INSTRUCTIONAL-DESIGN THEORIES AND MODELS
Volume II

A New Paradigm of Instructional Theory

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3 Cognitive Education and the Cognitive Domain

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INTRODUCTION

In the industrial-age paradigm of instructional-design theory, work focused almost exclusively on the cognitive domain, and within that domain, it focused almost exclusively on remember-level and application-level learning (memorization and procedural-skill development). While information technologies and information-age roles make those levels of learning less important now, they still have an important place. But higher levels of learning are becoming relatively much more important for the vast majority of learners. And there is a greater need for methods of instruction that allow for much greater customization of the learning experience and much greater utilization of information technology, fellow learners, and other resources for learning. This unit of the book describes a variety of emerging instructional-design theories to meet these needs: a new paradigm of instructional theories for the information age.

While it is certainly impossible to include all such instructional theories, the ones found in chapters 4–18 represent a wide array of thinking about what it means to teach and learn, and how we can best facilitate that learning. The influence of constructivism on instructional design since Volume I of *Instructional-Design Theories and Models* (Reigeluth, 1983) is reflected in many of the design theories presented in the present volume. The purpose of this chapter is twofold. First, it serves as an introduction to the theories in this book related to cognitive development. Second, this chapter provides a framework of dimensions with which to compare and contrast the various instructional theories. We offer this framework as a tool to help readers better understand the differences and commonalties among the disparate theories included in this unit. Finally, due to the promise of problem-based learning (PBL), we offer additional issues for thinking about theories for the design of PBL.

KINDS OF LEARNING

Before we go any further, it would be helpful to define exactly what we mean by cognitive domain and cognitive education. While there may be many different kinds of learning (Gardner, 1983), most theorists (Bloom, 1956; Gagné, 1985) categorize kinds of learning in three domains: cognitive, affective, and motor. For our purposes we will make a small addition to Bloom's (1956) definition of the *cognitive domain* as the domain that deals with the recall or recognition of knowledge and the development of understandings and intellectual abilities and skills. Thus, *cognitive education* is composed of the set of instructional methods that assist students in learning knowledge to be recalled or recognized, as well as developing students' understandings and intellectual abilities and skills. Since metacognition (the ability to think about one's own thinking) is an intellectual skill, we consider it to fall in the cognitive domain.

Bloom and his colleagues (1956) developed a taxonomy that is widely used to categorize types of educational objectives for the cognitive domain. Their work has provided a common language for educators and has become the standard for identifying and classifying educational objectives and activities. The main types of learning they identified are shown in Table 3.1.

Much of the focus of the new paradigm of instructional theories seeks to push us beyond the lower levels of objectives to the higher levels, commonly referred to as higher order thinking skills. This will be evident in many of the instructional theories in this unit, especially chaps. 14–15.

TABLE 3.1
BLOOM'S TAXONOMY

Knowledge	Students working at this level can remember and recall information ranging from concrete to abstract.
Comprehension	At the comprehension level, students are able to understand and make use of something being communicated. Bloom felt that this level was the major emphasis of schools and colleges. In this level, students can translate, interpret, and extrapolate the communication.
Application	Students can apply appropriate concepts or abstractions to a problem or situation even when not prompted to do so.
Analysis	Students can break down the material into its parts and define the relationship between the parts.
Synthesis	Students create a product, combining parts from previous experience and new material to create a whole.
Evaluation	Students make judgements about the value of materials, ideas, and so forth.

Various instructional theorists have proposed other taxonomies of types of learning in the cognitive domain. Gagné (1985) proposed a taxonomy of learning outcomes with three main categories for the cognitive domain:

- *verbal information*, in which the learner "may learn to *state* or *tell* a fact or set of events by using oral speech or by using writing, typewriting, or even drawing a picture" (p. 48),
- *intellectual skills*, in which the learner "interacts with the environment by *using symbols*" (p. 47); and
- *cognitive strategies*, in which "the individual has learned *skills that manage her own learning, remembering, and thinking*" (p. 48).

Ausubel (1968) distinguished two types of learning:

- *rote learning*, in which "learned materials are discrete and relatively isolated entities which are only relatable to cognitive structure in an arbitrary, verbatim fashion, not permitting the establishment of [significant] relationships" (p. 24); and
- *meaningful learning*, which "takes place if the learning task can be related in a nonarbitrary, substantive fashion to what the learner already knows, and if the learner adopts a corresponding learning set to do so" (p. 18).

Anderson (1983) distinguished between:

- *declarative knowledge*, which "comes in chunks or *cognitive units*.... Cognitive units can be such things as propositions, strings, or spatial images. In each case a cognitive unit encodes a set of elements in a particular relationship. Chunks contain no more than five elements" (p. 23); and
- *procedural knowledge*, which is the "knowledge about how to do things" (p. 215).

Similarly, Merrill (1983) proposed the following taxonomy:

- *remember verbatim*, which is "associated with the literal storing and retrieving of information" (p. 302);
- *remember paraphrased*, which is "associated with the integration of ideas into associative memory" (p. 303);
- *use a generality*, in which the student can "use a general rule to process specific information" (p. 303); and
- *find a generality*, in which "the student is finding a new generality or is finding a higher-level process" (p. 304).

These taxonomies all have many similarities, which leads us to propose a synthesis of them into a form that uses more intuitive language in verb–noun form (see

Table 3.2). The proposed synthesized terms are given in the column headed "Reigeluth." The following paragraphs provide an explanation of each of these new terms.

Memorize information is similar to Bloom's "knowledge," Ausubel's "rote learning," and Merrill's "remember verbatim." Also, combined with the next category, "understand relationships," it is similar to Gagné's "verbal information" and Anderson's "declarative knowledge." We find this refinement of Gagné's and Anderson's distinctions to be important because very different instructional methods are needed to help learners memorize information, compared to understanding relationships. As the simplest, most superficial level of learning, memorization is a type of learning that behaviorists have addressed extensively; but cognitivists have also explored the use of mnemonics and metacognitive skills for helping students to memorize information. This type of learning is greatly overused in schools and other instructional contexts today, perhaps partly because it is the easiest to teach and test.

Understand relationships is similar to Bloom's "comprehension," Ausubel's "meaningful learning," and Merrill's "remember paraphrased." Also, as mentioned in the previous paragraph, it is part of Gagné's "verbal information" and Anderson's "declarative knowledge." Understanding is primarily a matter of learning the relationships among elements of knowledge. Learners' construction of these relationships organizes the knowledge elements into knowledge structures, often called schemata. Behaviorism offered little guidance for this type of learning, and in fact greatly discouraged consideration of understanding as a valid learning outcome. Concern for such internal knowledge structures was one of the major benefits of cognitive learning theory over behaviorist learning theory, and much work has been done over the past two or three decades to advance our understanding of how this type of learning occurs and how to foster it. But it remains more difficult to teach and test than is memorizing information.

Apply skills is similar to Bloom's "application," Gagné's "intellectual skills,"Anderson's "procedural knowledge" and Merrill's "use a generality." It requires very different methods of instruction than does either memorize information or understand relationships. Behaviorism contributed much to our understanding

TABLE 3.2
INSTRUCTIONAL TAXONOMIES

Bloom	*Gagné*	*Ausubel*	*Anderson*	*Merrill*	*Reigeluth*
Knowledge	Verbal information	Rote learning	Declarative knowledge	Remember verbatim	Memorize information
Comprehension		Meaningful learning		Remember paraphrased	Understand relationships
Application	Intellectual skill		Procedural knowledge	Use a generality	Apply skills
Analysis Synthesis Evaluation	Cognitive strategy			Find a generality	Apply generic skills

of how to teach and test this kind of learning, and cognitive learning theory has added to that base. Applying skills is common in schools and training contexts. Although it is harder to teach and test than is memorizing information, it is still typically easier than is the development of deep understanding of complex phenomena.

Apply generic skills includes Bloom's "analysis," "synthesis," and "evaluation," Gagné's "cognitive strategies," and Merrill's "find a generality." It differs from the previous category in that the skills are domain–independent (usable to varying degrees across different subject areas), rather than domain–dependent (only applicable within one subject area), and it usually takes much longer to acquire generic skills. We feel that Bloom's distinction among analysis, synthesis, and evaluation, while useful for making decisions about what to teach, is not very useful for deciding on methods of instruction, for they are all taught through basically similar methods; hence we have collapsed them into a single category. This type of learning includes higher order thinking skills, learning strategies, and metacognitive skills. Cognitive learning theory has contributed the most to understanding how best to teach and test this type of learning, but it remains among the most difficult to teach and test.

FRAMEWORK FOR COMPARISON

The instructional theories for the cognitive domain that are described in this book are vast and varied. They offer methods that range from organizing print material to encouraging problem solving to creating open learning environments. In many ways, trying to compare the theories is like comparing apples and oranges. Therefore, we offer a comparison framework upon which you can build your understanding of each theory and how each one compares to or differs from other theories of instruction (see Table 3.3 and Figure 3.1).

We do not suggest that each instructional theory can be thought of as a discrete point on each of these comparison elements. Many of the instructional theories

TABLE 3.3
DESCRIPTION OF COMPARISON FRAMEWORK

Comparison Point	*Description*
Type of Learning	What type(s) of learning do the theory and its methods address?
Control of Learning	Who controls the nature of the learning process: the teacher, the student, the instructional designer?
Focus of Learning	Do the learning activities revolve around specific topics, or problems or something else?
Grouping for Learning	How are learners grouped? Do they work individually or with others?
Interactions for Learning	What is the primary nature of interaction: teacher with student, student with student, student with material?
Support for Learning	What kinds and levels of support are given to the learner? What kinds of cognitive support are given by the teacher or the materials? What kinds of resources are available? What kinds of emotional support are given?

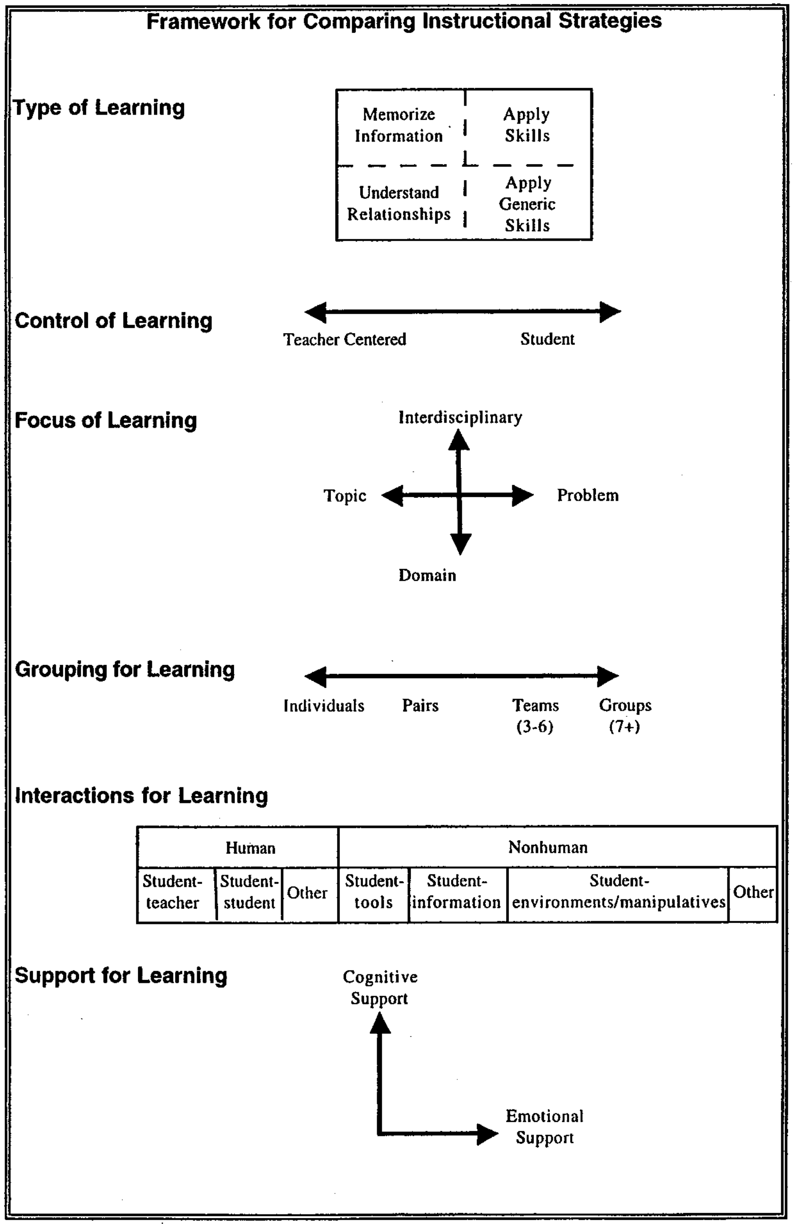
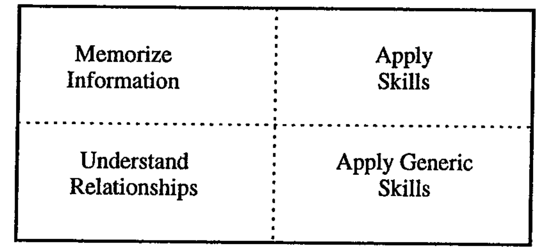


FIG. 3.1. Framework for comparing instructional strategies.

may offer particular attributes for some elements and not for others. Some theories are flexible enough to encompass several aspects across categories, while others promote only one alternative. Let's examine each of these comparison points in more detail.

Type of Learning

Type of Learning

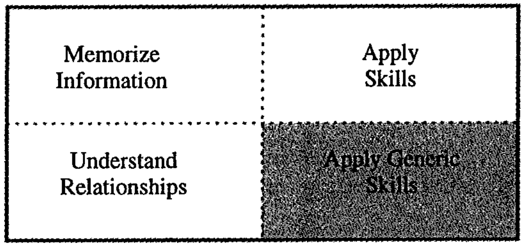


The type of learning relates to the purpose of the learning activity and the type of learning involved. In essence, this comparison point is the application of an instructional taxonomy to the content of instruction (i.e., to the type of learning or cognitive development desired). For our purposes, we will use Reigeluth's synthesis of taxonomies: memorizing information, understanding relationships, applying skills, and applying generic skills. We can visualize Reigeluth's taxonomy as an interconnected categorization scheme. While we see these categories as distinct, they can overlap and constitute a sort of continuum. For instance, it may be necessary for students to have memorized information to apply a skill, but this is not always the case. This interconnectedness is denoted in our framework through the use of dashed lines, showing that while there are categories, they can and do overlap or support one another.

Pogrow's theory (chap. 14 in this volume) discusses lessons learned from action research in teaching higher order thinking skills (HOTSs). The emphasis on students creating stories, predicting actions, and using a variety of sources to respond to questions certainly places his strategy on the "applying generic skills" quadrant (see next page).

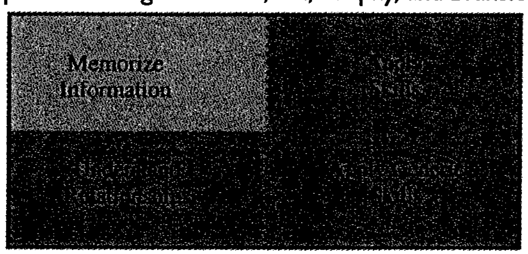
While some theories focus specifically on developing higher order skills (chaps. 14 and 15), those instructional theories which align themselves with the constructivist perspective use activities in the higher order thinking skills range (most notably problem solving, which includes analysis, synthesis, and evaluation) to develop the lower levels of learning, while simultaneously developing the higher order skills. An example of this is Schwartz, Lin, Brophy, and Bransford's STAR (Software Technology for Action and Reflection) LEGACY (chap. 9) software shell. The STAR LEGACY uses challenges and problems to stimulate iterative in-

Type of Learning: Pogrow's HOTS



quiry cycles. Within this framework, students work with others, use resources, and conduct simulations and hands-on experiments to solve the challenge. Through these problem solving activities, students develop skills, understandings, and to some extent information in several domains.

Type of Learning: Schwartz, Lin, Brophy, and Bransford



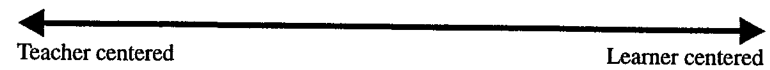
One area of generic skills that requires special attention is the area of metacognition, which is the ability to think about the way we think. Several instructional theories emphasize the importance of teaching metacognitive strategies explicitly (Corno & Randi, chap. 13; Pogrow, chap. 14; Landa, chap. 15), while others utilize metacognition within their model (Jonassen, chap. 10; Nelson, chap. 11).

Control of Learning

The traditional source of control in the learning process has been the teacher, who chooses educational objectives, selects content, determines the instructional strategies to be used, and evaluates learning. However, a key marker of the new paradigm of instructional theories is the creation of "learner-centered" environments, in which the learner takes more responsibility for defining learning outcomes and choosing the road needed to achieve those outcomes. Most educational situations are not entirely teacher centered or entirely learner centered, but exist on some point

along the continuum between the two. One extreme is not always better than the others; different points on the continuum are appropriate for different conditions.

Control of Learning



There are several questions you should ask while deciding where a particular instructional strategy fits on this continuum. This set of questions can be thought of as a categorization of elements, each of which is also a continuum:

1. Who determines the educational goals?
2. Who determines how the goals are to be accomplished?
3. Who selects the content?
4. Who selects the kinds and levels of support and resources?
5. Who chooses when support and resources are used?
6. Who decides what activities will be done, and in what order?
7. Who evaluates the learning?

Different situations will likely call for quite different positions on the continuum for different questions.

Gardner (chap. 4) provides an example of an instructional strategy whose locus of control is geared towards the teacher-centered end. While Gardner does promote using student interests and strengths to guide the choices that the teacher makes in presenting topics and information, it is the teacher who makes the decisions and guides the learning process. Most of Gardner's points are geared toward teacher behavior. These include telling stories, using analogies and examples, and choosing representations that capture important topic aspects that reach a large number of students. Therefore, the content and instructional decisions lie mainly in the hands of the instructor, not the students.

Control of Learning: Gardner

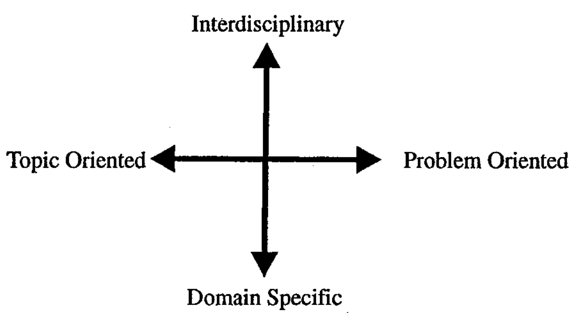
In contrast, Hannafin, Land, and Oliver (chap. 6) describe a learning environment in which the students take more control over their learning. The authors identify three different types of enabling contexts, which they describe as "vehicles through which individuals are oriented to a need or problem and interpretive perspectives are situated." The three types of enabling contexts (externally imposed, externally induced, and individually generated) describe a range of control types, from using a problem selected by the instructor with the means to solve it left to the learner, to a more learner-centered strategy of having students select not just the means to solve a problem but also the problem itself.

Control of Learning: Hannafin, Land, and Oliver

Focus of Learning

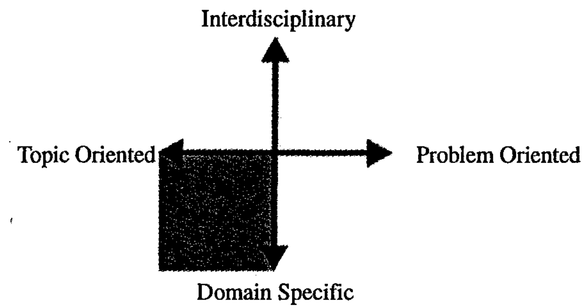
The focus of learning can vary widely, from the use of domain-specific topics to interdisciplinary problems. Unlike the previous elements of this framework, we see this point of comparison as a two-dimensional space which allows for comparison of not just the activity, but also the content upon which the activity is based. Again, each of these axes can be thought of as a continuum.

Focus of Learning



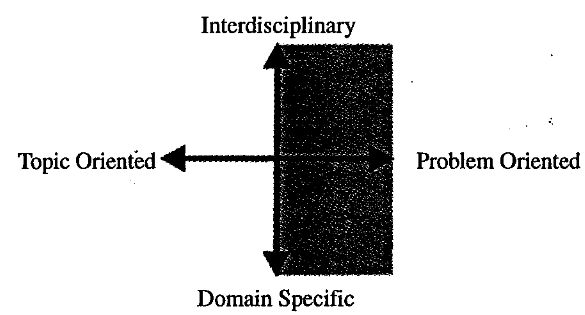
For example, Perkins and Unger, in chapter 5, "Teaching and Learning for Understanding," use generative topics as the basis for the learning activity. These topics are supposed to be "central to the domain," and therefore would be listed in our matrix as topic oriented and domain specific. While the understanding performances that students engage in may very well include problem-solving activity, these are wrapped around the topic, making the topic the primary learning vehicle.

Focus of Learning: Perkins and Unger



In some contrast, Shank, Berman, and Macpherson (chap. 8) organize learning around goal-based scenarios. These scenarios have both content and process goals and require that students learn certain content to be able to achieve the mission or goal. While this strategy is flexible, it is primarily problem oriented but could be either domain specific or interdisciplinary depending upon the nature of the goal or mission selected.

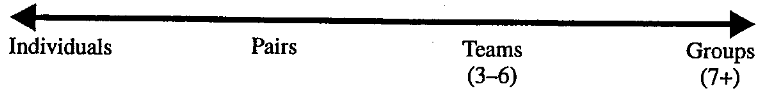
Focus of Learning: Shank, Berman, and Macpherson



Grouping for Learning

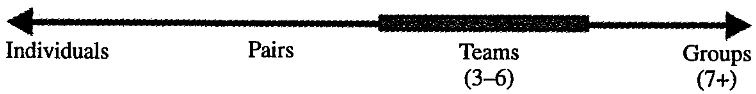
The next comparison point in our framework is learner grouping. This aspect considers the number of students who are working together. Are students working individually or in groups? For comparison purposes, we suggest the following breakdowns of learner grouping: individuals, pairs, teams (3–6), and groups (7+). Each type of grouping has its own logistical and process concerns that must be considered when planning instruction. Many instructional theories do not dictate using or not using groups. However, several have them as an essential feature.

Grouping for Learning



Nelson's "Collaborative Problem Solving" (chap. 11) is an instructional theory with the use of teams as its center point. Nelson outlines a series of "comprehensive guidelines" that should be carried through the entire experience, as well as "process activities," which are more sequential in nature. Specifically, she suggests that the groups be small, heterogeneous, and together for an extended amount of time. In her model, these group members are not just working together, but collaborating together to determine their own learning issues, needs, and plan.

Grouping for Learning: Nelson



Interactions for Learning

Another framework comparison revolves around the types of student interactions that result from use of a given instructional theory. While some instructional theories outlined in this book do not specify the types of interactions the instruction will inevitably require (e.g., Reigeluth, chap. 18), others are very specific in the types of interactions recommended. We separate student interactions into two major categories: human and nonhuman. Within each of these categories are various specific types of interactions that students may be engaged in during the learning process:

Interactions for Learning

Human			*Non-human*			
Student–teacher	Student–student	Other	Student–tools	Student–information	Student– environment/ manipulatives	Other

student–teacher: interacting with the teacher or instructor;

student–student: working with or utilizing other students as resources, individually or in a group;

student–other human: interacting with a community member, parent, or other individual (or group);

student–tools: using tools that enable completion of tasks;

student–information: working with, and making sense of, the information that is available or found;

student–environment/manipulatives: utilizing and working with resources and simulations, both within and outside the classroom environment;

student–other nonhuman: working with any other conceivable nonhuman resources.

In "Learning Communities in Classrooms" (chap. 12), Bielaczyc and Collins describe a community whose members work together to expand knowledge. As part of this community, students participate in multiple ways for multiple purposes. The result is that students must interact in a variety of ways. Bielaczyc and Collins describe an environment in which students work with teachers to define goals (student–teacher interaction), go beyond the bounds of the traditional classroom for approaches and challenges (student–environment interaction), and create a dependence on one another and share with one another (student–student). While use of resources and tools aren't specifically mentioned and may not be necessary at all times, students are expected to produce quality products. This product expectation suggests the use of some tools and resources for completion.

Interactions for Learning: Bielaczyc and Collins

Human			*Non-human*			
Student–teacher	Student–student	Other	Student–tools	Student–information	Student–environment/ manipulatives	Other

Landa, in chap. 15, proposes a general method of instruction, focusing on helping students build metacognitive skills. Landa concentrates on student interactions with the teacher as the teacher leads the students to discover a process by which they can recognize and classify knowledge. Therefore, while other interactions may (and most certainly will) occur, student–teacher interactions are the primary kind in this design theory.

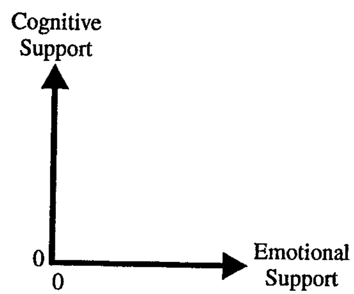
Interactions for Learning: Landa

Human			*Non-human*			
Student–teacher	Student–student	Other	Student–tools	Student–information	Student–environment/ manipulatives	Other

Support for Learning

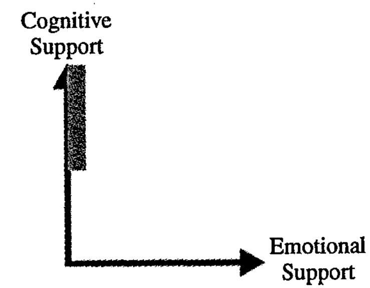
As students learn, support is needed for improvement and growth. This support comes primarily in two varieties: cognitive support and emotional support. Cognitive support consists of those elements which serve to support the students in building their understandings of, and competence in, the subject matter. This could be in the form of print resources, computer resources, human interaction, sequenced access to information, feedback, evaluation, and so forth. Emotional support consists of those elements that support learner attitudes, motivation, feelings, and self-confidence. These are not necessarily distinct items, as the manner in which a teacher provides feedback to correct a cognitive error certainly plays a role in the student's attitude, feelings, and confidence level. However, some strategies do explicitly support either the cognitive or the emotional development of the learner. Again, we use an axis as a means of representing this comparison.

Support for Learning



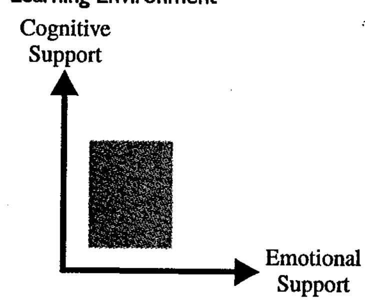
Mayer's SOI (selecting, organizing, and integrating) model (chap. 7) focuses on strategies for designing instructional messages. Mayer is concerned with providing strategies for organizing, emphasizing, and utilizing instructional messages that assist students in selecting, organizing, and integrating material to support their learning. As such, the support for learners that he provides rests completely in the cognitive area.

Support for Learning: Mayer's SOI Model



Jonassen's "Designing Constructivist Learning Environments" (chap. 10) focuses on elements of emotional as well as cognitive support. Jonassen uses the images of coaching and scaffolding to suggest strategies that provide emotional support to students. These strategies include emphasizing the importance of the task, boosting confidence levels, and adjusting task sequencing and difficulty. Cognitively, instructors should provide related cases, information resources, knowledge, construction tools, and conversation and collaboration tools. Additionally, the instructor prompts appropriate thinking strategies, consideration of related cases, and feedback on performance.

Support for Learning: Jonassen's Constructivist Learning Environment



ADDITIONAL ISSUES FOR THEORIES ON PBL

The central premise of PBL is that instruction should begin with a problem that is important and relevant to the learners. Learning, for both lower order and higher order thinking, occurs in the context of solving the problem. *Given this premise, we* *propose that any theory for the design of PBL should offer guidance for selecting appropriate problems, based on the lower order and higher order "content" that the learner and/or educator feels is important.* An inevitable concern in the selection of appropriate problems is problem complexity. Vygotsky (1978) proposes that instructional experiences should be within the zone of proximal development, or not so far beyond the learners' current capability that they have great difficulty mastering the experiences. *Therefore, a theory for the design of PBL should offer guidance that helps to design a sequence of problems that build appropriately upon each other in complexity (see e.g., the simplifying conditions method in Reigeluth, chap. 18).*

We propose that it is helpful to think of the learners as operating in two "spaces" during the problem-solving/learning process. One is the "problem space," in which the learners work directly on solving the problem. But when the learners encounter a knowledge or skill deficiency related to solving the problem, it is helpful to think of them as jumping out of the problem space and into an "instructional space," in which the learners work on acquiring the necessary knowledge, skills, and attitudes. This instructional space can be designed anywhere on a continuum from a highly constructivist approach, in which the learners are basically on their own to figure out where and how to acquire the knowledge, skills, and attitudes, to a highly directive approach, in which a lot of structure is provided to help the learners acquire the knowledge, skills, and attitudes. Basically, this "structure continuum" reflects the amount of structure and support that is provided to the learners.

This is important for several reasons. First, Anderson's (1976; Neves & Anderson, 1981) work on the acquisition of complex cognitive skills identifies several stages of skill development, including reaching a criterion for accuracy (which requires declarative encoding and proceduralization), followed by the automatization of the skill (composition). He states that this is important for complex cognitive skills, such as problem-solving, because automatization of lower order skills frees up a person's conscious cognitive processing resources to attend to higher order, more strategic concerns. Learning enough to solve one problem seldom offers enough varied practice to reach a criterion for accuracy, let alone automatization of the skill. This makes PBL vulnerable to poor skill development unless sufficient and appropriate types of practice are provided in the instructional space. The same concerns apply to building sufficient depth and breadth of understandings (including causal model development), memorizing important information, and acquiring important attitudes for the problem domain under study, as well as developing appropriate higher order thinking, problem-solving, and metacognitive skills. Different situations call for different degrees of support for each of these kinds of learning. It is not always best for learners to find and use primary sources. Learning requires active engagement by the learner, but active engagement is not always beneficial, for instance, if it is "busy work" or it only encompasses skills and understandings that the learner has already mastered.

Therefore, a theory for the design of PBL should offer guidance as to where you should be on the structure continuum for any given instructional situation; and it should offer guidance as to what methods should be used and when in order to provide each particular degree of support. For example, tutorials (demonstrations, explanations, and divergent practice with immediate feedback) may be beneficial in some situations for skill development; simulations or virtual worlds (e.g., SimCity) may be appropriate in some situations for complex causal model development, and proven mnemonics may be beneficial in some situations for memorizing information.

When the problem is finally solved, learners can learn much by reflecting back on what was learned about both the problem domain and the problem-solving process. What obstacles or difficulties did they encounter? How could they have dealt better with them? What do other problem-solvers or the literature in the field have to say about the issues they addressed? In some situations, learners can learn more from reflecting back on the problem-solving experience than they learned during it. *Therefore, a theory for the design of PBL should offer guidance on the reflection process.*

These additional issues for thinking about theories for the design of PBL are by no means comprehensive; they do not represent all the important issues in PBL. And they do not represent any variable aspects of PBL, such as whether to have learners work in teams or individually. But they do represent some of the most important issues that we believe theories in this area should address. As you study the PBL theories in this book (principally chaps. 8–11), we suggest that you add these issues to the above framework as a lens for understanding those theories, and that you try to identify additional issues that should also be considered.

CONCLUSION

As you examine the various instructional strategies for the cognitive domain described in the rest of this book, it will be helpful to have some means to compare them to one another. This chapter offers a framework that compares the type of learning, control of learning, focus of learning, grouping for learning, interactions for learning, and support of learning as a tool to guide this comparison. We also offer additional issues for thinking about PBL. These issues and the framework are not intended to be all-encompassing but, rather, to provide a starting point from which to begin your own process of analysis and discussion.

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4 Multiple Approaches to Understanding©

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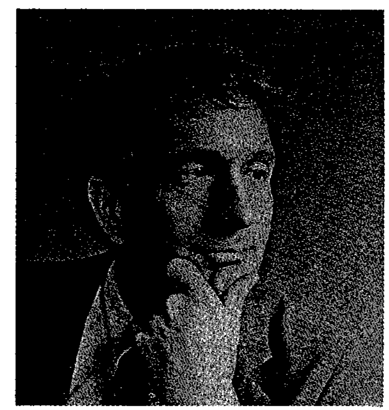

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INSTRUCTIONAL-DESIGN THEORIES AND MODELS Volume II

A New Paradigm of Instructional Theory

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1 What Is Instructional-Design Theory and How Is It Changing?

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The purpose of this chapter is to provide some ideas that will help you analyze and understand the instructional-design theories presented in this book. First, we will explore what an instructional-design theory is. This will include a discussion of the role that values play in instructional-design theories and a discussion of what an instructional-design theory is not. In the second half of the chapter, we will explore the need for a new paradigm of instructional-design theory. In particular, we will look at the need for a paradigm of training and education in which the learner is at the top of the organizational chart rather than the bottom. Then we will look at the implications that such a paradigm has for instructional-design theory, including the extent to which some of the design decisions should perhaps be made by the learners while they are learning.

WHAT IS AN INSTRUCTIONAL-DESIGN THEORY?

An instructional-design theory is a theory that offers explicit guidance on how to better help people learn and develop. The kinds of learning and development may include cognitive, emotional, social, physical, and spiritual. For example, in *Smart Schools*, Perkins describes an instructional-design theory, called "Theory One," which offers the following guidance for what the instruction should include to foster cognitive learning. The instruction should provide:

- *Clear information*. Descriptions and examples of the goals, knowledge needed, and the performances expected.

Sections of this chapter are excerpted or adapted from Reigeluth, C. M. (1996). A new paradigm of ISD? *Educational Technology, 36*(3), 13–20, with permission of the publisher.

- *Thoughtful practice.* Opportunity for learners to engage actively and reflectively whatever is to be learned—adding numbers, solving word problems, writing essays.
- *Informative feedback.* Clear, thorough counsel to learners about their performance, helping them to proceed more effectively.
- *Strong intrinsic or extrinsic motivation.* Activities that are amply rewarded, either because they are very interesting and engaging in themselves or because they feed into other achievements that concern the learner (Perkins, 1992, p. 45).

This is an instructional-design theory. Of course, Perkins elaborates on each of these guidelines in his book, but this overview provides a good example of what an instructional-design theory is like. So what are the major characteristics that all instructional-design theories have in common?

First, unlike more familiar kinds of theories, instructional-design theory is *design-oriented* (focusing on means to attain given goals for learning or development), rather than description oriented (focusing on the results of given events). In the case of Theory One, the goal is to enhance learning "for any performance we want to teach" (p. 45). Being design oriented makes a theory more directly useful to educators, because it provides direct guidance on how to achieve their goals.

Second, instructional-design theory identifies *methods* of instruction (ways to support and facilitate learning) and the *situations* in which those methods should and should not be used. In the case of Theory One, the methods (at this general level of description) are: clear information, thoughtful practice, informative feedback, and strong motivators. Perkins goes on to say, "Good teaching demands different methods for different occasions" (p. 53), and he describes how Theory One can underlie each of Adler's (1982) three different ways of teaching: didactic instruction, coaching, and Socratic teaching.

Third, in all instructional-design theories, the methods of instruction can be broken into *more detailed component methods*, which provide more guidance to educators. In the case of Theory One, Perkins provides considerable information about components for each of the four basic methods. For example, within the didactic framework, Perkins describes some of the components for clear information, based on Leinhardt's (1989) research:

- identification of goals for the students;
- monitoring and signaling processes toward the goals;
- giving abundant examples of the concepts treated;
- demonstration;
- linkage of new concepts to old ones through identification of familiar, expanded, and new elements;
- legitimizing a new concept or procedure by means of principles the students already know, cross-checks among representations, and compelling logic (Perkins, 1992, pp. 53–54).

And fourth, the methods are *probabilistic* rather than deterministic, which means they increase the chances of attaining the goals rather than ensuring attainment of the goals. In the case of Theory One, "Giving abundant examples of the concepts treated" will not ensure that the goals for the students will be attained. But, it will increase the probability that they will be attained.

So, instructional-design theories are design oriented, they describe methods of instruction and the situations in which those methods should be used, the methods can be broken into simpler component methods, and the methods are probabilistic. Each of these characteristics of instructional-design theories is described in more detail next.

Design-Oriented Theories

An important characteristic of instructional-design theories is that they are design oriented (or goal oriented). This makes them very different from what most people usually think of as theories. Theories can be thought of as dealing with cause-and-effect relationships or with flows of events in natural processes, keeping in mind that those effects or events are almost always probabilistic (i.e., the cause increases the chances of the stated effect occurring) rather than deterministic (i.e., the cause always results in the stated effect). Most people think of theories as descriptive in nature, meaning that the theory describes the effects that occur when a given class of causal events occurs, or meaning that it describes the sequence in which certain events occur. For example, information-processing theory is descriptive. Among other things, it says that new information enters short-term memory before it enters long-term memory. It doesn't tell you how to facilitate learning. Descriptive theories can be used for prediction (given a causal event, predict what effect it will have; or, given one event in a process, predict what event will likely occur next) or for explanation (given an effect that has occurred, explain what must have caused it or preceded it).

But design-oriented theories are very different from descriptive theories (see e.g., Cronbach & Suppes, 1969; Simon, 1969; Snelbecker, 1974; Reigeluth, 1983b, which is chapter 1 in Volume 1 of this book). Design theories are prescriptive in nature, in the sense that they offer guidelines as to what method(s) to use to best attain a given goal. (They are not usually prescriptive in the sense of spelling out in great detail exactly what must be done and allowing no variation. Prescription in that sense only applies to deterministic—or positivistic—theories, which are almost nonexistent in the social sciences.) For example, if you want to help long-term retention of some new information to occur (an instructional goal), you should help the learner to relate that information to relevant prior knowledge (an instructional method).

Simon (1969) referred to the distinction between descriptive theories and design theories as "the natural sciences" and "the sciences of the artificial," respectively. Cronbach and Suppes (1969) referred to it as "conclusion-oriented inquiry" and "decision-oriented inquiry." Whatever you choose to call them, they are very different kinds of theories that have very different purposes and require very different kinds of research. Design theories are intended to provide direct guidance to practitioners about what methods to use to attain different goals, whereas descriptive theories attempt to provide a deeper understanding of effects that result from phenomena. Therefore, descriptive theories are also useful to practitioners, because they provide an understanding of why a design theory works and because they can help practitioners to generate their own design theories for those many situations for which no adequate ones exist. The major concern for people developing and testing descriptive theories is validity, whereas for design theories, it is preferability (i.e., does this method attain your goals for your situation better than any other known method?). This is why design theories require different research methodologies from descriptive theories (see chap. 26, this volume, for a description of a methodology for advancing design theories).

Methods and Situations

Instructional-design theory requires at least two components: methods for facilitating human learning and development (which are also called methods of instruction), and indications as to when and when not to use those methods (which I call situations). Although the term "context," has a similar meaning in lay language and is often used in education, not all aspects of the context influence what methods should be used. Therefore, I use the term "situation" to refer to those aspects of the context that do influence selection of methods. An essential feature of instructional-design theories is that the methods they offer are situational rather than universal. In other words, one method may work best in one situation, while another may work best in a different situation.

There are two major aspects of any instructional situation (see Fig. 1.1): the conditions under which the instruction will take place and the desired outcomes of the instruction. *Instructional conditions*, which should not be confused with Gagné's conditions of learning, include:

- the nature of what is to be learned (e.g., understandings are learned differently from the way skills are learned);
- the nature of the learner (e.g., prior knowledge, learning strategies, and motivations);
- the nature of the learning environment (e.g., independently at home, in a group of 26 students at school, in a small team in a business); and
- the nature of the instructional development constraints (e.g., how much time and money you have for planning and developing the instruction).

All of these conditions may influence which methods will work best to attain your desired outcomes. Gagné's internal conditions of learning fall within the sec-

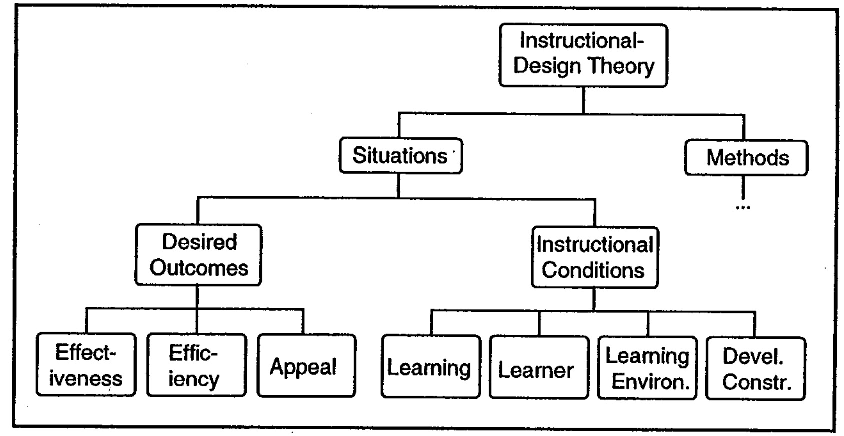

FIG. 1.1. The components of instructional-design theories.

ond item above (the nature of the learner), so they are instructional conditions; but his external conditions of learning are actually instructional methods, not instructional conditions.

The second major aspect of any instructional situation is the *desired instructional outcomes.*[1] These are different from learning goals. They do not include the specific learnings that are desired. Remember, the first item for conditions (see the previous bulleted list) was "the nature of what is to be learned." Instead, desired instructional outcomes include the levels of effectiveness, efficiency, and appeal you want or need from the instruction.

- Level of effectiveness is a matter of how well the instruction works, as indicated by how well (to what degree of proficiency) the learning goals are attained. The desired instructional outcomes are not concerned with what the learning goals are, but with how well they are achieved. The term "criterion" is often used to refer to the level of effectiveness. An example is correctly solving 8 out of 10 real-world problems that require the use of $a^2+b^2=c^2$ in a right triangle.
- Level of efficiency is the level of effectiveness of the instruction divided by the time and/or cost of the instruction. An example is how long it takes stu-

[1]As Landa (1983) indicated in Volume I, descriptive instructional theory (as opposed to instructional-design theory) is concerned with actual outcomes, rather than with desired outcomes. See also, chapter 1 of Volume I (Reigeluth, 1983b) for a discussion of the difference between desired and actual outcomes.

dents to reach the criterion mentioned above: correctly solving 8 out of 10 real-world problems that require the use of $a^2+b^2=c^2$ in a right triangle.
- Level of appeal is the extent to which the learners enjoy the instruction. An example is students asking where they could learn more about a topic.

Some trade-offs are often necessary among the three desired outcomes (effectiveness, efficiency, and appeal). The more effective you want the instruction to be, the more time and expense it may require, making it less efficient. And sometimes the more appealing (motivational) you want the instruction to be, the less efficient it will be. In this book, the instructional-design theories (see Units 2 and 3) explicitly state the situations for which their methods are recommended.

Component Methods

So, instructional-design theories are design oriented; they have methods, which are situational; and they specify the situations (instructional conditions and desired outcomes) for which the methods are appropriate or inappropriate. Their methods are also componential, meaning that each can be done in different ways and is therefore made up of different components (or features). For example, problem-based learning (PBL) can be viewed as a method of instruction. But PBL is made up of many smaller methods, such as presenting the problem and the scenario in which it occurs, forming teams, providing support for the teams' efforts, reflecting on the results of the individuals' and teams' efforts, and so forth. These are *parts* of the more general method.

In addition, there are usually many different ways in which a method can be performed. The problem can be presented in different ways, the scenario can have different kinds of characteristics, and so forth. These are *kinds* of their more general method. Sometimes one of those kinds is better than the others (better for a given set of conditions and desired outcomes), but sometimes they are equally efficacious. Often, it depends on the situation.

Finally, more detail can be provided for a method by offering *criteria* that the method should meet. These are neither parts nor kinds of the more general method; rather they indicate specifications that the method should meet. For example, realism might be specified as a criterion for designing the scenario in problem-based learning.

It should be apparent all of these components[2] (whether they are parts, kinds, or criteria) can usually be broken down into more detailed guidelines; in other words, they usually have subcomponents, which in turn can have subsubcomponents, and so forth, down to what have been called "elementary components" (components that for practical purposes have insignificant variation and therefore are not usefully analyzed into their components; see the Landa and Scandura theories in Volume I: Reigeluth, 1983a). Of course, those components are highly interrelated and usually highly situational in their effects on attaining the desired outcomes. An instructional-design theory is much simpler and easier to understand if it describes methods on a relatively general level. In other words, in a diagram that breaks the methods down into components and then breaks those components into their components, the general methods are those higher up in the diagram. But such a simple theory is also less useful to educators, because there are so many different ways that those methods can be performed, and educators have no guidance about which way (or ways) is (are) likely to work best for their situations. Therefore, an instructional-design theory is easier to apply if it describes methods on a relatively detailed level.

[2]I use the term "components" even though that is often viewed as synonymous with "parts," because the three kinds of "break-downs" (parts, kinds, and criteria) comprise, or are contained in, the more general method.

So, instructional-design theories can vary greatly in terms of the level of guidance they provide, ranging from very general theories to highly detailed theories. But just because a theory is detailed does not mean it is not flexible, in the sense of being adaptable to different situations. In the present book, the authors have only enough space to summarize their respective theories, so the level of guidance provided herein may be much lower than what the same authors have given elsewhere. In such cases, the authors provide references to their more thorough works, so readers can find additional guidance for using their methods.

Probabilistic Methods

Another characteristic of methods of instruction is that they are probabilistic. This means that methods do not guarantee the desired instructional and learning outcomes. They only increase the probability that the desired results will occur. This is because there are so many factors (situation, variables) that influence how well a method of instruction works. It is probably impossible to develop an instructional method that will work better than any other method 100% of the time, in the situations for which it is intended. But the goal of an instructional-design theory is to attain the highest possible probability of the desired results (which often include cost-effectiveness) occurring.

It would be nice if instructional-design theories could specify probabilities for each method component, but those probabilities likely differ for different situations and differ depending on what other method components are being used with them (an "interaction effect"). This makes it difficult to specify probabilities for each method in anything less than an electronic performance support system, though the theorist would still have the formidable problem of empirically determining or validating all the probabilities for all the qualitatively different situations. So, unfortunately, probabilities are rarely included in instructional-design theories.

Values

A major implication of design theory's goal (or design) orientation and emphasis on preferability of methods for attaining its goals is that values play an important role for design theories, whereas any talk of values for descriptive theories is usually considered unscientific. Values (or philosophy, if you prefer) are especially important to design theory in two ways. First, they play an important role in deciding what *goals* to pursue. Traditionally, instructional-design process models (see the "Instructional-Design Process" section below) have relied solely on needs-analysis techniques (a data-based approach) to decide what to teach. We need greater recognition of the important role that values play in such decisions, and instructional-design process models need to offer guidance on how to help all people who have a stake in the instruction reach consensus on such values. Second, for any given goal, there is almost always more than one *method* that can be used to attain it. Traditionally, instructional-design process models have relied primarily on research data about which methods work best. But which methods work best depends on what criteria you use to judge the methods. Those criteria reflect your values. In this book, all the instructional-design theories (see Units 2–4) state explicitly what values guide their selection of goals and what values guide their selection of methods.

So, instructional-design theories are design oriented, and they offer methods which are situational, componential, and probabilistic. They identify the situations for which the methods should be used. They also identify the values that underlie the goals they pursue and the methods they offer to attain those goals. So what kinds of things do not constitute instructional-design theories, but are often confused with such theories?

WHAT IS NOT AN INSTRUCTIONAL-DESIGN THEORY?

To understand what instructional-design theory is, it is helpful to contrast it with what it is not. It differs in important ways from *learning theory, instructional-design process*, and *curriculum theory.* But instructional-design theory is also closely related to each of these, and it is important for teachers and instructional designers to know about them. Each of them is discussed in what follows.

Learning Theory

Learning theories are often confused with instructional-design theories. But learning theories are descriptive. They describe how learning occurs. For example, one kind of learning theory, called schema theory, proposes that new knowledge is acquired by accretion into an existing schema, by tuning that schema when minor inconsistencies emerge, and by restructuring that schema when major inconsistencies arise (Rummelhart & Norman, 1978). But how does that understanding help me to teach, say, English grammar? If I'm creative and have a lot of

time, I may be able to develop instructional methods that facilitate accretion, tuning, and restructuring of schemata. But it is very difficult, and I may completely miss the mark. If I'm successful in identifying useful methods for particular situations, I've created an instructional-design theory. It may only apply to a very narrow slice of situations, but those methods and situations comprise an instructional-design theory.

In contrast to learning theories, instructional-design theories are more directly and easily applied to educational problems, for they describe specific events outside of the learner that facilitate learning (i.e., methods of instruction), rather than describing what goes on inside a learner's head when learning occurs. The same kind of analysis applies to theories of human development. They are descriptive and apply only indirectly to teaching (fostering learning and development of all sorts).

Nevertheless, that does not mean that theories of learning and human development are not useful to educators. As Winn (1997) put it, "any successful practitioner or researcher needs to be thoroughly versed in at least the immediately underlying discipline to his or her own. A good instructional designer knows [theories of learning and human development]" (p. 37). Indeed, learning and developmental theories are useful for understanding why an instructional-design theory works, and, in areas where no instructional-design theories exist, they can help an educator to invent new methods or select known instructional methods that might work.

So, instructional-design theories and theories of learning and human development are both important, and, like a house and its foundation, they are closely related. In fact, they are often so closely related that several of the theories in Units 2–4 provide some discussion of learning theory as well as instructional-design theory (see, e.g., chap. 7 in which Mayer has a section on the "SOI Model of Learning" as well as on the "Instructional Methods Suggested by the SOI Model"). But these kinds of theories also differ from each other in important ways, and it is difficult to adequately understand how to facilitate learning without understanding the differences between them.

Instructional-Design Process

Another thing that isn't instructional-design theory is the instructional-design process. Instructional-design theory concerns what the instruction should be like (i.e., what methods of instruction should be used) not what process a teacher or instructional designer should use to plan and prepare for the instruction. Other common terms that characterize this distinction are instructional theory, instructional model, and instructional strategies to represent instructional-design theory; and instructional development (ID) model or instructional systems development (ISD) process to represent instructional-design process.

However, instructional-design theories and instructional-design processes are also closely related. Different theories require differences in the process used to apply those theories to particular situations. Therefore, some of the chapters in Units

2–4 of this book contain brief summaries of the new aspects of the design process that are necessary to use their theory; for example, in chapter 23 Kamradt and Kamradt talk about "attitudinal needs analysis."

Curriculum Theory

In Volume I of this book (Reigeluth, 1983a), I discussed the distinction between what to teach and how to teach; and I indicated that decisions about what to teach have been viewed as the province of curriculum theories, whereas decisions about how to teach have been the province of instructional-design theories. However, the interrelationships between these two kinds of decisions are so strong that it often makes sense to combine the two. And, in fact, many curriculum theories have offered guidance for methods of instruction, while many instructional-design theories have offered guidance for what to teach. Therefore, although it is helpful to recognize the difference between deciding what to teach and how to teach it, some of the theories presented in Units 2 and 3 appropriately address both, for example, chapter 4, in which Gardner talks about "Topics Worth Understanding" as well as about ways of fostering understanding.

A fundamental question concerns bases for making decisions about what to teach and how to teach. Regarding what to teach (goals), the ISD process has traditionally looked only at what works, through the process of needs analysis, as I mentioned in the section on "Values" earlier. But many curriculum theories are based on a philosophy (a set of values). In fact, both empirics (data about what is needed) and values (opinions about what is important) are relevant and should be addressed in the ISD process for deciding what to teach, perhaps with different degrees of emphasis for different situations. Similarly, regarding decisions about how to teach (what methods to use), instructional-design theories have traditionally relied exclusively on data obtained through research, summative evaluations, and formative evaluations, typically assuming that the criteria used to judge "what works" are universal (indisputable). But they aren't. Criteria often differ from one situation to another, because people differ in their values about what outcomes are important. Thus, both values and empirics are important for making decisions about how to teach as well as what to teach, so elements of curriculum theory and the ISD process should be combined.

In this chapter, we have already explored what an instructional-design theory is. It is design oriented (or goal oriented), offering guidelines about what methods to use in what situations. Its methods are componential, offering varying levels of guidance for educators. The methods are also probabilistic, not always fostering the desired results. And we have seen that values play an important role in an instructional-design theory in that they underlie both the goals it pursues and the methods it offers to attain those goals. We have also explored what an instructional-design theory isn't. It isn't the same as a learning theory, an ISD process model, or a curriculum theory; but it is closely related to all three, and educators should supplement their knowledge of instructional-design theory with all three. In fact, it is often useful to combine instructional-design theory and curriculum theory.

Given this understanding of what an instructional-design theory is and isn't, we can move on to the question of why it is important.

Why Is Instructional-Design Theory Important?

Pogrow (1996) points out that "The history of educational reform is one of consistent failure of major reforms to survive and become institutionalized.... Cuban [1993] refers to the historical success of attempted curriculum reform as 'pitiful.'" (p. 657). Pogrow goes on to say that "The single biggest tool in promoting reform has been advocacy" (p. 658), which originates primarily from the "REsearch/Academic/Reform (REAR) community," made up of educational reformers and the academicians and researchers who develop ideas and rationales for them. Pogrow states that "The feeling is widespread in the REAR community that its responsibility is to produce general theory and that it is up to practitioners to figure out how to apply that theory" (p. 658).

What Pogrow is calling for is the need for design theory rather than descriptive theory. He goes on to say:

> It is far more difficult to figure out how to implement [descriptive] theory than it is to generate it. I am reasonably intelligent, and it took me 14 years of almost full-time effort to figure out how to consistently work just four thinking skills into a detailed and effective curriculum.... My own experience is that it is indeed possible for the right type of research to develop techniques and determine implementation details that are applicable to most local conditions—if REAR is so disposed. (p. 658)

To really help educators to improve education, it is essential that more people in the REAR community devote their efforts to generating design theories, rather than, as Pogrow puts it, "prefer[ing] to philosophize and preach" (p. 658). The purpose of this book is to summarize and publicize some of the promising work that is being done to generate design theories in the field of instruction. We leave it to others to do the same in other areas of education, including administration and governance/policy. We also leave it to others to generate design theories that deal with systemic change in the entire educational system (see e.g., Banathy, 1991; Reigeluth & Garfinkle, 1994).

Having addressed what instructional-design theory is and why it is important, I turn now to how and why it is changing in such a dramatic way as to require a Volume II, rather than a second edition, of the previous work on this topic (Reigeluth, 1983a).

WHY AND HOW ARE INSTRUCTIONAL-DESIGN THEORIES CHANGING?

It is helpful to think in terms of two basic kinds of change: piecemeal and systemic. Piecemeal change leaves the structure of a system unchanged. It often involves finding better ways to meet the same needs, such as using an analogy to help your students learn the science concepts you taught in an otherwise similar manner last year. In contrast, systemic change entails modifying the structure of a system, usually in response to new needs. For example, you may find that your students' characteristics (such as their entering knowledge, learning styles, interests, and motivations) are more diverse than they used to be and that they have very different goals (such as college, vocational school, or immediate employment). To respond to these changed needs, you may decide to use customized, team-based, problem-based learning with continuous progress and to use advanced technology more extensively. Piecemeal change usually changes one part of a system in a way that is still compatible with the rest of the system, whereas systemic change entails such a fundamental change that it requires changes throughout the system, because the other parts of the system are not compatible with the change.

So, does instructional-design theory need piecemeal change or systemic change? As we discussed earlier, instructional-design theory is a knowledge base that guides educational practice: how to facilitate learning. In turn, instructional practice is a subsystem that is a part of different kinds of systems, such as public education systems, higher education systems, corporate training systems, health agencies, the armed forces, museums, informal learning systems, and many others. I shall refer to the instructional practice subsystems as simply the "instructional systems."

Systems thinkers know that, when a human-activity system (or societal system) changes in significant ways, its subsystems must change in equally significant ways to survive. This is because each subsystem must meet one or more needs of its supersystem in order for the supersystem to continue to support it (Hutchins, 1996). So, if the supersystems for instructional systems are undergoing systemic changes, then—and only then—do instructional systems, and consequently instructional-design theory, need to undergo systemic change or risk becoming obsolete.

Instruction's Supersystem

So, are instruction's supersystems changing dramatically? In the agrarian age, businesses were organized around the family: the family farm, the family bakery, and so forth. In the industrial age, the family was replaced by the bureaucracy and departments, which became the predominant form of business organization. Now, as we evolve deeper into the information age, corporations are doing away with many of the midlevels of the bureaucracy and are reorganizing on the basis of holistic processes rather than fragmented departments; they are also organizing their staffs into

teams that are being given considerable autonomy to manage themselves within the purview of the corporate vision, rather than being directed from above (Drucker, 1989; Hammer & Champy, 1993). This allows the corporations to respond much more quickly and appropriately to their customers' and clients' needs. These changes certainly fit the definition of systemic change.

Increasingly, other organizations in the private, public, and "third" (nonprofit) sectors are undergoing similar transformations (see, e.g., Osborne & Gaebler, 1992). Fig. 1.2 shows some of the "key markers" that characterize the differences between industrial-age organizations and information-age organizations.

Industrial Age	*Information Age*
Standardization	Customization
Bureaucratic organization	Team-based organization
Centralized control	Autonomy with accountability
Adversarial relationships	Cooperative relationships
Autocratic decision making	Shared decision making
Compliance	Initiative
Conformity	Diversity
One-way communications	Networking
Compartmentalization	Holism
Parts oriented	Process oriented
Planned obsolescence	Total quality
CEO or boss as "king"	Customer as "king"

FIG. 1.2. Key markers that distinguish industrial-age and information-age organizations.

These fundamental changes in instruction's supersystems have important implications for instruction. Employees need to be able to think about and solve problems, work in teams, communicate, take initiative, and bring diverse perspectives to their work. Also, "people need to learn more, yet they have less time available in which to learn it" (Lee & Zemke, 1995, p. 30), and they need to demonstrate an impact on the organization's strategic objectives (Hequet, 1995). Can our systems of education and training meet those needs by merely changing the content (what we teach) or do we need to make more fundamental changes? To answer this question, we must take a closer look at our current paradigm of training and education.

The Current Paradigm of Education and Training

Fig. 1.2 indicates that our current paradigm in education and training is based on *standardization*, much like the mass production of industrial-age manufacturing, which is now giving way to customized production in the information-age economy. We know that different learners learn at different rates and have different learning needs. Yet our current paradigm of education and training entails teaching a large group of learners the same content in the same amount of time. Why? One reason is that group-based learning represents logistical and economic efficiencies, even though it does not do a good job of meeting learners' needs. As Campbell and Monson (1994) state, "We challenge this key assumption of traditional instruction that asserts that walking all learners through the content in the same way can be effective. This may be a model for efficiency, but certainly not for effectiveness" (p. 9).

When you consider that student assessment has typically been norm based and that teachers sometimes withhold information from students to see who the really bright ones are, it becomes clear that at least part of the reason for standardized instruction has been to sort learners in K–12 schooling, higher education, and corporate training. Standardized instruction allows valid comparisons of students with each other, which was an important need in the industrial age: separating the laborers from the managers. After all, you couldn't afford to—and didn't want to—educate the common laborers too much, or they wouldn't be content to do boring, repetitive tasks, nor to do what they were told to do without questions. So our current paradigm of training and education was never designed for learning; it was designed for sorting (Reigeluth, 1994).

But assembly-line workers acting as automatons are becoming an endangered species in the United States. The migration of manufacturing jobs abroad, the increasing complexity of equipment, and the current corporate restructuring movement's emphasis on quality combine to require ever-increasing numbers of employees who can take initiative, think critically, and solve problems. To meet this need in industry and the need for life-long learners, we must now focus on learning instead of on sorting. But how can we refocus our systems on learning? Educators agree that different people learn at different rates. So, when an educational or training system holds time constant, achievement must vary, as has been the case in our industrial-age educational system ever since it replaced the one-room schoolhouse. The alternative is to allow time to vary—to give each learner the time he or she needs to reach the learning goals. That would be a learning-focused system, which we show signs of moving toward (see, e.g., the special issue of *Educational Technology*, 1994, on goal-based scenarios developed by Northwestern University and Andersen Consulting Education). This means we need a focus on *customization*, not standardization. This is true in all instructional contexts: corporations and other organizations, as well as K–12 schools and institutes of higher education. Merely changing the content of what we teach will not meet this new need of instruction's supersystems.

Figure 1.2 indicates that our current paradigm of training and education is also based on *conformity* and *compliance*. Trainees and students alike are usually expected to sit down, be quiet, and do what they are told to do. Their learning is directed by the trainer or teacher. But employers now want people who will take *initiative* to solve problems and who will bring *diversity*—especially diverse perspectives—to the workplace. Both of these enhance the ability of a team to solve problems and keep ahead of the competition. Communities and families also need people who will take

initiative and honor diversity. Changing the content of what we teach is not sufficient to meet these new needs of the supersystems, for the very structure of our systems of training and education discourages initiative and diversity.

I could continue this process of analyzing how each of the key markers of our current paradigm of training and education (Fig. 1.2) are counterproductive for meeting the emerging needs of the information age, but the message should already be clear: the paradigm itself needs to be changed. This is the focus of the emerging field called educational systems design (ESD) (see, e.g., Banathy, 1991; Reigeluth, 1995), which is concerned both with what kinds of changes are required to better meet the needs of supersystems and learners (a product issue) and with how to go about making those changes (a process issue). So the next question is, does that mean instruction has to change?

Implications for Instructional-Design Theory

From the above discussion, we have seen that the current paradigm of education and training needs to change from one focused on sorting to one focused on learning—from the Darwinian notion of "advancement of the fittest" to the more spiritually and humanistically defensible one of "advancement of all"—and on helping everyone to reach their potential. This means that the paradigm of *instruction* has to change from standardization to customization, from a focus on presenting material to a focus on making sure that learners' needs are met, from a focus on putting things into learners' heads to a focus on helping learners understand what their heads are into: a "learning-focused" paradigm. This, in turn, requires a shift from passive to active learning and from teacher-directed to student-directed (or jointly directed) learning. It requires a shift from teacher initiative, control, and responsibility to shared initiative, control, and responsibility. It requires a shift from decontextualized learning to authentic, meaningful tasks. And, most importantly, it requires a shift from holding time constant and allowing achievement to vary, to allowing each learner the time needed to reach the desired attainments.

But to change the paradigm of instruction in this way, the teacher can't teach the same thing to a whole "class" at the same time. This means the teacher has to be more of a "guide on the side" rather than a "sage on the stage." So, if the teacher is a facilitator rather than the agent of most of the learning, what other agents are there? Well-designed resources are one, and instructional-design theory and instructional technology can play particularly large roles in developing these. But others include fellow learners (e.g., students or trainees), local real-world resources (e.g., practitioners), and remote resources (e.g., those available through the Internet). Instructional-design theories are needed to offer guidance for the use of all these kinds of resources for the learning-focused paradigm of instruction. Furthermore, this paradigm requires that our definition of *in*struction include what many cognitive theorists refer to as "*con*struction" (see, e.g., Ferguson, 1992): a process of helping learners to build their own knowledge, as opposed to (or in addition to) a process of merely conveying information to the learner. Instruction must be defined more broadly as anything that is done to facilitate purposeful learning.

Clearly, this new paradigm of instruction requires a new paradigm of instructional-design theory. But does this mean we should discard current instructional-design theories? To answer this question, let's consider some of the major contributions of current theories. If someone wants to learn a skill, then demonstrations of the skill, generalities (or explanations) about how to do it, and practice doing it, with feedback, will definitely make learning easier and more successful. Behaviorists recognized this, and called these elements examples, rules, and practice with feedback. Cognitivists also recognized this, but naturally had to give these elements different names, such as cognitive apprenticeship and scaffolding. And, yes, constructivists also recognize this, and even radical constructivists walk the walk, though they may not talk the talk. An analysis of instruction designed by some radical constructivists reveals a plentiful use of these very instructional strategies. Should we seriously consider discarding this knowledge? I don't think so. But is this knowledge sufficient to design high-quality instruction? I don't think that, either.

The point is that instructional designers and other educators should recognize that there are two major kinds of instructional methods: *basic methods,* which have been scientifically proven to consistently increase the probability of learning under given situations (e.g., for given types of learning and/or learners), such as the use of "tell, show, and do" (generality, examples, and practice with feedback) for teaching a skill, and *variable methods,* which represent alternatives from which you can choose, as vehicles for the basic methods (e.g., PBL versus tutorial versus apprenticeship). Although this greatly oversimplifies the relationships that exist between methods of instruction and the various situations under which they should and should not be used, it is nonetheless an important distinction of which designers should be aware. Traditional instructional-design theories have typically not provided guidance as to when to use each of these variable methods. As you read through Units 2–4, I suggest you try to identify which methods are basic and which are variable.

To provide guidance on when to use these methods, we need a truly new paradigm of instructional-design theory that has evolved from being a "monologue [to] a dialogue, not just between designers and users but also between designs and those who interact with them." (Mitchell, 1997, p. 64). This new paradigm should subsume current theory and should offer flexible guidelines about such things as when and how learners:

- should be given initiative (self-direction);
- should work in teams on authentic, real-world tasks;
- should be allowed to choose from a diversity of sound methods;
- should best utilize the powerful features of advanced technologies; and
- should be allowed to persevere until they reach appropriate standards.

Learning-focused instructional-design theory must offer guidelines for the design of learning environments that provide appropriate combinations of challenge and guidance, empowerment and support, self-direction and structure. And the learning-focused theory must include guidelines for an area that has largely been overlooked in instructional design: deciding among such variable methods of instruction as PBL, project-based learning, simulations, tutorials, and team-based learning. Fig. 1.3 and 1.4 show some of these kinds of approaches that learning-focused theory might encompass. We also need flexible guidelines for the design of each of these and other approaches to instruction.

Furthermore, the old paradigm of instructional-design theory focused on relatively few kinds of learning. But different types of learning require different methods of instruction (see, e.g., the partial list in Fig. 1.5). Attitudes and values and other types of learning in the affective domain are best facilitated in very different ways from cognitive skills and other types of learning in the cognitive domain, even though there are cognitive elements to those affective learnings, and even though cognitive and affective learnings are often highly interrelated. And learning of domain-dependent knowledge (confined to a particular subject area) is facilitated in different ways from that of domain-independent knowledge (which represents higher levels of learning, such as metacognitive skills), even though both types of knowledge are often used together.

In the industrial age, education needed to focus primarily on simple (domain-dependent) cognitive learning. But, as we evolve deeper into the information age, learners need more skills for complex cognitive tasks, such as solving problems in ill-structured domains. And they need more support to develop in noncognitive areas, such as emotional development, character development, and spiritual development. Instructional-design theories to date have focused almost exclusively on the cognitive domain and, within that, largely on simpler procedural tasks and information in well-structured areas. When you consider the full range of types of learning, it is clear that our current theories are not adequate. The new paradigm of instructional-design theory must address how to support learning in all its varieties and forms. This book contains a sampling of the early work being done for most of these important types of learning, but much work remains to be done to develop powerful guidelines for designing ways to facilitate their development.

For instructional-design theory to remain a vibrant and growing field that will help meet the changing needs of our systems of education and training, we desperately need more theorists and researchers working collaboratively to develop and refine this new paradigm of instructional-design theories. I hope that this book will encourage more people to work in this area, more funders to support work in this area, and more practitioners to use the growing knowledge base in this area. Formative research (see chap. 26) represents one possible methodology for developing such theories because it focuses on how to improve existing design theories, rather than on comparing one theory with another (as experimental research does) or on describing what happens when a theory is used (as naturalistic qualitative research does).

Apprenticeship: an experiential learning strategy in which the learner acquires knowledge and skills through direct participation in learning under immediate personal supervision in a situation that approximates the conditions under which the knowledge will be used.

Debate: a formally structured discussion with two teams arguing opposing sides of a topic.

Demonstration: a carefully prepared presentation that shows how to perform an act or use a procedure; accompanied by appropriate oral and visual explanations and illustrations; frequently accompanied by questions.

Field trip: a carefully planned educational tour in which a group visits an object or place of interest for first-hand observation or study.

Game: an instructional activity in which participants follow prescribed rules that differ from those of reality as they strive to attain a challenging goal; is usually competitive.

Group discussion, guided: a purposeful conversation and deliberation about a topic of mutual interest among 6–20 participants under the guidance of a leader.

Group discussion, free/open: a free group discussion of a topic selected by the teacher, who acts only as chairman; learning occurs only through the interchange among group members.

Ancient symposium: a group of 5–29 persons who meet in the home or private room to enjoy good food, entertainment, fellowship, and with the desire to discuss informally a topic of mutual interest.

Interview: a 5- to 30-minute presentation conducted before an audience in which a resource person(s) responds to systematic questioning by the audience about a previously determined topic.

Laboratory: a learning experience in which students interact with raw materials.

Guided laboratory: an instructor-guided learning experience in which students interact with raw materials.

Lecture/Speech: a carefully prepared oral presentation of a subject by a qualified person.

Lecture, guided discovery: a group learning strategy in which the audience responds to questions posed by the instructor selected to guide them toward discovery (also called recitation class).

Panel discussion: a group of 3–6 persons having a purposeful conversation on an assigned topic before an audience of learners; members are selected on the basis of previously demonstrated interests and competency in the subject to be discussed and their ability to verbalize.

Project: an organized task performance or problem solving activity.

Team project: a small group of learners working cooperatively to perform a task or solve a problem.

Seminar: a strategy in which one or several group members carry out a study/project on a topic (usually selected by the teacher) and present their findings to the rest of the group, followed by discussion (usually teacher-led) of the findings to reach a general conclusion.

Quiet meeting: a 15- to 60-minute period of meditation and limited verbal expression by a group of five or more persons; requires a group of people who are not strangers to each other; is used at a point when the leaders or members feel that reflection and contemplation are desirable.

Simulation: an abstraction or simplification of some specific real-life situation, process, or task.

Case study: a type of simulation aimed at giving learners experience in the sort of decision making required later.

Role play: a dramatized case study; a spontaneous portrayal (acting out) of a situation, condition, or circumstance by elected members of a learning group.

Think Tank/Brainstorm: a group effort to generate new ideas for creative problem solving; thoughts of one participant stimulate new direction and thoughts in another.

Tutorial, programmed: one-to-one method of instruction in which decisions to be made by the tutor (live, text, computer, or expert system) are programmed in advance by means of carefully selected, structured instructions; is individually paced, requires active learner response, and provides immediate feedback.

Tutorial, conversational: one-to-one method of instruction in which the tutor presents instruction in an adaptive mode; is individually paced, requires active learner response, and feedback is provided.

Socratic dialogue: a type of conversational tutorial in which the tutor guides the learner to discovery through a series of questions.

Note: There are many variations of these approaches, and different approaches are often used in combination.

FIG. 1.3. Approaches to instruction. (from Olson, Dorsey, & Reigeluth, 1988)

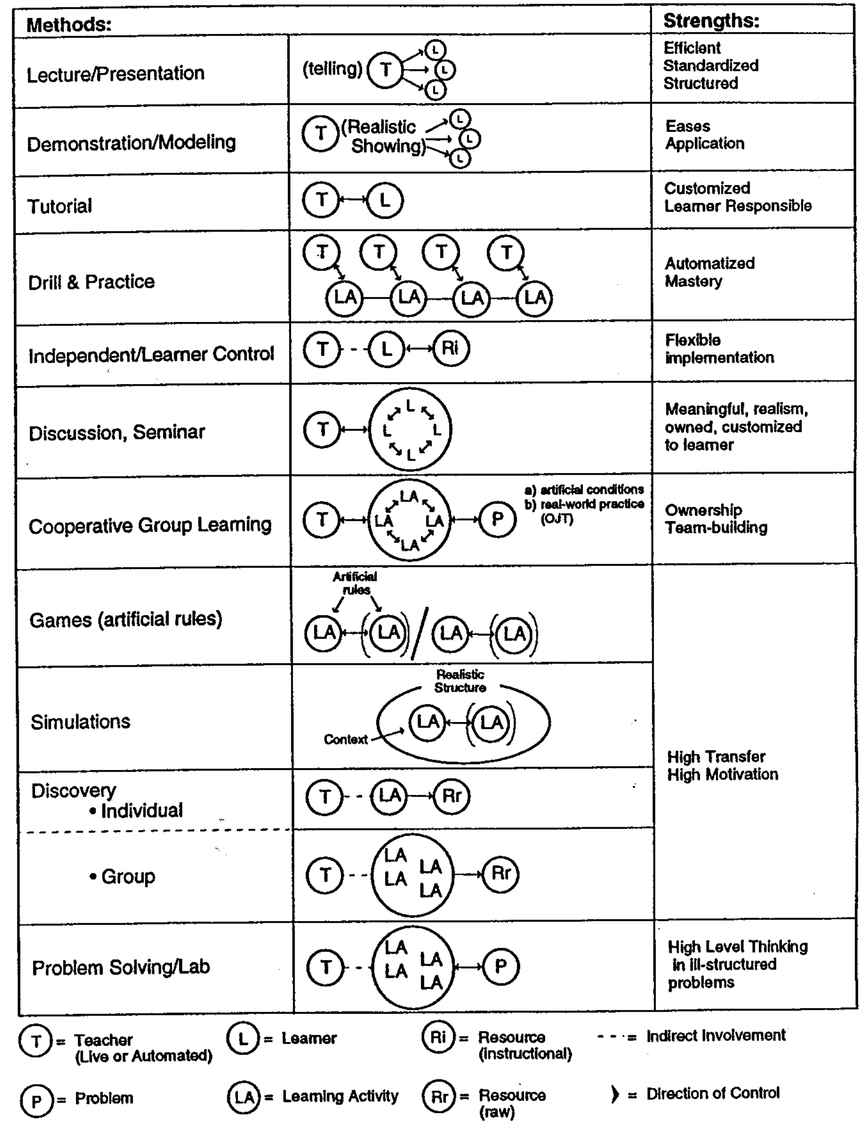

FIG. 1.4. Alternative methods for instruction. (Personal communication from M. Molenda, June 16, 1995.)

Affective domain
  Emotions and feelings
  Attitudes and values
  Morals and ethics
  Personal development
  ...
Cognitive domain
  (Subject area) domain-dependent
    Information and facts
    Understandings and comprehension
    Skills
  (Subject area) domain-independent
    Learning strategies
    Thinking and problem-solving skills
    Metacognitive skills
  ...
Psychomotor domain
  Reproductive skills
  Productive skills
  ...

FIG. 1.5. A partial list of different types of learning.

Use of the New Instructional-Design Theories

I expect that the new paradigm of instructional-design theories will be used differently from the way the old paradigm has been used, and that this will place new demands on what the theories must be like.

First, an instructional-design theory should help the stakeholders to develop a vision (or fuzzy image) of the instruction early in the design process, both in terms of ends (how the learners will be different as a result of it) and the means (how those changes in the learners will be fostered). This is an opportunity for all the stakeholders to share their values about both ends and means and to reach some consensus, so that there will be no major disappointments, misunderstandings, or resistance when it comes time for implementation. The practice of thinking about the vision in the ideal often leads to creative approaches that are all too often lacking in instruction. This kind of ideal-visioning activity is advocated by Diamond (1980), who finds a number of practical benefits of this approach, not the least of which is that it gets the design team excited about a solution. Perhaps every instructional theory should come with a prototypical scenario that would help users of the theory to create a "fuzzy" ideal vision of its application to their particular situation.

Second, an instructional-design theory should allow for much greater use of the notion of "user-designers" (Banathy, 1991). This is a natural progression beyond Burkman's (1987) notion of "user-oriented ID" in that it goes beyond measuring and incorporating relevant potential user perceptions—it entails having the users play a major role in designing their own instruction. Users are primarily the learners and facilitators of learning (which should not be confused with the current conceptions of students/trainees and teachers/trainers). But what does an instructional theory need to be like to meet the needs of user-designers? I think the most important issue is the form that the theory takes. Rather than being a printed chapter in a book (to which we are unfortunately constrained in the present work), it might take an electronic form that is more easily used by practitioners. I can imagine two different scenarios that go well beyond the innovation of adding users (students and teachers) to our typical instructional design teams. One of them requires high-tech learning tools, and the other does not.

In one scenario, an instructional-design theory is embodied in a computer system that will help a design team (including all stakeholders) to create flexible, computer-based learning tools, like intelligent tutoring systems. These learning tools, in turn, will allow learners—while they are learning—to create or modify their own instruction. This concept is like adaptive instruction, except that the learners are able to ask the computer system to use certain instructional methods, and the computer is able to give advice or make decisions on some methods based on learner input or information about the learner. As Winn (1989) put it:

> This means that the role of instructional designers will involve less direct instructional decision making and more concentration on the mechanisms by means of which decisions are made (Winn, 1987). ... It follows that the only viable way to make decisions about instructional strategies that meshes with cognitive theory is to do so during instruction using a system that is in constant dialogue with the student and is capable of continuously updating information about the student's progress, attitude, expectations, and so on. (pp. 39–41)

In this scenario instructional-design theories will have to provide guidance on three levels:

- What methods best facilitate learning and human development under different situations?
- What learning-tool features best allow an array of alternative methods to be made available to learners and allow them to make decisions (with varying degrees of guidance) about both content (what to learn) and methods while the instruction is in progress?
- What system features best allow an instructional design team (that preferably includes all stakeholders) to design quality learning tools?

The work of Dave Merrill and associates on "transaction shells" (Li & Merrill, 1990; Merrill, Li, & Jones, 1992; Merrill, chap. 17 of this volume) has produced this type of learning tool and could well lead to this type of system.

To fulfill this scenario, an instructional-design theory must offer guidance for designing a learning tool that can do much of the analysis and decision making during instruction that are now done by a designer for a whole "batch" of learners well ahead of the actual instruction. The learning tool must continuously collect information from an individual learner and/or a small team of learners and use that information to present an array of sound alternatives to the learner(s), about both what to learn next and how to learn it. Also, the instructional-design theory must prescribe that the computer system will afford teachers or trainers the opportunity and mechanisms to easily modify the system in ways they think are important, but with built-in advice to help teachers avoid selecting a weak method. The systems concept of "equifinality" reflects the reality that there are usually several acceptable ways to accomplish the same end. The new paradigm of instructional-design theory will, I believe, prescribe mechanisms to allow for such diversity of means, as well as a diversity of ends, for learners.

In the other scenario of instructional-design theories to implement the concept of user-designers, computers will play a relatively minor role, and teachers will select, adapt, and/or create a wide variety of materials that they can use, frequently in novel ways, during instructional activities. In these situations, the teachers also must (ahead of time) design the framework or support system within which the instruction will occur (though many instructional decisions may be made during the instruction).

For these situations, instructional-design theory will be embodied in electronic performance support systems (EPSSs), which teachers can use to adapt or design their own materials for instruction and the framework of activities in which those materials will be used. Such systems would provide powerful tools for developing a teacher's expertise in design theory if they had the capability for the teacher to query them for their rules or for other logic behind their instructional decisions. With such tools, teachers might gradually acquire all the complexity that the systems "know," and the EPSSs could even be designed to learn from the teacher and students. It could also be designed to help teachers keep track of all the important information about what each of their students has learned and how they learn best. At the same time, I believe that teachers will always have some capabilities that the systems cannot match, so their roles in meeting students' individual needs will likely diverge from (but still overlap to some extent with) the role of the EPSSs.

If this idea of EPSSs for users is construed to also be used by learners, as it should be, it seems likely that the distinction between EPSSs and the kind of computer system discussed in the first scenario may become negligible, as these same systems help learners to make instructional decisions that are instantly implemented by the system. Furthermore, it seems likely that these instructional-design EPSSs will merge with other EPSSs (e.g., a project-management EPSS) to provide simultaneous on-site performance support and instruction—the ultimate case of learning in context. Instructional-design theories will certainly need to change considerably to provide guidance for such integrated systems.

CONCLUSION

In this chapter we began by looking at what an instructional-design theory is. It is design-oriented, offering guidelines about what methods to use in what situations. Its methods are componential, offering varying levels of guidance for educators. The methods are also probabilistic: not always producing the desired results. And we have seen that values play an important role in instructional-design theories in that they underlie both the goals these theories pursue and the methods they offer to attain those goals. We have also explored what an instructional-design theory isn't. It isn't the same as a learning theory, an ISD process model, or a curriculum theory; but it is closely related to all three, and educators should supplement their knowledge of instructional-design theory with all three. In fact, it is often useful to combine instructional-design theory and curriculum theory. Hopefully, these ideas will make it easier for the reader to analyze and understand the theories that follow in Units 2–4.

We have explored the need for a new paradigm of instructional-design theory. We have looked at ISD's supersystems and seen some dramatic changes taking place—changes that have profound implications for what systems of training and education must do to meet the needs of their supersystems. Foremost among those implications is the need for a paradigm of training and education based on learning instead of on sorting students. Other implications include the need to develop initiative, teamwork, thinking skills, and diversity. To help all learners reach their potential, we need to customize, not standardize, the learning process. This, indeed, represents a new paradigm of education and training.

We have also seen that this new paradigm has important implications for instructional-design theory. There is a desperate need for theorists and researchers to generate and refine a new breed of learning-focused instructional-design theories that help educators and trainers to meet those needs, (i.e., that focus on learning and that foster the development of initiative, teamwork, thinking skills, and diversity). The health of instructional-design theory also depends on its ability to involve all stakeholders in the design process. But perhaps the most important of all implications is that much of the designing should be done by the learners (user-designers) while they are learning, with help from a computer system that generates options for the learners based on information collected from the learners. We also need to provide EPSSs to support trainers and teachers in their instructional-design activities. Our theories need to be designed to meet these new needs.

But with all these needs for a new paradigm of instructional-design theory, it is important not to completely reject and discard the old paradigm. In fact, the new paradigm needs to incorporate most of the knowledge generated by previous instructional-design theories, but that knowledge needs to be restructured into substantially different configurations to meet the new needs of those whom we serve.

In order for instructional-design theory to make this transformation to a new paradigm, we desperately need more people working to develop theories such as the ones in this volume—to help take these theories to a higher level of development (guidance and situationality) and to develop theories in other parts of the cognitive, affective, and psychomotor domains that haven't received much attention yet. I think I speak for all the authors in this book in saying that we hope that this book will draw more attention to the need for more work in this new paradigm, that it will encourage more people to contribute to this growing knowledge base for educators, and that it will help others to undertake work in this area by providing easy access to a broad range of work that has already been undertaken.

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