Principles of Instructional Design

Fourth Edition

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10 The Events of Instruction

Planning a course of instruction makes use of the principles described in the preceding chapters: determining what the outcomes of instruction are to be, defining performance objectives, and deciding upon a sequence for the topics and lessons that make up the course. When these things have been done, the fundamental "architecture" of the course is ready for more detailed planning in terms of both teacher and student activities. It is time to give consideration to the bricks and mortar of the individual lesson.

Supposing, then, that the course of instruction has been planned so that the student may reasonably progress from one lesson to the next. How does one ensure that he or she takes each learning step and does not falter along the way? How is the student coaxed along during the lesson itself? How does one, in fact, *instruct* the student?

THE NATURE OF INSTRUCTION

In designing the architecture for the course, we have said virtually nothing about how instruction itself may be done. During a lesson, there is progress from one moment to the next as a set of events acts upon and involves the student. This set of events is what is specifically meant by *instruction*.

The instructional events of a lesson may take a variety of forms. They may require the teacher's participation to a greater or lesser degree, and they may be determined by the student to a greater or lesser degree. In a basic sense, these events constitute a set of *communications to the student*. Their most typical form is as verbal statements, whether oral or printed. Of course, communications for young children may not be verbal but instead use other media of communication such as gestures or pictures. But whatever the medium, the essential nature of instruction is most clearly characterized as a set of communications.

The communications that make up instruction have the sole aim of aiding the process of learning—that is, of getting the student from one state of mind to another. It would be wrong to suppose that their function is simply "to communicate" in the sense of "informing." Sometimes it appears that teachers are inclined to make this mistake—they "like to hear themselves talk," as has sometimes been said. There is perhaps no better way to avoid the error of talking too much than to keep firmly in mind that communications during a lesson are to facilitate learning and that anything beyond this is mere chatter. Much of the communicating done by a teacher is essential for learning. Sometimes a fairly large amount of teacher communication is needed; on other occasions, however, none may be needed at all.

Self-Instruction and the Self-Learner

Any or all of the events of instruction may be put into effect by the learner himself when he is "self-instructing." Students engage in a good deal of self-instruction, not solely when they are working on programmed materials, but also when they are studying textbooks, performing laboratory exercises, or completing projects of various sorts. Skill at self-instruction may be expected to increase with the age of the learners, as they gain in experience with learning tasks. Events of the lesson, designed to aid and support learning, require teacher activities to a much greater extent in the first grade than they do in the tenth. As learners can experience and continue to pursue learning activities, they acquire more and more of the characteristics of "self-learners." That is, they are able to use skills and strategies by which they manage their own learning.

The events of instruction to be described in this chapter, therefore, should not be viewed as being invariably required for every lesson and every learner. In practice, a judgment must be made concerning the extent of self-instruction the learner is able to undertake. A more extensive consideration of self-instruction in systems of individualized instruction is contained in Chapter 14.

Instruction and Learning

The purpose of instruction, however it may be done, is to provide support to the processes of learning. It may, therefore, be expected that the kinds of events that constitute instruction should have a fairly precise relation to what is going on within the learner whenever learning is taking place. To undertake instructional design at the level of the individual learning episode, it appears necessary to derive the desirable characteristics of *instructional events* from what is known about *learning processes*.

Although we are unable within the confines of this book to describe modern theoretical notions of learning processes in detail, it appears worthwhile to provide a brief account of learning theory, which the reader may wish to supplement by reference to other works. In particular, we are concerned with establishing a sound basis in learning theory for the derivation of instructional events. Each of the particular events that make up instruction functions to aid or otherwise support the acquisition and the retention of whatever is being learned. These functions of external events may be derived by consideration of the internal processing that makes up any single act of learning. The kinds of internal processing to which we are referring are those involved in modern cognitive learning theories (Anderson, 1985; Estes, 1975; Klatzky, 1980).

The sequence of processing envisaged by cognitive theories of learning is approximately as follows (Gagné, 1977, 1985). The stimulation that affects the learner's receptors produces patterns of neural activity that are briefly "registered" by *sensory registers*. This information is then changed into a form that is recorded in the *short-term memory*, where prominent features of the original stimulation are stored. The short-term memory has a limited capacity in terms of the number of items that can be held in mind. The items that are so held, however, may be internally rehearsed and, thus, maintained. In a following stage, an important transformation called *semantic encoding* takes place when the information enters the *long-term memory* for storage. As its name implies, in this kind of transformation, information is stored according to its meaning. (Note that in the context of learning theory, *information* has a general definition that includes the five kinds of learned capabilities distinguished in this book.)

When learner performance is called for, the stored information or skill must be searched for and *retrieved*. It may then be transformed directly into action, by way of a *response generator*. Frequently, the retrieved information is recalled to the *working memory* (another name for the short-term memory), where it may be combined with other incoming information to form new learned capabilities. Learner performance itself sets in motion a process that depends upon external *feedback*, involving the familiar process of *reinforcement*.

Figure 10-1 shows the relation between the structures involved in cognitive theories of learning and memory and the processes associated with them.

In addition to the learning sequence itself, cognitive theories of learning and memory propose the existence of *executive control* processes (not shown in Figure 10-1). These are processes that select and set in motion cognitive strategies relevant to learning and remembering. Control processes of this sort modify the other information flow processes of the learner. A control process may select a strategy of continued rehearsal of the contents of short-term memory, for example, or a cognitive strategy of imaging sentences to be learned. They may exercise control over attention, over the encoding of incoming information, and over the retrieval of what has been stored.

The *kinds of processing* presumed to occur during any single act of learning may be summarized as follows:

1. *Attention:* Determines the extent and nature of *reception* of incoming stimulation.
2. *Selective perception* (sometimes called *pattern recognition):* Transforms this stimulation into the form of object-features, for storage in short-term memory.
3. *Rehearsal:* Maintains and renews the items stored in short-term memory.
4. *Semantic encoding:* Prepares information for long-term storage.

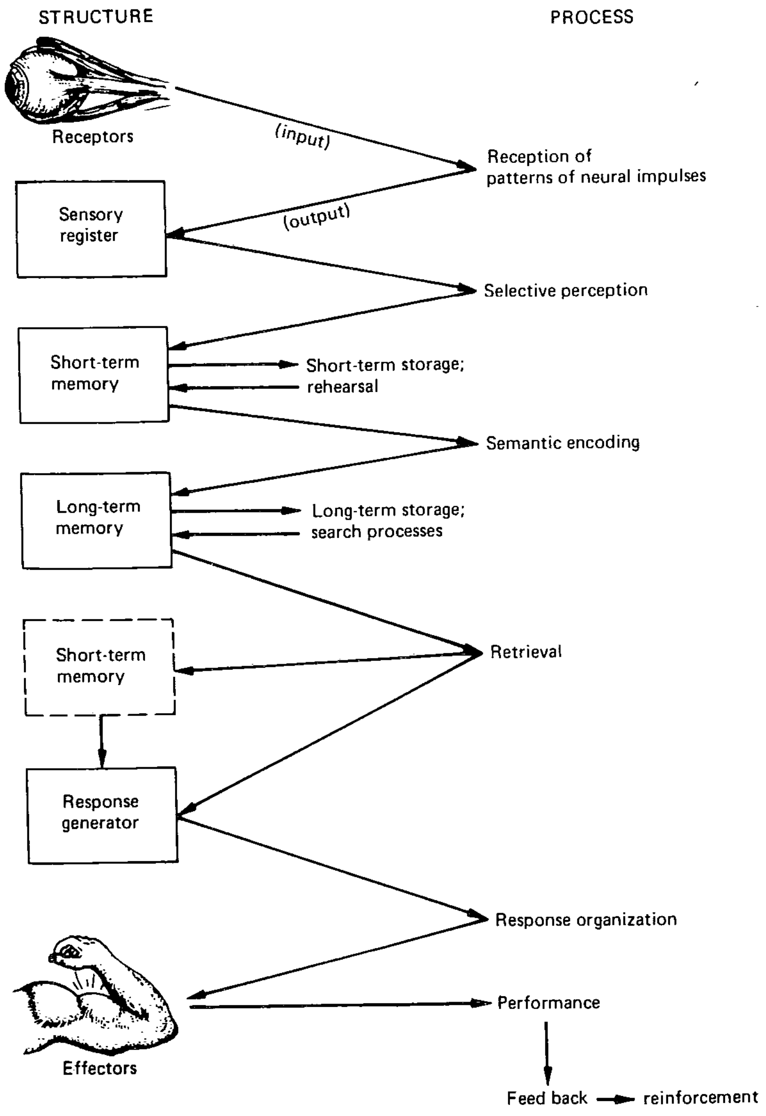

FIGURE10-1 **The Postulated Structures of Cognitive Learning Theories and the Processes Associated with Them**
(From R. M. Gagné, *The conditions of learning,* 4th ed., copyright 1985 by Holt, Rinehart and Winston, Fort Worth, TX. Reprinted by permission.)

5. *Retrieval,* including *search:* Returns stored information to the working memory or to a response generator.
6. *Response organization:* Selects and organizes performance.
7. *Feedback:* Provides the learner with information about performances and sets in motion the process of *reinforcement.*
8. *Executive control processes:* Select and activate cognitive strategies; these modify any or all of the previously listed internal processes.

Instructional Events

The processes involved in an act of learning are, to a large extent, activated internally. That is to say, the output of any one structure (or the result of any one kind of processing) becomes an input for the next, as Figure 10-1 indicates. However, these processes may also be influenced by *external* events, and this is what makes instruction possible. Selective perception, for example, may obviously be affected by particular arrangements of external stimuli. The features of a picture or text organized by perception may be influenced by highlighting, underlining, bold printing, and other measures of this general sort. Similarly, the particular kind of semantic encoding that is done in learning may be specified or suggested by meaningful information provided externally.

From these reflections on the implications of learning theory, one can derive a definition. Typically, *instruction consists of a set of events external to the learner designed to support the internal processes of learning* (Gagné, 1977, 1985). The events of instruction are designed to make it possible for learners to proceed from "where they are" to the achievement of the capability identified as the target objective. In some instances, these events occur as a natural result of the learner's interaction with the particular materials of the lesson, as, for example, when the beginning reader comes to recognize an unfamiliar printed word as something familiar in her oral vocabulary and, thus, receives feedback. Mostly, however, the events of instruction must be deliberately arranged by an instructional designer or teacher. The exact form of these events (usually communications to the learner) is not something that can be specified in general for all lessons, but rather must be decided for each learning objective. The particular communications chosen to fit each set of circumstances, however, should be designed to have the desired effect in supporting learning processes.

The functions served by the various events of instruction in an act of learning are listed in Table 10-1, in the approximate order in which they are typically employed (Gagné, 1968, 1985). The initial event of *gaining attention* is one that supports the learning event of reception of the stimuli and the patterns of neural impulses they produce. Before proceeding further, another instructional event is designed to prepare the learner for the remaining sequence. This is event number 2, *informing the learner of the objective,* which is presumed to set in motion a process of executive control by means of which the learner selects particular strategies appropriate to the learning task and its expected outcome. Event number 3 is also preparatory to learning and refers to the *retrieval of items* *of prior learning* that may need to be incorporated in the capability being newly learned. Events 4 through 9 of Table 10-1 are each related to the learning processes shown in Figure 10-1.

It should be realized that these events of instruction do not invariably occur in this exact order, although this is their most probable order. Even more important, by no means are all of these events provided for every lesson. Their role is to stimulate internal information processes, not to replace them. Sometimes, one or more of the events may already be obvious to the learner and, therefore, may not be needed. Also, one or more of these events are frequently provided by learners themselves, particularly when they are experienced self-learners. In designing instruction, the list of instructional events usually becomes a checklist. In using the checklist, the designer asks, "Do these learners need support at this stage for learning this task?"

Gaining Attention

Various kinds of events are employed to gain the learner's attention. Basic ways of commanding attention involve the use of stimulus change, as is often done in moving display signs or in the rapid "cutting" of scenes on a television screen. Beyond this, a fundamental and frequently used method of gaining attention is to appeal to the learner's interests. A teacher may appeal to some particular student's interests by means of a verbal question such as "Wouldn't you like to know what makes a leaf fall from a tree?" in introducing a lesson dealing with leaves. One student's interest may be captured by such a question as "How do you figure a baseball player's batting average?" in connection with a lesson on percentages. Naturally, one cannot provide a standard content for such questions—quite to the contrary since every student's interests are different. Skill at gaining attention is a part of the teacher's art, involving insightful knowledge of the particular students involved.

Communications that are partially or even wholly nonverbal are often employed to gain attention for school lessons. For example, the teacher may present a demonstration, perhaps exhibiting some physical event (a puff of smoke, an unexpected collision, a change in the color of a liquid), which is novel and appeals to the student's interest or curiosity. Or a motion picture or television scene may depict an unusual event and thus command attention.

A good preplanned lesson provides the teacher with one or more options for communications designed to gain attention. When instruction is individualized, the teacher is able to vary the content and form of the communication whenever necessary to appeal to individual student interests.

Table 10-1 **Events of Instruction and Their Relation to Processes of Learning**

Instructional Event	*Relation to Learning Process*
1. Gaining attention	*Reception* of patterns of neural impulses
2. Informing learner of the objective	Activating a process of *executive control*
3. Stimulating recall of prerequisite learning	*Retrieval* of prior learning to working memory
4. Presenting the stimulus material	Emphasizing features for *selective perception*
5. Providing learning guidance	*Semantic encoding;* cues for *retrieval*
6. Eliciting the performance	Activating *response organization*
7. Providing feedback about performance correctness	Establishing *reinforcement*
8. Assessing the performance	Activating *retrieval;* making *reinforcement* possible
9. Enhancing retention and transfer	Providing cues and strategies for *retrieval*

Informing the Learner of the Objective

In some manner or other, the learner should know the kind of performance that will be used as an indication that learning has, in fact, been accomplished. Sometimes this aim of learning is quite obvious, and no special communication is required. For example, it would be somewhat ridiculous to make a special effort to communicate the objective to a novice golfer who undertakes to practice putting. However, there are many performance objectives that may not be initially obvious to students in school. For example, if the subject under study is the Preamble to the United States Constitution, being able to recite it verbatim is not at all the same objective as being able to state its major ideas. If decimals are being studied, is it obvious to the student during any given lesson whether he or she is expected to learn to (1) read decimals, (2) write decimals, or perhaps, (3) add decimals? The student should not be required to guess what is in the instructor's mind. The student needs to be told (unless, of course, he or she already knows).

On the whole, it is probably best not to take the chance of assuming that the student knows what the objective of the lesson is. Such a communication takes little time and may at least serve the purpose of preventing the student from "getting entirely off the track." Communicating the objective also appears to be an act consistent with the frankness and honesty of a good teacher. In addition, the act of verbalizing the objective may help the teacher to stay "on target."

Of course, if objectives are to be communicated effectively, they must be put into words (or pictures, if appropriate) that the student can readily understand. For a six-year-old child, an objective like "given a noun subject and object and an active verb, formulate a correct sentence" must be translated into a communication that runs somewhat as follows: "Suppose I have the words 'boy,' 'dog,' and 'caught.' You could make them into a sentence, like 'The boy caught the dog.' This is called 'making a sentence,' and that's what I want you to do with the words I point to." Performance objectives, when used to describe a course of study, are typically stated in a form designed to communicate unambiguously to teachers or to instructional designers. The planning of instruction for a lesson, however, includes making the kind of communication of the lesson's objective that will be readily understood by students.

It is sometimes speculated that communicating an objective to students may tend to keep them from trying to meet still other objectives they may formulate themselves. No one has ever seen this happen, and the chances are it is a highly unlikely possibility. When one communicates a lesson's objective to students, they are hardly inclined to think that such a statement forbids them from giving further thought to the subject at hand. Working with an objective of "reading decimals," for example, it is not uncommon for a teacher to ask, "What do you suppose the sum of these decimals might be?" Thus, still another objective is communicated, about which the students are perfectly free to think about, while making sure that they have achieved the first objective. Naturally, one also wants the students to develop in such a way that they will think of objectives themselves and learn how to teach them to themselves. Nothing in the communication of a lesson's objectives carries the slightest hint that such activities are to be discouraged. The basic purpose of such communication is simply to answer the student's question, "How will I know when I have learned?"

When multiple objectives are to be attained, serving the purpose of an enterprise, here is the instructional event that may be elaborated to build a *goal schema.* The learner should be informed about the enterprise toward which the new learning is aimed as a basis for acquiring an appropriate *goal.* What kind of purposeful activity might the learner be engaged in once the multiple objectives of the lesson have been acquired? Is he likely to be asked to use his newly learned knowledge to pass a particular kind of test, to teach the knowledge to other people, to make some sort of practical application, or to solve a particular sort of problem? Whatever the enterprise is, it will draw upon the single objectives (verbal information, skills, attitudes) that make up the performance and that accordingly must be integrated into the goal. By means of verbal statements to the learner, a scenario is communicated that will relate the various single objectives to the goal.

Stimulating Recall of Prerequisite Learned Capabilities

This kind of communication may be critical for the essential event of learning. Much of new learning (some might say all) is, after all, the combining of ideas. Learning a rule about *mass* (Newton's second law of motion) involves a combination of the ideas of *acceleration* and *force,* as well as the idea of *multiplying.* In terms of modern mathematics, learning the idea of *eight* involves the idea of the *set seven,* the *set one,* and *joining.* Component ideas (concepts, rules) must be previously learned if the new learning is to be successful. At the moment of learning, these previously acquired capabilities must be highly accessible to be part of the learning event. Their accessibility is ensured by having them recalled just before the new learning takes place.

The recall of previously learned capabilities may be stimulated by asking a recognition or, better, a recall question. For example, when children are being taught about rainfall in relation to mountains, the question may be asked, "Do you remember what the air is like in a cloud that has traveled over land in the summer?" (The air is warm.) The further question may then be asked, "What is the temperature of the land on a high mountain likely to be?" (Cold.) This line of questioning recalls previously learned rules and obviously leads to a strand of learning that will culminate with the acquisition of a new rule concerning the effects of cooling on a warm, moisture-laden cloud.

Presenting the Stimulus Material

The nature of this particular event is relatively obvious. The stimuli to be displayed (or communicated) to the learner are those involved in the performance that reflects the learning. If the learner must learn a sequence of facts, such as events from history, then there are facts that must be communicated, whether in oral or printed form. If the learner is engaged in the task of pronouncing aloud printed words, as in elementary reading, then the printed words must be displayed. If the student must learn to respond to oral questions in French, then these oral questions must be presented since they are the stimuli of the task to be learned.

Although seemingly obvious, it is nevertheless of some importance that the proper stimuli be presented as a part of the instructional events. For example, if the learner is acquiring the capability of answering questions delivered orally in French, then the proper stimuli are *not* English questions or printed French questions. (This is not to deny, however, that such tasks may represent subordinate skills that have previously been used as learning tasks.) If the learner is to acquire the capability of using positive and negative numbers to solve verbally stated problems, then the proper stimuli are verbally stated problems and not something else. If one neglects to use the proper stimuli for learning, the end result may be that the learner acquires the "wrong" skill.

Stimulus presentation often emphasizes *features* that determine selective perception. Thus, information presented in a text may contain italics, bold print, underlining, or other kinds of physical arrangements designed to facilitate perception of essential features. When pictures or diagrams are employed, important features of the concepts they display may be heavily outlined, circled, or pointed to with arrows. In establishing discriminations, distinctive features may be emphasized by enlarging the differences between the objects to be distinguished. For example, in programs of reading readiness, large differences in shapes (such as those of a circle and triangle) may be introduced first, followed by figures exhibiting smaller differences. Distorted features of a *b* and *d* may be initially presented in order that the smaller differences of these letters will eventually be discriminated.

Stimulus presentation for the learning of concepts and rules requires the use of a *variety of examples.* When the objective is the learning of a concept such as *circle,* it is desirable to present not only large and small circles on the chalkboard or in a book, but also green circles, red ones, and ones made of rope or string. One might even have the children stand and join hands to form a circle. For young children, the importance of this event can hardly be overemphasized.

The failure to provide such a variety of examples accounts for the classic instance related by William James in which a boy could recognize a *vertical* position when a pencil was used as the test object, but not when a table knife was held in that position.

Comparable degrees of usefulness can be seen in the use of variety of examples as an event for rule learning. To apply the formula for area of a rectangle, $A = x \cdot y$, the student must not only be able to recall the statement that represents the rule, but he must know that A means area; he must understand what area means; he must know the x and y are the dimensions of two nonparallel sides of the rectangle, and he must know that the dot between x and y means to multiply. But even when all these subordinated concepts and rules are known, the learner must do a variety of examples to ensure that he understands and can use the rule. Retention and transfer are also likely to be enhanced by presenting problems stated in words, in diagrams, and in combinations of the two over a period of time.

Once such rules are learned, groups of them need to be selectively recalled, combined, and used to solve problems. Employing a variety of examples in problem solving might entail teaching the learner to break down odd-shaped figures into known shapes, like circles, triangles, and rectangles, and then to apply rules for finding the area of these figures as a way to arrive at the total area of the entire shape.

In the learning of both concepts and rules, one may proceed either inductively or deductively. In learning concrete concepts, like *circle* or *rectangle,* it is best to introduce a variety of examples before introducing the definition of the concept. (Imagine teaching a four-year-old child the formal definition of a circle before exposure to a variety of circles!) But for older learners who are learning defined concepts, a simple definition might best come first, such as "A root is the part of a plant below the ground." Assuming the learner understands the component concepts that are contained in the statement, this should be a good start, perhaps followed at once by a picture.

Providing Learning Guidance

Suppose one wishes a learner to acquire a rule (or it might be called a *defined concept)* about the characteristics of prime numbers. He might begin by displaying a list of successive numbers, say, 1 through 25. He then might ask the learner to recall that the numbers may be expressed as products of various factors: $8 = 2 \cdot 4 = 2 \cdot 2 \cdot 2 = 8 \cdot 1$, and so on. The learner could then be asked to write out all the factors for the set of whole numbers through 30. What is wanted now, as a learning outcome, is for the learner to discover the rule that there is a certain class of numbers whose only factor (or divisor) other than the number itself is 1.

The learner may be able to "see" this rule immediately. If not, he may be led to its discovery by a series of communications in the form of hints or questions.

For example, such a series might run somewhat as follows: "Do you see any regularities in this set of numbers?" "Do the original numbers differ with respect to the number of different factors they contain?" "In what way are the numbers 3, 5, and 7 different from 4, 8, and 10?" "In what way is the number 7 like the number 23?" "Can you pick out *all* the numbers that are like 7 and 23?"

These communications and others like them may be said to have the function of *learning guidance.* Notice that they do not "tell the learner the answer"; rather, they suggest the line of thought which will presumably lead to the desired "combining" of subordinate concepts and rules to form the new to-be-learned rule. Again, it is apparent that the specific form and content of such questions and hints cannot be spelled out in precise terms. Exactly what the teacher or textbook says is not the important point. It is rather that such communications are performing a particular function. They are stimulating a direction of thought and are thus helping to keep the learner on the track. In performing this function, they contribute to the efficiency of learning.

The amount of learning guidance, that is, the number of questions and the degree to which they provide "direct or indirect prompts," will obviously vary with the kind of capability being learned (Wittrock, 1966). If what is to be learned is an arbitrary matter such as the name for an object new to the learner (say, a pomegranate), there is obviously no sense in wasting time with indirect hinting or questioning in the hope that somehow such a name will be "discovered." In this case, just telling the student the answer is the correct form of guidance for learning. At the other end of the spectrum, however, are cases where less direct prompting is appropriate because this is a logical way to discover the answer, and such discovery may lead to learning that is more permanent than that which results from being told the answer.

Guidance for learning is an event that may readily be adapted to learner differences, as described in Chapter 6. Instruction that is highly didactic and that makes use of "low-level" questions is likely to find greatest appeal and effectiveness among learners of high anxiety, whereas low-anxiety learners may be positively affected by the challenge of difficult questions. As previously noted, guidance taking the form of frequent pictures and oral communications may aid learners of low ability in reading comprehension, whereas these measures may be quite inefficient with skillful readers.

The amount of hinting or prompting involved in the learning guidance event will also vary with the kind of learners. Some learners require less learning guidance than do others; they simply "catch on" more quickly. Too much guidance may seem condescending to the quick learner, whereas too little can simply lead to frustration on the part of the slow learner. The best practical solution may sometimes be to apply learning guidance a little at a time and allow the student to use as much as he needs. Only one hint may be necessary for a fast learner, whereas three or four may work better with a slower learner. Providing adaptive learning of this sort can readily be made part of a total system of computer-based instruction (Tennyson, 1984).

In the learning of attitudes, a *human model* may be employed, as indicated in Chapter 5. Models themselves, as well as the communications they deliver, may be considered to constitute the learning guidance in attitude learning. Thus, the total instructional event in this case takes a somewhat more complex form than is the case with the learning of verbal information or intellectual skills. The same function of semantic encoding is being served, however.

Eliciting the Performance

Presumably, having had sufficient learning guidance, the learners will now be carried to the point where the actual internal combining event of learning takes place. Perhaps they look less confused, or some indication of pleasure has crossed their faces. They have seen how to do it ! We must now ask them to show that they know how to do it. We want them not only to convince us, but to convince themselves as well.

Accordingly, the next event is a communication that in effect says "show me" or "do it." Usually, this first performance following learning will use the same example (that is, the same stimulus material) with which the learners have been interacting all along. For example, if they have been learning to make plurals of words ending in *ix* and have been presented with the word *matrix,* the first performance is likely to be production of the plural *matrices.* In most instances, the instructor will follow this with a second example, such as *appendix,* to make sure the rule can be applied in a new instance.

Providing Feedback

Although in many situations, it may be assumed that the essential learning event is concluded once the correct performance has been exhibited by the learner, this is not universally the case. One must be highly aware of the aftereffects of the learning event and their important influence on determining exactly what is learned. In other words, as a minimum, there should be feedback concerning the correctness or degree of correctness of the learner's performance. In many instances, such feedback is automatically provided—for example, an individual learning to throw darts can see almost immediately how far away from the bull's eye the dart lands. Similarly, a child who has managed to match a printed word with one in her oral vocabulary, which at the same time conveys an expected meaning, receives a kind of immediate feedback that has a fair degree of certainty. But, of course, there are many tasks of school learning that do not provide this kind of "automatic" feedback. For example, in practicing using the pronouns *I* and *me* in a variety of situations, is the student able to tell which are right and which are not? In such instances, feedback from an outside source, usually a teacher, may be an essential event.

There are no standard ways of phrasing or delivering feedback. In an instructional program, the confirmation of correctness is often printed on the side of the page or on the following page. Even standard textbooks for such subjects as mathematics and science customarily have answers printed in the back of the book. When the teacher is observing the learner's performance, the feedback communication may be delivered in many different ways—a nod, a smile, or a spoken word. Again in this instance, the important characteristic of the communication is not its content but its function: providing information to the learners about the correctness of their performance.

Assessing Performance

The immediate indication that the desired learning has occurred is provided when the appropriate performance is elicited. This is, in effect, an assessment of learning outcome. Accepting it as such, however, raises the larger questions of *reliability* and *validity* that relate to all systematic attempts to assess outcomes or to evaluate the effectiveness of instruction. These are discussed in a later chapter, and we shall simply state here their relevance to the single learning event.

When one sees the learner exhibit a single performance appropriate to the lesson objective, how does the observer or teacher tell that he or she has made a *reliable* observation? How does that person know the student didn't do the required performance by chance or by guessing? Obviously, many of the doubts raised by this question can be dispelled by asking the learner to "do it again," using a different example. A first grader shows the ability to distinguish the sounds of *mat* and *mate.* Has he been lucky, or can the child exhibit the same rule-governed performance with *pal* and *pale*? Ordinarily, one expects the second instance of the performance to raise the reliability of the inference (concerning the student's capability) far beyond the chance level. Employing yet a third example should lead to a higher probability so far as the observer is concerned.

How is the teacher to be convinced that the performance exhibited by the learner is *valid?* This is a matter that requires two different decisions. The first is, does the performance in fact accurately reflect the objective? For example, if the objective is to "recount the main idea of the passage in your own words," the judgment must be made as to whether what the student says is indeed the *main* idea. The second judgment, which is no easier to make, is whether the performance has occurred under conditions that make the observation *free of distortion.* As an example, the conditions must be such that the student could not have "memorized the answer" or remembered it from a previous occasion. The teacher must be convinced, in other words, that the observation of performance reveals the learned capability in a genuine manner.

Obviously, the single, double, or triple observations of performance that are made immediately after learning may be conducted in quite an informal manner. Yet they are of the same sort, and part of the same piece of cloth, as the more formally planned assessments described in a later chapter. There need be no conflict between them and no discrepancies.

Enhancing Retention and Transfer

When information or knowledge is to be recalled, the existence of the meaningful context in which the material has been learned appears to offer the best assurance that the information can be reinstated. The network of relationships in which the newly learned material has been embedded provides a number of different possibilities as cues for its retrieval.

Provisions made for the recall of intellectual skills often include arrangements for "practicing" their retrieval. Thus, if defined concepts, rules, and higher-order rules are to be well retained, course planning must make provision for systematic *reviews* spaced at intervals throughout weeks and months. The effectiveness of these spaced repetitions, each of which requires that the skill be retrieved and used, contrasts with the relative ineffectiveness of repeated examples given directly following the initial learning (Reynolds and Glaser, 1964).

As for the assurance of transfer of learning, it appears that this can best be done by setting some *variety* of new tasks for the learner—tasks that require the application of what has been learned in situations that differ substantially from those used for the learning itself. For example, suppose that what has been learned is the set of rules pertaining to "making the verb agree with the pronoun subject." Additional tasks that vary the pronoun and the verb may have been used to assess performance. Arranging conditions for transfer, however, means varying the entire situation more broadly still. This might be accomplished, in this instance, by asking the child to compose several sentences in which he himself supplies the verb and pronoun (rather than having them supplied by the teacher). In another variation of the situation, the student may be asked to compose sentences using pronouns and verbs to describe some actions shown in pictures. Ingenuity on the part of the teacher is called for in designing a variety of novel "application" situations for the purpose of ensuring the transfer of learning.

Variety and novelty in problem-solving tasks are of particular relevance to the continued development of cognitive strategies. As has previously been mentioned, the strategies used in problem solving need to be developed by the systematic introduction of occasions for problem solving, interspersed with other instruction. An additional event to be especially noted in the presentation of novel problems to the student is the need to make clear the general nature of the solution expected. For example, "practical" solutions may be quite different from "original" solutions, and the student's performance can easily be affected by such differences in the communication of the objective (cf. Johnson, 1972).

Instructional Events and Learning Outcomes

The events of instruction may be appropriately used in connection with each of the five kinds of learned capabilities described in Chapters 4 and 5. In the case of some instructional events, such as gaining attention, the particular means employed to bring about the event does not have to be different for intellectual skill objectives, say, and for attitude objectives. However, for learning guidance, the specific nature of the event is likely to be very different indeed. As we have seen in the previous section, the encoding of an intellectual skill may be guided by verbal instructions, such as communicating to the learner a verbal statement of a rule to be learned. In contrast, effective encoding of an attitude often requires a complex event that includes observation of a human model. The requirement of differing treatments of instructional events extends also to step 3, stimulating recall of prior learning, and to step 4, presenting the stimulus.

A summary of events 3, 4, and 5 for each type of learned capability is contained in Table 10-2, along with examples of the function served by these events. For each kind of learning outcome, appropriate conditions of learning are listed under each of the three events. These descriptions are not intended to be all inclusive; additional suggestions for the design of instructional events are given in the preceding paragraphs of this section.

Table10-2 **Functions of Instructional Events 3, 4, and 5 with Examples for Each of Five Kinds of Learning Outcomes**

Intellectual Skill

Event 3: Stimulate Recall of Prior Learning Essential for learner to retrieve to working memory prerequisite rules and concepts

Event 4: Present the Stimulus Display a statement of the rule or concept, with example giving emphasis to features of component concepts

Event 5: Provide Learning Guidance Present varied examples in varied contexts; also, give elaborations to furnish cues for retrieval

Cognitive Strategy

Event 3: Stimulate Recall of Prior Learning Recall task strategies and relevant intellectual skills

Event 4: Present the Stimulus Describe the task and the strategy, and show what the strategy accomplishes

Event 5: Provide Learning Guidance Describe the strategy and give one or more application examples

Verbal Information

Event 3: Stimulate Recall of Prior Learning Recall familiar well-organized bodies of knowledge related to the new learning

Event 4: Present the Stimulus Display printed or verbal statements, emphasizing distinctive features

Event 5: Provide Learning Guidance Elaborate content by relating to larger bodies of knowledge; use mnemonics, images

Attitude

Event 3: Stimulate Recall of Prior Learning Recall the situation and the actions involved in personal choice. Remind learner of human model

Event 4: Present the Stimulus Human model describes the general nature of the choice of personal action to be presented

Motor Skill

Event 3: Stimulate Recall of Prior Learning Recall the executive subroutine and relevant part skills

Event 4: Present the Stimulus Display the situation existing at the beginning of the skill performance. Demonstrate executive subroutine

Event 5: Provide Learning Guidance Continue practice with informative feedback

An inspection of the table will show that the particular form taken by each of these three instructional events depends upon the capability to be learned. For example, when an intellectual skill is to be learned, the stimulation of recall pertains to the retrieval of prerequisite concepts or rules; whereas if verbal information is to be learned, the recall of a context of organized information is required. Similar differences in the specific form of event 3, as well as events 4 and 5, may be noted throughout the table.

THE EVENTS OF INSTRUCTION IN A LESSON

In using the events of instruction for lesson planning, it is apparent that they must be organized in a flexible manner, with primary attention to the lesson's objectives. What is implied by our description of these events is obviously not a standard, routine set of communications and action. The invariant features of the single lesson are the functions that need to be carried out in instruction. Even these functions are adapted to the specific situation, the task to be accomplished, the type of learning represented in the task, and the students' prior learning. But each one of these functions should be specifically considered in lesson planning.

It is now possible to consider how these events are exemplified within an actual lesson. We have chosen, as an example, a set of instructions to the designer of a computer-based lesson, showing the implications of each instructional event for frame-by-frame design (Gagné, Wager, and Rojas, 1981). The lesson is about a *defined concept* in use of the English language, namely, the part of a sentence called the *object*. Instructions to the designer are outlined in Table 10-3.

It will be evident that this lesson in English grammar may best be conceived as part of a longer sequence in which such prior concepts as *sentence, subject,* and *predicate* have already been learned. For learners without such previous experience, instruction in the concept *object* would need to begin with simpler prerequisite concepts. It may be noted that the lesson is carefully planned in the sense that it reflects each of the instructional events described in this chapter. Obviously, it is an exercise in which the designer's art has considerable opportunity to flourish within the framework of events that support the desired learning.

Comparison with Lessons for Older Students

As instruction is planned for middle and higher grades, one can expect the events of instruction to be increasingly controlled by the materials of a lesson or by the learners themselves. Thus, when the units of instruction that make up a course of study are structurally similar, as may be the case in mathematics or beginning foreign language, for example, the objectives for each succeeding unit

Table10-3 **Events of Instruction in Design of a Computer-Based Lesson**

Instructional Event	*Procedure*
1. Gaining attention	Present initial operating instructions on screen, including some displays that change second by second. Call attention to screen presentation, using words like "Look!" "Watch!" etc.
2. Informing learner of lesson objective	State in simple terms what the student will have accomplished once he or she has learned. *Examples:* "Joe chased the ball." "The sun shines brightly." One of these sentences contains a word that is an *object*; the other does not. Can you pick out the object? In the first sentence, *ball* is the *object* of the verb *chased.* In the second sentence, none of the words is an object. You are about to learn how to identify the *object* in a sentence.
3. Stimulating recall of prior learning	Recall concepts previously learned. *Example:* Any sentence has a *subject* and a *predicate.* The subject is usually a noun, or a noun phrase. The predicate begins with a verb. What is the *subject* of this sentence? "The play began at eight o'clock." What verb begins the predicate of this sentence? "The child upset the cart."
4. Presenting stimuli with distinctive features	Present a definition of the concept. *Example:* An *object* is a noun in the predicate to which the action (of the verb) is directed. For example, consider the sentence, "The rain pelted the roof." The word *roof* is the *object* of the verb "pelted."
5. Guiding learning	Take a sentence like this: "Peter milked the cow." The answer is *the cow,* and that is the *object* of the verb. Notice, though, that some sentences do not have objects. "The rain fell slowly down." In this sentence, the action of the verb *fell* is not stated to be directed at something. So, in this sentence, there is no *object.*
6. Eliciting performance	Present three to five examples of sentences, one by one. Ask, "Type *O* if this sentence has an object; then type the word that is the object." *Examples:* "Sally closed the book." "The kite rose steadily."
7. Providing informative feedback	Give information about correct and incorrect responses. *Example: Book* is the object of the verb *closed* in the first sentence. The second sentence does not have an object.
8. Assessing performance	Present a new set of concept instances and noninstances in three to five additional pairs of sentences. Ask questions requiring answers. Tell the learner if mastery is achieved and what to do next if it is not.
9. Enhancing retention and learning transfer	Present three to five additional concept instances, varied in form. *Example:* Use sentences such as "Neoclassical expressions often supplant mere platitudes." Introduce review questions at spaced intervals.

Note. From "Planning and authoring computer-assisted instruction lessons" by R. M. Gagné, W. Wager, and A. Rojas, p. 23. *Educational Technology,* September, 1981. Copyright 1981 by Educational Technology Publications. Reprinted by permission of the authors and copyright owners.

may be evident to students and, therefore, may not need to be communicated. For reasonably well-motivated students, it is often unnecessary to make any special provisions for controlling attention since this event, too, may be appropriately managed by the learners themselves. This circumstance clearly contrasts with that prevailing in, say, a classroom of seventh graders where the teacher may need to make special provisions for getting their attention.

Homework assignments, such as those that call for learning from a text, depend upon the learners to employ cognitive strategies available to them in managing instructional events. The text may aid selective perception by its inclusion of bold printing, topic headings, and other features of this general sort. The text may, and often does, include a context of meaningful material that provides for semantic encoding by relating new information to organized knowledge already in learners' memories. An important part of "studying," however, is the necessity for practicing appropriate performance, whether this is a matter of stating information in the learner's own words, applying a newly learned rule to examples, or originating solutions to novel problems. For these events of self-instruction, as well as for the judgment of correctness that gives an immediate sort of feedback, learners frequently must depend upon cognitive strategies available to them.

SUMMARY

This chapter is concerned with the events that make up instruction for any single performance objective as they may occur within a lesson. These are the events that are usually external to the learner, supplied by the teacher, text, or other media with which the learner interacts. When self-instruction is undertaken, as is to be more frequently expected as the learner's experience increases, instructional events may be brought about by the learner himself. However they originate, the purpose of these events is to activate and support the internal processes of learning.

The general nature of supporting external events may be derived from the information-processing (or cognitive) model of learning and memory, which is employed in one form or another by many contemporary learning investigators. This model proposes that a single act of learning involves a number of stages of internal processing. Beginning with the receipt of stimulation by receptors, these stages include (1) a brief *registration* of sensory events, (2) *temporary storage* of stimulus features in the short-term memory, (3) a *rehearsal* process that may be employed to lengthen the period of short-term storage to prepare information for entry into long-term memory, (4) *semantic encoding* for long-term storage, (5) search and *retrieval* to recall previousy learned material, and (6) *response organization* producing a performance appropriate to what has been learned. Most theories include, either implicitly or explicitly, the process of (7) *reinforcement* as brought about by external feedback of the correctness of performance. In addition, this learning model postulates a number of (8) *executive control processes* that enable the learner to select and use cognitive strategies that influence other learning processes.

As derived from this learning model, instructional events are:

1. gaining attention
2. informing the learner of the objective
3. stimulating recall of prerequisite learnings
4. presenting the stimulus material
5. providing learning guidance
6. eliciting the performance
7. providing feedback about performance correctness
8. assessing the performance
9. enhancing retention and transfer

These events apply to the learning of all of the types of learning outcomes we have previously described. Examples are given to illustrate how each is planned for and put into effect.

The order of these events for a lesson or lesson segment is approximate and may vary somewhat depending on the objective. Not all of the events are invariably used. Some are made to occur by the teacher, some by the learner, and some by the instructional materials. An older, more experienced learner may supply most of these events by his own study effort. For young children, the teacher would arrange for most of them.

As these events apply to the various kinds of capabilities being acquired, they take on different specific characteristics (Gagné, 1985). These differences are particularly apparent in the following events from our list: event 3, *stimulating recall of prior learning;* event 4, *presenting the stimulus material;* and event 5, *providing learning guidance.* For example, *presenting the stimulus* (event 4) for the learning of discriminations requires conditions in which the differences in stimuli become increasingly fine. Concept learning, however, requires the presentation of a variety of instances and noninstances of the general class. Conditions of *learning guidance* (event 5) required for the learning of rules include examples of application; whereas these conditions for verbal information learning are prominently concerned with linking to a larger meaningful context. For attitude learning, this event takes on an even more distinctive character when it includes a human model and the model's communication.

An example is given of using the events of instruction for the design of a computer-based lesson on a defined concept in English grammar.

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