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Psychology of LEARNING FOR INSTRUCTION

Marcy P. Driscoll | Kerry J. Burner

Psychology of Learning for Instruction

FOURTH EDITION

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To Robin, for his constant and unwavering support
in all my endeavors
—M. P. D.

For my family, the generations before and those to come
—K. J. B.

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About the Authors

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Dean Driscoll received an A.B. Magna Cum Laude in Psychology from Mount Holyoke College and an MS and PhD in Educational Psychology from the University of Massachusetts Amherst. She lives in Tallahassee, Florida, where she and her husband are enthusiasts of flying radio-control airplanes.

Kerry J. Burner is a faculty member at Florida State University where she serves in the Office of Distance Learning. For over 10 years, she has also taught graduate courses for the Instructional Systems and Learning Technologies program in FSU's College of Education. She has taught in higher education settings for over 20 years. After graduating in 2007, in an administrative capacity, Kerry helped to launch the FSU-Teach program. Prior to returning to FSU as faculty in 2013, Kerry taught and mentored doctoral students for fully online universities and did freelance instructional design. She has extensive instructional design experience in the academic and government sectors. Her research interests include teaching and learning in online environments in particular with a focus on authentic engagement and learner agency.

Kerry received a BA in World and Comparative Literature with a minor in Mathematics from San Francisco State University. Her MA in Rhetoric and Composition is from the University of South Florida, and her PhD in Instructional Systems is from FSU. She lives in Tallahassee with her spouse, two children, and three cats.

About This Book

Welcome to *Psychology of Learning for Instruction, Fourth Edition*. As the title suggests, this book is about learning, but it is also about instruction and how knowledge about the psychology of learning helps to ensure the quality and effectiveness of instruction. In other words, the focus of the book is not just on learning theory, it is also on the application of learning theory to instruction. Moreover, we are concerned not just about instruction in preK–12 schools, we are also concerned about instruction in a variety of formal and nonformal settings. Tattooed across our foreheads as we were writing this edition was the question, What do people *really* need to know about learning theory to inform their professional practice, wherever that happens to take place?

You could already be or on the way to becoming a classroom teacher, an instructional designer, a counselor or counselor educator, a professional educator, an educational technologist, or a faculty member, for instance. In any of these roles, you are helping others to learn and using various means to do it. You could be designing leadership training for a Fortune 500 company, teaching biology to high school students in a virtual school, or developing case problems for medical students learning diagnostic skills. These are among the myriad instructional situations the topics discussed in this book can help you to address.

In addition to having an applied focus, this book embodies a theme of reflexive practice. Reflexive means "to turn back on oneself" and involves continually reflecting on your own knowing and learning. We do not believe that a single learning theory is the answer to all instructional problems. Nor do we believe that scholars have yet discovered or figured out all there is to know about learning. As we updated our knowledge of the research on learning that was published since the last edition, we found ourselves rethinking some topics and changing some of our conceptions.

For instance, it is common to see contrasts made between three paradigms of learning: behaviorism (focus on behavior), cognitivism (focus on cognition), and constructivism (focus on knowledge building). But the emphasis in constructivism *is* cognitive. Moreover, both cognitivism and constructivism focus on the individual learner. What's different about them is their views of knowledge as something acquired versus something constructed. Social constructivism, as opposed to cognitive constructivism, eventually emerged to account for the influences of social context on learning.

However, the situative perspective puts learning squarely in a social, historical, and political context with a focus on the system within which individuals are situated, not on individuals alone. Hence, we believe the appropriate contrast is between the behavioral, cognitive, and situative perspectives, and you will see this contrast reflected in the book.

As you read this book, we hope you will use the questions and activities at the end of each chapter to reflect on your learning and how it fits with your prior knowledge and beliefs about learning and instruction. Consider the multiple perspectives discussed in relation to not only the problems of practice you encounter but also your personal learning goals. Doing so will help to inform your actions and guide your future goals.

This book is unique in its applied focus and theme of reflexive practice. We take a look next at what's new to this edition.

New to This Edition

It may be a bit cheeky to ask what's *not* new in this edition, but it would perhaps be more efficient. A 15-year span from the third edition means that much has changed. Because of this, we felt unfettered from the previous edition and free to rethink both the content and organization of the book. We reflected on advances in the research on learning and instruction, we talked with our colleagues who teach courses—some using the previous edition—on learning and instruction, and we dreamed of what we wanted to see in this book.

The result is a simplified organization (i.e., no parts, only chapters), more chapters to fit easily into a semester-length course, and an intentional interspersing of application chapters after every two theory chapters. We discuss instructional implications in every learning theory chapter, but the instructional application chapters allowed us to examine some well-established, well-researched applications in more detail. Here, then, is what's new to this edition:

- **Four new application chapters.** In Chapters 4, 7, 10, and 13, we describe specific instructional applications of the theories that were discussed in the two chapters preceding each application chapter. The application chapters provide additional opportunities for practice in using learning and instructional theories in professional settings. Application is a major strength of this book, and our experience has taught us the importance of articulating a few examples in detail to illustrate what learning theories look like in practice.
- **A new chapter on learning and development.** The new Chapter 5 merges the two development chapters from the third edition and includes a new section on lifespan development. Questions concerning development have broadened from what makes children's learning different from adults to understanding how cognition and learning change over an individual's lifespan. Results from neuroscience are

also aligning with results from psychology to provide a more complete picture of development.

- **A new chapter on learning and prior knowledge.** The new Chapter 6 focuses on the learning of principled knowledge in subject-matter domains, including how learners revise implicit, intuitive theories about the world to align with canonical knowledge. Theories discussed in Chapter 4 of the third edition are revisited here, along with theories of conceptual change and the role of prior knowledge in comprehension, problem solving, and transfer.
- **A new chapter on learning and situativity.** As mentioned earlier, the situative perspective represents a significant departure from the behavioral and cognitive perspectives that preceded it. The new Chapter 8 incorporates situated cognition from Chapter 5 of the third edition as a core concept of the situative perspective and expands the discussion to the learning context as an activity system and knowing as successful situated participation.
- **A new chapter on learning and (digital) technology.** With shifts in perspectives on learning along with advances in computer tools and networking, technology can enhance learning in untold ways. The new Chapter 9 takes a look at the landscape of learning technology, including how technology supports learning, what technologies enhance learning, and what issues arise when technology is integrated into instruction.
- **A new chapter on learning and neuroscience.** The new Chapter 12 replaces Chapter 8 of the third edition, which focused on the biological bases of learning and memory. In the new chapter, we focus on the burgeoning field of educational neuroscience, which is bringing together scholars in neuroscience, psychology, and education to understand how the brain and mind together inform the learning process. We highlight the problem of neuromyths and examine the role of emotions in learning, showing that cognition and emotion are integrated in the brain, both contributing to the control of mental activities and behavior.
- **A new chapter on learning and instruction: Toward a personal theory.** The new Chapter 14 replaces Chapter 12 of the third edition. The overall focus of the chapter remains the same, that is, on developing a personal theory of learning and instruction. However, we elaborate in the new chapter on personal epistemology, including one's conceptions of knowledge and the ways one thinks about and evaluates knowledge. We also present a framework for epistemic reflexivity designed to guide you in being reflexive about your own learning and knowledge.
- **Opening Chapter Scenarios at a Glance.** Opening chapter scenarios provide a useful means of situating theoretical concepts in practical problems. Because the readers of this book come from different professional settings, we were intentional in the problems we chose for the scenarios to ensure that equivalent attention was given to K–12, higher education, and corporate examples. In some instances, scenarios cross settings, as when Anne in *Curricular Conundrum* (Chapter 7) relies on

her teaching experience in middle school to plan instruction for higher-education students. Similarly, *Sim Central* (Chapter 9) involves both nursing students and practicing nurses as participants in training to help them learn how to respond to respiratory emergencies. We provide an overview of all the chapter scenarios in *Opening Chapter Scenarios at a Glance* as part of the upcoming section on Pedagogical Features.

Key Content Updates by Chapter

- **Chapter 1:** Added a deeper discussion on learning theories and instructional theories; oriented readers to an epistemology of learning and instruction; moved historical approaches to other chapters of the book where they fit best; outlined the organization of the book
- **Chapter 2:** Added discussion of new behaviorism; added information about application of behaviorism in settings ranging from formal education to the workplace
- **Chapter 3:** Added a revised model of information processing; added discussions of new models of working and long-term memory; added new implications of information processing for instruction
- **Chapter 4:** (old Chapter 10, revised plus new content) Reoriented chapter to focus on instructional applications; added content on behavioral skills training; added discussion of the transtheoretical model of intentional behavioral change
- **Chapter 5:** (old Chapters 6 and 7, substantially revised plus new content) Added lifespan development theory; added implications of development theory for learning across the lifespan
- **Chapter 6:** (old Chapter 4, substantially revised plus new content) Added new work on conceptual change and knowledge revision; added discussion of the development of expertise in subject-matter domains
- **Chapter 7:** (old Chapter 11, substantially revised plus new content) Reoriented chapter to focus on instructional applications; added discussion of constructionism; added instructional design models that support constructivist learning; added an exploration of criticisms of constructivism
- **Chapter 8:** (old Chapter 5, substantially revised plus new content) Added exploration of the need for a situative perspective on learning; added discussion of the learning context as an activity system; added exploration of relevant learning concepts and processes; added discussion of instructional applications from a situative perspective
- **Chapter 9:** Entirely new chapter that discusses the learning technology landscape, what and how technology supports learning, and issues of learning technology for instruction
- **Chapter 10:** Entirely new chapter that focuses on technology-enhanced learning environments; discusses incorporating technology into instruction, computer-supported collaborative learning, game-based instruction, and open pedagogy

- **Chapter 11:** (old Chapter 9) Added discussion of mindsets; added discussion of emotions in learning, motivation, and self-regulation
- **Chapter 12:** (old Chapter 8, substantially revised with mostly new content) Added discussion of educational neuroscience including neuromyths; added discussion of learning and the brain including the impact of adverse childhood experiences; added discussion of the neuroscience of cognition and emotion
- **Chapter 13:** Entirely new chapter that focuses on motivation and neuroscience for instruction, including a model of motivational design, self-regulated learning strategies, socioemotional learning, and culturally responsive teaching
- **Chapter 14:** (old Chapter 12, substantially revised plus mostly new content) Added discussion of personal epistemology; added exploration of a model of epistemic cognition; added discussion of reflexivity and epistemic climate

Pedagogical Features

Concept Maps orient the reader to the important concepts discussed in each chapter and visually display how they are related to one another.

Content Outlines provide a verbal means of orienting the reader to important content discussed in each chapter.

Opening Scenarios present learning and instructional problems that are used throughout each chapter to illustrate theoretical concepts and how they can be applied. An overview of the opening scenarios is provided in *Opening Chapter Scenarios at a Glance* immediately following this section.

Reflective Questions and Activities at the end of every chapter provide a means for readers to apply chapter concepts and make connections across chapters.

Chapter	K–12	Higher Ed	Business and Industry	Other
2 Learning and Behavior	**Mr. Taheri's Class** Mr. Taheri and his fourth-grade, ethnically diverse students discuss what behavior is expected of them during class.		**Health Control** Ethan decides he needs to change his eating habits and increase his physical activity rather than take medications for high cholesterol and high blood pressure. **Customer Loyalty** Jayla earns points she can use for free room nights and other amenities by being a member of her favorite hotel's loyalty program.	
3 Learning and Cognition		**Medical Training** Medical students Camila, Gabe, and Hana observe and attempt to interpret symptoms in a patient at a clinic under the guidance of an attending physician.	**Accounting Crunch Time** Trainees Mason and Benjamin struggle to understand their workshop instructor, William, who, expert that he is in tax law, uses concepts they don't understand and works through examples faster than they can follow.	
4 Behavioral and Cognitive Instruction		**Continuing Education** State University launches a training program on sexual misconduct. The mandatory training is intended to help employees understand the university's policies and treat their coworkers and students with respect.	**Driver Change** The goal of a *3-in-3 Driver Change Course* is to help drivers who've had three crashes in 3 years to gain ownership over their unsafe driving behaviors and develop a realistic plan for change.	

(*continued*)

Chapter	*K–12*	*Higher Ed*	*Business and Industry*	*Other*
6 Learning and Prior Knowledge		**Misconceptions about Meteorites** Professor Flores leads teacher education students in an activity designed to reveal students' misconceptions in science.		**Making Mayonnaise** An elementary student and a psychology professor reveal differences in their schemas about mayonnaise.
7 Constructivism and Instruction		**New to Nursing** First-year faculty member Eduardo wants to implement new approaches to nurse education based on constructivism.		
	Curricular Conundrum Former middle school teacher Anne wants to incorporate collaborative learning and problem-solving approaches in her classes with education students. Those approaches worked well with her middle school students. Will they work with her college students as well?			
8 Learning and Situativity		**The Research Assistant** As a graduate student in educational psychology, Carlo is learning from his mentor and major professor how to develop and carry out a research agenda.	**Design Challenge** Kylee and Sameer lead an interdisciplinary team working on a proof-of-concept for an unmanned aerial vehicle. The team has a lot to learn about aircraft design and flight.	

9 Learning and (Digital) Technology	**Pandemic Possibilities** Schoolteachers and college professors had to move their instruction online when the coronavirus pandemic hit. Most had little previous experience with online learning and faced a myriad of instructional decisions.		
		Sim Central Nurses JoJo, Shenita, Olivia, and Rae participate in training with a high-fidelity simulation mannequin to learn how to respond to respiratory emergencies.	
10 Situated and Technology-Enhanced Instruction	**Voting Rights** High school teacher Lauren plans a lesson using the principles of CSCL (computer-supported collaborative learning).		**Smarter City** Instructional design consultant Kevin incorporates a city simulation game into training for city employees on sustainability issues and programs in the city of Perkinsburg.
11 Learning and Motivation	**Professional Development Decisions** Jenicia, a high school chemistry teacher, wants to become certified in ESOL to help her overcome language barriers with the nonnative English speakers in her class.		**Workshop Worries** Ari, a field education officer in a developing country, attends a workshop on action research, which has become a part of his job. He is anxious about his lack of prior knowledge and doesn't want to look stupid in class.

(*continued*)

Chapter	*K–12*	*Higher Ed*	*Business and Industry*	*Other*
12 Learning and Neuroscience	**Reading Riddle** Alyssa's teacher thinks she might be dyslexic because she struggles to read texts that are easy for her third-grade classmates. Alyssa's parents reveal common misconceptions about dyslexia.		**Talent Development** In her evaluation of a client's leadership workshops, Tiana discovers a number of neuromyths embedded in the materials, revealing misconceptions about learning and the brain.	
13 Motivation and Neuroscience for Instruction	**Rural Hitches** First-year teacher Rehn is at his wit's end. The third-grade students in his class are children of either local farmers or migrant farm workers, unlike each other and different from anyone in his experience.		**Writing Woes** Izara is developing a technical writing and professional speaking class to be delivered online and taken by employees throughout the large corporation she works for. She considers what's needed to reduce dropout rates and increase completion.	

Brief Contents

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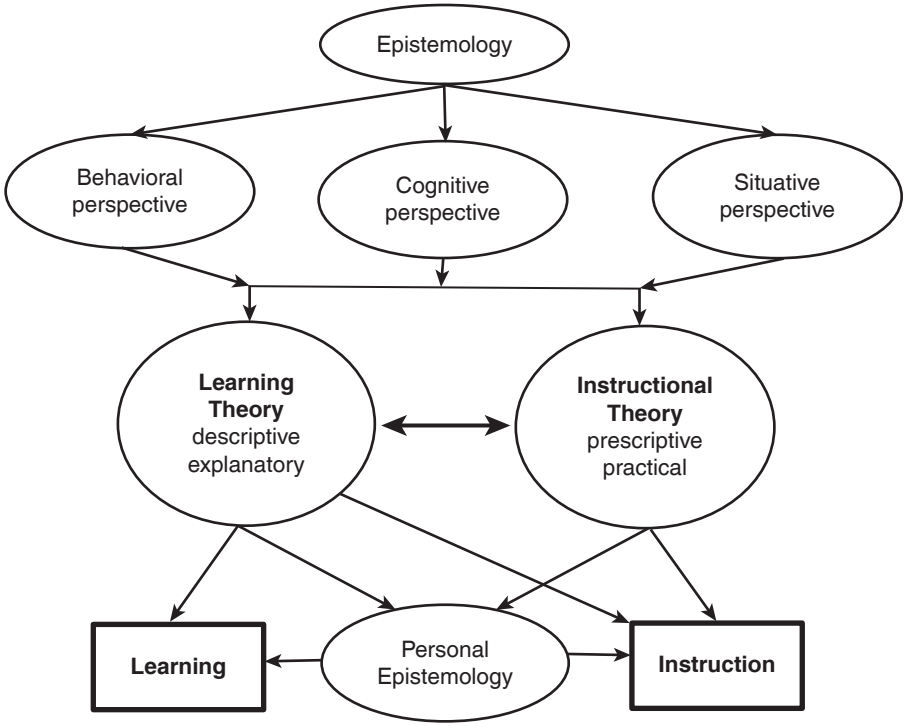
Introduction to Learning and Instruction



Children learn their native language in a remarkably brief period of time, but their parents may take years to acquire the same proficiency in a second language. Students in school learn how to ask questions in science and conduct experiments to answer them, while fund-raisers learn how to "make the ask" of a potential donor. Video-game players learn tactical strategies; delivery drivers learn efficient strategies for packing their trucks. These are all examples of what we call learning. But what is learning and how does it occur?

Learning is a lifelong activity. Learning occurs intentionally in formal instructional settings and incidentally through experience. Learning encompasses a multitude of competencies, from knowledge of simple facts to great skill in complex and difficult procedures. Learning sometimes requires great effort and sometimes proceeds with relative ease. These are a few of the things we know about learning. But learning is a complex affair. The results of learning are often observable in human performance, but the process of learning is much less obvious. As a consequence, different theories have been developed to explain learning. These theories represent different perspectives, different assumptions, and different beliefs about learning. It is therefore worthwhile to consider how learning theories develop and what assumptions underlie the specific theories discussed in this book.

What Is Learning Theory?

Most people have an intuitive answer to this question. A theory about learning is a coherent system of ideas or principles about learning that are intended to explain it. But what do these principles involve? Where do they come from? Let's start with the last question first.

Theories about anything typically originate with questions and observations. Why do large rings of mushrooms suddenly appear in meadows, and why are they called fairy rings? What makes a person successful in reading?

What do adults know about world geography or political systems around the world? How do effective teachers organize their instruction? How is instruction designed differently for online versus face-to-face delivery? Some of these questions are prompted by curiosity and a desire to understand the world around us. With the integration of learning technologies in all educational settings, for example, what role do textbooks play? Are textbooks even bound volumes any longer, and how does custom publishing affect the role of textbooks in learning and teaching?

Other questions may be motivated by problems that require the generation of new knowledge to effect their solutions. For example, should a school district adopt a new reading curriculum with integrated assessment tools that claim to aid teachers in diagnosing reading difficulties and tailoring instruction to improve reading competency? To make an informed decision, school officials might wish to know what evidence exists to support the publisher's claims. How do the instructional strategies embedded in the curriculum improve students' reading achievement? How do teachers use the assessment tools to gain accurate and useful information about their students' reading difficulties? Do students come away from their experience liking to read? What professional development do teachers need to become proficient in the assessment tools?

Finally, many questions are provoked by events that surprise us or somehow contradict our understanding of the way things are. For example, consider the following story heard over National Public Radio. A teacher was describing what happened during a science experiment that his students were conducting, which involved putting empty or partially filled cans of soda into a tub of water and observing whether they floated. To complete their experiment, the students added a couple of unopened cans, one of which happened to be diet soda. Lo and behold, the diet soda floated while the regular soda sank! Both were unopened 12-ounce cans. What could possibly account for the difference in their flotation capability? (The answer appears at the end of the chapter.)

Regardless of how questions arise, they generally lead researchers to conduct systematic observations so that plausible answers can be constructed. In some kinds of investigations, these observations are conducted without many advance, or a priori, expectations about what will be seen. Certainly, "inquiry demands the selection of a particular set of observations or facts from among the nearly infinite universe of conceivable observations" (Shulman, 1988, p. 5). But this selection may be quite broad and general. In a study examining a reading curriculum, for instance, the researchers might decide to look at types of reading difficulties students exhibit and what happens when they interact with different parts of the curriculum. Or the investigators might want to know how teachers are implementing the curriculum and what differences exist between experienced and first-year teachers. Finally, the researchers could be interested in understanding the students' experience of the curriculum and its impact on their enjoyment of reading.

By contrast, other kinds of investigations require the researchers to generate and test potential answers to a research question. The soda-can story is illustrative. In this case, the students proposed a working hypothesis about one can containing slightly more liquid than the other (therefore, having more volume). A hypothesis, or one's suggested answer to a research question, determines what variables (in this example, the amount of liquid) are thought to be important in understanding the event (sinking/floating). The hypothesis also specifies the presumed relationship between the variables and the observed event. That is, the can that sank should contain more liquid than the can that floated.

In order to examine the viability of hypotheses, a set of particular observations must now be conducted, which in this case consisted of the students pouring the contents of each can into a measuring cup and then comparing the amounts in the two cups. The results of these observations are then compared with the prediction that was hypothesized. The extent to which results and prediction agree determines whether the hypothesis has been verified or refuted. If refuted, then other, alternative explanations must be considered.

The observations made in any investigation enable researchers to construct or verify propositions about what is going on. These propositions, or explanations, form the basis of theories. In the soda-can example, the students can be said to have a theory of flotation in which the amount of liquid contained in the can determines whether it sinks or floats. Their subsequent observations, however, revealed that both the regular and diet soda cans contained the same volume of liquid. Therefore, the students were forced to abandon this variable as part of their theory and to consider alternative ones.

Likewise, consider how theory building might occur in an examination of the efficacy of a reading curriculum in helping students overcome reading difficulties and increase their enjoyment of reading. Although the investigation would not proceed from specific hypotheses, it is likely that researchers would begin with a question such as, how do the instructional strategies embedded in this curriculum affect students' reading capability? In answering this question, they might examine how teachers actually employ the instructional strategies, on the assumption that the teachers' actions will affect how the strategies work. Suppose that observations revealed systematic differences between experienced and novice teachers in how they used the curriculum, but these differences did not explain student performance entirely. This would suggest that the relation between the curriculum and learning to read involves more than what experienced versus novice teachers do with it. The original assumption must now be amended and might, for example, include additional variables such as the nature of students' reading difficulties and the teachers' ability to adapt instructional strategies to meet their students' unique needs. Eventually, a complex picture, or theory, of curriculum use and learning to read would be drawn.

As can be seen in these two examples, the process of theory building is recursive. The results of each phase of inquiry influence subsequent phases, which eventually feed back to modify original assumptions or ideas. In this

way, a theory constantly undergoes modifications as new results are accommodated. Figure 1.1 illustrates this process. The figure also reflects the essential purposes of a theory: to explain the occurrence of some phenomenon and to predict its occurrence in the future. A learning theory, then, should explain the results associated with learning and predict the conditions under which learning will occur again.

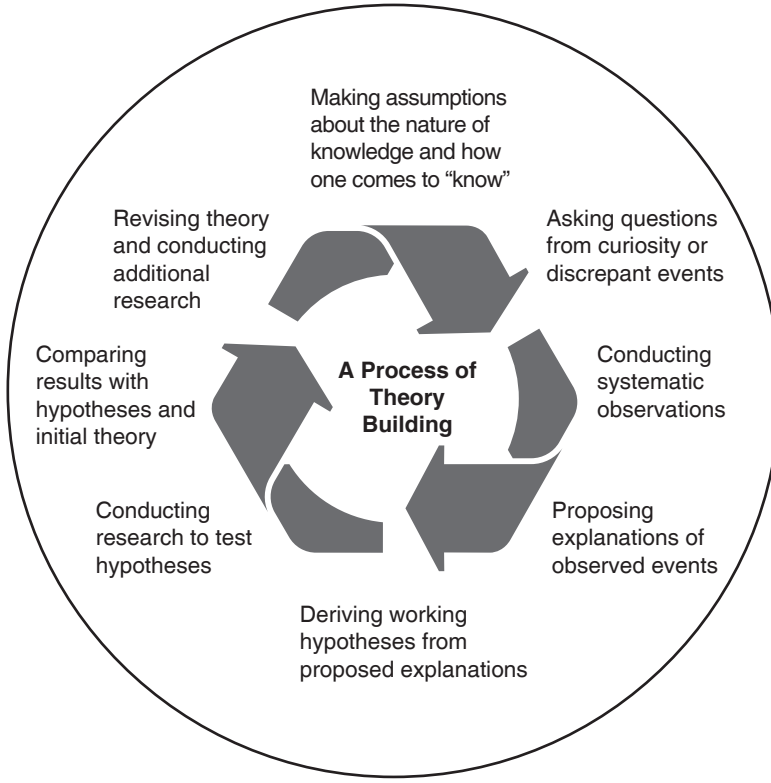


FIGURE 1.1 ***A Systematic and Recursive Process for Building a Theory***

Although theory building, as we have described it so far, seems orderly and objective, it is not necessarily either. "Theory is not discovered in an external reality. Rather it is made up, invented or built through creative imagination and personal cognitive ability, which allows the researcher to explore the logical relationships and causal connections between conceptual abstractions" (Kettley, 2010, p. 9). In other words, researchers make many decisions in theory building based on their training, interests, and assumptions.

Take, for instance, the problem of choosing what variables are important to investigate. If you assume that learning is a function of student characteristics, such as their intellectual ability or natural curiosity, you could look to

explain the effects of a particular curriculum on learning to read in terms of how interested students appeared in the curriculum and how smart they are overall. That is, more interested students would be expected to learn better than less interested students, and those with high general ability would be expected to learn to read better or more quickly than their peers of low general ability. Adopting this perspective emphasizes the inherent abilities of the student and what they bring to the learning task. Finding support for this explanation would probably involve administering tests to measure general ability and curiosity, and perhaps interviewing students to gauge their interest in the instructional materials. The results would then be correlated with reading performance.

Alternatively, you could assume that the design of the curriculum itself is responsible for student proficiency in learning to read. This might suggest that some instructional strategies should facilitate learning to read more effectively than others or that instructional strategies should be implemented based on the specific and unique needs of each student. Adopting this perspective emphasizes the instruction, and to find evidence of this explanation would require analysis of the curriculum, with subsequent correlation of its implementation and student performance. How does one decide which perspective to adopt? Is one more true than the other? Or is there a third alternative that recognizes the importance of both perspectives, as well as the cultural context in which learning to read occurs, in providing a more complete understanding of the phenomenon?

Research decisions such as these fundamentally stem from disciplinary assumptions, or beliefs, that investigators have about the phenomena they study. An anthropologist, for example, goes about the study of cross-cultural societies quite differently from how a psychologist would approach the same investigation.

> What distinguishes disciplines from one another is the manner in which they formulate their questions, how they define the content of their domains and organize that content conceptually, and the principles of discovery and verification that constitute the ground rules for creating and testing knowledge in their fields. These principles are different in the different disciplines. (Shulman, 1988, p. 5)

Because the study of learning is not itself a discipline, it has been approached by researchers representing a variety of disciplinary perspectives. You will see this in the resulting theories of learning that have been proposed. Behavioral psychologists, for example, argue that learning can be understood in terms of observable events, both environmental and behavioral. Cognitive psychologists, by contrast, believe that thought processes inside the head of the learner mediate learning. A third perspective is offered by social psychologists, who contend that learning is a social enterprise, dependent upon interactions between the learner and their sociocultural environment. The point is,

these beliefs dictate what questions about learning will be investigated and what theoretical constructs will be invented to provide explanations. This also means that two apparently competing theories may not be directed at even the same phenomena. Aspects of learning obscured by one theory may be illuminated by another.

In the development of a particular theory, research tends to be cumulative, or what Kuhn (1970) called "normal science." Investigators ask questions that are logical next steps based on previous findings. They aim to articulate theoretical principles that have already been devised, modifying those principles as necessary to account for unexpected or contradictory findings.

Sometimes, however, the predictions that follow from a theory continue to fail, despite whatever modifications are made to the theory. The result is that anomalies are amassed that cannot be explained very easily, and the theory becomes unwieldy and complex, dependent on too many assumptions to make it work. When this happens, one or more researchers will propose an alternative, truly competing theory. Kuhn called this "extraordinary science" and argued that it represents a real breakthrough in scientific progress and knowledge development.

To be a worthy competitor, any new theory must reinterpret all the previous findings as well as account for the anomalous ones that prompted its invention in the first place. This can occur on a limited scale within a particular theoretical orientation, as when cognitive psychologists propose new theories of long-term memory to accommodate research results not easily handled by the dominant theory. It can also occur on a grand scale when researchers shift theoretical orientations altogether, adopting disciplinary assumptions that are incommensurate with the previous orientation. One cannot, for instance, simultaneously believe that learning is entirely understandable in terms of external, observable events and believe that learning depends only on internal thought processes.

The fragmentation of knowledge caused by adherence to different disciplinary assumptions is more an artifact of scholarship than it is a reflection of the real world, Wilson (1998) argued, and he made a case for consilience. By consilience, he meant "a 'jumping together' of knowledge by the linking of facts and fact-based theory across disciplines to create a common groundwork of explanation" (p. 8). Consider, for example, the four quadrants shown in the top half of Figure 1.2. Represented are four domains in which scholars conduct research on learning. Each domain has its own practitioners, assumptions, language, and standards of validation, and the problems in learning they choose to study vary markedly from one another.

Consider now a series of concentric circles superimposed on the four quadrants, as shown in the bottom half of Figure 1.2. The closer one gets to the innermost circle, the more likely one is to encounter important real-world problems (Wilson, 1998). Yet it is in that innermost circle where the most confusion exists and where the perspectives of all four domains are essential for understanding the problem and constructing a potential solution.

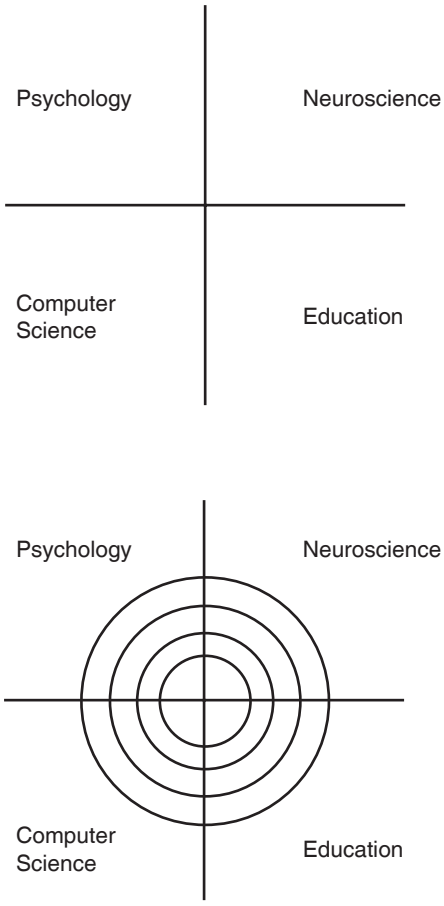


FIGURE 1.2 ***An Appeal to Consilience in Developing Theories about Learning and Instruction***

Source: Adapted from Wilson (1998).

For example, think about the controversy over attention-deficit/hyperactive disorder (ADHD). Despite years of research, the precise causes of ADHD are still unknown (Tarver et al., 2014). Although classified as a developmental disorder, ADHD can persist into adulthood. How, then, can the disorder be treated effectively? What should teachers do who have students in their classes that are diagnosed with the disorder? Depending on the approach taken—whether neurophysiological, psychological, or educational—different answers are proffered to each of these questions. Yet none of the answers is entirely satisfactory from someone's point of view.

As you study the theories presented and discussed in this book, keep in mind that, if we accept Figure 1.1 as a model of the theory-building process, then we must also accept the provisional character of theories. As much as we might like to think otherwise, theories do not give us the truth of the matter. They simply provide a conceptual framework for making sense of the data that have been collected so far. It is probably wise to adopt the attitude of

a "disciplined eclectic" (Shulman, 1988) and view each theory critically for what it can contribute to understanding learning. It is also useful to contemplate how these theories might be synthesized to offer new insights on learning. As you'll see, researchers from different perspectives and disciplines are, increasingly, finding common ground to solve thorny problems in learning and instruction. It is ultimately the purpose of this book to get to the question of application, to see how learning theories can inform decisions about instruction. Sometimes this occurs through the development of corresponding instructional theories, and these are also discussed in chapters following the learning theories to which they most relate.

A Definition of Learning

Despite the differences among the learning theories discussed in this book, they do share some basic, definitional assumptions about learning. First, they refer to *learning* as a persisting change in human performance or performance potential. This means that learners are capable of actions they could not perform before learning occurred and this is true whether or not they actually have an opportunity to exhibit the newly acquired performance. Typically, however, the only way a teacher, instructor, or researcher knows that learning has occurred is to ask the learners to demonstrate or use in some fashion what they have learned. Finding good indicators of learning is as important for designing instruction as it is for building theory.

Second, to be considered learning, a change in performance or performance potential must come about as a result of the learner's experience and interaction with the world. This statement has several implications. Some behavior changes, such as the acquisition of fine motor control, can be attributed to maturation and are therefore not considered learned. Other behavior changes, such as searching for food when hungry or becoming garrulous when drunk, are obviously explained on the basis of temporary states. These also do not imply learning. Learning requires experience, but just what experiences are essential and how these experiences are presumed to bring about learning constitute the focus of every learning theory.

A Definition of Learning Theory

A *learning theory*, therefore, is a conceptual framework linking observed changes in performance with what is thought to bring about those changes to explain learning. Learning theories define the concepts believed to be relevant in understanding learning, specify the relations among concepts, and make specific predictions about the conditions under which learning will occur. Concepts making up learning theories are generally abstract in nature and invented by theorists to describe psychological, neurological, or sociological variables. Memory, for example, is a psychological concept implicated in cognitive perspectives on learning. In other words, we look at the fact that