Thinking About Thinking and Learning

Chapter One

I. Bloom's Taxonomy of the Cognitive Domain
II. Multiple Intelligences and Learning Modalities
III. Memory Theory

Introduction

As you might imagine, hundreds and hundreds of books have been written on learning theory, each representing a different collection of approaches and angles on a complex body of research and hypotheses about how our brains receive, organize, process, and remember information.

With the acknowledgement that we will barely scratch the surface of all that it is known (and supposed) about this topic, we have selected several sets of concepts that fall under the general umbrella of learning theory that we believe are extraordinarily useful for new teachers. These four ideas—Bloom's Taxonomy of the cognitive domain, multiple intelligences and learning modalities, basic theories about memory, and cognitive development—will provide you with a foundation that will inform everything you read and learn as you work to become a highly effective teacher. For the sake of clarity, we will address the first three ideas—Bloom's Taxonomy, multiple intelligences and learning modalities, and memory theory—in this chapter, and we will save the fourth idea, cognitive development, for Chapter Two.

Here is brief preview of the ideas (and their utility) that we will address in this chapter:

Concept	What Is It?	Relevant Questions
Bloom's Taxonomy	A way of thinking about the increasingly demanding levels of learning that you may expect from your students	• How demanding are my objectives? • Do I teach students to memorize the Pythagorean theorem the same way I teach them to prove it?
Multiple Intelligences & Learning Modalities	Frameworks for thinking about how teachers can best present material	• Should I make a visual aid for this lesson? • Should I be concerned that my students are seated the entire period, every day?
Memory Theory	What we know about how our brains collect and store information	• Why did my students lose all memory of what we studied yesterday? • Why did I?

I. Bloom's Taxonomy of the Cognitive Domain

If you have taken an educational psychology course in college, you may recall that in the 1950s Benjamin Bloom and his colleagues developed a classification hierarchy for types of knowledge, cognitive processes, and skills. Bloom's Taxonomy has had a profound effect on education and educators, as it provides a mental model for thinking about the relative difficulty of different objectives that students are expected to master and provides guidance for how teachers should approach and assess various objectives.

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Bloom's hierarchy is based on six levels of cognition that increase in difficulty and in complexity, from basic knowledge of a specific fact (which is the first level) to evaluative judgment of some concept or knowledge (which is the sixth).

Six Levels of Cognitive Understanding

Consider the following table charting the definitions and providing examples for each level:

Level—and Associated Performances	**Definition**	**Example 1** *The student will be able to (SWBAT)...*	**Example 2** *The SWBAT...*	**Example 3** *The SWBAT...*
(1) Knowledge— write, list, label, name, state, define	• Restating information the way it was taught • Knowing information in a merely rote-learned way	Define the six levels of Bloom's Taxonomy of the cognitive domains	State the Pythagorean Theorem	From a list, identify three words that start with the /sh/ sound
(2) Comprehension— explain, summarize, paraphrase, describe, illustrate	• Interpreting and translating concepts and ideas from someone else's definition into your own	Explain the purpose of Bloom's Taxonomy	Discuss the uses of the Pythagorean Theorem	Explain what happens when an "s" and an "h" are put together
(3) Application— use, compute, solve demonstrate, apply, construct	• Applying definitions, formulas, principles to real world problems • Generalizing and using abstract information in concrete situations	Write an instructional objective for each level of Bloom's Taxonomy	Use the Pythagorean Theorem to figure out a distance from one spot in the parking lot to another	Write a sentence using two words that start with /sh/
(4) Analysis— analyze, categorize, compare, contrast, separate	• Breaking complex information into component parts and seeing how those parts are interrelated	Compare and contrast the cognitive and affective domain	Analyze the Pythagorean Theorem's applicability to non-right-triangles and explain why it does not apply	Compare words that start with the "s" to words that start with "sh"
(5) Synthesis— create, design, hypothesize, invent, develop	• Building a more complex result from a set of components • Putting together parts to form a whole	Design a lesson plan that incorporates each of Bloom's levels of cognitive understanding	Prove the Pythagorean Theorem	Create words that start with the /sh/ sound when given a series of word endings (-ut, -out, -ip)
(6) Evaluation— judge, recommend, critique, justify	• Judging something against a standard of quality	Judge the effectiveness of writing objectives using Bloom's Taxonomy	Evaluate and critique Pythagoras' original proof of the theorem	Evaluate the English system of spelling and inefficiencies related to the /sh/ sound

Despite considerable research in this area, for almost five decades Bloom's taxonomy has remained impervious to alternative models. In fact, most new research continues to validate this taxonomy. (There is some disagreement among learning theorists, however, as to whether the order of "synthesis" and "evaluation" should be switched on the grounds that evaluation may be less difficult to accomplish than synthesis. This dispute only affirms that the taxonomy should not be confused for a strict hierarchy; while higher-order objectives require definitional knowledge, you need not require your students to complete synthesis tasks before attempting evaluation.) Perhaps the key to its resiliency over the years is Bloom's Taxonomy's unquestionable usefulness for teachers.

Implications of Bloom's Taxonomy for Teachers

Generally speaking, Bloom's Taxonomy gives teachers a useful vocabulary for discussing their learning objectives. More specifically, Bloom's Taxonomy serves teachers by (1) helping them push students toward deeper understanding, (2) providing them insight into how to order objectives, and (3) revealing the best ways to teach a given objective.

(1) Bloom's Taxonomy illuminates the path to deeper understanding. This six-level model for thinking about knowledge gives us a gauge for determining the rigor of the learning objectives that we have for our students. Not all thinking requires the same amount of work. To commit the first seven digits of pi to memory is a qualitatively different endeavor than understanding that pi is the constant ratio between the circumference of a circle and the square of its radius. Knowing that pi *is* that ratio is qualitatively different still from being able to prove the truth of pi yourself. Or, to use another example, being able to sing or say the alphabet by rote is a far cry from recognizing the connection between the letter "k," the sound /k-/, and the written letter's role in the word "kite." Once we appreciate this taxonomy, we recognize that students can "understand" a topic or subject on a whole range of levels, and we are better able to lead our students toward those higher, more engaged, levels of knowledge.

We want to push students "up" the knowledge hierarchy for at least three reasons. First, although studies indicate that most teacher-made tests continue to test at the lower levels of the taxonomy, researchers tell us that students have a more lasting memory of what they have learned if they engage with the subject matter at the higher (analysis, synthesis, and evaluation) levels. Second, the very cognitive skills required to operate at that high level of knowledge are the most transferable to other areas. For example, a student who can recite the pros and cons of some government policy decision (at the lowest, "knowledge" level) does not have the transferable benefits that he or she would develop during the process of *creating* those pros and cons (at the "synthesis" level). Finally, lower-level objectives have little use on their own in the real world. You may be able to define a simile, but can you choose the right one to make your writing shine like the brass section of the Boston Pops? Of course, lower-level objectives are fundamental to our instruction because they form the very basis of higher cognition. Good teaching encourages students to think and perform on a variety of levels of the taxonomy.

(2) Bloom's Taxonomy helps us logically sequence our objectives. An underlying premise of Bloom's model is that students do have to work their way up the ladder of cognitive domains. That is, a student who does not know the definition of a right triangle (knowledge level) cannot complete a proof of the Pythagorean Theorem (synthesis level). Thus, in a very tangible way, Bloom's Taxonomy helps us shape and direct our instruction. Given that each level of Bloom's hierarchy builds on the next, we are provided with a step-by-step, metacognitive model for designing lessons. Within a lesson and over time, purposeful teachers gradually push their students up Bloom's ladder. As one learning theorist explains:

> The developmental approaches of higher-order thinking stress the importance of following a sequence of fostering lower forms of thought before higher forms of thought.

> Students need considerable experience interacting with concrete content and solving problems in order to be able to form abstractions and develop mastery over this information. . . . According to developmental views, then, it is not a problem if preschool or early elementary teachers focus mainly on lower-level skills. The problem is that teachers of older students never go beyond fact-learning.[4]

(3) Bloom's Taxonomy provides insight into *how* to teach a given objective. As is discussed in some detail in the *Instructional Planning & Delivery* text, Bloom's Taxonomy is an invaluable tool for a teacher considering specific teaching objectives. If the teacher is designing objectives (the daily end-goal of a lesson) from some general learning standards (the grand curriculum expectations for the year set by the state), Bloom's hierarchy provides a set of choices for the teacher so he or she can choose an appropriately rigorous objective.

We got really in to Bloom's Taxonomy— it was posted on the classroom wall, and every now and then I'd ask someone to categorize a question or assignment. My 6th graders got psyched up for the SYNTHESIZE and EVALUATE questions, and were more willing to "dig deep" to answer them. Plus, I couldn't slide by with too many easy-to-plan lower-level assignments— they'd catch me every time!

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At the same time, if the teacher is contemplating *how* to teach a given objective, Bloom's Taxonomy assists the teacher in thinking about how to design a lesson. Perhaps, for example, a teacher is given the following objective by her district curriculum: "The student will be able to construct a five-sentence paragraph with a topic sentence and a summation sentence." The verb "construct" immediately tells the teacher that her students' ability to define a paragraph, or a topic sentence, is not enough. In fact, even her students' ability to describe in detail *how* to write a five-sentence paragraph is not enough. The teacher's students are expected to bring together all of what they know about topic sentences, supporting details, transition words and conclusions to *create* a paragraph themselves (a synthesis-level demonstration of knowledge).

Because we recognize that different levels of cognition lend themselves to different forms of teaching, Bloom's hierarchy gives guidance for how to teach a lesson.

> Bloom and his colleagues were quite helpful in pointing out the connection between teaching objectives and teaching approaches. In particular, if one wants students to know information at the knowledge level, one can simply use a drill and practice approach. In contrast, if one wants students to know information at the comprehension level, they must be taught in ways which help them understand better (e.g., using analogies). Similarly, if teachers want students to be able to apply information, they must show students how to apply information and give them multiple opportunities to apply what they know. Students who are just taught facts (e.g., the definition of a "democracy") cannot immediately apply this information (e.g., recognize a democracy when they see one; take a non-democracy and change it into one).[5]

Having read this explanation, you may find it helpful to return to the table of Bloom's levels and examples above. Each of those three sets of examples illustrate how a teacher can address the same content in different objectives, each objective requiring more rigorous thought by students as the objectives climb

[4] Byrnes, James P. *Cognitive Development and Learning In Instructional Contexts*, 2d Ed. Allyn and Bacon: Boston, 2001, pp. 90-91.
[5] Byrnes, James P. *Cognitive Development and Learning In Instructional Contexts*, 2d Ed. Allyn and Bacon: Boston, 2001, p. 91.

the ladder of Bloom's Taxonomy. Again, it is important to highlight that the practice of lower-level objectives, such as memorizing multiplication tables, should not be considered shallow in and of itself. Practice is vital so that accessing basic facts and skills can become automatic, making room for higher-level processes. The problems begin when teachers spend all of their time drilling their students and never take those basic concepts and skills to the next level.

II. Multiple Intelligences and Learning Modalities

A second realm of learning theory that is particularly helpful to new teachers involve the ideas of multiple intelligences and learning modalities, which are frameworks for thinking about the most student-friendly ways to communicate new knowledge. If a teacher understands the appropriate methods for communicating a given objective, the teacher can be sure to maximize the impact of a lesson by introducing new knowledge in those formats.

Multiple Intelligence Theory

While the proposition has since evolved into a range of theories, in the early 1980s Harvard researcher Howard Gardner made a permanent impression on pedagogical theory by asserting that the concept of "intelligence" is actually a conglomeration of a number of different intellectual aptitudes. Gardner proposed that there are actually seven intelligences, and that each of us possesses some combination of relative strength in each of those several categories. This idea countered traditional measures of intelligence (IQ tests, etc.) that focused primarily on the linguistic and logical modes of thought and processing.

Those original seven "intelligences" are linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, intrapersonal, and interpersonal. While researchers (including Gardner) have continued to propose variations on this list, the basic idea—that there is not just one type of intelligence—has significantly impacted education. This notion that each student has a unique combination of strengths and weaknesses, and that teachers can capitalize on those diverse strengths to enhance learning, underlies the strong push for teachers to differentiate instruction to meet the academic needs of their students.

Gardner is not without his critics. Describing the theory as a way to make every child feel special, some educators and researchers believe that calling these areas "intelligences" has conferred on them a special meaning that would not have been considered revolutionary had they simply been called "talents." Opponents of the theory and how it is commonly applied to classroom instruction say that no compelling research suggests that teaching to multiple intelligences is an effective strategy. In fact, Gardner himself shies away from making pedagogical recommendations based on the multiple intelligences, a point that may surprise many classroom teachers. Those who shape their lessons to fit Gardner's theories are going too far according to Daniel Willingham, a professor of cognitive psychology at the University of Virginia. Willingham says the idea of teaching children who possess "bodily-kinesthetic" intelligence how to spell by forming letters with their bodies, or expecting students to learn mathematical concepts simply by setting them to music, is ludicrous. Students in mathematics need to learn how to think mathematically, not musically, Willingham argues. And Gardner agrees. You might draw in a musical child with music, but true mathematical thinking doesn't really begin until you start teaching math.

While the educational community continues to debate the finer points of Gardner's ideas, it is nevertheless valuable for all teachers to think about the aptitudes that they may favor, or ignore, in their students. The strengths and weaknesses of your students in these aptitudes can influence the ease with which they master particular objectives, complete various tasks, or participate in the classroom

community. Recognizing that your students, in concert, may differ in these intelligences will push you to adjust your instruction so that each child in your classroom is given the necessary support and attention to develop both their stronger and weaker skills. To return to our previous example, rather than simply teaching a musically inclined (but less mathematically inclined) student the process of long division through a song, you will need to increase the amount of mathematics instruction and practice you give to this student in order to build his mathematical muscle. To help you recognize the various intelligences students might possess, consider the following table.

Intelligence	Description of Person with this Strength
Linguistic (includes phonology, syntax, semantics, language pragmatics)	• Has sensitivity to the meaning and order of words and the varied uses of language • Has highly developed auditory skills • Enjoys reading and writing • Has good memory • Spells words easily and accurately • Uses language fluently • (Probably the most universal of the intelligences)
Logical-Mathematical Intelligence	• Has ability to handle long chains of reasoning and to recognize patterns and order in the world • Explores patterns and relationships • Likes to problem solve and reason logically • Follows sequential, logical directions • Enjoys mathematics • Uses experiments to test things out
Spatial Intelligence	• Has ability to perceive the visual world accurately • Enjoys art activities • Reads maps, charts, and diagrams • Thinks with images and pictures • Does jigsaw puzzles
Musical Intelligence	• Has sensitivity to pitch, melody, and tone • Is sensitive to sounds in his or her environment • Enjoys music • Listens to music when studying and/or reading • Taps or hums rhythms
Bodily-Kinesthetic Intelligence	• Has fine-tuned ability to use the body and to handle objects • Processes information through body sensations • Requires hands-on learning • Moves and acts things out • Uses body in unique and skilled ways and is often well coordinated
Intrapersonal	• Has direct access to one's own "feeling life" • Has strong self-awareness • Prefer inner world, to be alone • May be introverted
Interpersonal	• Has ability to notice and make distinctions between others • May be extroverted • Focuses on relationships

For tools to use with your students that will determine their intelligences, please see the **Learning Theory Toolkit** (pp. 1-2: "Identifying Your Multiple Intelligences"); this Toolkit can be found online at the Resource Exchange on TFANet. Also available in the Toolkit (p. 3) is a "Multiple Intelligences Product Grid" that categorizes classroom products that appeal to different intelligences. 🛠

Learning Modalities

A concept closely related to multiple intelligence theory is the notion of "learning modalities" (or "learning styles"). A learning modality is one of three senses through which students most readily input information.

- **Visual Modality.** As its name states, the visual modality involves taking in information by seeing it. Some students say that they are "visual learners" and remember a concept or fact best when they can recall a page in their textbook, or a drawing on the board. Text, diagrams, photographs, charts, graphs, and maps are all tools that aid visual learning.

- **Auditory Modality.** A modality that you may find your students need to develop, auditory learning emphasizes what is spoken and heard. Students must focus on listening when teachers lecture, lead a discussion, read aloud, or play music. Some students' auditory modality is so sensitive to noise that these learners cannot work unless it is quiet.

- **Tactile/Kinesthetic Modality.** Often forgotten is the tactile/kinesthetic modality, which emphasizes the need to touch objects and move one's body. An elementary literacy teacher might have students draw letters in the air with their finger as they practice alphabetic recognition. A French teacher might use the Total Physical Response System to teach students vocabulary, connecting the new word "jete" (throw), for example, to the gesture of tossing an imaginary ball across the room. Experiments, textured manipulatives such as sand paper letters, use of props, and other opportunities for movement address the tactile/kinesthetic modality. Creating centers in your classroom may allow students to move around your classroom and help diffuse restlessness from remaining in one seat all day, but this is different from presenting information through the tactile/kinesthetic modality.

As with multiple intelligences, there are scholarly disagreements about applying these ideas to the classroom. While it is clear that there are many senses through which human beings can input information, some educational researchers and practitioners do not believe that individual students learn "best" in one way. In fact, some worry that learning modalities theory can be destructive since it may lead teachers to spend the school year planning outlandish math lessons with role-plays and dancing to enable kinesthetic learning, instead of practicing calculations. Students with strong tactile/kinesthetic perceptions can still learn with visual and auditory cues, so it would be incorrect to assume that you must figure out a way to incorporate every learning style into every lesson.

Many believe that the most useful way to think about modalities is to consider the *material* rather than the student. It is better to see a plant cell through a microscope or in a book than to hear a description of the cell wall. Similarly, it's better to listen to a recording of a symphony than to read about it. Total Physical Response is an effective way to help students link spoken words to their meaning, but at some point students also need to learn how to recognize these words on a page. Always think about learning modalities from a content perspective. What is the most appropriate approach to represent an idea? A math teacher might introduce the concept of fractions for the first time by dividing an orange into various sections, or having students attempt to divide a circle into equal parts. This approach simply best presents the concept of fractions.

Teachers often deliver instruction in one modality, and student recognition and recall improves when information comes in multiple forms. The key is to avoid relying too heavily on any one modality, as your students will benefit from getting material from a variety of angles.

III. Memory Theory

Another arena of learning theory that offers immediately practical knowledge for teachers is the study of human memory. Among the many fruits of cognitive psychology has been a more complete understanding of how the brain receives and stores information. That understanding can be translated into specific tips for teachers who are interested in ensuring that their students are not only receiving information but are also transferring it from short-term to long-term memory.

Cognitive psychologists describe two types of memory: working memory and long-term memory. "Working memory," also referred to as "short-term" memory, is the component of memory where new information stays while it is mentally processed. We can think of this memory as a temporary holding bin for incoming information. We do most of our thinking and processing of information that is in that "bin," as we make sense of a movie, have an argument, or shop for groceries. It's the place we temporarily store the phone number of the pizza place. Information stays in working memory, however, only as long as it is being actively used. Get interrupted in between looking up the phone number and actually dialing it, and you'll find yourself needing to look it up again.

"Long-term memory," on the other hand, is the final storage component of the memory system that holds information for some longer period of time—perhaps a day, a week, a month, a year, or one's entire lifetime. Because working memory has limited capacity, the goal is to learn facts and procedures well enough to store them in long-term memory, making them automatic and freeing up working memory for other things. Some people cannot learn to drive with the radio on; they need some time and practice before they can belt out "Build Me Up Buttercup" while switching multiple lanes on the interstate. (Researchers disagree about why information in long-term memory can fade, but that's a whole other story.) Not surprisingly, when you use knowledge frequently, it's likely to enter long-term memory.

Cognitive science also emphasizes for teachers the all-important role of the input stream for building memory. In teachers' language, that refers to students' attention to the material being presented. Teachers know that given all of the stimuli available to a student's mind in class, it is imperative that they work to focus students' attention on the "input" that the teacher is trying to "transmit" to the students' minds.

Strong teachers develop an extensive repertoire of techniques for assuring the deep, long-term internalization of the concepts they are teaching. Although not all of the following strategies will always apply to all kinds of knowledge, as a general matter, teachers can move information from working memory to long-term memory through:

- **Varied, Repeated Rehearsal.** Practice matters. Practice matters. Practice matters. Repeated rehearsal of information, preferably in a number of different contexts and in a variety of ways, helps to transfer it to long-term memory. Most district curricula are "spiraled," building in times to return to key points. Your long-term plan should also allow for periodic rehearsal of past objectives.

- **Building Connections to Prior Knowledge.** Students remember knowledge longer and more completely if they learn it in a meaningful context with which they are familiar. As you plan instruction, consider carefully what your students already know about the new information. Math teachers might begin a multiplication unit by highlighting instances when addition becomes inefficient. Social studies teachers interested in conveying the impact of the Bubonic Plague might draw parallels with the AIDS epidemic. English teachers might investigate the ways in which they can use the vocabulary students are learning in their

science class to teach word origins. In all cases, help students access that known information to provide a context and "resting place" for the new information. We'll discuss various means of connecting new information to students' prior knowledge in Chapter Four. Of course, this concept implies that students *have* prior knowledge, so it is always important for teachers to assess and build this base.

- **Organization.** We retrieve long-term memory through a pathway of associations. You might remember someone's name by associating it with that of a celebrity, or by going down the alphabet until you recall it. We can learn and remember a body of new information more easily when we organize it in some way. By categorizing information in meaningful ways, we create pathways to the new information that help us access it. You should encourage your students—through graphic organizers, tables, lists, etc.—to "bucket" information in a logical way. Both the process and the product of that organizing will help students remember the new information.

  As you know from your own experience, it is difficult to remember a number of disparate bits of information thrown at you at one time. Memory theorists point out that it is not necessarily the size of these "bits," but the number of them that trips up our memory. By placing these bits into larger "chunks" that are organized in ways that have meaning for us, we can remember them far more easily. For means of illustration, take three seconds to try to remember the 21 letters in each sequence below:

  1. HJAUIERYERWHABRBAGFCD
  2. GOAT JUMP TENT ASK RED SUM
  3. WARRIORS FOUGHT BRAVELY

  Clearly, we can remember the 21 letters much more easily when they are grouped meaningfully. By grouping ideas and creating categories, students have much less to remember, or at least have an automatic filing system for the data you want them to process.

  As an example, imagine that you are attempting to digest a huge mass of knowledge in preparation for a new job as a teacher of students who need considerable help immediately. If you were simply handed all of that information in an unorganized pile, you would have a difficult time accessing and remembering it. So, you might start "chunking" that information by thinking about it in different "folders" in your mind. Perhaps you could organize it as *Instructional Planning & Delivery*, *Classroom Management & Culture*, *Learning Theory*, etc. Then, within each of those "folders," you do another layer of mental grouping so that the mass of information in *Instructional Planning & Delivery* becomes another handful of mental "folders"—Assessment, Long-Term Planning, etc. These layers of organization in our minds make huge amounts of information accessible and memorable. And it's often precisely this organization – the connections between ideas – that we want students to know.

  Teachers can fail to take full advantage of the ways in which learners organize information in their minds. When writing assessments, multiple-choice questions and word banks can be very effective tools to discover if students can discern the correct answer among tempting alternatives. But this "recognition task" is far different from a "retrieval task" without a word bank, where students must supply an answer without the same cues. If your goal is for Gabriel to use synonyms for the word "nice" on his own, a multiple-choice vocabulary test would not serve your ultimate purpose, since it only lets you know if he can pick out an appropriate word from a list. You will exercise his pathway of associations most by creating

tests – and providing practice – that require him to search in long-term memory and generate synonyms without aid.

Circumstances will dictate how to build your students' cognitive filing systems. If Allyson is having difficulty spelling the word "invalidate," you might ask her to start by trying to find a word within it that she knows how to spell. Her web of associations may then locate the word "valid," and she will be on her way. Plus, by guiding her in this manner, you'll be helping her with strategies and cues for solving similar problems in the future.

- **Elaboration.** By pushing students to go beyond the information actually presented to them by analyzing or critiquing it, students are more likely to move that information into their long-term memory. You can help your students elaborate on the presented information by asking questions such as "Why do you think this happens?" "Can you think of some examples of this concept?" or "What can we conclude from this information?"

  Robert Sternberg, a Yale psychologist, recommends having students process (or "elaborate on") information in three ways: analytically, creatively, and practically. His "triarchic theory," therefore, is a method for ensuring that students engage with knowledge several times from several meaningful angles. Consider Sternberg's table of examples detailing this engagement of the concepts in the first column:

Concept	Analytical Processing	Creative Processing	Practical Processing
Tom Sawyer	Compare the personality of Huck to that of Tom	Write a very short story with Tom as a character	Describe how you could use Tom's power of persuasion
The formula for distance = rate x time	Solve a word problem using d=r(t)	Create your own word problem using d=r(t)	Show how to use d=r(t) to estimate driving time from one city to another
List of factors that led up to the U.S. Civil War	Compare/contrast the arguments of supporters and opponents of slavery	Write a page in the journal of a Confederate or Union soldier	Discuss the applicability of the lessons of the Civil War to countries today, like Yugoslavia
The main types of bacteria	Analyze the means that the immune system uses to fight bacterial infection	Name some ways to cope with the increasing immunity bacteria are showing to antibiotic drugs	Suggest three steps that one might take to reduce the chance of bacterial infection

But consider what your students are thinking about when they are learning the material. Daniel Willingham, a professor of cognitive psychology and neuroscience at the University of Virginia, warns that teachers ought to be very strategic when presenting material from a particular angle—because that is what students will remember.[6] If you have your students make a cake in the shape of Texas to reflect its geography, they will likely leave the activity remembering how they licked batter from the bowl far more readily than how the creation reproduced their state's natural features. Crafting activities that focus your students on what you want them to remember – such as having students find everyday objects that represent the natural resources of Texas's regions, and emphasizing the relationship between those resources and the products they yield – might focus the activity more.

[6] Willingham, Daniel. "Students Remember…What They Think About," *American Educator,* Summer 2003.

- **Explicitly teach these various memory strategies.** You should discuss with your students how they are remembering information. Discuss with them what we know about practice, organization, and elaboration. Encourage them to experiment with various strategies to see which ones are most effective for them.

Conclusion and Key Concepts

These three concepts—Bloom's Taxonomy, multiple intelligences and learning modalities, and memory theory—provide a solid foundation upon which to build your planning and instructional skills. You will find them useful as you formulate daily, unit, and year-long instructional plans, and we will return to them throughout the curriculum texts that you are reading in preparation for teaching. Having read this chapter, you should have a basic understanding of the following concepts:

- **Bloom's Taxonomy** is a six-level hierarchy that classifies levels of cognitive understanding. You should be able to describe, and provide examples of objectives that fall within, each of these six levels:
    - Knowledge
    - Comprehension
    - Application
    - Analysis
    - Synthesis
    - Evaluation

- Bloom's Taxonomy has many important implications for teachers. It illuminates the path to higher-order thinking, helps teachers logically sequence learning objectives, and provides insight into how to teach given objectives.

- **Multiple Intelligences** theory indicates that students may be "intelligent" in a number of different ways. Among the intelligences teachers should consider are linguistic, logical-mathematical, spatial, musical, bodily-kinesthetic, intrapersonal, and interpersonal.

- Similarly **Learning Modalities** theory describes the ways that individuals best learn new knowledge and skills. As a teacher, you must consider varying your instructional methods to meet the needs of visual learners, auditory learners, tactile learners, and kinesthetic learners.

- **Memory Theory** provides teachers with insights about how to best move students' knowledge from short-term to long-term memory. Among the key methods are varied and repeated rehearsal, accessing prior knowledge, strategically organizing new information, and elaborating on new information in ways that emphasize what you want students to remember.

In the next chapter, we will add a fourth component of learning theory to your toolbox—cognitive development. If the concepts in this chapter gave you a sense of how students understand, learn, and remember, the cognitive development theory will give you a sense of how students' understanding, learning, and memory develop and change as students grow older.