Instructional-Design Theories and Models Volume III

Building a Common Knowledge Base

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audiences, in other cultures, and across subject-matter domains. It is the author's hope that perhaps these principles might form a starting point for developing a common knowledge base about instructional models, methods, and theory, and for encouraging future research on instructional design.

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Situational Principles of Instruction

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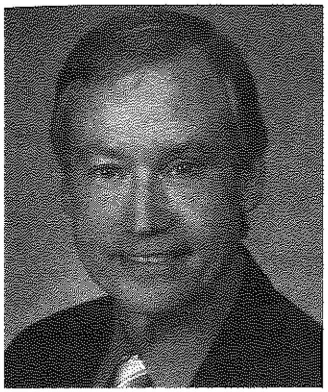

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EDITORS' FOREWORD

Vision

- *To increase the precision of universal principles such that we can create higher quality instruction*

Defining Situational Principles

- *Situational principles only apply in some situations. They range from being close to universal to being very rare.*
- *Some situational principles are sequential, but most are heuristic in nature, due to the complexity of the task of designing instruction.*

Important Situations

- *Analogy: A universe with galaxies and solar systems*
- *Two types of situationalities that call for fundamentally different methods:*
  1. *Situationalities based on different approaches to instruction (means), such as:*
     - *1.1. Role play*
     - *1.2. Synectics*
     - *1.3. Mastery learning*
     - *1.4. Direct instruction (see unit 2)*
     - *1.5. Discussion (see unit 2)*
     - *1.6. Conflict resolution*
     - *1.7. Peer learning*
     - *1.8. Experiential learning (see unit 2)*
     - *1.9. Problem-based learning (see unit 2)*
     - *1.10. Simulation-based learning (see unit 2)*
  2. *Situationalities based on different learning outcomes (ends), such as:*
     - *2.1. Knowledge*
     - *2.2. Comprehension (see unit 3)*
     - *2.3. Application (see unit 3)*
     - *2.4. Analysis*
     - *2.5. Synthesis*
     - *2.6. Evaluation*
     - *2.7. Affective development*
     - *2.8. Integrated learning*

—CMR & ACC

SITUATIONAL PRINCIPLES OF INSTRUCTION

In chapter 3 Merrill identified five "first principles" that he characterized as "general," meaning that they apply to "any…instructional approach, including direct methods, tutorial methods, experiential methods, and exploratory methods" (see p. 43). But clearly, to be of high quality, instruction must be different in different situations, as was discussed in chapter 1. This does not necessarily mean that there are no general (universal) principles of instruction, just that they are not sufficiently precise (or detailed) for practitioners to create high quality instruction. Instructional designers and teachers need more precise guidance about how to implement such general principles, and the more precise the guidance we offer, the less it generalizes to all situations—in other words, the more situational the principles become. One could envision a vertical continuum that ranges from a few highly general (or universal) yet imprecise principles (or methods) on the top, to many highly precise yet extremely local (situational) principles (or methods) on the bottom.

In this chapter we first explain what situational principles are and how they can serve to increase the precision of guidance for instruction. We then turn our attention to understanding which situations are important; that is, which situations are likely to have the greatest influence on the selection of methods. After defining both values and conditions as situations that are important, in our view, we link situationalities with universalities through the metaphor of a universe with galaxies and solar systems, to illustrate the relationships among various methods and approaches. We believe that there are clusters of methods tied to clusters of situationalities, and that one way to move toward a common knowledge base in instructional theory is to identify where those clusters may best serve one another. We conclude with some thoughts about these clusters of situationalities and methods.

Situational Principles

Situational principles are ones that are not universal—they only apply in some situations. They exist on a continuum from situations that are very common (close to universal) to ones that are highly local (apply very rarely). They become necessary when we attempt to offer precision in our instructional principles or guidelines.[1] For example, practice (or learner activity of some kind) is called for at some point during instruction—this is a universality for good instruction. But what should the practice be like? When we address this question, we are moving from a universal, "Use practice," to a situational form of guidance. Practicing a skill, for instance, is far different from practicing an understanding or an emotional disposition. So the directive, "Use practice," is highly imprecise, yet in its imprecision it maintains a universal quality. In contrast, "Students should practice this concept-classification skill by distinguishing between examples and nonexamples of apples" is much more precise and necessarily situational.

1 *Instructional guideline* is defined as having two major components: an instructional method and an instructional situation (when to use the method). A *prescriptive instructional principle* is synonymous with "instructional guideline," whereas a *descriptive instructional principle* has the following two major components: an instructional method and its probable effects or influence on learning (see volume I, chapter 1).

Increased precision is important for helping practitioners to design and enact quality instruction, as well as for helping researchers to design useful research for building a common knowledge base. Therefore, instructional theorists seek to increase precision, and we have found three ways to make methods more precise: kinds, parts, and criteria (see chapter 1).

Kinds

If we continue with our example of practice as a largely universal method offered by instructional theories, we might add precision by asking, what are the different *kinds* of practice? They might include concept-classification practice (which asks the learner to select examples of the concept) and procedure-using practice (which asks the learner to use a set of steps to accomplish a goal). Descriptions of each of these kinds of practice increase the precision of the method (the amount of guidance it offers). But the more precise descriptions are each less broadly applicable—each should only be used in some situations (in this case, for fostering the development of concept-classification skills or for fostering mastery of a procedure). Therefore, it is a situational method, and the method combined with its situationality (when to use the method) is called a guideline or a situational principle of instruction.

Parts

An instructional theory may alternatively provide additional precision for a method by describing parts of the method. For example, for practice on a procedural skill, the theory might identify the following parts: first present a particular case (including the goal and inputs), then ask the learner to achieve the goal for that particular case and provide coaching or scaffolding for the learner's performance. One critical difference between parts and kinds is that with kinds you will use only one for any given use of the method, whereas with parts, you typically use all the parts that are recommended (though some of those parts could be situational, such as only using coaching or scaffolding in the early stages of the development of the skill). In essence, all the parts are needed to make up a whole method, whereas each kind *is* a whole method.

Criteria

Often more precise guidance doesn't take the form of either a kind or a part, but instead may specify some standard or criterion. For example, "Practice should be short" is neither a part nor a kind. An instructional theory may specify criteria or standards that a given method should meet in order to be considered "good."

While it is possible that a practitioner may look at a recommendation and see that it is parts of a method or a kind of a method or a criterion for a method, these distinctions are typically more useful for theorists and researchers to consider. When developing instructional-event theory, it is important to utilize all three of these when each is appropriate for giving more precise guidance. In some cases guidance will entail all three, whereas in other cases any of the three might be inappropriate.

Heuristics

To oversimplify the world, experts think in terms of steps when they perform some tasks, but not for other tasks—they think instead of heuristics; that is principles, rules of thumb, guidelines, causal models, and so forth. For example, a complex heuristic task, such as instructional design or psychological counseling, is not performed by experts as a step-by-step procedure. Rather, experts use heuristics of various kinds to guide their performance.

Now, most tasks have a combination of heuristic and procedural elements and may be normally distributed along a continuum from simple, procedural tasks on one extreme to complex, heuristically based ones on the other, with the majority of tasks in the middle somewhere. Such "combination" tasks often have a procedure on the highest (most imprecise) level of description. For example, when we *describe* the instructional systems design (ISD) process, we often list the steps in analysis, design, development, implementation, evaluation (ADDIE), but as we attempt to provide more precise guidance, we find we must resort mostly to heuristics and nonlinear thinking. As another example, in psychological counseling, first the counselor welcomes the patient and helps him or her to feel comfortable, then tries to diagnose the nature of the patient's problem, determines some possible solutions, selects the most appropriate one, develops a plan, and so forth. We can describe these steps at a very high level, but, when we try to offer more precision on *how* to accomplish each of those steps (to provide more detailed guidance for that performance), there are many, many factors that experts must consider, so substeps are inadequate for capturing the way an expert thinks and the kind of knowledge an expert uses. For example, what are the steps involved in welcoming the patient and helping him or her to feel comfortable? Experts' performances of this step vary tremendously from one situation to another (a friendly patient, an angry patient, a despondent patient, and so forth), so it is impractical for the expert to think in terms of steps.

Instruction is a combination task but is predominantly heuristic. Therefore, the kinds of knowledge that may be most helpful in an instructional theory include some sequential elements, but mostly heuristic elements. And the sequential elements are likely to be on the less precise levels of description, while the heuristics are likely to be on the more precise levels of description. Of course, both steps and heuristics can be situational. But when a method or guideline is elaborated to a more precise level of description, heuristics are more likely to be used.

Important Situations

Which situations are important? Since their only purpose is to tell us when and when not to use a particular method, important situations are the ones that are most useful for deciding what the instruction should be like.

In chapter 1 we identified two broad kinds of situational variables:

- Values (about goals, about methods, and about priorities) and
- Conditions (content, learner, learning constraints, and ISD process constraints).

But which situationalities have the broadest *impact*—which ones lead us to choose fundamentally different methods?

A Metaphor

To address this question, we can use a metaphor based on Merrill's first principles (chapter 3) as potentially "universal" principles:[2] some of the principles might apply to the entire universe of instructional-event theory. However, there are galaxies in the universe, and some principles and methods of instruction may only apply within one galaxy. Also, within each galaxy there are both "universal" principles (that apply throughout the galaxy) and situational principles (that may apply only in one solar system). This assumes that there are some sets of methods that work together as a *system* to promote optimal learning (as opposed to thinking of methods as a kind of smorgasbord in which one can pick and choose any methods to go with each other).

If we assume there are such "systems" of methods, this gives rise to the question, "What are the 'galaxies' that represent significantly different systems of methods from other galaxies?" Do Gagné's five domains of learning outcomes (Reigeluth, 1983, chapter 4) constitute five different galaxies? If so, his different kinds of intellectual skills could represent different solar systems in that galaxy. Or could the major levels in Bloom's (1956) taxonomy be considered galaxies, with his sublevels as solar systems? Or could problem-based instruction and direct instruction be considered galaxies? The answer to these questions is critical to building (and understanding) a common knowledge base about instruction.

Methods of instruction may not fit so neatly into this universe-galaxy-solar system view of instructional theory as we might hope. The same type of solar system may exist in many galaxies. Similar suns may exist in many solar systems. And instructional situations are so complex that there may be a need for some smorgasbord-type selections of methods in addition to those methods that are "universal" within a galaxy or a solar system. Furthermore, there is an important creative element that may strongly influence the quality of instruction, and it may be difficult to address this in instructional-event theories.

2 Merrill makes some claim that his First Principles are universal. Certainly, the concept of "universal" principles (that apply to all instruction) is a tantalizing one and useful for this discussion.

However, this does not make the concept of galaxies and solar systems of instructional methods and principles useless, any more than it makes Merrill's first principles useless. They still have much value. There is considerable economy in having a class of instructional situations that calls for the use of a system of methods that can be used as a "package deal," even if there are additional situationalities to further tailor that package to a particular instructional situation.

The challenge is to figure out what are the galaxies (and solar systems)—what are the systems of methods that are frequently used together in high quality instruction, and what are the situations in which they work so well together. We recognize that there may be many methods that do not cluster at all, and so they may be more like a smorgasbord, where you pick and choose depending on your situation, and these will also need to be addressed by a common knowledge base on instruction.

Common Systems of Methods

We have attempted to identify the most common systems of methods, but these are certainly not exhaustive. We believe some of these systems will prove very useful, while others may not, depending on your particular situation.

Our first observation was that methods for developing skills are quite different from methods for helping students to memorize information, which in turn are quite different from methods for fostering deep understandings. The situationalities for selecting these systems of methods are clearly based on the kind of *learning outcome* they promote. Gagné and Merrill based their instructional theories primarily on this kind of situationality.

Our second observation was that methods in problem-based instruction tend to be very different from methods in direct instruction, both of which are quite different from experiential instruction. Furthermore, they are not tied to kinds of learning outcomes; they represent different *approaches* one could use for teaching the same learning outcome. Yet they are clearly systems of methods that are interrelated and interdependent with each other.

Therefore, we have found two major kinds of situationalities that influence the selection of different systems of methods: those based on different approaches to instruction, and those based on different learning outcomes. Approaches are *means-centric*, for they are focused on the methods, whereas learning outcomes are *ends-centric* for they are focused on the nature of what is learned. While means and ends seem to cover much territory, these two may not be the only categories or even necessarily the most useful categories of systems of methods, but they are the most useful categories that we have found to date.

Our next challenge was to identify the systems of methods within each category.

Approaches to Instruction

Approaches to instruction vary widely, and the most common confusion here tends to be confusing approaches with learning outcomes (which are addressed following this section). Joyce, Weil, and Calhoun (2000) are among the leaders in instructional approaches with their seminal text, *Models of Teaching*. Some of the models are oriented toward approaches, others toward outcomes. Among the more clearly approach-oriented models that they describe are role playing, synectics, mastery learning, and direct instruction. Similarly, Gunter, Estes, and Schwab (2003) describe several models of teaching that are clearly approaches—direct instruction, synectics, and classroom discussion—while others are more clearly outcomes related.

McKeachie (2002) offers the following teaching methods: (1) learning through journaling, writing, papers, reports; (2) reading as active learning; (3) cooperative, collaborative, and peer learning; (4) problem-based learning (PBL) (cases, games, simulations); (5) laboratory instruction; (6) experiential learning (service learning, fieldwork, collaborative research); and (7) project methods (independent study, one-on-one teaching). Fenstermacher and Soltis (2004) break approaches to teaching into three broad classroom approaches: *executive, facilitator, and liberationist*.

However, these differ from what we typically think of as approaches in that they are primarily management and classroom-attitude approaches rather than specific methods of teaching/learning.

We have included five instructional approaches in unit 2 of this text—*direct instruction, discussion, experiential, problem-based*, and *simulation*. In our view, these are among the most well-grounded and well-researched methods in instructional theory today, although these clearly do not constitute an exhaustive list of the most current or influential approaches to instruction. Based on our current understandings of human learning and advanced theories of instruction, we suspect that these are among the most useful approaches, but there are clearly many others that could and should be added to develop a common knowledge base.

Learning Outcomes

For the learning outcomes category, there has been a long tradition of learning taxonomies. Bloom, for example, has taxonomies in three broad domains: cognitive (head), affective (heart), and psychomotor (hand). Bloom's cognitive taxonomy (1956) breaks cognitive learning into knowledge, comprehension, application, analysis, synthesis, and evaluation. *Knowledge* is typically understood to be recall tasks such as list, define, tell, and so on. *Comprehension* is a higher-level learning outcome asking for students to grasp meanings such as distinguish, describe, predict, and so forth. *Application* asks learners to use, in novel situations, the information gained from knowledge and comprehension

tasks. In this taxonomy, we may ask the learner to demonstrate, calculate, show, relate, or classify. *Analysis* asks the learner to understand patterns or parts. Here we might see if the learner can separate, order, connect, explain, infer, and classify. In *synthesis*, new ideas are created by using prior learning and knowledge. So we might ask learners to integrate, plan, create, design, invent, and so forth. Finally, *evaluation* is considered the highest level of thinking (though this is switched with synthesis in Anderson and Krathwohl's (2001) update of Bloom's cognitive taxonomy), and here students are using lower levels of learning in order to discriminate and assess value. We might ask the learner to decide, grade, measure, select, or judge. While Bloom's taxonomy is well known and thoroughly describes a number of naturally cohesive learning outcomes, we feel that Bloom's taxonomy was primarily designed to describe and assess learning outcomes rather than to select different sets of methods.

Anderson and Krathwohl's (2001) update of Bloom's classic taxonomy incorporated types of knowledge as well as processes for learning; creating the knowledge dimension (fact, concept, procedure, metacognitive), as well as the cognitive process dimension (remember, understand, apply, analyze, evaluate, create).

Perhaps the next best known taxonomy in the instructional arena is Gagné's (1965, 1984) learning outcomes. Gagné's taxonomy accounts for the cognitive domain (in the form of intellectual skills, cognitive strategies, and verbal information), as well as motor skills and attitudes, much like Bloom's cognitive, psychomotor, and affective domains, respectively (though attitudes are but one aspect of the affective domain). Within the *intellectual skills* part of the cognitive domain, Gagné breaks down learning outcomes into discriminations, concrete concepts, defined concepts, rules, and problem solving (higher-order rules). Intellectual skills of the *discrimination* type ask learners to respond differently to different stimuli. Those of the *concrete concept* type ask learners to classify instances of concepts that cannot be verbally defined. Intellectual skills of the *defined concept* type typically ask learners to label or classify instances based on a definition. Those of the *rule* type ask learners to apply rules and demonstrate principles. Those of the *problem solving* type ask learners to generate solutions requiring sets of rules. *Cognitive strategies* are complex sets of rules that tend to generalize across subject domains, such as strategies for learning (e.g., use of mnemonics or reflection). *Verbal information* is typically understood as recall and typically asks students to state some information, but it does include understanding as well. Gagné's taxonomy was more specifically intended for guiding the selection of methods of instruction, so his categories could serve well as galaxies and solar systems in the universe of instructional methods.

Ausubel (1963; Ausubel, Novak, & Hanesian, 1978) has distinguished between rote and meaningful learning. Rote learning is relatively isolated bits of information that a learner is able to relate to other bits of information only in arbitrary ways. Meaningful learning, however, entails making nonarbitrary and substantive connections among ideas. Anderson (1983) dichotomizes learning as either declarative or procedural knowledge: declarative knowledge is chunked into not more than five elements in which the learner is asked to describe facts, things, tasks, or methods, while procedural knowledge is knowledge of how to do things, including both motor and mental skills. This is more of a say vs. do dichotomy, compared to Ausubel's rote vs. meaningful learning dichotomy.

Merrill (Merrill, Reigeluth, & Faust, 1978) expanded Gagné's taxonomy into a two-dimensional taxonomy of learning outcomes based on the type of content being learned and the level on which it is learned (which was subsequently used in the revision of Bloom's taxonomy of the cognitive domain). The types of content include facts, concepts, procedures, and principles, while the levels of learning include remember (verbatim or paraphrased), use (identify or produce), and find. With the exception of facts, all the types of content can be learned at any of the levels of learning. Facts can only be learned at the remember level.

Reigeluth has carefully analyzed these taxonomies in terms of their usefulness for selecting different systems of instructional methods and has developed a synthesis of them (see Table 4.1). In his analysis, he found that "verbal information" requires very different methods of instruction, depending on whether it entails Ausubel's rote learning (memorizing) or meaningful learning (understanding). He also found that analysis, synthesis, and evaluation require very similar methods of instruction. This left four types of learning outcomes that have a significant impact on selecting methods of instruction in the cognitive domain: memorize information, understand relationships, apply skills, and apply generic skills (see Table 4.1). There is certainly more overlap in methods between apply skills and apply generic skills than between any of the other kinds of learning outcomes, so one could make an argument for combining them, and then having variations for concept classification, procedure using, principle using, and generic skills (or cognitive strategies), somewhat similar to Gagné's intellectual skills.

Based on these various taxonomies, we believe that each of the following learning outcomes calls for a unique system of methods:

Table 4.1 A Comparison of Taxonomies of Learning Outcomes

Bloom	Gagné	Ausubel	Merrill	Reigeluth
Knowledge	Verbal information	Rote	Remember verbatim	Memorize information
Comprehension	Verbal information	Meaningful	Remember paraphrased	Understand relationships
Application	Intellectual skill		Use	Apply skills
Analysis Synthesis Evaluation	Cognitive strategy		Find	Apply generic skills

- Memorization
- Understanding
- Skills (including generic skills)
- Emotional development
- Integrated learning (across types of learning outcomes and subject domains)

Again, this is not a comprehensive list. We have added a kind of learning from the affective domain, but there are many other kinds of learning in this domain (e.g., the taxonomy in Reigeluth, 1999, chapter 20). We have also added integrated learning, because authentic tasks require learning many kinds of outcomes simultaneously, and there are unique methods for addressing this type of learning. An argument could be made that integrated learning is an approach to instruction rather than a learning outcome, but we believe it results in a qualitatively different way of thinking. In fact, we believe it is some of both but have chosen to include it in the learning outcomes section of this volume. Unit 3 includes chapters that describe elements of a common knowledge base for each of the last four of these five kinds of learning outcomes. We are not including a chapter for memorization outcomes because we believe that a common knowledge base has already been well established in this area (see e.g., Anderson, 1976; Cooke & Guzaukas, 1993; Merrill & Salisbury, 1984; Salisbury, 1990; Woodward, 2006).

Organization of Units 2 and 3 of this Book

The next two units of this book are dedicated to capturing the common knowledge base within systems of methods that fall within our two major categories: instructional approaches and learning outcomes. Unit 2 describes five different approaches, and Unit 3 describes systems of methods for four different kinds of learning outcomes. It should be clear by now that these are not mutually exclusive categories, rather these are two different perspectives about how to organize instructional theories and methods. We hope this will encourage other theorists to identify other categories that are useful for selecting systems of instructional methods.

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Unit 2
Theories for Different Approaches to Instruction

Unit Foreword

In chapter 4 we identified means and ends as two major ways to define different galaxies in the universe of instruction. This unit addresses the means—the different kinds of approaches that represent different systems of methods to use. This introduction provides a bit more detail on the approaches that are described in this unit.

In chapter 5, William Huitt, David Monetti, and John Hummel describe elements of a common knowledge base about the direct approach to instruction, or just direct instruction (DI). It is a method that accounts for student differences, groups students based on pretests, and presents information in an active format. DI focuses on student–teacher interaction and heavy use of examples, as well as constant assessment of student learning prior to moving on. We believe that DI, while perhaps not in vogue among scholars currently, likely has a useful place within an information-age paradigm of education. While DI can be used as a separate approach in its own right, it can also be used as a component within other approaches, such as problem-based instruction or experiential instruction to build lower-level skills and knowledge. Huitt, Monetti, and Hummel point out that DI has been shown through empirical research to increase standardized test scores—a common measure of instructional effectiveness in an increasingly accountable education system. Chapter 5 describes what the authors propose as the common knowledge base for this approach.

In chapter 6 Joyce Gibson describes elements of a common knowledge base about the discussion approach to instruction. It is a method for incorporating student experiences into the learning process rather than relying strictly on content presentation. There are kinds of learning that seem to particularly benefit from deep discussions, such as understanding. We also appreciate the ways in which this method tends to alter established power relations between learners and instructors. The emphasis on valuing learner experiences and learner empowerment are important for an information-age society. The effectiveness of the discussion approach depends to some extent on discussion-leading and participation skills. Just as direct instruction is often called for by other approaches, discussion is also often called for by other approaches, such