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CONDITIONS-BASED THEORY

To many in the field, the core principles of instructional design (ID) are rooted in what is known as conditions-based theory. Conditions-based theory is basically a cognitive orientation that is especially pertinent to the selection and design of instructional strategies. It is closely related to the work of Robert M. Gagné, a pioneer of ID theory and research. While Gagné saw his key principles as elements of instructional theory, his work has been applied directly to the development of the conditions-based genre of ID theory and practice. Today, there are a number of conditions-based ID theories and models which are consistent with most (if not all) of Gagné's original principles. Recent thinking expands his original premises and often emphasizes new aspects of the learning and performance improvement processes.

Conditions-based theory evolved originally from instructional psychology research, highlighting the direct lineage between this branch of psychology and the field of ID that emerged in the late 1960s and 1970s. At one point during this period, the term "psychoeducational design" was used to emphasize the relationship between psychological principles and improved practice (Snellbecker, 1974). Today, conditions-based theories continue to be rooted in psychological research to some extent, but also rely on the findings of ID research as well.

In this chapter, we will describe:

- The foundations of conditions-based theory by identifying and exploring illustrations of its key elements;
- The expansion of conditions-based approaches to ID; and
- The research supporting conditions-based approaches to ID.

THE FOUNDATIONS OF CONDITIONS-BASED THEORY

Conditions-based theory has been called "commonplace, if not universal, in current instructional psychology and instructional design thinking" (Ragan, Smith, & Curda, 2008, p. 384). Nonetheless, many scholars struggle to specifically decide what constitutes such a theory, or what practice truly reflects the principles of conditions-based theory. Here we describe conditions-based theory in terms of three key premises. These principles are rooted in Gagné's work, but generalized to accommodate new interpretations of the theory. These premises are:

- There are different types of learning outcomes, and each type of learning calls for different types of instruction.
- Instructional sequencing relies upon relationships among the various learning outcomes.
- Instructional strategies should facilitate the internal processes of learning.

Others have described these principles somewhat differently, although we believe their essence is fundamentally consistent with our interpretation (Wilson & Cole, 1991; Ragan et al., 2008). Essentially, conditions-based theory encompasses the belief that all learning is not the same. Good instructors recognize this and modify their teaching to accommodate the unique nature of the content, being especially mindful of the relationships and complexities of various aspects of the subject matter. These variations in teaching, in effect, create a match between the internal conditions of learning (i.e., what is going on inside the learner's mind) and the external conditions of learning (i.e., the manner in which instruction is delivered). Thus, learning is enhanced and made more efficient. We will explore each of these ideas by describing the contributions of the foundational theorists.

Types of Learning Outcomes

The notion that there are different types of learning is not new. However, scholars originally categorized these differences in terms of how learning occurs. Thus, the literature included topics such as stimulus-response learning, incidental learning, or rote learning. On the other hand, when researchers directed their attention to topics such as verbal learning, concept learning, or learning perceptual-motor skills, they were venturing into thinking of variations in learning from a content perspective. This is the orientation of the various learning types in conditions-based ID theory. Here we will discuss the initial ways in which learning tasks were categorized by Benjamin Bloom, Robert Gagné, and David Merrill.

The Classification of Educational Goals

From 1949 to 1953, experts in psychology, education, and psychometrics worked to identify taxonomies of educational goals in the cognitive, affective, and psychomotor domains. The result of this work is now commonly called Bloom's taxonomies. These taxonomies are hierarchical, with outcomes moving from simple to complex. Objectives in each category build upon those in previous categories. According to Krathwohl, Bloom, and Masia (1964), the largest proportion of educational objectives are in the cognitive domain. These range from recalling simple facts to synthesizing new ideas when solving problems. The framework includes six main categories of cognitive objectives: knowledge, comprehension, application, analysis, synthesis, and evaluation (Bloom, 1956). Each of these groupings also include subcategories of outcomes. For example comprehension is supported by the subcategories translation, interpretation, and extrapolation.

Objectives in the affective domain represent interest, attitude, values, emotion, and bias. This framework includes five main categories of affective objectives: receiving, responding, valuing, organization, and characterization (Krathwohl et al., 1964). Psychomotor objectives focus on motor skills and the manipulation of tools and objects for a particular job. Bloom and his associates did not identify categories in the psychomotor domain since there were few examples of these objectives in the literature when the classification systems were introduced.

The taxonomies developed by Bloom and his colleagues have noteworthy implications for the systematic design of instruction. As van Merriënboer (2007) points out, the cognitive, psychomotor, and affective domains identified by Bloom generally correspond to the knowledge, skill, and attitude (KS&A) outcomes at the center of most traditional ID models. They are general behavioral descriptors of content addressed in education and training programs. In addition, since the content classifications are arranged from simple to complex, they also highlight the relationships between content areas. Bloom (1956) and his colleagues viewed their taxonomy as also serving as a vehicle for test development and curriculum construction. (See Chapter 5 for a discussion of Bloom's approach to curriculum.)

The Domains of Learning

Robert M. Gagné explicitly recognized the pioneering work of Bloom and his colleagues when he reasoned that different categories of learning domains are required for measuring outcomes regardless of the subject matter being taught (see Gagné, 1972/2000). Gagné's (1964, 1965) early identification of the various learning types strongly reflected the then dominant influence of behavioral psychology. However, over the years, he modified his views. Table 7.1 shows Gagné's various attempts to distinguish among the types of learning tasks and the relationships among these classification systems.

Initially, Gagné (1964) identified six categories of learning: response learning, chaining, verbal learning, concept learning, principle learning, and problem solving. With the publication in 1965 of the first edition of his landmark book, *The Conditions of Learning*, these categories were somewhat expanded. Response learning was divided into signal learning and stimulus-response learning. Verbal learning was then seen as verbal associations, and the notion of multiple discriminations was included as a precursor to concept learning.

Gagné's initial approach to categorizing learning tasks blends learning process concerns with learning content concerns. He provides examples across subject areas of content in each category. Teaching soldiers to be alert when hearing the command "Attention" is signal learning. Teaching a child the meaning of the word "middle" is an example of concept learning (Gagné, 1965). However, Gagné has two rationales for determining the various types of learning: (1) to show the simple to complex relationships among the categories (not unlike Bloom) and (2) to demonstrate common circumstances (i.e., external conditions) that facilitate each type of learning. He is concerned with both how learning occurs and the nature of the learning content.

This dual concern was also evident when Gagné made the transition from "types of learning" to "domains of learning". His initial presentation of domains was motor skills, verbal information, intellectual skills, cognitive strategies, and attitudes (Gagné, 1972/2000). On the surface this category system seems more content-oriented, and

Table 7.1 A Summary of Gagné's Interpretations of the Types of Learning from Least to Most Complex

Gagné (1964) Type of Learning	Gagné (1965) Type of Learning	Gagné (1972/2000) Domains of Learning	Gagné, Briggs, & Wager (1992) Intellectual Skills Commonly in Education and Training
	Signal Learning		
Response Learning	Stimulus-Response Learning		
Chaining	Chaining		
Verbal Learning	Verbal Associations	Verbal Information (or Declarative Knowledge, see Gagné, 1984)	
	Multiple Discrimination	Intellectual Skills (or Procedural Knowledge, see Gagné, 1984)	Discrimination
			Concrete Concept
Concept Learning	Concept Learning		Rules and Defined Concepts
Principle Learning	Principle Learning		Higher-Order Rules
Problem Solving	Problem Solving		Problem Solving
		Cognitive Strategies	
		Motor Skills*	
		Attitudes*	

* Domain outside of the complexity hierarchy

indeed he does consider them to be "classes of instructional objectives" (Gagné, 1972/2000, p. 103). They are similar in some ways to Bloom's taxonomy. However, he is still profoundly concerned with how learning occurs and sees these classes of objectives as each having a "different set of critical conditions to insure efficient learning" (Gagné, 1972/2000, p. 103). Thus, each category would be taught in a similar manner regardless of whether one was teaching physics or poetry. In addition, each domain tends to require different ways of assessing the learning outcomes, again similar to Bloom.

Gagné went on to expand the intellectual skill domain. Ultimately, he saw the intellectual skills (also arranged in a simple to complex fashion) as being discriminations, concrete concepts, rules and defined concepts, higher-order rules, and problem solving (Gagné, Briggs, & Wager, 1992). This classification system drew from his early identification of types of learning.

Gagné's thinking about the types of learning has greatly influenced ID practice. Classifying the learning task is one of the first steps designers typically take. This decision then provides direction for many subsequent design steps, especially strategy selection. Gagné's position on types of learning also establishes his conviction that there are general types of learning that cut across all disciplines; there are not types of science learning or mathematics learning, for example (Gagné, 1984). This assumption suggests that ID itself is a generic process that can be applied to all disciplines.

The Performance-Content Matrix

Merrill and Boutwell (1973) and Merrill (1983) proposed another configuration for classifying learning tasks. This was known as the Performance-Content Matrix. It shows the learning task as a combination of two independent phenomena: the content categories and the behaviors students demonstrate when they have met the instructional objective. This scheme does not directly address how learning occurs. The matrix is presented in Figure 7.1.

The types of content (fact, concept, procedure, principle) build upon Gagné's categories, a variation of the domains of verbal information, intellectual skill, and cognitive strategies (Gagné & Merrill, 1990). The alternative types of student behaviors are remember, find, and use. Merrill and Boutwell (1973) saw this system of classifying learning outcomes as being a more complete taxonomy than those previously suggested. It reflects the basic underlying assumption "that there is more than one kind of learning and perhaps more than one kind of memory structure" (Merrill, 1983, p. 300). Thus, Merrill is subscribing not only to multiple types of learning, but also to the notion of internal conditions of learning.

In 1992, Merrill, Jones, and Li identified 13 classes of instructional transactions as a precursor to Merrill's continued development of his theoretical position. Merrill (1999) defines an instructional transaction as "all of the learning interactions necessary for a student to acquire a particular kind of knowledge or skill" (p. 402). These transaction classes are shown in Table 7.2.

In essence, Merrill has expanded the performance component of his matrix.

Integrative Goals

Gagné and Merrill (1990) also worked together to expand both of their classification systems. The addition dealt with instruction that addresses comprehensive activities

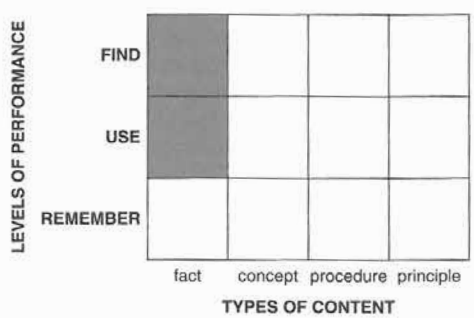

Figure 7.1 The Performance-Content Matrix.

Note: From "Component Display Theory" by M. D. Merrill, 1983. In C. M. Reigeluth (Ed.) *Instructional-Design Theories and Models: An Overview of Their Current Status*, p. 286. Copyright 1983 by Lawrence Erlbaum Associates, Publishers. Used with permission.

Table 7.2 Classes of Instructional Transactions

Component Transactions	
IDENTIFY:	Name and remember information about parts of an entity
EXECUTE:	Remember and do steps in an activity
INTERPRET:	Remember events and predict causes in a process
Abstraction Transactions	
JUDGE:	Order instances
CLASSIFY:	Sort instances
GENERALIZE:	Group instances
DECIDE:	Select among alternatives
TRANSFER:	Apply steps or events to a new situation
Association Transactions	
PROPOGATE:	Acquire one set of skills in the context of another set of skills
ANALOGIZE:	Acquire steps of an activity, or events of a process, by likening to a different activity or process
SUBSTITUTE:	Extend one activity to learn another activity
DESIGN:	Invent a new activity
DISCOVER:	Discover a new process

Note: From "Instructional Transaction Theory" by M. D. Merrill, 1999. In C. M. Reigeluth (Ed.) *Instructional-Design Theories and Models, Volume II: A New Paradigm of Instructional Theory*, p. 405. Copyright 1999 by Lawrence Erlbaum Associates, Publishers. Used with permission.

involving multiple types of learning tasks directed toward a common, integrative goal. Gagné and Merrill called this type of activity an enterprise. Moreover, they suggest that:

> . . . different *integrated goals* of various enterprises are represented in memory as different kinds of cognitive structures . . . a schema that reflects the purpose or goal of the enterprise category, the various knowledges and skills required to engage in the enterprise, and a scenario which indicates when and how each piece of knowledge or skill is required by the enterprise. (p. 25; emphasis in the original)

The integrative goals of an enterprise are critical to designers who are concerned particularly with transfer. The enterprise scenario relates the various knowledge and skill objectives to a final goal and often to a larger project that encompasses this goal. Instruction of this type incorporates a number of learning outcomes into a holistic and integrated teaching-learning activity and results in unique learning conditions and instructional strategies (Gagné & Merrill, 1990).

Sequencing Learning Outcomes

In a conditions-based orientation, decisions concerning instructional sequencing are dependent to a great extent upon the nature of the learning task and its connection to other related tasks. Each of the original systems of classifying learning tasks implied prerequisite relationships between the various learning outcomes. This dominant conditions-based position on sequencing was presented initially by Gagné, and then this thinking was extended by other theorists, such as Charles Reigeluth.

Learning Hierarchies and the Theory of Cumulative Learning

One of Gagné's fundamental beliefs was that "behavioral development results from the cumulative effects of learning" (Gagné, 1968/2000a, p. 40). He suggested that learning is an ordered process, involving new learning being built upon the foundations of past learning. This principle was empirically supported by Gagné's own research and that of many others (see Gagné, 1973). The components of this theory of cumulative learning are those hierarchical classes of human performance shown in Table 7.1, especially the various intellectual skills.

Cumulative learning theory has obvious implications for the sequencing of instruction, a task Gagné (1973) carefully distinguishes from the sequencing of learning. However, instructional sequencing is dependent upon first identifying and diagramming the knowledge and skills that are subordinate to the intended outcome of instruction. This diagram is known as a learning hierarchy. To Gagné (1973) learning hierarchies are "descriptions of successively achievable intellectual skills, each of which is stated as a performance class" (p. 21). Figure 7.2 shows a generalized example of such a hierarchy.

This example shows the relative level of complexity of all tasks, and identifies those which are essential prerequisites to the higher level tasks. It also shows the relationships of the tasks in the three major strands of skills (i.e., 3–4–7–10, 1–5–8–10, and 2–6–9–10).

One can use learning hierarchies to determine the most effective instructional sequence. However, Gagné (1968/2000b) clearly noted that the sequences suggested by these hierarchies were not the only path students could take to the final objective. While there seems to be evidence of increased efficiency when instruction requires systematic recall of prerequisites (Gagné, 1973), hierarchy-directed sequences may not necessarily be the most efficient route for a particular learner given the broad range of individual differences. What is likely, however, is that the learning hierarchy sequence has "the most probable expectation of greatest positive transfer for an entire sample of learners" (Gagné, 1968/2000b, p. 69).

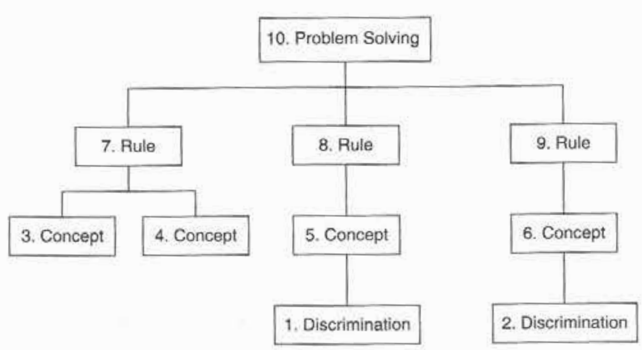

Figure 7.2 A Sample Learning Hierarchy.

Elaboration Theory

Reigeluth's Elaboration Theory provides direction for sequencing large units of instruction dealing with many ideas, often at the course level. At its inception, it extended Merrill's early ID theory which dealt primarily with the microdesign of individual lessons. In addition, Elaboration Theory originally pertained exclusively to Bloom's cognitive domain, covering "all of the levels of Bloom's taxonomy, plus an additional level which is often referred to as 'meta-cognition'" (Reigeluth & Darwazeh, 1982, p. 23). In later explanations of the theory, Reigeluth (1999) emphasized the holistic and learner-centered aspects of this approach to sequencing and its role in building firm cognitive foundations, and meaningful, motivated learning. This is possible because of the relationships (i.e., superordinate, coordinate, and subordinate) among the concepts to be sequenced. Such relationships must be first identified through a theoretical analysis resulting in a hierarchical structure of the concepts or principles to be taught (Reigeluth, 1999).

In essence, Elaboration Theory prescribes a general-to-detailed sequence that is another variation of the simple-to-complex approach. The initial generality presented is called an epitome, a special kind of content overview.

> Epitomizing always entails identifying either very *general* or very *simple* ideas, but *not abstract* ones. . . . [and presenting] a small number of the most fundamental, representative, general, and/or simple ideas . . . including whatever of the other types of content that are highly relevant (including learning prerequisites). (Reigeluth & Stein, 1983, p. 346; emphasis in the original)

For example, the various economic principles (such as the law of supply and demand) serve as the epitome for an introductory course in economics, and concepts such as price or quantities supplied are examples of supporting content (Reigeluth & Stein, 1983).

The epitome is followed by presenting various levels of content elaboration, each of which provides additional content detail or complexity (Reigeluth & Stein, 1983). These elaborations provide more comprehensive versions of the task at hand. These versions may be more complex and more realistic than the preceding example, or they may show less representative cases (Reigeluth, 1999). For example, in the economics course example, elaborations might include the effects of changes in supply schedules on price (Reigeluth & Stein, 1983). This elaboration process may be interrupted to return to the general epitome to reestablish the context and to review the instruction to date, but then further elaboration of the content would take place. Reigeluth and Stein (1983) call this the "zoom lens" approach.

The lessons end with the use of an internal summarizer and an internal synthesizer. The summarizers review the original generality, a specific example, and some self-test practice situations. The synthesizers show the relationships among the various ideas in the lesson (Reigeluth & Darwazeh, 1982).

Elaboration Theory itself has a multifaceted theoretical foundation. It is primarily a type of conditions-based theory, because it is based upon the assumption that there are different types of learning tasks and instruction varies in terms of each type. Moreover, Elaboration Theory integrates Gagné's hierarchical approach to sequencing into its structure by recognizing the place of teaching prerequisite skills. It expands Merrill's generality-instance-practice pattern. It also reflects Ausubel's notion of subsumptive sequencing (see Chapter 4), and Bruner's concept of a spiraling curriculum (see Chapter 5) (Reigeluth & Darwazeh, 1982; Reigeluth & Stein, 1983).

Facilitating Internal Learning Processes

The third major premise of conditions-based theory is that instructional strategies should facilitate the internal processes of learning. In many ways, this is the heart of conditions-based theory. The effective external conditions of instruction (i.e., the teaching strategies, the instructional materials, and the student activities) facilitate learning which is fundamentally an internal process. These external conditions, however, are dependent upon the type of learning task and the sequencing of the activities. Our discussion once again will begin with the groundbreaking work of Robert Gagné. It will then continue with David Merrill's theories that expanded Gagné's thinking to account for new cognitive interpretations of learning and new technologies.

The Events of Instruction

Gagné's views of learning primarily reflect the cognitive orientation, and more specifically that of information processing. Consequently, the learning process was seen as involving sensory perception, working memory, encoding and storage in long-term memory, and retrieving information from long-term memory. (See the more complete discussion of cognitive learning theory in Chapter 4.) Effective instruction consists of activities that facilitate these various aspects of the learning process. Gagné (1985) summarized these activities in his Events of Instruction. They begin with gaining students' attention, letting them know what the goals of the lesson are and how the goals relate to things they already know, presenting the content and helping students with its complex aspects, providing opportunities for practice and information on how well they are doing, testing, and helping students to remember and use what they have just learned. These events are the general steps teachers would follow in any lesson. They are the external conditions of learning. Table 7.3 identifies these nine events. In addition, it shows how each event relates to the learning process as seen from a cognitive point of view.

The order of these events is one that is typically followed, although Gagné never suggested that the order or even the use of each event was required in every lesson (Gagné et al., 1992). Instead, designers should ask themselves a simple question: "Do these learners need support at this stage for learning this task?" (Gagné et al., p. 190).

While the Events of Instruction provide a general design approach, the framework is modified to match the different instructional conditions associated with the different types of learning. These modifications are made typically in Event 3 (Stimulating recall of prior learning), Event 4 (Presenting the stimulus material), and Event 5 (Providing learning guidance). For example, intellectual skills demand the recall of prerequisite facts, rules, and concepts, while cognitive strategies depend upon the recall of their component tasks. Concept learning requires guidance in terms of many examples of the concept, but learning verbal information may utilize a memory aid such as mnemonics for guidance (Gagné et al., 1992).

The Events of Instruction provide a basic structure for designers to follow after they complete the analysis phase of ID and proceed into determining the strategies that will be employed to facilitate student learning. On the surface, the Events appear to be a simple, almost intuitive approach to instruction. However, a careful examination of the

Table 7.3 The Relationship Between Gagné's External Events of Instruction and the Internal Processes of Learning

Event of Instruction	Process of Learning
1. Gain attention	• Reception of stimuli in sensory memory
2. Inform learner of the objective	• Expectancies and cognitive strategies
3. Stimulate recall of prior learning	• Retrieval from long-term memory to working memory
4. Present the content	• Selective perception of distinctive features
5. Provide learning guidance	• Encoding for long-term storage • Cues for retrieval
6. Elicit performance	• Activates response organization
7. Provide feedback	• Establishes reinforcement • Correct errors
8. Assess performance	• Retrieval from long-term memory • Response organization • Reinforcement and feedback
9. Enhance retention, and transfer	• Cues for retrieval and retention • Generalization for transfer

events shows that they serve as a link between the tenets of cognitive learning theory and everyday ID practice.

Component Display Theory and Instructional Transaction Theory

Merrill provided a second approach to applying the conditions-based ideal of using external conditions to facilitate learning. He developed two major theories of ID: Component Display Theory (CDT) and Instructional Transaction Theory (ITT). In the process of evolving these theories, there were intervening descriptions of what he called ID_2. Each of these emerging points of view is fundamentally conditions-based with instructional strategies varying by the type of learning outcome. (Note the earlier discussion of Merrill's performance-content matrix.)

A central feature of Merrill's (1983) Component Display Theory (CDT) is that all instructional content can be presented using a series of what he called "primary presentation forms". These presentations forms are based upon the propositions that all types of learning can be represented in two dimensions:

- By presenting either a generality or a particular instance of the topic; and
- By using either expository (telling) or inquisitory (asking) techniques.

Table 7.4 shows how Merrill's (1983) combines these elements to form a type of taxonomy of general instructional strategies.

Each of these presentation forms can also be elaborated. Expository presentations, for example, can be expanded by providing prerequisite knowledge, additional context information, or mnemonic aids. Inquisitory presentations can be elaborated with feedback, or additional examples. These elaborations are called secondary presentation forms.

These presentation forms serve as the "displays" that combine the type of presentation with the targeted level of performance and the targeted content. In addition, Merrill (1983) recognizes that the various displays can themselves be related. Designers select

Table 7.4 The Primary Presentation Form Taxonomy

Type of Presentation	Type of Presentation Technique	
	Expository	Inquisitory
Generality	Instructor tells, shows, illustrates, or demonstrates a rule or generality.	Students practice and test their understanding of a generality by completing a general statement.
Instance	Instructor tells, shows, illustrates, or demonstrates an instance or a specific case.	Students practice and test their understanding of an instance by applying a given generality to a specific case.

Note: Adapted from "Component Display Theory" by M. D. Merrill, 1983. In C. M. Reigeluth (Ed.) *Instructional- Design Theories and Models: An Overview of Their Current Status*, p. 306. Copyright 1983 by Lawrence Erlbaum Associates, Publishers. Used with permission.

instructional strategies by determining the proper display for the content and then determining when each display should be presented in isolation or related to another display.

Merrill (1983) suggests that the CDT approach to structuring learning activities implies a sequence of presenting first a generality, then an example, followed by practice. For example, if one were teaching the concept of conifer, the first step would be to provide the general definition of the term. Next, specific examples of conifers would be given. Finally, students would practice picking out the conifers from large groups of trees. However, the empirical support for this approach to sequencing varies. Some of the most robust findings conclude that it is best to present generalities before instances, and it is best to include practice, but the order in which this occurs is not critical (Merrill, 1983).

Merrill subsequently expanded the notion of primary and secondary presentation forms into the concept of an instructional transaction. A transaction "is characterized as a mutual, dynamic, real-time give-and-take between the instructional system and the student in which there is an exchange of information" (Merrill, Li, & Jones, 1990, p. 9). It typically consists of multiple displays and multiple interactions with the learners. There are various types of transactions, but they employ many of the traditional aspects of an instructional strategy. They include the content (known as the knowledge structure), presentation techniques, practice opportunities, and learner guidance (Merrill, 1999).

There were two major reasons why Merrill and his colleagues turned to the transaction format. The first related to the "assumption that learning results when mental models are organized and elaborated in memory" (Merrill et al., 1990, p. 9). Consequently, instruction should encompass everything necessary to facilitate the acquisition of a particular mental model. Because these models are typically complex, there should be many integrated instructional interactions between learners and teachers or the instructional materials (Merrill et al., 1990). Hence, there is a need for a more complex transaction, as opposed to a simple display which usually demands only a single student response.

There was a second reason for using transactions, however. Transactions, by definition, emphasize interaction rather than simply delivering information to learners. One way of promoting complex types of student interactions during the teaching-learning process is through the use of computer-based instruction, a rapidly growing instructional tool. Merrill explored new ways of designing such instruction, and in doing so became involved in the development of a computer-based ID system called ID Expert. This system used transaction shells which were "pieces of computer code that, when delivered to a student via an appropriate delivery system, cause a transaction or set of transactions to occur" (Merrill, Li, & Jones, 1991, p. 8). ID Expert sought not only to automate the ID process, but also to create learning environments that are adaptive to students; instruction could be tailored on the spot to the needs and characteristics of individual students (Merrill, 1999). Instructional Transaction Theory was developed in conjunction with this computerized design and development system which produced instruction that not only facilitated the acquisition of many types of knowledge and skills, but also attempted to truly individualize instruction.

The Philosophical Orientations of Conditions-Based Theory

The various approaches to ID are influenced not only by the theories that we have been discussing, but also by the beliefs and values of the designers (Smith & Ragan, 2005). One could certainly say that those espousing conditions-based theory were scholars who only advocated a particular position if it had research support. They were empiricists at heart. This position is similar to that of the learning theorists, the early communications theorists, and others whose theories are primarily rooted in research, rather than pure reasoning. With respect to conditions-based theory specifically, this implies an empirically supported explanation of the learning process and of the instructional activities which facilitate knowledge acquisition and transfer of learning to new settings.

Strike (1972), however, points out one complexity of the empiricist point of view for those studying human behavior:

> When the social scientist claims to understand an action, he is grasping its meaning by seeing it as governed by a particular set of rules. But seeing an act as the following of a rule is very different from seeing it as an instance of some regularity or law. Rules can be broken, laws cannot. Rules give meaning to action, laws merely relate the condition under which they occur. Thus, to understand an action is not at all like giving a scientific *explanation* of it. (p. 41; emphasis in the original)

Perhaps this is why today we seldom see educational theories constructed in terms of laws. Perhaps this is why the ID "rules" of conditions-based theory are often stated with caveats, such as recognizing the effectiveness of instructional sequences that do not match those implied in a learning hierarchy.

As one examines the work of Gagné and Merrill especially, it is clear that their theories evolved over time. This is in keeping with Petrie's (1972) admonition for "empirical researchers constantly to be theorizing . . . and to be elaborating their theory with its presuppositions as they go" (p. 73). However, these presuppositions can provide interesting entanglements for an empiricist, because they may not be totally based upon evidence; instead they may well be influenced by personal (or perhaps disciplinary) values. Strike (1979) suggests that "facts and values come in integrated conceptual packages" (p. 14).

Conditions-based theorists do seem to share some common values. Smith and Ragan (2005) identify a number of these values or assumptions, including: (1) the notion that "learning goals should be the driving force behind decisions about activities and assessment" (p. 23), (2) the generic role of principles of instruction, and (3) the importance of instructional effectiveness and efficiency. These values do seem to imply an acceptance of generalizations and a predisposition towards objectivist viewpoints. It is not implausible that the views of conditions-based theorists reflect philosophical empiricism. Or perhaps as Smith and Ragan (2005) again suggest, there is more of a pragmatic flavor to the theory. In this light they see instructional designers as proposing "that knowledge is built up by testing [the] 'truth for now' hypothesis and revising or discarding this 'truth' as common experience and interpretation implies it should be modified" (p. 22).

THE REFINEMENT OF CONDITIONS-BASED INSTRUCTIONAL DESIGN THEORY

Theorists have expanded the notion of conditions-based ID in recent years to include principles found in the latest theories of learning, motivation, and instruction. These developments relate to advances in cognitive psychology, social learning theory (see Chapter 4), and constructivism (see Chapter 8). Below we discuss four such developments in conditions-based theory including:

- Supplantive and generative instruction;
- Complex learning;
- Problem solving; and
- Motivational design.

Each of these theoretical approaches includes elements of conditions-based ID theory. They recognize the relationships and complexities of various kinds of outcomes, address the internal processes of learning, and have implications for the external conditions of instruction.

Supplantive and Generative Strategies

A key development in conditions-based ID theory can be found in the work of Patricia Smith and Tillman Ragan, who sought to extend Gagné's theory by addressing strategies for providing learning guidance to students. Smith and Ragan (2005) address the question "Which should be the locus of control of information processing – the instruction or the learners?" (p. 141). They contend that the answer depends on the learning task, the amount of prior knowledge held by the learner, and the quantity and variety of learning strategies the learner possesses. They propose a continuum of supplantive-generative instructional strategies to deal with these issues.

Supplantive instructional strategies provide more support to learners than generative strategies. Smith and Ragan (2005) argue that supplantive strategies are appropriate for novices with low prior knowledge and few learning strategies because they limit responsibility for structuring their own learning. However, they also caution that learners may engage fewer internal processes of learning when supplantive strategies are used incorrectly. Examples of supplantive strategies are found in expository instructional methods.

Generative instructional strategies allow learners to construct their own meaning from instruction by "generating their own educational goals, organization, elaborations, sequencing and emphasis of content, monitoring of understanding, and transfer to other contexts" (Smith & Ragan, 2005, p.141). Smith and Ragan (2005) suggest that learners with extensive prior knowledge and well-developed learning strategies can be given control of their own learning. They propose the use of a generative environment where learners provide many events of instruction for themselves. Examples of generative strategies are found in learner-centered environments such as problem-based learning.

Based on research findings, Ragan et al. (2008) suggest that instruction should use as many generative strategies as possible. However, they caution that supplantive strategies that provide support to learners may be more appropriate when a limited amount of time is available for instruction or when generative strategies may lead to frustration, anxiety, or danger. They recommend that instructional designers use a problem-solving approach to determine "the amount of cognitive support required for the events of instruction based on careful consideration of context, learner, and learning task" (Ragan et al., 2008, p. 392).

Designing for Complex Learning

Another expansion of conditions-based ID theory can be found in the work of Jeroen van Merriënboer and his colleagues, who focus on how to design instruction to achieve complex learning. According to van Merriënboer and Kirschner (2007):

> Complex learning involves the integration of knowledge, skills and attitudes; the coordination of qualitatively different **constituent skills**, and often the transfer of what is learned in the school or training setting to daily life and work settings. (p. 4; emphasis in the original)

Complex learning centers on integrated learning goals and multiple performance objectives that comprise tasks found on the job or in life. These coordinated goals and objectives promote the application and transfer of skills that make up complex learning (van Merriënboer, Clark, & de Croock, 2002). They are similar to the integrated goals that Gagné and Merrill (1990) proposed to expand their classification systems.

Sequencing decisions are important when designing for complex learning. van Merriënboer et al. (2002) state "a sequence of learning tasks is the backbone of every training program aimed at complex learning" (p. 43). van Merriënboer et al. (2002) propose a hierarchy to account for two types of relationships between skills that must be taken into account when designing for complex learning. The first type of relationship in a hierarchy is a horizontal relationship between coordinated skills that can be sequential (e.g., first you do this; next you do that). The second type of relationship in a hierarchy is vertical, where skills at the lower part of the hierarchy enable (or are prerequisite to) skills at the higher levels of the hierarchy. van Merriënboer acknowledges that Gagné's work on learning hierarchies influenced his own thinking about sequencing for complex learning tasks.

Complex learning includes both recurrent and nonrecurrent skills. Designers identify different performance objectives for both types of skills (van Merriënboer et al., 2002). Recurrent (i.e., routine) skills are those that can be applied in similar complex situations. They consist of rules that generalize from one situation to another. Nonrecurrent (i.e., novel) skills vary from situation to situation.

According to van Merriënboer et al. (2002) "for the nonrecurrent aspect of a complex skill and the complex skill as a whole, the main learning processes that must be promoted are related to schema construction" (p. 42). Schemata facilitate the use of skills from one situation to another because they contain generalized and concrete knowledge. (See Chapter 4 for a discussion of schemata.) To help them construct and reconstruct schema, learners are provided with concrete experiences and encouraged to "abstract information away from the details" (van Merriënboer & Kirschner, 2007, p. 20).

Other internal processes of learning are addressed by van Merriënboer and his colleagues. They hypothesize that when a new schema is constructed, mental models facilitate reasoning because they reflect how content is organized. In addition, cognitive strategies also affect problem solving because they impact how a problem is approached. For example, the processes of discrimination and generalization impact the reconstruction of existing schema to align them with new experiences (van Merriënboer et al., 2002).

van Merriënboer and his colleagues developed the Four-Component Instructional Design (4C/ID) model that centers on the integration and coordination of skills that make up complex learning (van Merriënboer et al., 2002; van Merriënboer & Kirschner, 2007). The four-component model includes ten steps that designers follow to address complex learning. (See Table 7.5.)

Learning tasks for complex learning can be performed in either real or simulated environments; they provide learners with whole-task practice of all the constituent skills that make up a complex skill (van Merriënboer et al., 2002; van Merriënboer & Kirschner, 2007). These authentic whole-task experiences facilitate rule generalization for recurrent tasks and support schema construction for nonrecurrent tasks.

Supportive information "provides the bridge between learners' prior knowledge and the learning tasks" (van Merriënboer et al., 2002, p. 43). It is used to support the construction of schemata through the elaboration of relationships between new information and prior knowledge. Supportive information for each successive task is an elaboration of previous information that assists learners to do things that they could not previously do. Expository or inquiry strategies can be used for this type of information. These ideas extend Merrill's (1983) CDT discussed above. Supportive information also includes

Table 7.5 Components of the 4C/ID Model with Corresponding Steps

Components of 4C/ID	Ten Steps to Complex Learning
Learning Tasks	1. Design Learning Tasks 2. Sequence Task Classes 3. Set Performance Objectives
Supportive Information	4. Design Supportive Information 5. Analyze Cognitive Strategies 6. Analyze Mental Models
Procedural Information	7. Design Procedural Information 8. Analyze Cognitive Rules 9. Analyze Prerequisites Knowledge
Part-Task Practice	10. Design Part-Task Practice

Note: From *Ten Steps to Complex Learning: A Systematic Approach to Four-Component Instructional Design* by J. J. G. van Merriënboer & P. A. Kirschner, 2007, p. 10. Copyright 2007 by Lawrence Erlbaum Associates, Publishers. Used with permission.

cognitive feedback to encourage learners to reflect on the quality of their approach to problem solving and their solutions. It is also provided to enhance learners' cognitive learning strategies (van Merriënboer & Kirschner, 2007).

Procedural information provides learners with the steps they require to perform a recurring skill. Also referred to as "just-in-time information" (van Merriënboer et al., 2002), it is given when learners require it to work on recurring tasks. It includes demonstrations of how rules and procedures are applied, as well as corrective feedback on errors (van Merriënboer & Kirschner, 2007). Procedural information is organized in small units, called information displays. Based on Merrill's Component Display and Instructional Transaction Theories (1983, 1999), van Merriënboer et al. (2002) suggest that information displays should consist mostly of generalities and examples:

> For instance, rules are general in that they can be applied in a variety of situations, and prerequisite concepts are general in that they refer to a category of objects or events. It is often desirable to present examples that illustrate or exemplify those generalities. For rules, such examples are called demonstrations; for concepts, plans, and principles, they are called instances. (p. 52)

The final component in the 4C/ID model is part-task practice. Part-task practice supports the strengthening of rules and procedures which often require extensive amounts of practice (van Merriënboer et al., 2002). While a whole-task approach is used to facilitate schema construction, a part-task strategy breaks a complex task into component parts, each of which are taught separately. Then the various parts are combined into the whole task. van Merriënboer and Kirschner (2007) think this approach will facilitate rule learning more quickly.

A Design Theory for Problem Solving

A further refinement in conditions-based ID theory can be found in David Jonassen's work on problem solving. His contributions can be viewed as conditions-based theory because they speak to:

- A typology of problems with each category requiring different instructional support;
- Identification of the relationships among problem types in terms of their structure, complexity, and specificity; and
- Internal processes and individual differences that impact problem-solving learning.

Jonassen (1997) states that problems vary in terms of their structure, complexity, and abstractness. He also distinguishes between well-structured and ill-structured problems. Well-structured problems have known solutions that require the application of a fixed number of concepts, rules, and principles. Ill-structured problems have multiple solutions, unknown elements, and inconsistent relationships among concepts, rules, and principles. Types of well-structured problems include logic and story problems, while instances of ill-structured situations include design problems (e.g., constructing an expansion bridge) and dilemmas (e.g., how to withdraw from a country at the end of a war).

Problem types also differ in terms of their complexity, defined in terms of the number of variables or issues involved in solving the problem (Jonassen, 1997). Simple problems involve fewer cognitive operations than complex ones. Simple problems are also more static than complex ones. Jonassen (2000) states "the most complex problems are dynamic, that is, those in which the task environment and its factors change over time" (p. 68). He also thinks problems are domain specific, situated, and embedded in a specific context. Figure 7.3 shows a sample of types of problems and how they differ based on Jonassen's classification scheme.

In discussing structural relationships and problem solving, Jonassen (2000) distinguishes between his theory and other approaches to sequencing. He believes that the hierarchical structure of intellectual skills advocated by Gagné and Merrill does not adequately address the complex relationships found in problems solving. Jonassen (2000) writes:

> Problem solving, as an activity, is more complex than the sum of its component parts. Without question, problem solving necessarily engages a variety of cognitive components, such as propositional information, concepts, rules, and principles . . . However, it also involves structural knowledge . . . metacognitive skills. . . . motivation/attitudinal components . . . [and] knowledge about self. (p. 64)

Like other conditions-based theorists discussed in this chapter, Jonassen indicates that elements internal to the learner affect how to solve different kinds of problems. Jonassen (2000) hypothesizes that "problem solving skill is dependent on a schema for solving particular types of problems" (p. 65). He suggests that learners construct mental models consisting of structural, procedural, strategic, and reflective knowledge (Jonassen &

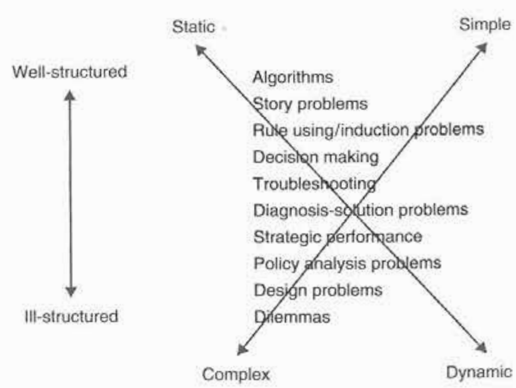

Figure 7.3 Typology of Problems.

Note: From *Learning to Solve Problems: A Handbook for Designing Problem-Solving Learning Environments*, by D. Jonassen, 2011, p. 12. Copyright 2011 Taylor & Francis. Used with permission.

Henning, 1999). Jonassen (2000) indicates that individual differences within learners mediate problem solving. These factors include:

- General problem-solving skill;
- Familiarity with the problem type;
- Domain knowledge;
- Structural knowledge (i.e., knowledge of how concepts in a domain are interrelated);
- Cognitive and meta-cognitive processes; and
- Affective, motivational, and volitional factors.

Based on his typology of problems, the internal conditions impacting problem solving, and knowledge of how humans solve problems, Jonassen (1997) proposes an ID model for well- and ill-structured problem solving. This model provides the steps and activities (i.e., external conditions) designers should follow when developing instruction for the two major kinds of problems: well-structured and ill-structured problems. (See Table 7.6.) He also suggests a number of instructional strategies to engage learners in problem solving, including authentic cases, simulations, modeling, coaching, and problem-based learning.

Jonassen (2010) thinks that it is not enough to merely teach learners about problem solving if they are expected to actually solve problems. If the outcome is for students to learn how to solve problems, Jonassen believes that learners must be engaged in problems centered on job tasks or other real-life activities.

Table 7.6 Jonassen's (1997) Model for Designing Problem-Solving Instruction

Well-Structured Problems	Ill-Structured Problems
1. Review prerequisite component concepts, rules, and principles.	1. Articulate the problem context.
2. Present conceptual or causal model of problem domain.	2. Introduce problem constraints.
3. Model problem solving performance using worked examples.	3. Locate, select, and develop cases for learners.
4. Present practice problems.	4. Support knowledge base construction.
5. Support the search for solutions.	5. Support argument construction.
6. Reflect on problem state and solution.	6. Assess problem solution.

Motivational Design of Instruction

Another development in conditions-based ID theory is found in the writing of John Keller on motivational design. As shown in Figure 7.4, his model of motivation, performance, and instructional influence (Keller, 1983) includes:

- Outcomes of instruction consisting of effort, performance, consequences, and satisfaction;
- Characteristics internal to learners such as expectancies, values, prerequisite knowledge, and skills; and
- Environmental inputs including motivational design, learning design, and contingency management.

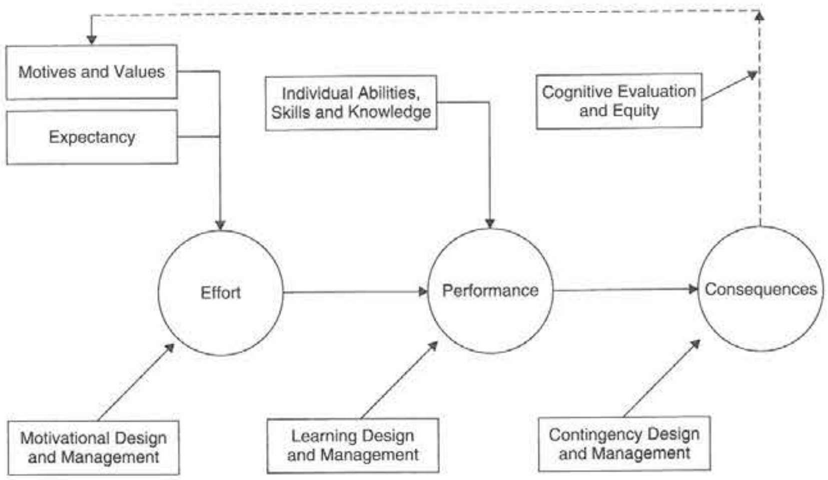

Figure 7.4 A Model of Motivation, Performance, and Instructional Influence.

Note: Adapted from "Motivational Design of Instruction" by John M. Keller, 1983. In C. M. Reigeluth (Ed.) *Instructional-Design Theories and Models: An Overview of Their Current Status*, p. 392. Copyright 1983 by Lawrence Erlbaum Associates, Publishers. Used with permission.

According to Keller (1983), "the primary concern with this theory . . . is to illustrate a systematic basis for a motivational-design model" (p. 384). Like other ID theorists, Keller (1979) explains how learning design, along with an individual's abilities, skills, and prior knowledge, impact learning and performance. Yet the bulk of his ideas center on designing instruction to address learner motivation. As defined by Keller (1983), motivation equals the choice a person makes to approach or avoid a task plus the effort applied to completing it. He theorizes that effort is influenced by a learner's curiosity, interest, motives, values, and expectations. Designers can impact effort by following principles of motivational design. Effort impacts performance, which in turn leads to positive or negative consequences. Consequences are evaluated by the learner, who may or may not feel satisfied by them (Keller, 2010).

The motivational design model (Keller, 1987a, 2010) includes the same components found in most general systems models of ID. (See Chapter 2.) It is an overlay model that can be used in conjunction with other ID models. The motivational design model includes the steps for designing instruction that have a positive impact on learner effort and satisfaction. Following this model, a designer analyzes learners and the instructional environment to identify any motivational problems that may exist. The process begins with obtaining information about the course, including its setting and delivery system. Learner analysis is completed to construct a motivational profile focusing on student attitudes, motives, and expectations. Current course materials are also analyzed, with special attention given to the strategies used to motivate learners. Next, motivational objectives, measures, and strategies are designed and implemented. These are integrated into instructional materials and are then evaluated, tested, and refined.

Motivational problems and strategies relate to the four main components in Keller's (1987b, 2010) attention, relevance, confidence, and satisfaction (ARCS) model of motivation:

- Attention—learner interest and curiosity must be aroused and maintained;
- Relevance—learners must perceive their personal needs are met in an instructional situation;
- Confidence—learners must have appropriate expectations about themselves, others, and the subject matter; and
- Satisfaction—learners must receive the appropriate intrinsic and extrinsic rewards from instruction.

According to Dick, Carey, and Carey (2009), Keller's work addresses the criticism that designers who follow the systems approach often produce instructional materials that lack appeal to learners. Therefore, we think Keller's ideas extend the notion of conditions-based ID and provide an important foundation to the field.

RESEARCH ON CONDITIONS-BASED INSTRUCTIONAL DESIGN THEORY

Many of the constructs embedded in the conditions-based ID theories discussed in this chapter have been empirically investigated. While a few studies have examined the total application of a particular theory to the design of instruction, most studies have been conducted to examine one or more components. Below we provide a summary of representative research that informs ID practitioners of the important findings related to conditions-based theory. Then we suggest new avenues of research that could provide further support for this type of ID theory.

Empirical Support of Conditions-Based Applications in Instructional Design

Most of the research on conditions-based ID theory has been conducted by providing learners with a small number of instructional events or components. Very few studies have been conducted where the effects of a combination of elements have been tested. Sasayama (1984) compared the effects of providing rules, examples, and practice on learning concepts, principles, and procedures based on Merrill's CDT. The lesson that included rules, examples, and practice was more effective than that which provided rules only, examples only, or rules and examples only. Coats (1985) tested the impact of providing all of Gagné's nine events to an experimental group and only some events to two different control groups. No significant differences were found among the three treatment groups on achievement. Martin, Klein, and Sullivan (2007) compared the effects of several of Gagné's events including objectives, practice, examples, and review in a computer-based lesson. They found that of the instructional elements tested in the study, practice had the most impact on both learner achievement and attitudes.

According to Martin and Klein (2008) "some of these events produce a much different effect when they are studied individually than when they are combined into a more complete set that incorporates most or all of the events" (p. 172). Research on computer-based instruction consistently shows that practice with feedback has the most impact on learning, especially when compared to providing objectives and review opportunities to learners (Hannafin, 1987; Hannafin, Phillips, Rieber, & Garhart, 1987; Martin & Klein, 2008; Martin et al., 2007; Phillips, Hannafin, & Tripp, 1988).

In addition to the studies cited above, Ragan and Smith (2004) reviewed and summarized a number of other empirical studies of conditions-based ID theory. Results of their comprehensive review indicate:

- Strong empirical support for the validity of learning hierarchies and the extent to which they accurately describe relationships among subskills and prerequisite skills;
- Strong support for the notion that different events of instruction lead to different kinds of learning, especially for declarative and procedural outcomes;
- Some support for the effectiveness of instruction designed following principles of Component Display Theory and Elaboration Theory; and
- Weak support for the hypothesized relationship between internal process of learning and the acquisition of different learning outcomes.

Turning to research on supplantive and generative learning, Grabowski (2004) wrote an extensive review of empirical studies that have been conducted on these strategies. Her findings show:

- Some studies indicate that learner-generated organizational schemes are more effective than instructor-provided strategies.
- Cognitive ability impacts the effectiveness of learner-generated organizational strategies.
- Student-generated examples and questions improve retention and transfer, but not always more than instructor-provided elaborations.
- The difficulty of a task must be considered when a combination of generative strategies is used.
- Learners may become frustrated if they are not developmentally ready for a generative activity.

Research has also been conducted to validate the 4C/ID model. van Merriënboer and Kester (2008) summarized the findings from studies conducted by van Merriënboer and colleagues. These studies suggest:

- Teachers trained to use the 4C/ID model developed qualitatively better designs (as measured by experts) than teachers not trained to use the model.
- Low achievers benefited more from competency-based instruction developed using the 4C/ID model when they worked in teams rather than alone.
- Whole-task practice is more effective than part-task practice for learning complex tasks.
- Novice and advanced learners achieved better whole-task performance and better transfer performance when they received whole-task training.

In proposing his design theory for problem solving, Jonassen (2000) stated:

> It is important to note that the typology presented in this paper is not promulgated as a definitive theory, but rather as a work in progress. Experimentation, assessment, and dialogue about these problem types and the forthcoming models are needed to validate anything approaching a definitive theory for problem solving instruction. (p. 82)

Since the publication of that seminal article, Jonassen and colleagues have conducted several empirical studies to validate some of the constructs in his theory. Much of this research was done in the context of science and engineering. Findings from these studies suggest that the component skills required for solving well-structured problems and ill-structured problems may differ:

- Domain knowledge and justification skills are related to solving both types of problems (Shin, Jonassen, & McGee, 2003).
- Self-regulation and attitudes toward science are related to solving ill-structured problems (Shin et al., 2003).
- Metacognition and argumentation are related to solving ill-structured problems in simulations (Hong, Jonassen, & McGee 2003).
- Communication patterns in teams differ when groups solve well-structured and ill-structured problems (Cho & Jonassen, 2002; Jonassen & Kwon, 2001).

Findings also indicate how experts approach problem solving, including:

- Expert problem solvers index their knowledge by using their past experiences (Hung & Jonassen, 2006).
- Experts use their domain knowledge to impose structure, filter alternatives, test hypothesis, identify constraints, and propose solutions when solving problems (Wijekumar & Jonassen, 2007).

Furthermore, after reviewing contemporary research on story problems in instruction, Jonassen (2003) reported that:

- Story problems vary in terms of their context, structural relationships, and processing operations.
- Story problems require learners to construct a conceptual model that includes structural relationships that define the class of problem, situational characteristics of the problem situation, and a reconciliation of the structural and situational characteristics required to solve the problem.

Keller's motivation model is based on his own extensive review of behavioral, cognitive, and motivational theory and research. These include studies of curiosity, needs, motives, values, expectancies, and rewards (see Keller, 1979, 1983, 2010). Furthermore, some research has been conducted to examine the use of his models. Our review of this work suggests:

- There is some empirical evidence for Keller's (1987a) claim that his model of motivational design can be used along with other ID models (Main, 1993; Okey & Santiago, 1991; Shellnut, Knowlton, & Savage, 1999).
- There is evidence of alternative ways to design effective motivational messages using ARCS principles (e.g., Oh's (2006) study of the design and use of reusable motivational objects and Tilaro and Rossett's (1993) examination of motivational job aids).
- There is support that application of the ARCS model can lead to increased student motivation (Visser & Keller, 1990; Means, Jonassen, & Dwyer, 1997; Song & Keller, 2001; Visser, Plomp, Amirault, & Kuiper, 2002; Kim & Keller, 2008).
- There is also a little evidence that students can be taught to utilize ARCS strategies to increase their own motivation (Klein & Freitag, 1992).

Recommendations for Continuing Research

As we have noted, most of the research on conditions-based ID is aimed at examining certain components of each theory rather than looking at the entire theory. This suggests that additional research should be conducted to validate these theories when practitioners apply them to ID projects. A particularly useful approach for these kinds of studies is design and development research (Richey & Klein, 2007). This type of research would allow us to answer questions about the benefits and constraints of using each conditions-based theory.

The findings cited above also suggest another fruitful area for additional research. A basic tenet of conditions-based theory is that internal process impacts learning outcomes. However, there is little empirical support for the hypothesized relationship between the attainment of learning outcomes described in conditions-based theory and various cognitive processes of learning (Ragan & Smith, 2004). Future studies on this issue should be conducted using qualitative research methods such as think-aloud protocols to examine how learners are processing information.

Finally, future research on conditions-based theory should center on the application of knowledge and transfer of skills. This suggestion is particularly pertinent for theories related to complex learning, problem solving, and motivational design. The increased focus of the ID field on performance improvement (see Chapter 9) requires us to examine the impact of these theories on individual, group, and organizational outcomes.

SUMMARY

This chapter has examined conditions-based theory and its contribution to the ID knowledge base. We began by discussing the foundations of conditions-based theory by identifying and exploring illustrations of its three key elements. Next, we examined developments in conditions-based approaches by discussing generative instructional strategies, complex learning, and problem solving. We also reviewed a range of empirical research conducted to support conditions-based approaches to ID and provide some recommendations for future study in this area.

Table 7.7 provides a summary of the key principles, theoretical foundations, philosophical orientations, early contributors, and applications of conditions-based ID theory. Furthermore, Table 7.8 offers a synopsis of how the elements of conditions-based theory relates to the domains of ID.

Table 7.7 An Overview of Conditions-Based Theory and Instructional Design

1. **Key Principles:**
   - There are different types of learning outcomes, and each type of learning calls for different types of instruction.
   - Instructional sequencing relies upon relationships among the various learning outcomes.
   - Instructional strategies should facilitate the internal processes of learning.
2. **Philosophical Emphases:** The following generalizations can be made:
   - Conditions-based theory is based upon an empiricist philosophy with many pragmatic applications.
   - There are common beliefs and values supporting the theory that may not be empirically derived.
   - There is an emphasis on goal-directed instruction, efficiency, effectiveness, and process generalization.
3. **Basic Research Support:** Gagné's research on cumulative learning; research on prerequisite content relationships
4. **Early Contributors:** Benjamin Bloom, Robert Gagné, and M. David Merrill
5. **ID Applications:**
   - Domains of Learning
   - Events of Instruction
   - Generative and Supplantive Strategies
   - Problem Solving
   - Learning Hierarchies
   - Performance-Content Matrix
   - Complex Learning
   - Motivational Design
6. **Supporting ID Research:** Studies of:
   - Learning hierarchies (Gagné and colleagues)
   - Instructional events (Hannafin and colleagues; Klein and colleagues)
   - Generative strategies (Wittrock)
   - Designing for complex learning (van Merriënboer and colleagues)
   - Expertise and problem solving in science and engineering; story problems (Jonassen and colleagues)
   - Motivational design (Keller and colleagues)
7. **Related Concepts:**
   - Cumulative Learning Theory
   - Instructional Transaction Theory
   - Enterprise Scenario
   - Problem-Based Learning
   - ARCS Motivation
   - Component Display Theory
   - Elaboration Theory
   - Generative Learning
   - 4C/ID

Table 7.8 Instructional Design Domains and Elements Related to Conditions-Based Theory

Learner and Learning Processes
- All learning is not the same
- Internal conditions of learning
- Learner Characteristics (affective characteristics such as motivation, background, learning strategies, mental models, prerequisite knowledge, schema)

Learning and Performance Contexts
- Authentic and simulated settings for complex learning and problem solving

Content Structure and Sequence
- Learning Task Classifications (e.g., cognitive/affective/psychomotor)
- Instructional Sequences (e.g., simple to complex)
- Vertical and horizontal relationships among recurring and non-recurring component skills for complex learning
- Problem solving includes structural knowledge, metacognitive skills, and motivation components

Table 7.8 *Continued*

Instructional and Noninstructional Strategies
- External instruction conditions should match the internal learning conditions
- Events of instruction (e.g., provide learning guidance)
- Adapt strategies to type of learning task
- Primary presentation forms (generality or instance and expository or inquisitory)
- Secondary presentation forms (e.g., mnemonic aids)
- Generative strategies allow learners to construct their own meaning
- Supplantive strategies provide direct instructional support
- Part- versus whole-task practice
- Strategies for motivation

Media and Delivery Systems
- Use computer-based instruction to facilitate complex interactions between the learner and the instruction
- Use simulations for problem-solving outcomes

Designers and Design Processes
- Analysis (theoretical analysis of concepts, determine prerequisite relationships)
- Design (events of instruction, primary and secondary presentation forms, supportive and procedural information, integrative goals, part- and whole-task sequencing, motivational design)
- Design Tools (learning hierarchies, ID Expert)

Chapter 8 examines constructivist design theory as a foundation to the ID knowledge base. Constructivism expands the scope of ID by suggesting new ways of knowledge development that in many ways fundamentally alters designers' interpretations of how to facilitate the learning process.