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Psychology of Learning for Instruction

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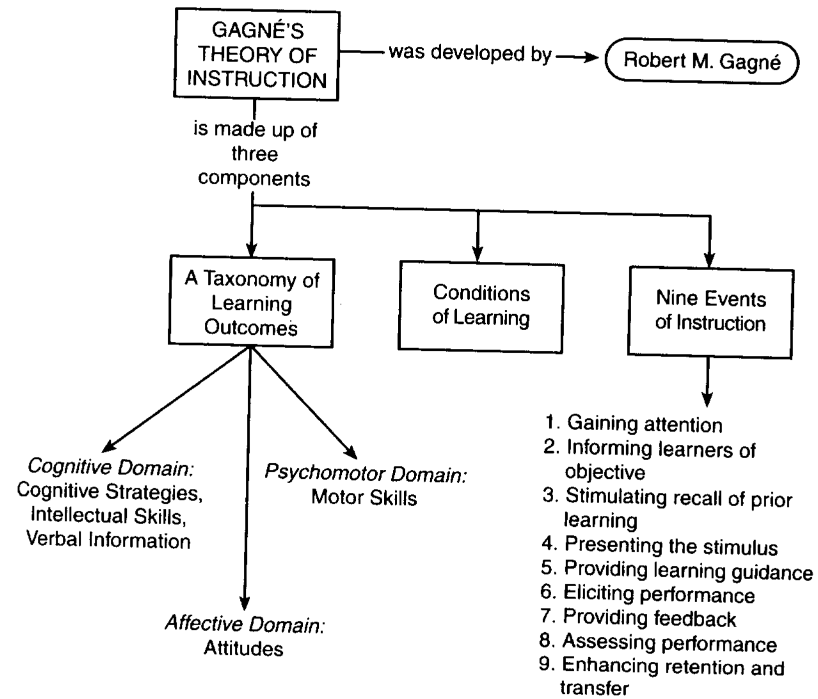
CHAPTER

10 Gagné's Theory of Instruction



Consider these scenarios.

- **Medical School**

At the University of Anywhere Medical School, instructors routinely face the problem of biomedical misconceptions among students. That is, medical students, despite exposure to appropriate information, continue to make diagnostic errors in many of the clinical cases that they study. Instructors have found that students, in their diagnoses, tend to oversimplify, overrely on general theories, and disregard unique or puzzling symptoms. How to best deal with these problems is of major concern, particularly in light of the spiraling costs of medical school education. The instructors want to know how they should revise their instruction or devise new learning experiences, so that students will avoid making so many errors.

- **A&B Agency**

Like other organizations in recent times, A&B Agency has become increasingly sensitive to issues of sexual harassment in the workplace. The Agency Board of Directors decides that the training provided to all new employees should be expanded to include the topic of sexual harassment.

Primarily, the Board wants employees to know the legal definition of sexual harassment and procedures for reporting it, whether the harassment is either personally experienced or observed in others. An implicit goal of the training, or course, is that employees will treat their co-workers with respect and refuse to engage in any form of sexual harassment, no matter how seemingly benign.

Think back for a moment to the scenarios with which the other chapters in this book began. How do the scenarios here differ from those? All of the scenarios are in some way concerned with a learning problem, which is used to illustrate the theories discussed in each chapter. But whereas the scenarios from the previous chapters described the problem from the perspective of a learner (or learners), the ones in this chapter (and the next) focus on the problem from the standpoint of an instructor or designer of instruction. For you to think about learning from the instructor's or designer's perspective is, in a sense, a goal of every chapter. After all, a major purpose for reading this book is to acquire a sufficient understanding of learning to teach effectively or to design effective instruction. But the two chapters in this section are specifically devoted to discussions on theories of instruction, rather than theories of learning.

It is important to note that several theories (or partial theories) of instruction have already been suggested in some of the other chapters, as they have derived from particular views of learning. Radical behaviorism (Chapter 2), for example, provided a foundation for performance analysis and improvement. Ausubel's meaningful reception learning (Chapter 4) served as the foundation for Reigeluth's (1983) Elaboration Theory. Notions about situated cognition (Chapter 5) led to concepts of authentic instruction and apprenticeship models of teaching. Bruner himself (Chapter 7) articulated features of an instructional theory, and his work bears significant similarity to the Inquiry Models developed by Collins and Stevens (1983), Taba (in Joyce & Weil, 1986), and Suchman (in Gunter, Estes, & Schwab, 1990). Finally, Bandura's (1986, 1997) work in self-efficacy and social learning theory and Keller's (1983) model of motivational design (Chapter 9) suggested ways to enhance students' motivation to learn.

What these theories all have in common, with the possible exception of behaviorism, is a limitation of scope. That is, each proposes instructional methods thought to provide the necessary learning conditions for a particular type of learning goal. Ausubel, for example, was largely concerned with how learners acquire bodies of information as knowledge. Bruner, along with Collins and Stevens, Taba, and Suchman, addressed himself to the attainment of concepts and inquiry skills. Keller obviously confined his attention to the engagement of students in learning. As for behaviorism, Skinner would probably have argued that its principles serve equally well for promoting any kind of learning. However, with its emphasis on observable behavior, it has not always served educators well who want to engender skills and knowledge in learners that are not easily observed.

In this chapter and the next, two theories that their proponents claim are significantly broader in scope than those mentioned earlier will be discussed. The first, Gagné's (1985) conditions for learning, has undergone development and revision for twenty or more years. With behaviorist roots, it now brings together a cognitive information-processing perspective on learning with empirical findings of what good teachers do in their classrooms. Gagné's theory also serves as the basic framework for a prominent instructional design theory (Gagné, Briggs, & Wager, 1992). In contrast to Gagné's theory is the constructivist approach to instruction. Rather than a single theory, constructivism represents a collection of similar approaches which are gaining currency in education and training. They stem from a view of learning more compatible with the ideas of Piaget, Bruner, and Vygotsky than with information processing. Since constructivism is still developing, it remains to be seen whether a single instructional theory will emerge. At present, then, we can only examine the similarities among approaches as they collectively differ from Gagné's theory.

Before proceeding to the specific instructional theories of Gagné and constructivism, let us take a brief look at instructional theory in general.

Instructional Psychology, Instructional Theories, Instructional Models

Instructional psychology is essentially what this book is about. "Instructional psychologists...are concerned with how best to enhance learning" (Dillon & Sternberg, 1986, p. ix). Therefore, they rely on the findings of psychological and instructional research to solve instructional problems and make decisions about instructional practice (Gagné & Dick, 1983; Gagné & Rohwer, 1969; Resnick, 1981). Instructional theory results when instructional psychologists deductively derive principles of instruction from existing learning theory or inductively develop such principles from empirical studies.

Reigeluth (1983) defined **instructional theory** as *identifying methods that will best provide the conditions under which learning goals will most likely be attained.* He stated further that, for an instructional theory to be effective, it must either build on or be compatible with existing learning theory. In other words, learning theory specifies the link between what is learned and the conditions under which learning occurs. Instructional theory, as depicted in Figure 10.1, adds the component of instructional method to the existing equation. What should also be noted about instructional theory is that it involves intentional learning goals. That is, learning will occur whenever conditions are ripe, and in fact, learning goes on all the time. **Instruction,** however, refers to *the deliberate arrangement of learning conditions to promote the attainment of some intended goal.* Therefore, the purpose of instructional theory is to be prescriptive, to provide principles by which teachers and instructional designers can assure learning.

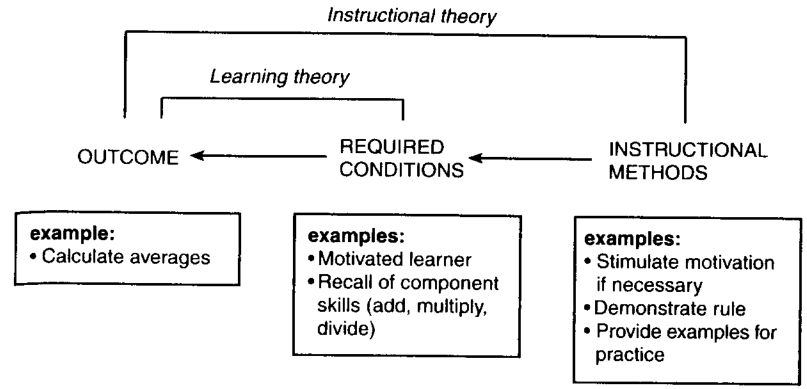


FIGURE 10.1 The Relationship between Instructional Theory and Learning Theory

Schott and Driscoll (1997) proposed a universal instructional theory, arguing that teachers and designers must consider these four components when they develop instruction:

1. The learner
2. The learning task (including desired learning outcomes)
3. The learning environment (learning conditions and instructional methods)
4. The frame of reference (or the context in which learning is to occur)

Perhaps an example will be illustrative. Suppose a chemistry instructor is assigned to teach a section for preservice teachers of elementary education. The instructor wants students to learn not only chemistry, but also how they might teach it effectively to their students in elementary school. What learning conditions are necessary for the preservice teachers to achieve these goals? From motivation theory, we know that the students must see some value in learning chemistry, and they must have some confidence that they can both learn it themselves and teach it to others. Information-processing theory suggests that the students must know certain prerequisite information and that new information should be presented to them in a way that facilitates encoding. Finally, if situated cognition theory is considered, then it is important for students to engage in activity that is meaningful and relevant. These learning conditions all have implications for the types of learning tasks and instructional methods that are likely to be most effective.

On the basis of instructional theory, effective methods might include demonstrations, followed by providing, as practice, meaningful chemistry problems for students to solve. But even these simple methods can be implemented in various ways. The practice problems might appear in a textbook, on an overhead transparency displayed in class, or embedded in a discovery scenario in which students are asked to experiment and describe what they learn from the chemical reactions that they try.

To guide an instructor's actions, then, are instructional models, or "step-by-step procedure[s] that lead to specific learning outcomes" (Gunter et al., 1990, p. 67). Such models are typically articulated as the principles of instructional theories are tested and validated. Any comprehensive instructional theory that pertains to multiple learning outcomes will provide multiple instructional models. And what models are implemented for a specific goal can depend on the context for instruction as well as the nature of the learning goal. In the case of the chemistry instructor, for example, the conduct of experiments requires certain resources and a laboratory setting that may be unavailable to the instructor.

Gagné's theory of instruction is perhaps a clearer demonstration of a comprehensive instructional theory, so let us consider it first. Then the collective approaches to constructivism will be discussed in Chapter 11.

Robert M. Gagné and the Conditions of Learning

Robert M. Gagné published the first edition of *The Conditions of Learning* in 1965 and the fourth edition in 1985. In that time, the theory evolved significantly from one that was extensively behavioral to one that is now predominantly cognitive in nature. Most recently, Gagné has published an adaptation of *The Conditions of Learning* specifically for the job-training context (*The Conditions of Learning: Training Applications*, published in 1996 by Robert M. Gagné and Karen L. Medsker).

Much of Gagné's early experience as an instructional psychologist was spent tackling practical problems of training air force personnel. He dealt particularly with problems in determining just what skills and knowledge are required for someone to be an effective performer at a given job. Once job requirements were identified, the task then became one of determining how those requirements might best be learned by a person in training for the job.

Briggs (1980), who was a long-term collaborator of Gagné's, wrote, "I have never asked Gagné about this, but I believe that his early work in the Air Force must have been an important factor in his later derivation of his

(a) taxonomy of learning outcomes, (b) concept of learning hierarchies, and (c) related concepts of instructional events and conditions of learning" (pp. 45–46). As it has evolved, Gagné's theory incorporates three major components: a taxonomy of learning outcomes, specific learning conditions required for the attainment of each outcome, and the nine events of instruction. Because Gagné has adopted information-processing theory as a foundation for his theory, the conditions for learning include both internal events (such as previously encoded information) and external events (such as methods of elaboration to facilitate encoding). Additionally, the events of instruction refer to methods or procedures designed to facilitate the specific processes (such as encoding, retention, retrieval, etc.) thought to occur during learning.

A Taxonomy of Learning Outcomes

If you recall from Chapters 3 and 8, cognitive psychologists and neuroscientists both provided evidence supporting a distinction between declarative and procedural knowledge. Declarative knowledge refers to factual knowledge, or knowing that (e.g., "I know that Shakespeare lived in the sixteenth century"). Procedural knowledge, by contrast, refers to cognitive skills, such as knowing how (and therefore being able to demonstrate how), for example, to conjugate Latin verbs or balance a budget. Cognitive psychologists have also investigated conditional knowledge, the metacognitive knowledge that enables learners to determine when and how to apply declarative or procedural knowledge. For example, I know to look for major headings to organize my learning from textbooks.

All of these types of knowledge are undetectable in the learner purely by observation. That is, I cannot tell by looking at you whether you know when Shakespeare lived, whether you can balance a budget, or whether you pay attention to headings when you study from a textbook. Such knowledge must be inferred from some behavior that is observable. You could tell me the dates Shakespeare lived, or write down the conjugations of certain Latin verbs, or construct an outline of some text chapter.

Telling and writing are behaviors that imply another kind of knowledge. For instance, to write anything, a learner must be able to form the appropriate letters with a writing device. This type of performance is fundamentally different from declarative, procedural, or conditional knowledge in that it involves the use and movement of muscles. Generally called motor skills, these capabilities must also have a psychological component, because they do not have to be relearned with every performance. Despite long periods of nonuse, people generally do not forget completely how to ride a bicycle, shift a car, or swim the breaststroke.

In addition to cognitive and motor types of knowledge, humans appear to have the capacity for affective knowledge. Why, for example, do you listen to a certain type of music or participate in a certain sport or physical activity? Because you like it, it makes you feel good. These internal states of feeling predispose learners to engaging in some activities over others. This helps to explain why an individual who knows perfectly well what to do ("Stop when the light turns red") may choose not to do it ("I'm worried that my pay will be docked if I'm late").

In their search for ways to facilitate learning, then, instructional theorists have found it useful to distinguish the variety of capabilities humans can acquire. In doing so, they make a fundamental assumption that different capabilities require different conditions for learning. Helping someone learn to operate a piece of machinery, in other words, is assumed to demand different types of assistance than helping someone memorize lines to a play.

Benjamin Bloom, a contemporary of Gagné's, was among the first to accept the notion that humans' learned capabilities comprise three major domains: cognitive, affective, and psychomotor. Furthermore, he proposed a taxonomy of levels within the cognitive domain that is still in wide use today (Bloom et al., 1956; see Table 10.1). Extending this work, Krathwohl, Bloom, & Masia (1964) developed a taxonomy of outcomes within the affective domain (Table 10.2). Finally, Simpson (1966–1967) prepared a plan for a taxonomy of psychomotor outcomes (Table 10.3). Gagné, however, was the first to propose an integrated taxonomy of learning outcomes that included all three domains.

According to Gagné (1972), there are five major categories of learning outcomes: (1) verbal information, (2) intellectual skills, (3) cognitive strategies, (4) attitudes, and (5) motor skills. The five categories are also summarized in Table 10.4, along with examples of each.

Verbal Information. **Verbal information** is Gagné's category in the cognitive domain for *declarative knowledge*. It refers to the vast bodies of organized knowledge that learners acquire through formal schooling, books, television, and many other means (Gagné, 1985; Gagné & Driscoll, 1988). Verbal information is what individuals recall when playing such popular games as *Jeopardy*™ and *Trivial Pursuit*™. Examples include stating the capital city of Botswana, reciting Hamlet's famous soliloquy, and, as might be required in the scenario, Medical School, listing the symptoms typical of a heart attack.

It should be obvious by now that researchers have been interested for a long time in understanding how information is acquired and what functions it serves for the learner. Gagné's view is consistent with the views of Ausubel, information-processing theorists, and schema theorists in accepting that learners organize their knowledge in themes or schemata. These then provide the necessary foundation for acquiring related information as well as solving problems. Problem solving is not itself verbal information, but its success depends upon the learner being able to apply relevant information to the problem. For example, to assist your learning about a particular tribe in Africa, you would call to mind anything else you knew about the region in question—its geography, weather, or form of government. Likewise, in order

TABLE 10.1 Bloom's Taxonomy of Cognitive Outcomes

Knowledge	Remembering previously learned material, including facts, vocabulary, concepts, and principles
Comprehension	Grasping the meaning of material
Application	Using abstractions, rules, principles, ideas, and other information in concrete situations
Analysis	Breaking down material into its constituent elements or parts
Synthesis	Combining elements, pieces, or parts to form a whole or constitute a new pattern or structure
Evaluation	Making judgments about the extent to which methods or materials satisfy extant criteria

TABLE 10.2 A Taxonomy of Affective Outcomes

Receiving	Becoming sensitized to or willing to receive certain information
Responding	Becoming involved or doing something
Valuing	Displaying a commitment to something because of its inherent worth
Organization	Organizing a set of values and determining their relationships, including which should dominate
Characterization by value	Integrating values into a total philosophy and acting consistently in accord with that philosophy

TABLE 10.3 Simpson's Plan for Taxonomy of Psychomotor Outcomes

Perception	Becoming aware of stimulation and the need for action
Set	Preparing for action
Guided response	Responding with assistance from a teacher or coach
Mechanism	Responding habitually
Complex response	Resolving uncertainty and performing difficult tasks automatically
Adaption	Altering responses to fit new situations
Origination	Creating new acts or expressions

TABLE 10.4 Gagné's Taxonomy of Learning Outcomes with Examples

Learning Outcome	Definition	Example
Verbal Information	Stating previously learned material such as facts, concepts, principles and procedures	Listing the seven major symptoms of cancer
Intellectual Skills		
Discrimination	Distinguishing objects, features, or symbols	Feeling the difference in texture between two fabrics being considered for drapery linings
Concrete concepts	Identifying classes of concrete objects, features, or events	Picking all the wrenches out of a toolbox
Defined concepts	Classifying new examples of events or ideas by their definition	Noting the armed conflict between two peoples in a country as a "civil war"
Rules	Applying a single relationship to solve a class of problems	Calculating the earned run averages (ERAs) of the Atlanta Braves
Higher order rules	Applying a new combination of rules to solve a complex problem	Generating a plan to manage a major change in a client organization
Cognitive Strategies	Employing personal ways to guide learning, thinking, acting, and feeling	Incorporating visual displays into a presentation for a client
Attitudes	Choosing personal actions based on internal states of understanding and feeling	Choosing to respond to all incoming e-mail within 24 hours
Motor Skills	Executing performances involving the use of muscles	Performing CPR on a person who has stopped breathing

to diagnose the probable cause of a particular patient's distress (an example of problem solving), a doctor would rely on his or her knowledge of symptoms associated with particular diseases.

Gagné's conception of verbal information appears to incorporate the first two levels of Bloom's taxonomy, knowledge and comprehension.

Sometimes, for instance, learners memorize information without regard to its meaning. Although they may then be able to recite what was learned, they probably cannot give an adequate account of it in their own words. On the other hand, when comprehension has occurred, learners can paraphrase or otherwise explain the information that was acquired. In this case, the information no longer remains isolated in memory but becomes integrated within a larger context of related ideas. For obvious reasons, comprehension is usually considered to be a more desirable educational goal than inert, memorized knowledge.

Intellectual Skills. A second category in the cognitive domain of Gagné's taxonomy is that referred to as intellectual skills (Gagné, 1985). **Intellectual skills** are the equivalent of *procedural knowledge* and are divided into five, hierarchically ordered subcategories. These are: discriminations, concrete concepts, defined concepts, rules, and higher-order rules.

Gagné's proposal to subdivide the intellectual skill category grew out of his work with learning hierarchies (e.g., Gagné, 1968, 1977). A **learning hierarchy** refers to *a set of component skills that must be learned before the complex skill of which they are a part can be learned* (Gagné, 1985). The hierarchy itself results from an analysis of the desired terminal skill in terms of its prerequisites. Moreover, the relationship between each skill in the hierarchy and its immediate prerequisite is one of "necessary, whether or not sufficient." Consider the example shown in Figure 10.2.

According to the assumptions of learning hierarchies, students must already be able to distinguish triangles from other shapes (Box 2) before they will be able to learn the identifying characteristics of triangles (Box 4). In other words, if they cannot see a perceptual difference between triangles and, say, squares, they will be unable to identify examples of triangles. Thus, the discrimination skill is a necessary (and sufficient) prerequisite to the identification skill. Similarly, identification of right triangles (Box 5) requires identification of triangles and right angles. These two identifications are each necessary and together sufficient for the final skill to be acquired.

Learning hierarchies provide three distinct advantages for planning instruction (Gagné & Medsker, 1996). First, they ensure that instruction is complete by identifying all the components of an intellectual skill that could be included in a lesson. Second, they enable appropriate sequencing of instruction by showing what components must be learned before others are tackled. Finally, they provide for efficient instruction by focusing on essential components rather than extraneous or "nice-to-know" topics.

Based on the types of relationships that could result from an instructional analysis, Gagné proposed the five levels of intellectual skills. Discrimination is the ability to distinguish, on the basis of perceptual characteristics, one object from another, one feature from another, one symbol from another. Discrimination is also prenominal, which means that some difference

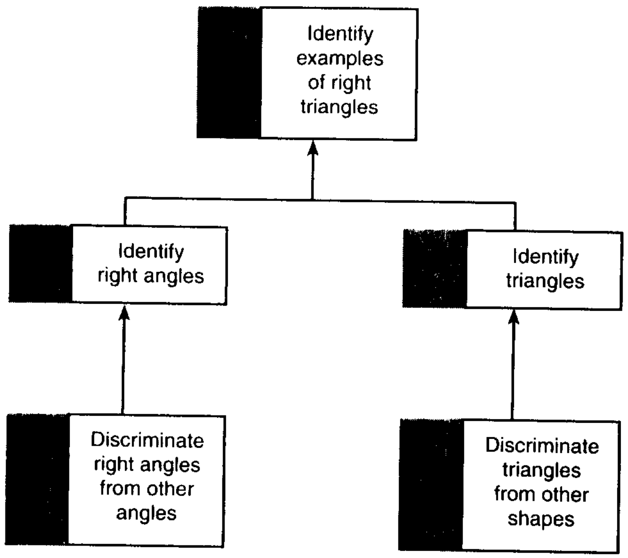


FIGURE 10.2 A Simple Learning Hierarchy

is detected without the learner being capable of naming or explaining that difference. In other words, infants can feel and respond to differences in textures of cloth without the words to express *smooth* or *rough*. Similarly, my husband can distinguish among different colors quite plainly, but apparently he never learned the same color terms as the rest of us. For instance, he can draw matching socks out of his drawer, but he is likely to call a green dress "purple" or a tan car "brown."

Humans typically acquire many gross discriminations pertaining to the environment at a very young age. Then with experience, these discriminations increase in the fineness of detail to which they refer (Gagné & Driscoll, 1988). Certain environmental circumstances also demand that finer discriminations be developed. Eskimos, for example, can distinguish many more snow conditions than the average person who lives where snow is not common. Likewise, counselors have learned to detect subtle differences in the facial expressions of their clients, microbiologists have learned to see tiny irregularities in the shape and makeup of cells, and sailors have learned to feel almost imperceptible changes in wind direction or velocity.

Once prerequisite discriminations have been acquired, concept learning can occur. According to Gagné (1985), concrete concepts are classes of objects, features, and events, distinguishable by their perceptual characteristics and identifiable by name. So, for example, young children learn such concrete

concepts as colors, shapes, and letters of the alphabet. At a more advanced level, a home carpenter must learn to identify wood screws and toggle bolts, whereas a mechanic should know engine oil and brake fluid.

Many concepts, however, cannot be pointed out directly but must be identified by means of a definition. Gagné (1985) called these defined concepts and argued that for learners to have truly acquired defined concepts, they must use the definitions for classifying new instances. It is not enough, therefore, to say that "positive reinforcement means increasing the occurrence of some behavior by rewarding it." One must recognize examples such as a child speaking up in class more often following encouragement by the teacher.

Tessmer, Wilson, and Driscoll (1990) agreed with Gagné that defined concepts make up a significant part of school learning. They suggested, however, that classification of new examples is not the only desirable outcome of defined concept learning. Some defined concepts, such as perestroika or beauty, do not always yield clear or unambiguous examples. A learner's understanding of such terms might be better assessed in other ways. Tessmer et al. (1990) suggested, as alternatives to concept classification, asking learners to generate inferences or reason through some problem involving the concept in question.

Although a defined concept is arguably the simplest type of rule, rule learning typically involves the use of symbols to represent and interact with the environment in generalized ways (Gagné & Driscoll, 1988). There are rules for decoding words, for constructing grammatical sentences, for calculating averages, and for factoring equations. What is particularly important about rule learning is not whether students can verbalize, or state, the rule. Rather, it is whether they can demonstrate the rule by applying it appropriately to a class of problems, even problems that have not been encountered before.

Finally, higher-order rules represent combinations of simpler rules for the solving of complex problems. "A higher-order rule is still a rule and differs only in complexity from the simpler rules that compose it" (Gagné & Driscoll, 1988, p. 52). Higher-order rules are thought to develop when learners must apply a new combination of rules already known and used individually. This would occur, for example, when a carpet layer must determine how much carpet is required to cover an irregularly shaped room. This is a novel problem, because the carpet layer has not encountered a room with quite this shape before, but it is a solvable one using standard rules of geometry. Similarly, when a nutritionist devises meal plans for a given client, he or she applies standard rules in a unique way to meet the particular needs of that person.

Altogether, Gagné's intellectual skills incorporate reasonably well the remaining four levels of Bloom's taxonomy. Application is demonstrated in concept and rule use, whereas analysis, synthesis, and evaluation are all, to some degree, present in higher-order rule using (or problem solving). In order to determine what rules are likely to be effective for solving a given problem, the learner must analyze it, generating subproblems or taking note of important constraints. Applying some combination of rules to solve the problem represents a synthesis. Evaluation occurs when the learner monitors the success of the selected rules for effecting a solution. It also seems likely, however, that analysis, synthesis, and evaluation would also be present in the next category of Gagné's taxonomy.

Cognitive Strategies. **Cognitive strategies** consist of *numerous ways by which learners guide their own learning, thinking, acting, and feeling.* Gagné (1985) conceived of cognitive strategies as representing the executive control functions of information processing, and they compose what others have called conditional knowledge. As such, learners employ cognitive strategies to monitor their own attention, to help themselves better encode new information, and to improve their success at remembering critical information at test time. Learners may arrive at these strategies through their own trial-and-error experiences, or they may be explicitly taught strategies that have proven effective with other learners.

Developing unique as well as effective cognitive strategies is typically considered a part of learning to learn and learning to think independently. Unfortunately, a difficulty with cognitive strategies as desirable learning outcomes is that they are not particularly amenable to assessment. Frequently, because cognitive strategies are employed in the service of other learning goals, it is the attainment (or not) of those goals that is noticed. What cognitive strategies were used is often not immediately evident.

Another aspect of learning to think independently, however, is learning to think creatively, and it is creative thinking where we may detect better evidence of effective cognitive strategies. What constitutes creative thinking is certainly a matter of some debate, but most would agree that it involves originality, seeing problems in new and insightful ways, or finding a solution to what others did not recognize as a problem. Bruner (1973b) perhaps put it best when he distinguished between problem solving and problem finding. In problem solving, the learner tackles a problem defined by someone else. Moreover, the existing parameters of the problem generally constrain its solution, so that all solvers will arrive at more or less the same outcome. The carpet example described earlier illustrates this well. There are only so many ways to determine how much carpet is required, and all carpet layers (if they want to remain in business) will generate similar estimates for the same room.

By contrast, learners generate their own problems in problem finding and bring to bear upon them both previously acquired rules and their own personal ways of thinking (Gagné & Driscoll, 1988). As an example, consider the long, lamented decline in Scholastic Aptitude Test (SAT) scores that has been seen in the United States over the last 20 years. Some statisticians do not perceive this to be a problem, claiming the observed decline is merely an artifact of test construction procedures and statistical regression effects. Other educational researchers, however, perceive the decline in scores to be a symptom of some educational problem. How they define what the problem is determines what actions they take to generate solutions. As a result, many different solutions are offered to what is thought to be wrong with the American education system. These solutions, then, are the outcomes, or evidence, of cognitive strategies.

Attitudes. Whereas verbal information, intellectual skills, and cognitive strategies are all part of the cognitive domain, attitudes are considered to be in affective domain. Gagné (1985) defined **attitudes** as *acquired internal states that influence the choice of personal action* toward some class of things, persons, or events. For example, one's attitudes toward pollution and ecology will affect the purchasing of substances in aerosol spray cans, which have been shown to have a deleterious effect on the earth's ozone layer. Likewise, choosing to save part of one's income every month reflects attitudes toward money and the future. Finally, attitude learning is likely to be involved in several ways in the A&B Agency scenario. Any employee who knows that sexual harassment is illegal and not tolerated within the Agency can still engage in such behavior. Similarly, employees who learn Agency policies regarding sexual harassment can choose not to report observed incidences.

When attitudes are organized into a consistent set, philosophy, or worldview that governs subsequent personal action, then they are typically referred to as values. According to taxonomy of affective outcomes (cf. Krathwohl et al., 1964), we may consider Gagné's definition of attitudes to incorporate the first two levels of receiving and responding. These two levels also highlight two of the three accepted components of attitude formation: the informational component and the behavioral component. That is, information pertaining to an attitude must be known to a learner before he or she can choose to respond in a particular way. The response itself constitutes the behavioral component. The third, or emotional, component of attitude formation refers to the feelings that frequently accompany the choice of personal action. As we shall see later in the chapter, all three components are important to consider when designing instruction to teach or influence attitudes.

Finally, notice the similarity between Gagné's concept of attitude and motivation as discussed in the previous chapter. Clearly, attitudes can serve as motivating forces, and motivating learners is, to some extent, a matter of attempting to instill certain attitudes in them. Motivation, however, is probably a more transitory state than that typically associated with attitudes. For example, a student who is interested in a particular subject may be motivated to attend class regularly. Given a different class, however, the same student may choose to come irregularly, if at all. By contrast, a student with a positive attitude toward school (including obedience to its rules and regulations) is likely to attend all classes regularly, regardless of how interesting or boring they may be.

Motor Skills. The fifth type of outcome in Gagné's taxonomy, corresponding to the psychomotor domain, is motor skills. By **motor skills,** Gagné means the *"precise, smooth and accurately timed execution of performances involving the use of muscles"* (Gagné & Driscoll, 1988, p. 59). Examples of motor skills include serving a tennis ball, executing a triple axle jump in ice skating, dribbling a basketball, and lifting a barbell with weights. These are performances all associated with sports and all continuous in nature. That is, although each skill can be roughly subdivided into component movements (e.g., a tennis serve consists of the toss, contact, and follow-through), it is intended to be performed in a single fluid motion.

Other examples of motor skills, however, are complex procedures made up of discrete subskills. For example, a dance may call for a series of discrete steps to be performed. Rounding a mark in a sailboat regatta requires raising one sail, lowering another, resetting the positions of the sails, and moving the tiller to change the direction of the boat. Taking a blood sample from a patient requires putting a cuff around the patient's arm, locating a vein, sterilizing the point of injection, and so on. These examples, along with those above, also illustrate that motor skills are generally acquired in combination with various cognitive skills. To play tennis competitively, for instance, one must know the rules of the game and play strategically, in addition to executing the shots with precision. Therefore, not only motor skills, but also intellectual skills and cognitive strategies, are involved.

As indicated previously, Gagné, like other instructional theorists, proposed his taxonomy with the assumption that different outcomes call for different learning conditions. Thus, during the design of instruction, complex learning goals like those cited above must be considered for their multiple types of outcomes and learning conditions provided that will support the attainment of all components. Just what learning conditions should be provided is the subject of the next section.

Conditions for Learning

In order to plan what learning conditions should be present in instruction, Gagné, Briggs, and Wager (1992) recommended categorizing learning goals according to the type of outcome they represent. From the standpoint of the teacher or instructional designer, this means some very careful consideration of just what ends or results are desired. It may also mean making reasonably concrete what are otherwise fuzzy, vague, or unspecified goals. For example, the goal of an instructor in the Medical School scenario might be that students "understand views associated with a patient's 'right-to-die'." What does this mean to the instructor? It probably does not suggest that students must be able to recite the arguments leading to a 1997 Supreme Court decision on a "right-to-die" case. Nor is it likely to mean that students must adopt a particular view. But to provide effective instruction, the medical school professor should decide more precisely what he or she expects of students.

There has been considerable controversy over the use and effectiveness of instructional objectives in facilitating learning. Objectives obviously spring from a behavioral tradition, because they are intended to specify the learned behavior that is desired of students (see Chapter 2). Most studies investigating their use, however, have shown either a small positive or no effect on intentional learning (i.e., that related directly to the objectives) and a deleterious effect on incidental learning (i.e., information unrelated to the objectives) (Klauer, 1984). Despite these results, objectives have gained and maintained a solid footing in education and training. Why?

To begin with, investigations on objectives can be faulted on several grounds, so that findings of no effect may not be true. First, most researchers defined objectives for the recall of information only. Second, the instruction used in the studies was typically very short, not more than a few pages. As a result, the objectives in some cases bore a one-to-one correspondence with the sentences in the experimental text. Third, objectives were frequently employed with no regard for whether students knew how to use them, and, in fact, students are likely to disregard objectives unless they are shown how objectives can help them learn. Finally, the only outcome examined by most studies was some measure of student learning. Therefore, the potential benefit of objectives for anyone other than learners (e.g., teachers or designers) remained in question.

Although objectives may indeed be of limited benefit to learners, they can be extremely useful to teachers and other designers of instruction as a plan both for instruction and for testing. A central tenet of most instructional design models (e.g., Reiser & Dick, 1996; Gagné, Briggs, & Wager, 1992) and many texts on criterion-referenced testing (e.g., Gronlund, 1988; Tuckman, 1988) is that there should be congruence between instructional goals, lessons, and assessment measures. The only way to determine such congruence is from an initial statement of goals.

Once instructional goals have been categorized into types of learning outcomes, then, planning for instruction can proceed systematically. A teacher or instructional designer can determine just what unique conditions are required for learners to acquire each desired skill, knowledge, or attitude. Summarized in Table 10.5 are the external conditions that Gagné proposed as essential for learning the different varieties of outcomes. Recall

TABLE 10.5 A Summary of External Conditions That Can Critically Influence Learning of the Five Major Varieties of Learning Outcomes

Type of Learning Outcome	Critical Learning Conditions
Verbal Information	1. Draw attention to distinctive features by variations in print or speech. 2. Present information so that it can be made into chunks. 3. Provide a meaningful context for effective encoding of information. 4. Provide cues for effective recall and generalization of information.
Intellectual Skills	1. Call attention to distinctive features. 2. Stay within the limits of working memory. 3. Stimulate the recall of previously learned component skills. 4. Present verbal cues to the ordering or combination of component skills. 5. Schedule occasions for practice and spaced review. 6. Use a variety of contexts to promote transfer.
Cognitive Strategies	1. Describe or demonstrate the strategy. 2. Provide a variety of occasions for practice using the strategy. 3. Provide informative feedback as to creativity or originality of the strategy or outcome.
Attitudes	1. Establish an expectancy of success associated with the desired attitude. 2. Assure student identification with an admired human model. 3. Arrange for communication or demonstration of choice personal action. 4. Give feedback for successful performance, or allow observation of feedback in the human model.
Motor Skills	1. Present verbal or other guidance to cue the executive subroutine. 2. Arrange repeated practice. 3. Furnish immediate feedback as to the accuracy of performance. 4. Encourage the use of mental practice.

Source: From Gagné, R. M. & Driscoll, M. P. *Essentials of learning for instruction* (2nd ed.). Boston, MA: Allyn and Bacon, 1988. Reprinted with permission.

that internal conditions are specified by the information-processing model and research conducted on human cognition.

Conditions for Learning Verbal Information. Assuming that verbal information is stored in vast, interrelated networks in human memory (see Chapter 3) or in schemata and mental models (see Chapter 4), how might instruction be planned to best facilitate learning of new information? To be meaningful, new information must be related in some way to what learners already know. Therefore, important internal conditions include the recall of related material. In addition, learners can process only so much information at one time because of the limitations of short-term memory.

As for external conditions, then, it is important to present information in meaningful chunks so as not to overload the learner's processing system. And for effective encoding to occur, a meaningful context must be either activated or provided. Techniques such as imagery, organizers (advance or comparative), themes, and mnemonics have proven to be effective for this purpose. Remember from Chapter 3 that whatever cues are used for encoding are also likely to be effective retrieval cues. Moreover, a greater variety of cues used during initial learning is likely to ensure better generalization of the information to appropriate but new contexts.

When planning instruction for verbal information outcomes, it is also important to remember that information is typically embedded in some larger context. Not everything a professor says in a lecture must be learned and retained in detail, for example. Similarly, textbooks, computer simulations, movies, and television documentaries present tremendous amounts of information—far more than a learner is expected to remember or use. Therefore, instructional tactics should be used that direct learners' attention to significant points. These include, for example, the use of italics and boldface print in textbooks or voice inflections and gestures in a lecture.

Conditions for Learning Intellectual Skills. Intellectual skills are similar to verbal information in that it is easy to overload the learner in their instruction. Whereas information had to be associated with previously learned and related ideas, intellectual skills build upon previously learned component skills. Therefore, these must be recalled for learning to proceed effectively. Moreover, multiple steps to a new skill should be presented in increments and at a pace that does not strain the limitations of short-term memory. Imagine the result, for example, if a statistics professor explained a new analysis procedure rather rapidly, in highly complicated steps and without defining terms.

As with information, the learning of intellectual skills requires the learner's attention to be directed, but in this case to distinctive features of the concept or rule to be learned. For example, the three sides of triangles distinguish them from other similar shapes and so should be emphasized to the learner. Likewise, staining slides can highlight features of cells or tissues to which biologists should attend when learning to distinguish normal from abnormal conditions.

When rules require a series of steps to be performed in sequence, instruction in their use should include cues as to the appropriate order of steps. These cues can range from verbal statements listing the steps, as might occur in long division, for example, to reminders of the conceptual basis for the rule. Converting temperatures between the Fahrenheit and Celsius scales, for example, can be cued with a reminder as to which number should be larger. "You're starting with a temperature on the Celsius scale. That's the smaller number. So that must mean..." (thus prompting the rule to multiply by 9/5 and add 32).

Finally, Gagné and Driscoll (1988) pointed out the ease and speed with which intellectual skills may be initially acquired, but the apparent difficulty with their being retained and widely applied in new situations. For example, students who appeared to understand the new statistical analysis procedure when the instructor went over it in class may experience problems trying to use it on new sets of data outside of class. They may also fail to recognize instances in which the use of the procedure would be appropriate. Therefore, practice with a variety of examples and problems is an essential external condition to facilitate the internal processes of retention and transfer (or generalization).

Conditions for Learning Cognitive Strategies. Internal conditions necessary for the acquisition of cognitive strategies include prior knowledge of the simple concepts and rules that make up highly general strategies, such as "Break the problem down into parts" (Gagné, 1985). But they may also include task-relevant concepts, rules, and information. In the case, for example, of developing a strategy to research the decline of SAT scores (a task-specific, undoubtedly complex strategy), learners must have prior research skills, know facts related to the SAT, and understand certain concepts of education.

What external conditions will facilitate the development of cognitive strategies is a matter of some debate. Certainly, many simple and task-oriented strategies are discovered by learners in their attempts to solve a problem or remember something for a test (Gagné, 1985). Other such strategies can apparently be established through demonstration or verbal instructions to the learner (Gagné & Driscoll, 1988). Teachers frequently remind learners to paraphrase, for example, when they say, 'Tell me in your own words what ____ [you fill in the blank] means," or "Don't just copy the definitions in your book; write them in your own words." More complex or difficult strategies may also require demonstration. The main idea of a textbook or lecture is

not always self-evident to learners, but identification can be easily modeled by a teacher who constructs outlines of important information.

Whether strategies are taught or discovered, learners must have ample opportunities to practice them, particularly in novel situations. The Cognition and Technology Group at Vanderbilt (1991a) lamented their students' inability to generate relevant plans for solving problems, which they attributed to a curricular emphasis on memorization of facts and practice on isolated subskills. They suggested as a solution more in-context practice on complex problems. Derry and Murphy (1986) also recommended that teachers of different subjects coordinate their efforts for developing strategies useful across disciplines. They stated, for example:

> One form of coordination is through the use of a common planning model, or metastrategy, called the Four C's Learning Plan. The four C's are as follows: clarify the learning situation, come up with a plan, carry out the plan, and check your results. Thus language arts teachers explain how reading and memorization tactics fit into the four C's, while math teachers explain problem-solving, and physical education teachers explain mood control tactics using the same framework. (p. 18)

Finally, Gagné and Driscoll (1988) considered the provision of informative feedback to be as important as the setting of problem situations. Learners must have some notion as to whether their strategic efforts are effective, creative, or efficient. In some situations, it may also be desirable to explicitly encourage learners to be systematic and efficient in their use of strategy. Duffield (1990) and Atkins and Blissett (1992), in separate studies investigating what children learn from instructional software that purports to teach problem-solving strategies, showed that learners most often used trial and error, despite feedback providing clues, which could be used systematically to solve the problem at hand. In neither case, however, were learners encouraged to adopt a systematic strategy or one that would help them solve the problem quickly. Indeed, reflection of any sort concerning strategy effectiveness was generally absent and not nurtured. Yet, such reflection may well be essential to cognitive strategy learning and so should be facilitated by relevant external conditions.

Conditions for Learning Attitudes. For any attitude to be learned and expressed, learners must already possess a variety of related concepts and information. If the attitude to be acquired is "Just say no to drugs," for instance, learners must know something about drugs and their effects. According to Gagné (1985), they must also understand the source of the attitudinal message, the situations in which drugs are likely to be encountered, and the actions likely to be involved in "just saying no." With these prerequisite internal conditions in place, attitudes may be established through a variety of external learning conditions.

Consistent with Skinner's views on the establishment of any behavior, some attitudes are likely to be acquired because they have been consistently reinforced over time. Consider, for example, the enjoyment of reading as a pastime activity. Individuals who like to read probably had parents who reinforced this activity at a young age, perhaps by reading to the child, discussing what was read, and ensuring that many interesting books were available to be read. Undoubtedly, the experience of being successful at the task also had a hand in establishing a positive attitude toward reading. As Gagné (1985) noted, repeated experiences of failure will tend to engender attitudes of dislike. Moreover, when these experiences occur in association with events that produce fear or other unpleasant feelings (as in a teacher, parent, or peers berating a person for failing), then the negative attitude that results may persist for years, changing only with great effort and difficulty.

An equally effective set of external conditions for altering or establishing attitudes can be found in human modeling (Bandura, 1969; Gagné, 1985). As we have already seen in the previous chapter, learners modified expectations of themselves and their own behavior after observing the behavior of models with whom they could identify. Because attitudes are a matter of choice, learning attitudes from models involves learning to make the same choices of action that they do. This occurs because people tend to want to "be like" those whom they respect or with whom they identify.

For modeling (or reinforcement) to be most effective in establishing attitudes, instructional conditions should (1) create an expectation in learners that they will be successful in the chosen activity, (2) provide for the activity associated with the attitude to be performed (by the model or the learner), and (3) give feedback for successful performance (Gagné & Driscoll, 1988). In the case of modeling, the latter is often communicated in a testimonial given by the model, as in a sports figure describing during a school visit the improvements in his life since getting off drugs.

Conditions for Learning Motor Skills. Whether a particular motor skill is made up of discrete subskills (e.g., a pattern dance) or continuous part-skills (e.g., a tennis serve), it nonetheless has component skills that must be mastered separately before they can be assembled into the single, terminal performance. These, then, comprise important internal conditions for the learning of motor skills. Also an essential prerequisite, however, is recall of the executive subroutine (Fitts & Posner, 1967), or procedure that dictates the sequence of movements.

As for external conditions, Gagné, along with many motor learning theorists (e.g., Singer & Dick, 1980) incorporated the three phases Fitts and Posner (1967) proposed for motor learning. These are: (1) the early cognitive phase, in which learners attempt to understand the executive subroutine; (2) the intermediate phase, during which learners alternate practice of the subskills with practice of the total skill; and (3) the final autonomous phase, in which skill performance becomes virtually automatic. With the increased emphasis on lifelong motor development that has accompanied recent theories of motor development, Gallahue and Ozmun (1995) characterized these three phases as transition (getting the idea of how to perform the motor skill), application (developing higher levels of skill through practice), and lifelong utilization (fine-tuning of skills over a lifetime of use).

Instructional conditions corresponding to these phases require methods for cueing the subroutines (such as verbal directions or demonstrations of the skill), repeated practice, and immediate feedback to correct errors and avert the possibility of bad habits developing. Gallahue and Ozmun (1995) also recommend a simple-to-complex and general-to-specific approach during practice that will enable learners to produce increasingly refined performances.

When learners reach the autonomous phase of skill development, mental practice may be useful in helping them reach their peak for competition (Singer, 1980). World class athletes, for example, report benefits of imagining their entire performance before they take their turn to compete. It is useful to remember, however, that only perfect practice makes perfect; imperfect practice simply leads to bad habits that may become nearly impossible to break.

Summary. The learning conditions described in this section appear to critically influence the learning of various outcomes. For this reason, Gagné and Driscoll (1988) referred to them as the building blocks for instruction. At the least, instruction should provide for these conditions, and when multiple outcomes are desired, all types of goals with their corresponding conditions should be considered. But planning instruction also requires taking care to support, throughout a lesson or course, all of the internal processes presumed to occur during learning regardless of what is being learned. Gagné (1985) referred to these external conditions as the events of instruction.

The Nine Events of Instruction

Recall from Chapter 3 that information is presumed to undergo a series of transformations as it passes through the stages of memory. Processes thought to be responsible for these transformations include attention, pattern recognition, retrieval, rehearsal, encoding, retention, and so on. Modifying the information flow, as well as setting processing priorities, are executive control processes. Because learning takes place only when these processes are activated, the goal of instruction, according to Gagné (1985), should be to facilitate this activation. And he proposed the events of instruction to do just that.

Listed in Table 10.6 are the nine events of instruction together with the internal processes that they support. Although Gagné believes that most lessons should follow the sequence of events as shown, he recognized that this order is not absolute (Gagné & Driscoll, 1988). Moreover, the manner in which the events are implemented may vary greatly depending upon the instructional delivery system that is chosen. What a teacher will do in the classroom, for example, is likely to differ markedly from activities embedded in a computer-based tutorial. But the effects of the two types of activities, in terms of learning, should be similar if both are designed to implement the same event of instruction. This point should become clearer as the instructional events are illustrated with specific examples. Let us now turn to an examination of these events.

Event 1: Gaining Attention. Since learning cannot occur unless the learner is in some way oriented and receptive to incoming information, gaining attention is the obvious first event that must occur in instruction. The importance of attention was also discussed in the previous chapter, where it played a prominent role in Keller's model of motivational design. Typically, gaining attention is accomplished by some sort of stimulus change, which may be repeated in various forms throughout a lesson to regain students' attention when they appear to be off-task. Examples include the teacher calling out particular students' names, using verbal signals such as 'Listen up, everybody," or turning the lights on and off. In mediated instruction, gaining attention might take the form of flashing signals on the screen or the sound of beeps indicating "Look for a message on the screen."

TABLE 10.6 Gagné's Nine Events of Instruction Associated with the Internal Learning Process They Support

Internal Process	Instructional Event	Action
Reception	1. Gaining attention	Use abrupt stimulus change.
Expectancy	2. Informing learners of the objective	Tell learners what they will be able to do after learning.
Retrieval to working memory	3. Stimulating recall of prior learning	Ask for recall of previously learned knowledge or skills.
Selective perception	4. Presenting the content	Display the content with distinctive features.
Semantic encoding	5. Providing "learning guidance"	Suggest a meaningful organization.
Responding	6. Eliciting performance	Ask learner to perform.
Reinforcement	7. Providing feedback	Give informative feedback.
Retrieval and reinforcement	8. Assessing performance	Require additional learner performance with feedback.
Retrieval and generalization	9. Enhancing retention and transfer	Provide varied practice and spaced reviews.

Source: Gagné, R. M. & Medsker, K. L. *The conditions of learning: Training applications.* Fort Worth: Harcourt Brace College Publishers, 1996. Reprinted with permission.

Event 2: Informing the Learner of the Objective. We saw in the previous chapter the effect that self-expectations can have on motivation. A similar case is holding an expectancy about what one is to learn will influence subsequent processing of information related to that expectancy. If, for example, learners are aware and prepared to learn certain information, they will be more alert to any stimuli related to that goal. Expectancies are easily established by simple statements of instructional goals, references to what students will be able to do after instruction, or demonstrations of anticipated learning outcomes. It should be noted that all students, whether young or mature, will develop expectations about what they are supposed to learn in any instructional situation. When the teacher or instructional material is not explicit about learning goals (or they are in conflict with one another), students are likely to take their cues from what happens in class and what appears on tests (Driscoll et al., 1990).

Event 3: Stimulating Recall of Prior Learning. Although new learning depends to a large extent on what has been learned before, students do not always call to mind and use relevant information when faced with a new learning task. This is perhaps truer of younger learners than older learners, simply because younger learners have not yet built a broad base of knowledge. However, as discussed in Chapter 5, the transfer of knowledge, i.e., the application of something previously learned to a new problem or in a new context, is difficult at any age. Therefore, to prepare learners for encoding or transfer, instructors should assist them in recalling relevant and prerequisite information.

Stimulating recall of prior learning can be as simple as reminding learners of what was studied the day before, or last week, in class. This is often observed in the quick reviews with which many teachers begin each day's activities. In some instances, however, simple reminders are not enough. It then becomes necessary to reinstate the prerequisite knowledge or skills by some practice activity (Gagné & Driscoll, 1988). An example can be seen in the following protocol, taken from Driscoll and Dick's (1991) observations of an eighth grade science teacher about halfway through an instructional unit on light and lenses.

> MLH is circulating about the classroom, helping individual kids as they ask questions. Then she goes to the board, puts up the formula—$t = d/r$

(*t* is time, *d* is distance, *r* is the speed of light)—and says, "Listen up, everybody. Remember how we do these problems. We're given the distance, which is what? 3.8 times 10 to the eighth meters. Right! And we know the speed of light through a vacuum. Remember, it's in your book. Yes, it's 3.0 times 10 to the eighth meters per second. So what do we do to figure out how long it will take for the light to go this far? Righhhht! That's good! Divide...." MLH goes on to give several more examples. The kids are apparently having difficulty with Question 1 under *READING CRITICALLY.* Several seem to have asked her a question about it, so she goes over the procedures again for everyone.

Considerable effort is often required for learners to transfer prior knowledge to new situations, even when they are aware that they have such relevant knowledge (Salomon & Perkins, 1989). Moreover, learners may simply find it easier to ask someone else for the answer than to figure it out for themselves. In situations in which the process of solving problems is an important goal of instruction, then, students should be prompted in ways that promote their persistence in "sticking with it."

Event 4: Presenting the Stimulus. This event of instruction depends upon what is to be learned. If the goal of instruction is information acquisition, then the stimulus may consist of a textbook chapter, lecture, or film containing the content. If, on the other hand, the desired outcome is intellectual skill learning, then the most effective stimulus is one that prominently displays distinctive features of the concept or rule to be learned. In Driscoll and Dick's (1991) observations, for example, the concept of focus was presented by the textbook in a diagram highlighting its essential features and by the teacher using a light box, lenses, and chalk dust. In the latter case, the teacher emphasized essential features of the concept through gestures and verbal explanations as she conducted the demonstration.

Presenting the stimulus for motor skill or cognitive strategy learning consists of demonstrating the desired outcome or giving verbal directions. For attitude learning, the stimulus is a demonstration of the desired action or choice, generally by a model. For all types of outcomes, the stimulus presentation should emphasize distinctive features or essential elements of the desired outcome in order to facilitate the processes of pattern recognition and selective perception.

Event 5: Providing Learning Guidance. How or what learning guidance is provided in instruction also depends upon the desired outcome, but the primary process to be facilitated is semantic encoding. Specifically, instructional activities should promote the entry of what is to be learned into long-term memory in a meaningful way. Here is where a teacher or instructional designer should refer to the learning conditions that are critical and unique to each type of learning outcome.

How much learning guidance to provide is a separate question and one that depends upon several factors, including the ability and sophistication of the learners, the amount of time available for instruction, and the presence of multiple learning goals. Very able or sophisticated learners probably require less guidance than not so able students. For example, highly educated communications technicians who attend training to learn the latest developments in technology typically approach the situation with very focused goals. "Just tell me what I should know or where I can find the required information," they say, indicating a need for mostly stimulus presentation and little learning guidance. By contrast, third grade children having difficulty reading are likely to require considerable learning guidance.

When the process or experience of learning and problem solving is to be emphasized, instructors may find it desirable to provide minimal learning guidance of a highly directive nature. Rather, discovery learning is stressed. Hints or cues are provided, but learners are expected to figure things out for themselves without being told just what to do. Because discovery learning can also be quite time consuming, instructors generally must weigh its benefits (e.g., facilitating long-term retention and transfer) against its costs (e.g., need for extensive resources and time). Remember as well that Ausubel argued against using discovery learning for most school situations because he believed that meaningful reception learning was as cognitively active and much more efficient. Bruner, however, would be more likely to argue that, although active cognition might be possible under conditions of receiving information, it does not occur very often that way. Certainly, instructor beliefs will also play a part in the decision to use discovery learning methods.

Event 6: Eliciting Performance. Instructional Events 1 through 5 presumably assure that learning has occurred, i.e., that what was to be learned has been sufficiently encoded and stored in long-term memory. Event 6, then, enables the learners to confirm their learning—to themselves, their teachers, and others. It requires the learner to produce a performance, something that is an appropriate indicator of what was learned. Remember that learning must be inferred from behavior, so for this event, an important question to answer concerns what behavior will serve as the best index of the desired learning goal.

The intent of eliciting performance is for learners to demonstrate what they have learned without penalty. In other words, this event provides an opportunity to gauge progress, with the assumption that errors are still undergoing correction and performance is still being improved. The next event, then, provides the learners with information useful for effecting performance improvement.

Event 7: Providing Feedback. Having shown what they can do, learners should be provided informative feedback on their performance. This implies, for knowledge and skills that call for discrete answers, telling the learners whether or not their answers are correct. If incorrect, feedback should assist learners in detecting and correcting their errors.

Kulhavy and Stock (1989) developed a feedback model from their research that explains how feedback works as a function of learners' confidence in their initial responses. Consider, for example, any test you have taken recently. You get the test back and discover marked wrong a question that you were really sure you had answered correctly. What would you do? According to Kulhavy and Stock's model, you would most likely pay careful attention to what the teacher says about that item when she goes over the test. Or, you might carefully search through your notes or the textbook to determine what your mistake had been. In either case, the feedback plays an important role in your correcting the error, and you will pay close attention to it.

By contrast, when learners get test items wrong that they were most unsure about anyway, feedback plays a different role. In this case, error correction is not so much the issue as learning better what the question was intended to assess. Instead of a definite misconception, the learner has only a vague conception. Feedback, then, should consist of reteaching or extended elaboration on the knowledge or skill in question.

Obviously, not all material to be learned consists of right and wrong answers. Motor skills, for example, may be performed correctly, but inexpertly or clumsily. Feedback, then, should be aimed at showing learners how to improve their current skill. Similarly, feedback for cognitive strategy learning may inform learners as to how their performance might become more strategic or more creative.

Event 8: Assessing Performance. Remember that learning was defined in terms of a change in behavior or performance that persists over time. In other words, a new skill must be performed dependably before most teachers will agree that it has been well learned. Therefore, after learners have had opportunities to demonstrate and refine their knowledge, it may be formally assessed. This event is typically carried out through unit or chapter tests, projects, portfolios, skill demonstrations, and so on. It also tends to be the basis on which student grades are assigned. Even with this event occurring so late in a lesson, however, Gagné and Driscoll (1988) stated that it is desirable for each correct performance to be given suitable feedback.

Event 9: Enhancing Retention and Transfer. Although this is the last event in the series, instructional activities to enhance retention and transfer are frequently built into the instruction at a much earlier phase. It has already been suggested, for instance, that a variety of examples and contexts are critical learning conditions for learners to be able to transfer intellectual skills appropriately. These would most likely be planned during Event 5, providing learning guidance. Similarly, spaced reviews facilitate retention of intellectual and motor skills and could be planned as several iterations of Events 6 and 7, eliciting performance and providing feedback.

Attitude learning perhaps has unique requirements for retention and transfer. Many attitudes, such as that pertaining to drug use, are unlikely to be performed in the context of the original instruction. That is, it would be unethical, not to mention illegal, for a teacher to offer drugs to students in the hope that they would say no and that behavior would be appropriately reinforced. Therefore, activities should be used, such as role plays or discussions centered around scenarios and questions of "What would you do if...?". The point of these activities is to encourage students to reflect upon their own knowledge and belief systems as they are exposed to those of other people. Finally, computer-based simulations, albeit still in their infancy, are likely to prove useful in helping students to examine their own attitudes in a wide variety of situations. Simulations can show students what the consequences of their decisions can be, thus making more personal the information associated with attitudes.

Summary: Planning Instructional Events. Does effective instruction depend upon the inclusion of all nine events of instruction? Is the teacher or instructional designer always responsible for planning the instructional events? Cannot learners sometimes be held responsible for their own instruction? In answer to these questions, the choice of instructional events, and who makes that choice, should depend upon the nature of the learning situation (Gagné & Driscoll, 1988). For example, in the classroom that Driscoll et al. (1990) studied, the teacher reviewed material frequently (Events 3 and 9), perhaps because the textbook did a poor job of it. Using cooperative learning structures, however, she often relied on the students to provide each other with both learning guidance and feedback.

Finally, "including more instructional events than are necessary is likely to lead to boredom on the part of the students. Providing fewer than are needed, however, has the serious consequence of inadequate learning, misdirected learning, or no learning at all" (Gagné & Driscoll, 1988, p. 131). Gagné and Medsker (1996) noted that many training failures occur because one or more of the nine events of instruction has been omitted. For example, either practice is not included or insufficient practice is included, with the expectation that the information from a lecture or one-way communication will be enough. As they point out, "Hearing about a new product line does not mean that salespeople can describe it to customers or use the information to determine customer needs. 'Being exposed' to the latest technologies does not ensure that engineers can apply them in their work. Yet many training programs offer no practice, too little practice, or inappropriate practice" (Gagné & Medsker, 1996, p. 151). Perhaps the best guide to planning instructional events is the students themselves.

An Application of Gagné's Instructional Theory

Throughout this chapter, we have examined the components of Gagné's instructional theory and what each implies for the design of instruction. But we have not yet seen how the theory might be applied from start to finish in the solving of a complex instructional problem. Let us reexamine the Medical School scenario and see how Gagné's theory might play out.

To begin with, we must determine what sort of learning outcome is desired. Because the details provided in the scenario are limited, assumptions will have to be made about the intent of the medical school instructors. Let us assume that the outcome of interest is something like this:

> Students will appropriately diagnose a medical problem based on the presenting symptoms of the patient.

Using Gagne's taxonomy as a guide, this outcome would probably be classified as the intellectual skill of problem solving. While that sounds simple enough, an analysis of the desired outcome would undoubtedly reveal that a considerable amount of prerequisite knowledge and skills must be acquired before medical students would be capable of mastering this desired outcome. Imagine, for example, the vast array of possible medical conditions and their attendant symptoms that any given patient might present. By the time medical students start making diagnoses, they would have learned discriminations (e.g., is the patient's temperature elevated from normal?), concepts (e.g., basal metabolic temperature), rules (e.g., how to read a thermometer or blood pressure monitor), motor skills (e.g., how to withdraw a sample of blood or insert a catheter), and verbal information (e.g., an elevated temperature is often the first sign of infection).

Once the desired outcome is determined, one would consider the conditions necessary to learn that outcome. In the case of intellectual skills, previously learned component skills must be recalled, distinctive features of the skill to be learned must be apprehended, and the skill must be practiced, preferably in a variety of contexts (refer to Table 10.5 for the conditions of learning). What might those conditions suggest in this case? Assuming that students had appropriate prerequisite skills, effective instruction should, at least, provide opportunities for students to solve a variety of medical diagnostic problems. During the problem-solving process, instructors could

point out distinguishing characteristics of cases that point to one diagnosis over another, especially when symptoms are similar or present in more than one affliction. For example, elevated body temperature is a symptom caused by a variety of diseases, so it would not be the distinguishing feature that leads to a particular diagnosis.

How might the events of instruction be employed in designing instruction to teach medical diagnostic problem solving? It is particularly important at this point to consider who the students are and which events they might reasonably be expected to supply for themselves. At the risk of promoting stereotypes, it is probably safe to assume that most medical students are motivated to learn diagnostic procedures, so that their attention is readily assured. Likewise, the instructional objective of diagnosing illness is implicit in all of their training. Therefore, Events 3 through 9 are probably the most important to include in this instruction (refer to Table 10.6).

What strategies are chosen to implement the events of instruction depends at this point on a variety of factors, such as the availability of resources and the inclusion of other objectives in the instruction. For example, medical case books abound that provide descriptions of patients that could be used for diagnostic problem solving. However, when the time comes for medical students to learn how to solicit information about symptoms from patients, then it would be important for them to have contact with real patients.

Regardless of what instructional strategies are chosen or the form the instruction takes in the end, instructional design theorists point to the importance of formatively evaluating the instruction to make sure it is effective (Dick & Carey, 1996; Gagné, Briggs, & Wager, 1992). If it is not, then revisions would be undertaken to improve those aspects of the instruction that are not performing as desired.

Conclusion

Gagné's instructional theory is widely used in the design of instruction by instructional designers in many settings, and its continuing influence in the field of educational technology can be seen in the more than 130 times that Gagné has been cited in prominent journals in the field during the period from 1985 through 1990 (Anglin & Towers, 1992). The increasing interest in constructivism, however, has caused researchers to question theories like Gagné's and to examine whether they are compatible with the goals and assumptions of constructivist epistemology.

In a case study investigating a particular teacher's implementation of cooperative learning, for example, Flynn (1992) attempted to determine if and how Gagné's events of instruction are carried out in a cooperative learning structure. He concluded that the two approaches—cooperative learning and the events of instruction—each brought something valuable to the understanding of what went on in that classroom. More such studies are necessary, however, to determine just what is illuminated or obscured by each perspective about learning.

In the next chapter, the various approaches to constructivism are discussed, with contrasts drawn to the theory discussed in this chapter.

SUGGESTED READINGS

Gagné, R. M. (1985). *The conditions of learning.* (4th ed.). New York: Holt, Rinehart & Winston.

Gagné, R. M., Briggs, L. J., and Wager, W. W. (1992). *Principles of instructional design.* (4th ed.). Fort Worth: Harcourt Brace Jovanovich.

Gagné, R. M., and Driscoll, M. P. (1988). *Essentials of learning for instruction.* (2nd ed.). Englewood Cliffs, NJ: Prentice-Hall.

Gagné, R. M., and Medsker, K. L. (1996). *The conditions of learning: Training applications.* Fort Worth: Harcourt Brace College Publishers.

REFLECTIVE QUESTIONS AND ACTIVITIES

1. Apply Gagné's taxonomy to a subject you expect to teach and generate examples in each category. Give your examples (randomly ordered) to a fellow student and ask him or her to sort the examples into the same categories. Do your categorizations agree? Discuss any disagreements. Try to reach consensus on the usefulness of Gagné's conception of learning outcomes.

2. Select a unit of instruction, such as a single topic in a course syllabus or a stand-alone, independent study module. Examine this instruction (and its accompanying materials, such as textbooks, lectures, handouts, and the like) from the perspective of Gagné's theory. What features would be considered well designed, and what features does it lack to be "good instruction"? Predict what effects this instruction is likely to have on learners. If it is possible, observe learners going through the instruction and compare its actual effects to those you predicted.

3. Rewrite one of the instructional plans you have already generated in the course of reading this book. Apply Gagné's instructional theory. Evaluate the results in terms of the probable effects on learning. What has Gagné's theory added to the plan that was lacking before?

CHAPTER

11 Constructivism