual, or graphic. Children in this stage use visual

images of a word, rather than letter-sound correspondences to read a word (e.g., a store logo). Logographic readers move to the alphabetic stage when they stop attending to visual cues and begin to read the print.

The alphabetic stage begins when readers can read words by processing and recognizing letter-sound relationships. Alphabetic readers can phonologically recode written words into pronunciations, meaning that they know the names and sounds of letters and have the ability to break words into pronounceable segments or chunks; This skill allows readers at this stage to decode unfamiliar words accurately. Alphabetic readers are also able to store the spellings of sight words and letter-sound connections in memory. Treiman (1985) found that onsets (initial consonants) and rimes (remaining vowel stems) are natural ways to divide words and are stable spelling patterns. Adams (1990) contends that a major difference between good and poor readers is their proficiency to use such spelling patterns and their ability to translate spelling and sound relationships.

Children in the orthographic stage have word knowledge that includes prefixes, suffixes, and digraphs. These readers are able to use grapheme-phoneme patterns that recur across words that they have learned to read. Orthographic readers are able to recognize spelling patterns (e.g., -ate, -ment, -ed) and are able to store these patterns in memory. The ability to read words can also happen by decoding words by analogy through the use of spelling patterns and using contextual clues (Ehri, 1991). Decoding is the process of making letter-sound connections into pronunciations that may include blending and sounding out letters to make meaning. Decoding by analogy and the use of spelling patterns are other ways to read unfamiliar words. Analogy is the strategy that teaches readers to compare a word they don't know to a word they do know. For example, if students know the word *cat,* they can read the word *mat* by comparing the rhyming part of the word and changing the initial consonant from *c to m.* They learn that this "at" pattern is stable and remains the same in the words *hat, fat, rat, that.* Contextual clues are important in the decoding of unfamiliar words because the text preceding a word enables readers to form expectations about what the word is (Goodman, 1965). Researchers have found that young readers' expectations are working because they substitute words that are semantically and syntactically consistent with the text up to the point of the unfamiliar word (Biemiller, 1970).

One effective way of strengthening low or high-order skills and transform a non-strategic reader into a strategic reader is to apply techniques such as reinforcement and contingency. These operant learning and conditioning principles should be consistently applied while the reader is learning to read, as well as during the utilization of low-order and high-order reading skills and strategies. An example of applying the principles is when an individual uses appropriate strategies or skills, an extrinsic reinforcer such as positive feedback (e.g., words of praise) immediately follow. Intrinsic motivations, such as enjoying what one reads or simply getting pleasure out of gaining knowledge from the materials read, are often considered superior measures of reinforcement. Whatever the reinforcer, it should increase the frequency of the individual's utilization of the correct skills and strategies. In order for the reinforcer to be effective, it must be appropriate and contingent upon the

voluntary desired behavior of the reader. (see Honig, 1966, for general discussion of reinforcers).

The way in which students read, whether reading expressively to an audience, reading aloud to oneself, silent reading, or silent reading while listening, may also affect comprehension. Some researchers speculate reading orally to oneself aids comprehension because it focuses closer attention on the words and involves a second modality. When there are distracting noises in the environment or when the concept load of the text increases the difficulty level to a near frustration point, readers often resort to reading aloud. Under these conditions, the reader is not concerned with perfect intonation or pronunciation, but rather with their own understanding of the text.

Holmes (1985) conducted a study to determine which of mode of reading best facilitated the answering of post comprehension questions. In the study, students read an expository passage in each reading mode (i.e., silent reading, silent reading while listening, oral reading to one self, expressive reading to an audience) and answered comprehension questions that included gist, literal recall of details, inferences and scriptal comparisons. Silent and oral reading to oneself were both found to be superior to oral reading to an audience. Additionally, silent reading was also found to facilitate comprehension to a greater extent than did silent reading while listening to the text being read. When reading to oneself silently or orally, the reader is able to concentrate on understanding the text and can re-read portions that were not clearly understood or utilize various comprehension techniques because he/she does not have to divide attention. This study supported the findings of Poulton and Brown (1967), which showed that when the reader is concerned about his vocal output as the case may be when reading to someone, attention is diverted away from comprehension. However, when reading to ones-self, these factors were not relevant because of the absence of an audience.

A plethora of research indicates the importance of explicit instruction in processes to help students acquire phonological awareness, word recognition, spelling patterns, and vocabulary development (Adams, 1990; Ball & Blachman, 1991; Stahl & Murray, 1994; Whitehurst et al., 1994).

Transitioning from Automaticity to Transfer: Reading Comprehension

Reading comprehension is "the process of simultaneously extracting and constructing meaning through interaction and involvement with written language" (RAND Reading Study Group, 2002, p. 11) and there are three elements required in comprehension: the reader, the text, and the activity. The reader comprises all the capacities and abilities as well as the knowledge and experience it entails in order to comprehend information. The text is what the reader is attempting to comprehend and includes any printed or electronic text. Reading has a purpose and this is the activity. The activity comprises all the processes and consequences used in reading that is motivated by the purpose. (RAND Reading Study Group, 2002).

Summarized by Dole, Duffy, & Roehler (1991), comprehension techniques include grasping the critical elements of a single text, questioning, summarizing,

making inferences, and drawing conclusions about the theme for a narrative or the moral of a fable (Graesser, Golding, & Long, 1991). In their work, Britton and Graesser (1996) define text understanding as "the dynamic process of constructing coherent representations and inferences at multiple levels of text and context, within the bottleneck of a limited-capacity working memory" (p. 350). Indeed, the successful comprehender should connect incoming textual information with prior knowledge in such a way that she constructs a coherent and stable representation of the passage rather than a random list of ideas. Also, she should recognize the main idea of a text, generate relevant inferences, and reconcile multiple interpretations of the text reading. One of our goals as educators is to help readers move from recalling simple sentences to the construction of internal representations of meaning.

Ausubel (1960, 1962, 1969) used the Piagetian theory to argue that learning new materials greatly depend upon the existing cognitive structure or what the person already knows. New information will be more easily learned if it is explained and also related to prior ideas in the student's cognitive structure. Accordingly, instruction should begin with a general concept, the advanced organizer, and move to more specific information. This principle includes teaching the most general ideas of a subject first, and then integrating new information with the information previously taught. Reading instruction should include real-world (authentic or functionally relevant) tasks, use many examples and concentrate on similarities and differences. The most important factor in instruction is what the student already knows. The process of meaningful learning involves recognizing the relationship between new information and what is already known. We have discussed this in Chapter 1 as the spiral curriculum. Harvey and Goudvis (2000) describe this from an instructional perspective as aligning the teaching content and teaching process.

In order to differentiate conceptual text learning from mere recall of text, Kintsch and van Dijk (1978) developed a theory of expository text comprehension (see also van Dijk & Kintsch, 1983). In this model, Kintsch and his colleagues (1983) defined three levels of text representation: a linguistic model, a textbase model and a situational model.

The linguistic representation comprises the meaning of specific words in memory often at a verbatim level. At this level of meaning, the reader typically recalls explicit information and preserves the surface structure of the text. At this level of text representation, content from the text is subject to rapid decay.

The text-base representation includes information expressed in the text that is organized such that it remains relatively faithful to the passage. Though the text structure may be modified to emphasize the more important information from the text, these representations consist of the direct textual propositions along with necessary inferences that satisfy coherence among the propositions. This representation is more stable than the linguistic level of representation because it contains a macrostructure that ties the main ideas together and a microstructure that reflects the interrelated semantic details of the passage.

The situational level of representation captures readers' integration and restructuring of text information such that it has connected meaningfully with prior

knowledge. The situation model shows **a** higher-level integration process wherein vital information is inferred and made part of the representation. Thus, the reader gains a deeper understanding of the material, resulting in the transfer of knowledge to novel situations and problem-solving tasks (Kintsch & van Dijk, 1978).

How do we know when students have made these integrated knowledge connections suggested in the situation model? Michelene Chi's work (1994) has been particularly informative in describing the organization and quality of conceptual knowledge gained from text. The degree to which knowledge is connected and integrated depends on the number of connections between nodes of knowledge. Nodes are connected with regard to structures, functions, and relationships. Using the atrium, a feature of the heart, as an example, Chi and her colleagues (1994) describe differing nodes of knowledge that must connect and co-exist in order to achieve conceptual understanding. She explains that the local features of the atrium include a structural property, that it is a muscular chamber, a behavioral component, that it squeezes blood, and a functional aspect, that it is a holding bin. The connections between these three components represent one network of relations. As the web of relations expand, however, the reader understands connections among the various features and form hierarchical relations. The greater the number of connections, both at the micro-level (between structures) and at the macro-level (among structures) defines the level of conceptual learning.

Viewed from a schema perspective (e.g., Sweller et al, 1998), these micro- and macro-structural developments might also be seen as the basis for complex schema learning. Certainly we would see these structures as aiding transfer both within the topic of focus; and as the complexities develop, and with multiple-example contexts, they would provide the foundation for transfer of these rules (schemas) to apply across domains as well. Guthrie and his colleagues (2004) have developed similar rubrics to understand elementary-aged students' levels of conceptual learning from text.

Strategic Reading

There are two important aspects of reading comprehension. One aspect involves reading becoming more automatic with strategy use. Strategies such as making inferences, using analogies, predicting, and questioning all become automatic as readers become more proficient and have familiarity with text. The other aspect is the ability to use complex reading strategies deliberately and consciously.

Harvey & Goudvis (2000) discuss strategies used by proficient readers that support these two aspects. They suggest that a reader must make connections between prior knowledge and the test, ask questions, visualize, draw inferences, determine important ideas, synthesize the information and repair and misunderstandings. These skills "interact and intersect to help readers make meaning and often occur simultaneously during reading" (p. 12). Strategies students need to become more efficient readers include acquiring initial associative skills as emergent readers and high-order strategies as more experienced readers.

Many reading theorists believe reading is very much a constructive process (Hiebert & Raphael, 1996), involving the development of these higher-order strategies. A strategy is a plan of action that can be applied to different situations or tasks and it helps increase understanding, improve memory, solve a particular problem, reach a desired goal, or increase efficiency in performance. Strategies are crucial when planning a vacation, playing a game of chess, a championship basketball game, golf, or tennis. In Reading, strategies are cognitive processes that are controllable and conscious activities. They help learners increase their abilities to become efficient in decoding, comprehension, memory, problem solving, and transferring conceptual understanding from one text to another. Being a strategic reader requires effort, time, careful planning, and persistence. Strategies are necessary when students are learning how to read, solve problems, or when reading material that is unfamiliar or too difficult (Paris, Lipson, & Wixon, 1983).

Strategies differ from skills in the sense that skills are more automatic strategies. Gagne (1977) and Fischer (1980) define skills as automatic sequences of complex actions. Skills are continuous changes in performance that are compared to normative standards such as speed and complexity. Strategies are skills that can be broken down and analyzed, modeled, shared, and examined more closely. Strategic behavior adds motivational intent to skills and is personalized from learner to learner. There is not a uniform pattern to which each learner applies strategies. Readers individualize strategy use based on his or her personal needs and methods (Paris, Lipson, & Wixon, 1983).

Strategic readers have control over their strategy execution and are meta-cognitive about monitoring their comprehension and strategy use. These readers take into consideration the task at hand, which may include evaluating different strategies and deciding which ones are most appropriate and necessary. They are aware of what strategies to apply in a given situation in order to increase comprehension of the text. They also use more strategies as they read and they use them more efficiently than poor readers. For example, they may use context clues in order to decipher the syntax and meaning of a text. Strategic readers employ techniques such as looking at the words around the word that they do not know in order to construct meaning. These readers also know when a strategy they are using is not working, and are able to evaluate and change their strategies to one that will facilitate understanding of a particular text. This evaluation may include an assessment of the learner's effort, intelligence, and amount of prior knowledge that they might need to accomplish the task.

Thus, a major distinction between experts and novices in any domain is self-controlled strategic behavior. An expert reader and/or problem solver is someone who can read and comprehend different and various types of texts by transferring their strategic knowledge to different genres (e.g., expository, narrative, goal-based expository). These readers are also able to monitor their strategy use and transfer this knowledge to different domains (e.g., writing). Higher-order skills and effective reading strategies are quite valuable, yet they are rarely learned well. Since they are difficult to acquire, readers, both emergent and skilled, need intrinsic motivations,

sustaining reinforcers, and purposes for learning to aid in the successful acquisition and use of cognitive strategies (Guthrie & Wigfield, 2000). In order to encourage reading and the utilization of skills and strategies reading activities should as often as possible be enjoyable and this enthusiasm should either be inherent to the task itself or an internal desire of the learner. The key to effective strategy use, however, is the way in which these strategies get moved from teacher to students through effective and explicit instruction within meaningful contexts and authentic, or functionally relevant, literacy tasks.

Near Term Transfer Processes

Early behaviorist theories believed that transfer occurred only to the extent that the original and transfer tasks had identical or similar elements (Thorndike, 1931). Behaviorist views have since focused on how transfer is affected by stimulus and response characteristics in both the original and transfer situations. In specific transfer, the original learning task and transfer task overlap in content. In general transfer or transfer of principles, the original task and the transfer task are different in content.

The cognitive perspective views transfer as involving a process of retrieval in which people are apt to transfer previously learned information and skills to a new situation only when they retrieve the information and skills at the appropriate time. In order to make the connection between their current situation and prior knowledge, they must have both things in working memory at the same time. The presence or absence of retrieval cues in the transfer situation determines what relevant knowledge is retrieved in working memory. According to cognitive theorists, the probability of retrieving any particular piece of information is considered low considering the limited capacity of working memory and many relevant pieces of information may very well not be transferred in situations in which they would be helpful. More recently, cognitivists proposed that most learning is context specific and is unlikely to result in transfer to new contexts, especially when they are very different from the ones in which learning originally occurred (see Druckman & Bjork, 1994, for a review of transfer; Lave & Wenger, 1991, for a discussion of situated learning; and Sweller et al., 1998, for a cognitive view of how transfer occurs).

A slightly different view of transfer worthy of discussion, captures the notion of "situated" learning and cognition and comes from Gestalt theory roots (e.g. Köhler, 1947). Linder's (1993) theory of transfer (conceptual dispersion), called phenomenagraphic, focuses on enhancing the learner's appreciation of context and the ability to make conceptual distinctions based on a concept's appropriateness to a given context. This appreciation or lack thereof results in the facilitation or inhibition of the learning of new tasks from previous experiences. Learning is viewed as a function of ""experienced variation ...explored in relation... to make sense of things in confusing and complex situations" (Linder & Marshall, 2003, p. 271). Linder and Marshall (2003) introduce the concept of "mindful conceptual dispersion". This is characterized by: (1) experiencing a phenomenon in different

ways in different contexts, and (2) developing an explicit conceptual appreciation of the variation in context. Taken together these attributes provide the basis for learning. The learner solves problems by being able to shift his or her conscious or mindful appreciation of context, so that s/he can establish new figure from ground relationships. Thereby, we are able to reason from the familiar to the unfamiliar; or in our terms, to accomplish near or far term transfer.

One of Piaget's (1957) basic assumptions is that children are active and motivational learners. They construct knowledge from their prior experiences and seek out information that will help them understand and make sense of what they encounter. He identified schemas as groups of similar thoughts or actions that organize the things that are learned. While searching for information, one uses the processes of assimilation and accommodation to modify and recognize the relationship of existing schemas. According to Piaget (1957), assimilation is the process of using prior knowledge in existing schemas to understand new information. Successful assimilation results in a state of equilibrium. Disequilibrium occurs if the new information does not fit within existing schemas. One will modify existing schemata or form an entirely new schema in order to accommodate the new information. Equilibration is the process of moving between the states of equilibrium and disequilibrium. This process promotes development of higher levels of comprehension and complex thought. Readers use these processes to make meaning from text. In a derivative way, Perfetti (1995) sees Reading as a perceptual process, an interpretive process, a conceptual and thinking process. Strategic learners continually expand the scope of their cognitive grasp through *problem solving* by transferring knowledge to new situations. Their degree of transfer of knowledge depends primarily on the level of previous conceptual knowledge. Strategic learners continually test old schemas against new information and tailor the information for a better understanding.

Strategic readers are better than non-strategic readers, not only at reading, but also at monitoring, controlling, and adapting their strategic processes while reading (Dole, Duffy, & Roehler, 1991). Effective meaning construction in reading is enhanced by the amount of knowledge the reader already has about the topic in question (van Dijk & Kintsch, 1983). Knowing what strategies to employ will only result from practice in reading and using problem solving techniques. Non-strategic readers, on the other hand, are unaware of what strategy works for them. If poor readers have difficulty understanding text, they may not know what will help them gain an understanding. If a strategy is not working, poor readers are less likely to be aware of this problem and are unable to adjust their strategy use to increase understanding of various texts (Baker & Brown, 1984; Garner, 1987). Poor readers face these difficulties due to their lack of ample experience in reading and employing problem solving strategies.

It is well documented that some reading strategies help foster deep understanding with text (Baker & Brown, 1984; Brown & Day, 1983; Collins-Block & Pressley, 2002; Harris & Graham, 1992; Paris, Wasik, & Turner, 1991; Symons, McLatchy-Gaudet, & Stone, 2001). A few powerful reading strategies that are widely recognized include: (1) using prior knowledge, (2) questioning (self and

teacher) (3) searching for information (4) summarizing, (5) using graphic and semantic organizers, and (6) elaborative interrogation. We explicate these cognitive reading strategies in the following research discussion. The reader will note that the procedures for implementing these strategies were described in Section I of this chapter.

Using Prior Knowledge

First, using prior knowledge is essential to comprehending new information (Anderson & Pearson, 1984; Spires & Donley, 1998), and it is imperative to the advancement of conceptual knowledge (Alexander & Jetton, 1996). Activating students' prior knowledge about a topic provides students with a way to connect their new knowledge to their previous understanding, which is how comprehension and learning occurs. Past experiences can help create *schemas* (Anderson, 1994) that are recalled when cued from text. For example, we have schemas about how to order dinner in a restaurant, how to travel by airplane, and how to get ready for school or work each week morning. These common events in our lives are loaded with different kinds of declarative and procedural knowledge. When reading new text, activating students' prior knowledge allows students the opportunity to reflect upon what they already know about the topic, which enhances their understanding of new information. Inferences can be made in reading the new text, which allows for meaning to be made by the student. Activated schemata guide attention to text and allow inferencing to occur with the new information.

Questioning

Questioning is one comprehension strategy that aids in the understanding of new information in single texts (Rosenshine, Meister, & Chapman, 1996). Students are typically eager to pose questions that address what they needed and wanted to understand about literature and life (Commeyras & Sumner, 1998; Taboada & Guthrie, 2004). Questioning is a strategy that triggers students' prior knowledge and allow them to attach new knowledge and meaning to their previous knowledge. Asking students to question and predict outcomes helps to engage them in the text. Self-questioning is also suggested to increase comprehension. While students are questioning themselves, they are thinking, seeking meaning, and connecting new ideas to already learned concepts (King, 1995), which generates more learning.

Miyake and Norman (1979) believe that asking questions is helpful in comprehension; however, the interaction between the level of knowledge of the student and the material should also be considered. Their 1979 study suggested that with easier material beginning readers asked more questions than advanced readers; with the harder material, advanced readers asked more questions than the beginning readers. Also, Scardamalia and Bereiter (1992) performed a study examining the ability of elementary school children to ask and recognize constructive and beneficial questions. They found that there were two different types of questions: knowledge-based and text-based questions. Knowledge-based questions (including "basic questions" asking for information and "wonderment questions" asking for

explanations), questions formulated in advance of instruction, were found to be more sophisticated than text-based questions, which were produced after exposure to the text being learned. The researchers concluded that knowledge-based questions would better lead to conceptual learning than the text-based questions.

Taboada and Guthrie (2004) developed a rubric for questioning asserting that there are four levels of students questions consisting of Level 1, Factual questions, Level 2, Questions requesting simple descriptions, Level 3, Questions requesting complex explanations, and Level 4, Questions requesting patterns of relationships. In a study of third grade students, Taboada and Guthrie (2004) showed that students who asked lower-level or factual questions (Level 1) showed lower levels of comprehension on the passage comprehension task whereas students who asked complex explanation questions had the highest levels of comprehension. The value of questions in comprehension learning has also been found when they are strategically posed in written materials given to students (Rothkopf, 1972; Rothkopf & Billington, 1974).

Searching For Information

When engaged, learners are motivated to understand and explain the world they see around them. As they explore their environment, they are inevitably involved in a process of *searching for information.* Pursuing their personal goals, they seek information from multiple sources including libraries, multiple media, and informational books. They browse multiple texts, examine a variety of documents, and extract critical details during their search (Guthrie, Weber, & Kimmerly, 1993). Searching for information refers to students seeking and finding a subset of information in the total text by forming specific goals, selecting particular sections of text, extracting information accurately, combining new and old information, and continuing until goals are fulfilled (Guthrie, Weber, & Kimmerly, 1993). Searching for information is a reading strategy that will help students in both a single text environment and a multi-text environment.

Reynolds and Symons (2001) performed three studies on 3rd, 4th, and 5th graders, which provided experimental evidence of the effects of choice and response format on children's search of informational text. They found that choice and context were motivating factors for information seeking. When students were given a choice of which book to search, they were faster at locating information and they used more efficient search strategies than if they were assigned a book to search. The context or format of the task improved the children's approach to the task. In addition, it was found that prior knowledge and topic interest might contribute to the child's performance as well.

Multiple scaffolds can be used to support learning search processes (van Merrienboer, Kirschner, & Keester, 2003). van Merrienboer, Kirschner, and Keester, submit that scaffolds, such as "worked out examples, goal-free problems, or completion tasks are associated with a lower extraneous cognitive load than conventional problem solving" (p. 8). Therefore, depending on the goal of instruction, students can use worked examples, completion tasks, or reverse tasks to support the teaching of search. For example, learners can be given a full worked

example as a scaffold and the task of evaluating the search process in the example. Further, students can be given a ½ worked example to be completed. Lastly, students can receive a list of books and the search process used to produce the list of books and students can make predictions about what the research question for the search was.

Summarizing

Summarizing refers to students forming an accurate abstract representation (summary) of text after reading (Brown & Day, 1983). During summarizing, students may copy verbatim from a text or may use text-explicit information only. Often, they follow the sequence of information in a text, rather than form their own coherent conceptual organization. Therefore, instruction in summarizing is geared toward helping students to reconstruct the text by identifying main ideas and supporting details.

Using Graphic and Semantic Organizers

The construction of concept maps facilitates meaningful learning by requiring students to integrate information from the text into existing knowledge structures. Concepts maps are visual representations of a student's knowledge which organize concepts in a hierarchical fashion to represent the relationships among concepts (Novak, 1995). Using graphic and semantic organizers relies on "the need for deeper understanding of concepts as a prerequisite for meaningful learning" (Starr & Krajcik, 1990, p. 999). Novak (1995) developed the idea of hierarchical representation of concepts based on Ausubel's (1968) assimilation theory of cognitive learning, which briefly states that all cognition is hierarchically organized and that any new conceptual meaning must build upon existing concepts. Concept maps can be used to represent a variety of domains (Novak, 1995) for all age levels (Novak & Musonda, 1991).

Concept mapping supports students' generation of multi-layered knowledge. When students generate concept maps they retain knowledge (Novak & Musonda, 1991) and increase awareness of relationships among concepts (Novak, 1995). In a meta-analysis of 10 studies using concept maps as instruction tools, Horton et al. (1993) found that while the effect size for teacher versus student-prepared maps were similar, the greatest effect size was observed for student-construed maps in which students identified key terms. Since students must specify the hierarchical relationships and create valid links among concepts, it is a significant predictor of text comprehension and conceptual learning from text.

Starr and Krajcik (1990) recommended that teachers use graphic and semantic organizers to enhance activity designed to aid the learner's conceptual development. The mapping process itself is an opportunity for teachers to consider and discuss the importance of individual concepts, the placement of the concepts on the map (including the relationships between concepts), and the propositions, which are used to connect concepts.

Elaborative Interrogation

Simply asking the question "why" often leads students to discern facts from concepts and increase elaboration and integration of knowledge. The elaborative interrogation method is a higher-order questioning strategy that requires students to explain why phenomenona described in text occur. It has been found that students make significant improvements in integrating prior knowledge with text information when they explain the answer to the question, "Why is that true?" In a study of 6th and 7th graders recall of knowledge, Woloshyn, Paivio, and Pressley (1994) found that students performed significantly better in an elaborative interrogation condition compared to a condition in which children were simply asked to read for understanding. The elaborative interrogation condition supported short and long-term knowledge growth even when facts were inconsistent with students' prior knowledge.

Far Term Transfer Process

When instruction is coherent, far term transfer is likely to occur. Guthrie et al. (2000) define coherent instruction as "teaching that connects. It connects the student's reading skills to writing. It connects reading and writing to content. It links the content of learning to student interests. Coherent teaching makes it easy for students to learn because it combines the strange-new with the familiar-old. When the classroom is coherent, teachers help students make connections among reading, writing, and content" (Guthrie et al., 2000, p. 209). Coherent instruction is essential to aide the transfer process.

Research has also revealed that students read more energetically and persistently, use more metacognitive strategies, and remember more content when they are interested in what they are reading (Alexander, Schallert, & Hare, 1991). Reading is said to require metacognitive, reflective knowledge. That is, a reader must possess: (1) the awareness of whether or not comprehension is occurring, and (2) the ability to consciously apply one or more strategies to correct comprehension difficulties.

Comprehension monitoring is one strategy that fosters far term transfer. Effective comprehension monitoring requires students to set goals, focus their attention, engage in self-reinforcement, and cope with hurtles in the reading process. Students can use "think alouds" to help with comprehension monitoring. Another instructional method that encourages students to be reflective about their reading processes is explanation both to oneself and others (Chi, de Leeuw, Chiu, & Lavancher, 1994). Explaining concepts supports conceptual learning from text because it requires students to become more reflective about their knowledge (Brown, 1997). Explaining can be facilitated through writing, private speech, or with peers. For example, King, Staffieri, and Adelgais (1998) studied the effects of explanation on knowledge acquisition. In their study students were assigned to one of three groups: explanation only, inquiry plus explanation, and sequenced inquiry plus explanation. When students received training in asking each other thought-provoking questions and explaining the concept to each other, they increased

conceptual understanding in measures of knowledge integration and retention. A large body of evidence indicates that self-explanations increase conceptual learning from text and transfer propensity (Chi, de Leeuw, Chiu, & Lavancher, 1994).

Metaphorical Reasoning

Students can benefit from metaphorical reasoning in several ways: understanding concepts, interpreting representations, connecting concepts, improving recall, computing solutions, and detecting and correcting errors (Chiu, 2001). In addition, metaphorical reasoning functions as a valuable teaching tool with those learners having difficulties in comprehension. However, there are some possible limitations to metaphorical reasoning. These include: invalid inferences, unreliable justifications, and inefficient procedures (Chiu, 2001). The learner must be careful of these possible difficulties when using this technique. The instructor as well needs to be selective in its use so that the metaphor can capitalize on the prior knowledge of the learner, thereby minimizing possibilities for communicating confusing material to the learner.

This type of confusion could have been the problem in a study where children were found to use metaphors more often than adults to compute, detect and correct errors, and justify their answers; however adults used more metaphors with fewer details during understanding tasks (Chiu, 2001). Children as young as second graders are able to engage in metaphorical reasoning (Kincade, 1991). Not only can they recall metaphorical propositions in text, but they truly understand the metaphorical meaning. Kincade's study (1991) suggested that providing externally generated, structured probes can greatly enhance children's reading recall. This is suggested to enable children to demonstrate metaphorical comprehension prior to the age at which it spontaneously appears. This concept allows for far-term transfer to occur at earlier ages which can enhance education and learning in many areas.

Metaphorical reasoning does not just apply to the example of Reading. Kincade (1991) stated it best: "School learning at all levels of science, social studies, and mathematics involves reading to acquire knowledge and the use of analogical-metaphorical examples to facilitate the acquisition of new concepts" (p. 94). An individual uses prior knowledge or developed schemas from many domains as part of the far term transfer process to allow for the acquisition and comprehension of new ideas and concepts. For example, Carreira (2001) suggested "that the activity of applied situations, as it fosters metaphorical thinking, offers students' reasoning a double anchoring for mathematical concepts" (p. 261). In addition, Chiu (2001) suggested that the metaphors used by both the children and adults are central to understanding arithmetic. Novices uncertain about their mathematical knowledge while solving an applied mathematics problem can create a chain of metaphors" (Chiu, 2001, p. 95). The trick in teaching the learners to use metaphors and facilitate far term transfer is to capitalize on the relevant experience base of the individual learner. As teachers, we probably do a better job with less care instructing adult learners in this manner because of the broader experience base of the adult learner.

Multiple Text Environments

In a multi-text environment, readers must integrate information across texts, combine new knowledge with prior knowledge, connect information across texts, link illustrations with accompanying prose, and abstract common themes from multiple frameworks. When students are capable of integrating content from multiple texts their comprehension of the topic is evident. Stahl & Hynd (1998) found that for high school students, instruction is necessary for students to profit from multiple texts, especially those presenting conflicting opinions. Students do not automatically know how to integrate multiple texts even in the presence of an integrative goal and a multi-text environment. These multi-text comprehension strategies have to be taught directly and explicitly. In a study examining students multiple perspectives on historical events. These strategies may entail drawing, charting, note taking, and composing either in narrative, expository, or persuasive rhetorical structures (Harris & Graham, 1992).

Strategies for solving problems include identifying the problem, defining terms, exploring various strategies, acting on strategies, and looking at the effects (Bransford & Stein, 1993). These five stages of problem solving can be used with a variety of curricula (i.e., far term transfer) but are especially helpful when reading in multiple text environments. All of the above are classic examples of positive transfer being facilitated by the use of multiple-context learning, and provide an excellent transition to our next topic concerning problem solving and transfer.

Reading Engagement and Motivation

Reading engagement is important to facilitate reading later in one's academic life, career, and personal enjoyment. Engaged readers are students who are intrinsically motivated to read for knowledge and enjoyment (Guthrie & Cox, 2001) and are highly achieving and strategic readers. Engaged readers "exchange ideas and interpretations of text with peers. Their devotion to reading spans across time, transfers to a variety of genre, and culminates in valued learning outcomes" (Guthrie & Wigfield, 2000, p. 403).

Intrinsic reading motivation refers to students' enjoyment of reading activities as well as their disposition to participate in reading events (Deci, Vallerand, Pelletier & Ryan, 1991; Wigfield & Guthrie, 1997). Intrinsically motivated reading practices and dispositions include students' curiosities for learning, preference for challenge, and involvement in reading. Empirical research has indicated that high levels of intrinsic motivation are associated with a sense of competence (Miller, Behrens, Green, & Newman, 1993), coping with failure (Leitenen et al., 1995) and high achievement in reading (Benware & Deci, 1984). Consistent with previous motivation research, we believe that a teacher plays a large role in creating and maintaining students' intrinsic motivation.

Another aspect of reading motivation is readers' efficacy, or their belief that they can accomplish a given reading task (Bandura, 1998). When students think they can accomplish an assignment in English class, they are likely to choose to do it, to

continue working despite difficulties in the reading process, and ultimately persist until the task is accomplished (Schunk & Zimmerman, 1997). Reading efficacy has been linked to achievement (Pajares, 1996), goals for understanding (Schunk & Zimmerman, 1997), and intrinsic motivation. For instance, Schunk (1991) reported that school students with strong efficacy beliefs were able to successfully master reading comprehension tasks even after prior achievement and cognitive skills were accounted for. Finally, Stipek (1996) prescribed some classroom practices that lead to positive self-efficacy beliefs, such as providing challenging tasks and attributing student success and failure to effort.

Past research has been done that supports these suggested instructional strategies. For instance, Stipek (1996) and Guthrie et al. (2004) state that "stimulating activities" will support motivation; and we believe that *real-world interactions* represents a class of highly stimulating activities (see also, Paris, Yambor, & Packard, 1998). Also, regarding using *interesting texts*, Wade et al. (1999) found that texts with important, new, and valued information were associated with student interest and Morrow and Young (1997) found that an abundance of texts within the classroom and availability to community resources are known to directly facilitate motivation.

With regard to *autonomy support*, Stefanou, Perencevich, DiCintio, and Turner (2004) found that when students are supported in making important decisions in school, they are highly motivated. Specifically, they refer to three levels of autonomy support, organizational autonomy wherein students can make decisions over classroom management procedures, procedural autonomy wherein students have decisions about how to present their ideas, and the most important, cognitive autonomy support, wherein students are afforded a wide array of choices that are significant and important. Moreover, Guthrie, Wigfield and Perencevich (2004) and Cordova and Lepper (1996) have found that significant choices over reading materials leads to sustained reading and measured achievement increase.

Self-perceived competence and *self-efficacy* is related to intrinsically motivated reading, students are given a sense of self-perceived competence when they are supported to use strategies and be successful readers (Bandura, 1998).

Brown (1997) and Turner (1995) emphasized that social discourse in learning communities, *collaboration support*, is intrinsically motivating and Wentzel (1993, 2000) demonstrated that students' possession of prosocial goals leads to constructive social behaviors in the classroom (read more on this in Chapter 5).

Several programs have also utilized conceptual instruction in science with beneficial results on reading engagement and conceptual learning from text. Guthrie and his colleagues (1998) implemented a classroom intervention to emphasize conceptual instruction in reading and science, called Concept-Oriented Reading Instruction (CORI). CORI teachers were trained to provide multi-layered instruction, knowledge transformation activities, and optimal challenge during an integrated reading/science unit. CORI teachers used conceptual themes to organize central disciplinary principles in a multi-layered fashion. The conceptual theme was accessible to all students and allowed for an ebb and flow between the facts and principles of the domain. Using the theme of "birds around the world" teachers

helped their students to embrace nine ecological principles (such as defense and predation). CORI teachers enabled students to search through multiple trade books to integrate information about the theme. After reading, students often summarized, made graphic organizers (student construction of a spatial representation of text-based knowledge, such as concept map or Venn diagram), drew and labeled illustrations of the text information, and created models and artifacts based on their new understandings gleaned from the multiple texts. In terms of optimal challenge, CORI teachers used a wide array of interesting texts to accommodate a range of ability levels in order to ensure students worked at the edge of their competencies.

In a typical CORI classroom, students conduct science activities within a conceptual theme of study. In the midst of a conceptual theme on aquatic life, a science activity might be to visit a freshwater habitat for students to collect pond water and specimens. Students would then ask personal questions about the animals and plants they observed. Next, they would search through multiple texts to find the answers to their questions and they would choose from an abundance of books ranging in difficulty level. For example, students may have begun with an easy text when the topic was new and knowledge relatively fragmented. As students gained knowledge, they would become increasingly able to read and gain information from more challenging texts. Students would use multiple knowledge transformation activities to learn knowledge from the text. This would include concept mapping, illustrating and labeling text ideas, or conducting experiments based on text information. Finally, students would present a display of their knowledge to classmates. This, too, would be accomplished using a variety of knowledge transformation activities, ranging from poster presentations to the creation of artifacts. In several quantitative studies of CORI, Guthrie and his associates have documented the benefits of concept instruction on conceptual learning from text, reading strategy-use, and reading motivation (see Guthrie, Wigfield & Perencevich, 2004, for review).

Among other classroom intervention programs that have also emphasized concept instruction with text, Marlene Scardamalia and her colleagues (1994) implemented a classroom intervention called Computer Supported Intentional Learning Environments (CSILE). CSILE classrooms contained networked computers connected to a communal database. During a typical day in a CSILE classroom, students researched topics using the computers for 30 minutes per day. Students browsed through expert and classmates' notes and information, attached notes and graphics found in databases, and recorded information found through other avenues. Used simultaneously by students were multiple text sources to gather information (see entry multiple text in this chapter). Personal inquiries were posted in the database to which other students responded, thus, an ongoing communication among students provided the impetus for knowledge growth.

In a series of studies, the effects of CSILE on students' ability to construct knowledge from multiple texts and other sources were reported. For instance, CSILE students exhibited their ability to represent knowledge in multiple forms, including graphics, and to better comprehend expository text. In one study, students' cognitive actions were analyzed in order to examine whether student

usage of the computer system resulted in differential conceptual learning from text (Oshima, Scardamalia and Bereiter, 1996). Indeed, students who treated information flow from computer to self as a unidirectional exchange learned relatively few principles and higher order relations. In contrast, students who sought to construct meaning in a bi-directional interchange of textual information with other students and sources, gained higher levels of knowledge. These students questioned and rebutted information and acted as co-creators of the knowledge. In addition, high conceptual learners took notes that were coordinated with the principles of the domain; whereas low conceptual learners wrote many fragmented notes.

Ann Brown (1997) designed a curriculum to Foster a Community of Learners (FCL) in 2nd through 5th grade science classrooms. Her general philosophy was that students develop their knowledge through dialogue in a social learning community. Students were expected to research some subset of a topic, and produce an artifact based on the content. In one study, three groups of students were compared with regard to conceptual learning outcomes. One group received instruction characterized by a jigsaw approach (teams of students studying various sub-themes of a topic and sharing their subset of expertise with classmates in order for all students to integrate sub-theme information with the overall conceptual theme) to learn sub-themes of a conceptual unit. During various phases of learning, students were involved in three participant structures: composing on the computer, conducting research using multiple texts, and interacting with the teacher. In these structures, jigsaw groups worked simultaneously on sub-topics of a conceptual theme. Students gathered and presented findings to each other and engaged in asking questions of peers and clarifying concepts. A summary of the Fostering Communities of Learners studies showed that students gained deep level understandings about the scientific topics of study as expressed in problem solving by analogy tasks.

Taken together, the CORI, CSILE, and Fostering Communities of Learner studies show the powerful effects of a conceptual emphasis in instruction. In each of these programs students were given multiple opportunities to create relations between the facts and principles of the conceptual domain, to experience optimal challenge, and to manipulate information in order to transform meaning. It has been shown that concept instruction helps students to understand that there exist multiple, often rival viewpoints within a domain of knowledge. Students should learn to create their personal understandings based on text and to reconcile discrepancies among diverse texts and their own knowledge. Thus, searching for information in multiple trade books or original documents, being presented with diverse viewpoints, and manipulating incoming information into a variety of forms are instrumental in being able to accomplish these understandings.

Amount and Breadth of Reading

Reading amount and breadth is defined as wide and frequent reading for a variety of purposes (Cox & Guthrie, 2001). Reading amount has been defined and characterized by many researchers and thus has been referred to as voluntary

reading (Morrow, 1996), print exposure (Cunningham & Stanovich, 1997; Stanovich & Cunningham, 1993), leisure reading, and time spent reading. It is well documented that students who read frequently and widely have higher reading achievement and possess more knowledge than those students who read less often. Essentially, this activity can be described as increasing time on task, a factor important for all types of learning.

Amount of reading is important because it enhances both reading comprehension and conceptual learning from text. First, among elementary school children reading comprehension is substantially predicted by amount of independent reading (Cipielewski & Stanovich, 1992). This strong contribution of reading amount to reading comprehension has been documented with a wide variety of indicators including, activity diaries (Wigfield & Guthrie, 1997), self-report questionnaires, such as the Reading Activity Inventory (RAI) (Guthrie, Wigfield, Metsala, & Cox, 1999), and measures of print exposure, such as a title recognition tests (TRT) and author recognition tests (ART) (Cunningham & Stanovich, 1993, 1997).

Amount and breadth of reading is significantly correlated with reading comprehension (Guthrie, Wigfield, Metsala, & Cox, 1999). It may seem obvious that children who read widely and frequently are high achievers. However, amount of reading is not only correlated to achievement in a simple association, but is a source of growth in reading comprehension (Cunningham & Stanovich, 1997). In a zero order correlation, of course, the causal influence may point in either direction or it may be reciprocal. However, longitudinal studies and studies that control for previous reading achievement help to explain growth in reading achievement.

Additionally, Cunningham and Stanovich (1997) argue that amount of time reading measured by print exposure techniques, is a causal factor in reading achievement (see Cunningham & Stanovich, 1997 for a review). In a series of longitudinal investigations, using multiple control variables, Stanovich and his colleagues (1997) have shown that wide and frequent reading (measured by print exposure) accounts for growth in reading comprehension and knowledge gains. The print exposure method is one in which children are presented with titles and authors of books and they are asked to indicate which titles and authors they recognize. Combined with actual titles and authors are non-author and non-book title names. In a 2-year longitudinal study of students in grades 3, 4, and 5, fifth graders' amount of reading (as measured by print exposure) predicted reading comprehension after prior achievement and prior amount of reading, as well as intelligence and parental income had been controlled (Cipielewski & Stanovich, 1992).

It is plausible that students who read frequently and widely should gain knowledge about the topics and domains in which they read and this expectation has been confirmed (Cunningham & Stanovich, 1997; Cipielewski & Stanovich, 1992).

Several studies have also shown that the increase in reading comprehension during an academic year, from fall to spring, is predicted by children's amount of reading (Cipielewski & Stanovich, 1992; Guthrie, Wigfield, Metsala, & Cox, 1999). For instance, in a study of 117 third and 154 fifth graders, Guthrie, Wigfield, Metsala and Cox (1999) found that reading for school and reading for enjoyment

predicted passage comprehension and conceptual learning from text on a performance assessment task.

The influence of the amount and breadth of reading is not limited to one locality or even one country. For instance, Elley (1994) showed that for nine-year-old students frequency of reading silently significantly contributed to achievement in 32 nations after statistically controlling for a variety of health, wealth, and school resource indicators within and across countries.

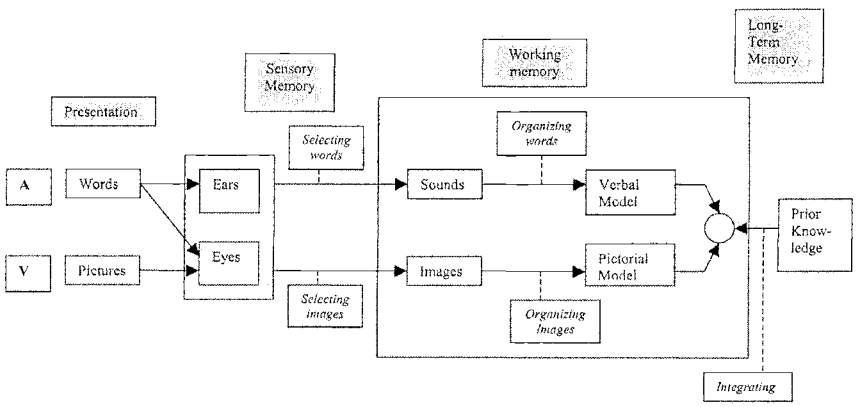
In classroom and school settings, student time engaged in reading is a stable predictor of reading comprehension (Morrow, 1996). In Morrow's study an experimental group was exposed to literacy centers including a volume and diverse array of reading materials, teacher-modeled literacy activities, and time for sharing information about books. They proved superior to a control group receiving traditional reading instruction from basal readers with occasional storybook reading. The experimental group scored significantly better on measures of reading comprehension, vocabulary, and creating original stories. Additionally, experimental students were asked to record the amount of books they took home from the literacy center. From the total amount of books taken home, 15% were taken home in the beginning of the school year whereas 50% of books were taken home after the literacy center was introduced.

Taken together the evidence indicates that amount and breadth of reading contributes to reading comprehension and conceptual learning from text and is supported by a network of cognitive and contextual supports within the classroom.

Reducing Cognitive Load

We save this topic for last because the danger of cognitive overload reaches across all of the processes: Acquisition, Automaticity, Near and Far Term Transfer. Key features of cognitive overload are found in the research dealing with dual channel receiving, processing, storing, and retrieval. Broadbent was the first researcher to notice the effects of interference or facilitation involving the dual channel processing (1952a, 1952b). (Strategies were recommended by this theoretical position in Section I.) The following is the cognitive theory of multimedia learning proposed by Mayer & Moreno (2003):

- Information processing consists of two channels: auditory/verbal and visual/pictorial (Pavio, 1986; Baddeley, 1998; Mayer & Moreno, 2003).
- Each channel has a limited capacity; therefore, only a limited amount of cognitive processing can take place in one channel at any one time (Chandler & Sweller, 1991; Sweller, 1999; Mayer & Moreno, 2003).
- Cognitive processing occurs in each channel: selecting (paying attention to the material), organizing (into a coherent structure), and integrating with existing knowledge (Mayer, 1999, 2002) (as shown in the diagram below).



A=auditory channel
V=visual channel

Figure 3.1. Mayer & Moreno's Cognitive Theory of multimedia learning (2003)

Implications of Cognitive Load Theory for Instructional Design

Sweller et al. (1998) report on studies of problem solvers distinguishing between problem solving where the schema is automated vs. problem solving where surface structure differences in the problems required conscious attempts at use of rules rather than the use of automated rules . "Problem solvers using automated rules had substantial working memory reserves to search for problem solution" (Sweller et al., 1998, p. 257). We would add for the reader that the automaticity of the schema tied to a limited surface structure (i.e., few concrete example types) restricts the "meaning" of that schema to the concrete level and inhibits 1) abstraction, and 2) generalization, and therefore, 3) limits near term positive transfer, and prevents far term transfer. Further, it is precisely the use of multiple "surface structure" differences in problem examples, which use encourages the learning of abstract, transferable principles, which in agreement with Sweller, et al. (1998), promotes the development of new schemas. Thus, the key for good instructional design is to build new principle capacity by adding just the right mix of multiple-example, surface structures to challenge with germane cognitive load for the learner without overloading her or him. We discussed this approach earlier as exemplified with the teaching of Reading.

As noted in Chapter 1, according to Sweller et al. (1998), schemas provide the basis for knowledge organization and storage. They also provide the function of reducing working memory load. This approach is extremely important for teaching

Reading as well as being the foundation for learning all other cognitive subject matters as well as Psychomotor, Affective, and even Interpersonal skills.

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