Preface

Learning is a fundamental activity in educational contexts. The more we understand learning, the better we are able to create conditions that promote it. Fortunately there has been a steady increase in the amount of learning research, which has helped to clarify theory, spawned further research, and benefited educational practice.

As our understanding of learning processes increases, the primary objectives of this seventh edition seem as important as they were when previous editions were published: (a) to inform students of learning theoretical principles, concepts, and research findings, especially as they relate to education, and (b) to provide applications of principles and concepts in settings where teaching and learning occur. Although behaviorism is covered, the focus remains on cognition. Cognitive perspectives are consistent with the prevailing constructivist emphasis on learners who actively seek, form, and modify their knowledge, skills, strategies, and beliefs.

STRUCTURE OF THIS TEXT

The text's 12 chapters are organized as follows. The introductory chapter covers learning theory, research methods, and issues, as well as the historical foundations of the study of learning. Chapter 2 discusses the neuroscience of learning. Placing this content here helps readers better understand subsequent links made between brain functions and cognitive and constructivist learning principles. Behaviorism, which dominated the field of learning for many years, is addressed in Chapter 3. Current cognitive and constructivist views of learning are covered in the next five chapters: social cognitive theory; information processing theory—encoding and storage; information processing theory—retrieval and forgetting; cognitive learning processes; and constructivism. The next three chapters cover topics relevant to and closely integrated with learning theories: motivation, self-regulated learning, and contextual influences. The final chapter serves as a wrap-up and challenges students to develop their own perspective on learning.

NEW TO THIS EDITION

Readers familiar with prior editions will notice many content and organizational differences in this edition, which reflect changing theoretical and research emphases. Information processing theory, which previously was covered in one chapter, now is split into two chapters. This expansion is necessary given the large literature on the topic, and the division into two chapters provides greater coherence to the content. The sections in the text dealing with technology also have been expanded to include the latest advances and learning using social media. Perhaps the biggest change is a new chapter on contextual

influences on learning. Although some of this content appeared in prior editions, the content has been expanded to incorporate the increased volume of research. Material on development, which previously appeared in one chapter, has been infused in appropriate places throughout the text. Prior-edition readers also will notice that some chapters have been reordered in the text and topics shifted between chapters to provide a better flow. The continued growth of research relevant to academic learning led to many new terms incorporated into the glossary and to more than 250 new references, while several dated references have been dropped.

This edition continues to provide many examples of learning concepts and principles applied to settings where learning occurs. Each chapter except the introductory and concluding chapters contains a section on instructional applications. Chapters open with vignettes that illustrate some of the principles discussed in the chapters and also contain many informal examples and detailed applications. Most of the applications involve K–12 settings, but applications also address other learning contexts.

The text is designed for use by graduate students in education or related disciplines, as well as by upper-level undergraduates interested in education. It is assumed that most students have taken a course in education or psychology and currently work in an educational capacity or anticipate pursuing an educational career. In addition to courses on learning, the text is appropriate for any course that covers learning in some depth, such as courses on motivation, educational psychology, human development, and instructional design.

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Chapter 1

Introduction to the Study of Learning

Russ Nyland teaches a graduate education course on learning and cognition. It is toward the end of the semester, and as class finishes one day, three students approach him: Jeri Kendall, Matt Bowers, and Trisha Pascella.

Jeri: Dr. Nyland, can we talk with you? It's late in the course and we're still confused.

Russ: About what?

Jeri: Well, we've been studying all these theorists. It seems like they're saying different things, but maybe not. Bandura, Skinner, Vygotsky, and the others. They make different points, but then some of what they say seems to overlap what others say.

Matt: I'm confused too. I read these theorists and think I agree with that. But it seems like I agree with everything! I thought you were supposed to have one theory, to believe one way and not others. But it seems like there's a lot of overlap between theories.

Russ: You're right, Matt, there is. Most of what we've studied in this course are cognitive theories, and they are alike because they say that learning involves changes in cognitions—knowledge, skills, beliefs. Most theorists also say that learners construct their knowledge and beliefs; they don't automatically adopt what somebody tells them. So yes, there is much overlap.

Trisha: So then what are we to do? Am I supposed to be something like an information processing theorist, a social cognitive theorist, a constructivist? That's what I'm confused about.

Russ: No, you don't have to be only one. There may be one theory that you like better than the others, but maybe that theory doesn't address everything you want it to. So then you can borrow from other theories. For example, when I was in grad school I did research with a professor whose specialty was cognitive learning. There was another professor who did developmental research. I really liked her research, probably because I had been a teacher and was interested in development, especially the changes in kids from elementary to middle school. So I was a learning theorist who borrowed from the developmental literature and still do. It's okay to do that!

Jeri: Well, that makes me feel better. But it's late in the course, and I guess I want to know what I should be doing next.

Russ: Tell you what—next class I'll spend some time on this. A good place to start is not to decide which type of theorist you are, but rather determine what you believe about learning and what types of learning you're interested in. Then you can see which theory matches up well to your beliefs and assumptions and maybe do as I did—borrow from others.

Matt: Isn't that being eclectic?

Russ: Perhaps, but you may still have one preferred theory that you adapt as needed. That's okay to do. In fact, that's how theories are improved—by incorporating ideas that weren't in them originally.

Trisha: Thanks, Dr. Nyland. This is really helpful.

Learning involves acquiring and modifying knowledge, skills, strategies, beliefs, attitudes, and behaviors. People learn cognitive, linguistic, motor, and social skills, and these can take many forms. At a simple level, children learn to solve $2 + 2 = ?$, to recognize *y* in the word *daddy*, to tie their shoes, and to play with other children. At a more complex level, students learn to solve long-division problems, write term papers, ride a bicycle, and work cooperatively on group projects.

This text focuses on how human learning occurs, which factors influence it, and how learning principles apply in educational contexts. Animal learning is de-emphasized, which is not intended to downgrade its importance because we have gained much knowledge about learning from animal research. But human learning is fundamentally different from animal learning because human learning is more complex, elaborate, rapid, and typically involves language.

This chapter provides an overview of the study of learning. Initially, learning is defined and examined in settings where it occurs. An overview is given of some important philosophical and psychological precursors of contemporary theories that helped to establish the groundwork for the application of learning theories to education. The roles of learning theory and research are discussed, and methods commonly used to assess learning are described. The links between learning theories and instruction are explained, after which critical issues in the study of learning are presented.

The opening scenario describes a situation that many students find themselves in when they take a course in learning, instruction, or motivation and are exposed to different theories. Students often think that they are supposed to believe in one theory and adopt the views of those theorists. They may be confused by the perceived overlap between theories.

As Russ says, that is normal. Although theories differ in many ways, including their general assumptions and guiding principles, many rest on a common foundation of cognition. This text focuses on these cognitive theories of learning, which contend that learning involves changes in learners' thoughts, beliefs, knowledge, strategies, and skills. These theories differ in how they predict that learning occurs, which learning processes are important, and which aspects of learning they stress. Some theories are oriented more toward basic learning and others toward applied learning (and, within that, in different content areas); some stress the role of *development*, others are strongly linked with instruction; and some emphasize motivation (Bruner, 1985).

Russ advises his students to examine their beliefs and assumptions about learning rather

than decide which type of theorist they are. This is good advice. Once we are clear about where we stand on learning in general, then the theoretical perspective or perspectives that are most relevant will emerge. As you study this text, it will help if you reflect on your beliefs and assumptions about learning and decide how these align with the theories.

This chapter should help to prepare you for an in-depth study of learning by providing a framework for understanding learning and some background material against which to view contemporary theories. When you finish studying this chapter, you should be able to do the following:

- Define learning and identify instances of learned and unlearned phenomena.
- Distinguish between rationalism and empiricism and explain the major tenets of each.
- Discuss how the work of Wundt, Ebbinghaus, the structuralists, and the functionalists helped to establish psychology as a science.
- Describe the major features of different research paradigms.
- Discuss the central features of different methods of assessing learning and criteria for assessment methods.
- Explain what value-added assessment of learning is and how it can be used to determine progress in student learning.
- Explicate the ways that learning theory and educational practice complement and refine each other.
- Explain differences between behavior and cognitive theories with respect to various issues in the study of learning.

LEARNING DEFINED

People agree that learning is important, but they hold different views on the causes, processes, and consequences of learning (Alexander, Schallert, & Reynolds, 2009). There is no one definition of learning that is universally accepted by theorists, researchers, and practitioners (Shuell, 1986). Although people disagree about the precise nature of learning, the following is a general definition of *learning* that is consistent with this text's cognitive focus and that captures the criteria most educational professionals consider central to learning:

> *Learning is an enduring change in behavior, or in the capacity to behave in a given fashion, which results from practice or other forms of experience.*

Let us examine this definition in depth to identify three criteria for learning (Table 1.1).

One criterion is that *learning involves change*—in behavior or in the capacity for behavior. Change is a central ingredient of learning (Alexander et al., 2009). People learn when they become capable of doing something differently. We do not observe learning directly but rather its products or outcomes. In other words, learning is inferential—it is

Table 1.1
Criteria of learning.

■ Learning involves change.
■ Learning endures over time.
■ Learning occurs through experience.

demonstrated based on what people say, write, and do. The definition also says that learning involves a changed capacity to behave in a given fashion because it is not uncommon for people to learn skills, knowledge, beliefs, or behaviors without demonstrating them at the time they learn them (Chapter 4).

A second criterion is that *learning endures over time*. This excludes temporary behavioral changes (e.g., slurred speech) brought about by such factors as drugs, alcohol, and fatigue. Such changes are temporary because when the cause is removed, the behavior returns to its original state. Although learning is enduring, it may not last forever because forgetting occurs. Researchers debate how long changes must last to be classified as learned, but most people agree that changes of brief duration (e.g., a few seconds) do not qualify as learning.

A third criterion is that *learning occurs through experience* (e.g., practice, observation of others). This criterion excludes behavioral changes that are primarily determined by heredity, such as maturational changes in children (e.g., crawling, standing). Nonetheless, the distinction between maturation and learning often is not clear-cut. People may be genetically predisposed to act in given ways, but the actual development of the particular behaviors depends on the environment. Language offers a good example. As the human vocal apparatus matures, it becomes able to produce language; but the actual words produced are learned from interactions with others. Although genetics are critical for children's language acquisition, teaching and social interactions with parents, teachers, and peers exert a strong influence on children's language achievements (Mashburn, Justice, Downer, & Pianta, 2009). In similar fashion, with normal development children crawl and stand, but the environment must be responsive and allow these behaviors to occur. Children whose language and movements cannot be expressed freely in an environment may not develop normally.

PRECURSORS OF MODERN LEARNING THEORIES

The roots of contemporary theories of learning extend far into the past. Many of the issues addressed and questions asked by researchers today are not new but rather reflect a desire for people to understand themselves, others, and the world about them.

This section traces the origins of contemporary learning theories, beginning with a discussion of philosophical positions on the origin of knowledge and its relation to the environment and concluding with some early psychological views on learning. This review is selective and includes historical material relevant to learning in educational settings. Readers interested in a comprehensive discussion should consult other sources (Bower & Hilgard, 1981; Heidbreder, 1933; Hunt, 1993).

Learning Theory and Philosophy

From a philosophical perspective, learning can be discussed under the heading of *epistemology*, which refers to the study of the origin, nature, limits, and methods of knowledge. How can we know? How can we learn something new? What is the source of knowledge? The complexity of how humans learn is illustrated in Plato's *Meno* (427?–347? B.C.):

> I know, Meno, what you mean . . . You argue that a man cannot enquire (*sic*) either about that which he knows, or about that which he does not know; for if he knows, he has no need to enquire (*sic*); and if not, he cannot; for he does not know the very subject about which he is to enquire (*sic*). (Plato, 1965, p. 16)

Two positions on the origin of knowledge and its relationship to the environment are rationalism and empiricism. These philosophies are recognizable in current learning theories.

Rationalism. *Rationalism* reflects the idea that knowledge derives from reason without recourse to the senses. The distinction between mind and matter, which figures prominently in rationalist views of human knowledge, can be traced to Plato, who distinguished knowledge acquired via the senses from that gained by reason. Plato believed that things (e.g., houses, trees) are revealed to people via the senses, whereas individuals acquire ideas by reasoning or thinking about what they know. People have ideas about the world, and they learn (discover) these ideas by reflecting upon them. Reason is the highest mental faculty because through reason people discover abstract ideas. The true nature of houses and trees can be known only by reflecting upon the ideas of houses and trees.

Plato escaped the dilemma expressed in *Meno* by assuming that true knowledge, or the knowledge of ideas, is innate and is brought into awareness through reflection. Learning is recalling what exists in the mind. Information acquired with the senses by observing, listening, tasting, smelling, or touching constitutes raw materials rather than ideas. The mind is innately structured to reason and provide meaning to incoming sensory information.

The rationalist doctrine also is evident in the writings of René Descartes (1596–1650), a French philosopher and mathematician. Descartes employed doubt as a method of inquiry. By doubting, he arrived at conclusions that were absolute truths and not subject to doubt. The fact that he could doubt led him to believe that the mind (thought) exists, as reflected in his dictum, "I think, therefore I am." Through deductive reasoning from general premises to specific instances, he proved that God exists and concluded that ideas arrived at through reason must be true.

Like Plato, Descartes established a mind–matter dualism; however, for Descartes the external world was mechanical, as were the actions of animals. People are distinguished by their ability to reason. The human soul, or the capacity for thought, influences the body's mechanical actions, but the body acts on the mind by bringing in sensory experiences. Although Descartes postulated dualism, he also hypothesized mind–matter interaction.

The rationalist perspective was extended by the German philosopher Immanuel Kant (1724–1804). In his *Critique of Pure Reason* (1781), Kant addressed mind–matter dualism and noted that the external world is disordered but is perceived as orderly because order is imposed by the mind. The mind takes in the external world through the senses and alters it according to subjective, innate laws. The world never can be known as it exists but only as it is perceived. People's perceptions give the world its order. Kant reaffirmed the role of reason as a source of knowledge, but contended that reason operates within the realm of experience. Absolute knowledge untouched by the external world does not exist. Rather, knowledge is empirical in the sense that information is taken in from the world and interpreted by the mind.

In summary, rationalism is the doctrine that knowledge arises through the mind. Although there is an external world from which people acquire sensory information, ideas originate from the workings of the mind. Descartes and Kant believed that reason acts upon information acquired from the world; Plato thought that knowledge can be absolute and acquired by pure reason.

Empiricism. In contrast to rationalism, *empiricism* reflects the idea that experience is the only source of knowledge. This position derives from Aristotle (384–322 B.C.), who was Plato's student and successor. Aristotle drew no sharp distinction between mind and matter. The external world is the basis for human sense impressions, which, in turn, are interpreted as lawful (consistent, unchanging) by the mind. The laws of nature cannot be discovered through sensory impressions, but rather through reason as the mind takes in data from the environment. Unlike Plato, Aristotle believed that ideas do not exist independently of the external world, which is the source of all knowledge.

Aristotle's contribution to psychology was his principles of association as applied to memory. The recall of an object or idea triggers recall of other objects or ideas similar to, different from, or experienced close, in time or space, to the original object or idea. The more that two objects or ideas are associated, the more likely that recall of one will trigger recall of the other. Such associative learning is reflected in many learning theories (Shanks, 2010).

Another influential figure was British philosopher John Locke (1632–1704), who developed an empirical school of thought that stopped short of being truly experimental (Heidbreder, 1933). In his *Essay Concerning Human Understanding* (1690), Locke noted that there are no innate ideas; all knowledge derives from two types of experience: sensory impressions of the external world and personal awareness. At birth the mind is a *tabula rasa* (blank tablet). Ideas are acquired from sensory impressions and personal reflections on these impressions. What is in the mind originated in the senses. The mind is composed of ideas that have been combined in different ways. The mind can be understood only by breaking down ideas into simple units. This atomistic view of thought is associationist; complex ideas are collections of simple ones.

The issues Locke raised were debated by such profound thinkers as George Berkeley (1685–1753), David Hume (1711–1776), and John Stuart Mill (1806–1873). Berkeley believed that mind is the only reality. He was an empiricist because he believed that ideas derive from experiences. Hume agreed that people never can be certain about external reality, but he also believed that people cannot be certain about their own ideas. Individuals experience external reality through their ideas, which constitute the only reality. At the same time, Hume accepted the empiricist doctrine that ideas derive from experience and become associated with one another. Mill was an empiricist and associationist, but he rejected the idea that simple ideas combine in orderly ways to form complex ones. Mill argued that simple ideas generate complex ideas, although the latter need not be composed of the former. Simple ideas can produce a complex thought that might bear little relation to the ideas of which it is composed. Mill's beliefs reflect the notion that the whole is greater than the sum of its parts, which is an integral assumption of Gestalt psychology (Chapter 5).

In summary, empiricism holds that experience is the only form of knowledge. Beginning with Aristotle, empiricists have contended that the external world serves as the

basis for people's impressions. Most accept the notion that objects or ideas associate to form complex stimuli or mental patterns. Locke, Berkeley, Hume, and Mill are among the better-known philosophers who espoused empiricist views.

Although philosophical positions and learning theories do not neatly map onto one another, conditioning theories (Chapter 3) typically are empiricist whereas cognitive theories (Chapters 4–8) are more rationalistic. But overlap often occurs; for example, most theories posit that learning occurs through association. Cognitive theories stress association between cognitions in memory; conditioning theories emphasize the association of stimuli with responses and consequences.

Beginnings of the Psychological Study of Learning

The formal beginning of the psychological study of learning is difficult to pinpoint (Mueller, 1979), although systematic psychological research began to appear in the latter part of the 19th century. Two persons who had a significant impact on learning theory are Wundt and Ebbinghaus.

Wundt's Psychological Laboratory. The first psychological laboratory was opened by Wilhelm Wundt (1832–1920) in Leipzig, Germany, in 1879, although William James had started a teaching laboratory at Harvard University four years earlier (Dewsbury, 2000). Wundt wanted to establish psychology as a new science. His laboratory acquired an international reputation with an impressive group of visitors, and he founded a journal to report psychological research. The first research laboratory in the United States was opened in 1883 by G. Stanley Hall (Dewsbury, 2000).

Establishing a psychological laboratory was particularly significant because it marked the transition from philosophical theorizing to an emphasis on experimentation and instrumentation (Evans, 2000). The laboratory included scholars who conducted research aimed at scientifically explaining phenomena (Benjamin, 2000). In his book *Principles of Physiological Psychology* (1874), Wundt contended that psychology is the study of the mind. The psychological method should be patterned after the physiological method; that is, the process being studied should be experimentally investigated in terms of controlled stimuli and measured responses.

Wundt's researchers investigated such phenomena as sensation, perception, reaction times, verbal associations, attention, feelings, and emotions. Wundt also was a mentor for many psychologists who subsequently opened laboratories in the United States (Benjamin, Durkin, Link, Vestal, & Acord, 1992). Although Wundt's laboratory produced no great psychological discoveries or critical experiments, it established psychology as a discipline and experimentation as the method of acquiring and refining knowledge.

Ebbinghaus's Verbal Learning. Hermann Ebbinghaus (1850–1909) was a German psychologist who helped to validate the experimental method and establish psychology as a science. Ebbinghaus investigated higher mental processes by conducting research on memory. He accepted the principles of association and believed that learning and the recall of learned information depend on the frequency of exposure to the material. Properly testing this hypothesis required using material with which participants were

unfamiliar. Ebbinghaus invented *nonsense syllables*, which are three-letter consonant-vowel-consonant combinations (e.g., cew, tij).

Ebbinghaus often used himself as the subject of study. In a typical experiment, he would devise a list of nonsense syllables, look at each syllable briefly, pause, and then look at the next syllable. He determined how many times through the list (trials) it took to him learn the entire list. He made fewer errors with repeated study of the list, needed more trials to learn more syllables, forgot rapidly at first but then more gradually, and required fewer trials to relearn syllables than to learn them the first time. He also studied a list of syllables some time after original learning and calculated a *savings score*, defined as the time or trials necessary for relearning as a percentage of the time or trials required for original learning. He found that meaningfulness of material made learning easier. The results of his research are compiled in the book *Memory* (1885/1964).

Although important historically, there are concerns about this research. Ebbinghaus typically employed only one participant (himself), and it is unlikely he was unbiased or a typical learner. We also might question how well results for learning nonsense syllables generalize to meaningful learning (e.g., text passages). Nonetheless, he was a careful researcher, and many of his findings later were validated experimentally. He was a pioneer in bringing higher mental processes into the experimental laboratory.

Structuralism and Functionalism

The work by Wundt and Ebbinghaus was systematic but confined to particular locations and of limited influence on psychological theory. The turn of the century marked the beginning of more widespread schools of psychological thought. Two perspectives that emerged were structuralism and functionalism. Although neither exists as a unified doctrine today, their early proponents were influential in the history of psychology as it relates to learning.

Structuralism. Edward B. Titchener (1867–1927) was Wundt's student in Leipzig. When he became the director of the psychology laboratory at Cornell University in 1892, he imported Wundt's experimental methods into U.S. psychology.

Titchener's psychology, which eventually became known as *structuralism,* represented a combination of associationism with the experimental method. Structuralists believed that human consciousness is a legitimate area of scientific investigation, and they studied the structure or makeup of mental processes. They postulated that the mind is composed of associations of ideas that to be studied must be broken down into single ideas (Titchener, 1909).

The experimental method used often by Wundt, Titchener, and other structuralists was *introspection*, a type of self-analysis. Participants in introspection studies verbally reported their immediate experiences following exposure to objects or events. For example, if shown a table they might report their perceptions of shape, size, color, and texture. They were told not to label or report their knowledge about the object or the meanings of their perceptions. Thus, if they verbalized "table" while viewing a table, they were attending to the stimulus rather than to their conscious processes.

Introspection was a uniquely psychological process and helped to demarcate psychology from the other sciences. It was a professional method that required training in its use so that an introspectionist could determine when individuals were examining their own conscious processes rather than their interpretations of phenomena.

Unfortunately, introspection often was problematic and unreliable. It is difficult and unrealistic to expect people to ignore meanings and labels. When shown a table, it is natural that people say "table," think of uses, and draw on related knowledge. The mind is not structured to compartmentalize information so neatly, so by ignoring meanings introspectionists disregarded a central aspect of the mind. Watson (Chapter 3) decried the use of introspection, and its problems helped to rally support for an objective psychology that studied only observable behavior (Heidbreder, 1933). Edward L. Thorndike, a prominent psychologist (Chapter 3), contended that education should be based on scientific facts, not opinions (Popkewitz, 1998). The ensuing emphasis on behavioral psychology dominated U.S. psychology for the first half of the 20th century.

Another problem was that structuralists studied associations of ideas, but they had little to say about how these associations are acquired. Further, it was not clear that introspection was the appropriate method to study such higher mental processes as reasoning and problem solving, which are more complex than immediate sensation and perception.

Functionalism. While Titchener was at Cornell, other developments challenged the validity of structuralism. Among these was *functionalism,* the view that mental processes and behaviors of living organisms help them adapt to their environments (Heidbreder, 1933). This school of thought flourished at the University of Chicago with John Dewey (1859–1952) and James Angell (1869–1949). Another prominent functionalist was William James (1842–1910). Functionalism was the dominant American psychological perspective from the 1890s until World War I (Green, 2009).

James's principal work was the two-volume series, *The Principles of Psychology* (1890), which is considered one of the greatest psychology texts ever written (Hall, 2003). An abridged version was published for classroom use (James, 1892). James was an empiricist who believed that experience is the starting point for examining thought, but he was not an associationist. He thought that simple ideas are not passive copies of environmental inputs but rather are the product of abstract thought and study (Pajares, 2003).

James (1890) postulated that consciousness is a continuous process rather than a collection of discrete bits of information. One's "stream of thought" changes as experiences change. "Consciousness, from our natal day, is of a teeming multiplicity of objects and relations, and what we call simple sensations are results of discriminative attention, pushed often to a very high degree" (Vol. I, p. 224). James described the purpose of consciousness as helping individuals adapt to their environments.

Functionalists incorporated James's ideas into their doctrine. Dewey (1896) believed that psychological processes could not be broken into discrete parts and that consciousness must be viewed holistically. "Stimulus" and "response" describe the roles played by objects or events, but these roles could not be separated from the overall reality (Bredo, 2003). Dewey cited an example from James (1890) about a baby who sees a candle burning, reaches out to grasp it, and experiences burned fingers. From a stimulus–response perspective, the sight of the candle is a stimulus and reaching is a response; getting

burned (pain) is a stimulus for the response of withdrawing the hand. Dewey argued that this sequence is better viewed as one large coordinated act in which seeing and reaching influence each other.

Functionalists were influenced by Darwin's writings on evolution and studied how mental processes helped organisms adapt to their environments and survive (Bredo, 2003; Green, 2009). Functionalists were interested in how mental processes (e.g., thinking, feeling, judging) operate, what they accomplish, and how they vary with environmental conditions. They also saw the mind and body as interacting rather than existing separately.

Functionalists opposed the introspection method, not because it studied consciousness but rather because of how it studied consciousness. Introspection attempted to reduce consciousness to discrete elements, which functionalists believed was not possible. Studying a phenomenon in isolation does not reveal how it contributes to an organism's survival.

Dewey (1900) argued that the results of psychological experiments should be applicable to education and daily life. Although this goal was laudable, it also was problematic because the research agenda of functionalism was too broad to offer a clear focus. This weakness paved the way for the rise of behaviorism as the dominant force in U.S. psychology (Chapter 3). Behaviorism used experimental methods, and this emphasis on experimentation and observable phenomena helped to secure psychology's standing as a science (Asher, 2003; Tweney & Budzynski, 2000).

LEARNING THEORY AND RESEARCH

Theory and research are integral to the study of learning. This section discusses some general functions of theory, along with key aspects of the research process.

Functions of Theory

A *theory* is a scientifically acceptable set of principles offered to explain a phenomenon. Theories provide frameworks for interpreting environmental observations and serve as bridges between *research* and education (Suppes, 1974). Research findings can be organized and systematically linked to theories. Without theories, people might view research findings as disorganized collections of data, because researchers and practitioners would have no overarching frameworks to which the data could be linked. Even when researchers obtain findings that do not seem to be directly linked to theories, they still must attempt to make sense of data and determine whether the data support theoretical predictions.

Theories reflect environmental phenomena and generate new research through *hypotheses*, or assumptions that can be empirically tested. Hypotheses can be cast as statements of relation, such as, "*X* should relate positively to *Y*," or stated as if-then statements (e.g., "If I do *X*, then *Y* should occur"), where *X* and *Y* might be such events as "inform students of their progress in learning" and "raise their motivation for learning," respectively. Thus, we might test the hypothesis, "If we inform students of their progress

in learning, then they should display higher motivation for learning than students who are not informed about their progress." A theory is strengthened when hypotheses are supported by data. Theories may require revision if data do not support hypotheses.

Researchers often explore areas where there is little theory to guide them. In that case they formulate research objectives or questions to be answered. Regardless of whether researchers are testing hypotheses or exploring questions, they need to specify the research conditions as precisely as possible. Because research forms the basis for theory development and has important implications for teaching, the next section examines types of research and the process of conducting research.

Conducting Research

To specify the research conditions, researchers need to answer such questions as: Who will participate? Where will the study be conducted? What procedures will be employed? What are the variables and outcomes to be assessed?

Researchers must define precisely the phenomena they are studying by providing conceptual and operational definitions. An *operational definition* defines a phenomenon in terms of the measures and procedures used to assess it. For example, a researcher might define *self-efficacy* (covered in Chapter 4) conceptually as one's perceived capabilities for learning or performing a task and operationally by specifying the measures and procedure used to assess self-efficacy in the research study (e.g., one's score on a 30-item questionnaire administered privately before students received instruction). Ideally, conditions are specified so precisely that, after reading the description, another researcher could replicate the study.

Research studies that explore learning employ various types of *paradigms* (or *models*; Table 1.2). The following paragraphs describe the correlational, experimental, and qualitative paradigms, followed by a discussion of laboratory and field studies.

Correlational Research. *Correlational research* deals with exploring relations that exist between variables. A researcher might hypothesize that self-efficacy is positively correlated with (related to) achievement such that the higher the students' self-efficacy, the higher they achieve. To test this relation, the researcher might measure students' self-efficacy for solving mathematical problems and then assess how well they actually solve

Table 1.2
Learning research paradigms.

Type	Qualities
Correlational	Examines relations between variables
Experimental	One or more variables are altered and effects on other variables are assessed
Qualitative	Concerned with description of events and interpretation of meanings
Laboratory	Project conducted in a controlled setting
Field	Project conducted in a natural setting (e.g., school, home, work)

the problems. The researcher could statistically correlate the self-efficacy and achievement scores to determine the direction of the relation (positive, negative) and its strength (high, medium, low).

Correlational research helps to clarify relations among variables. Correlational findings often suggest directions for further research. If the researcher were to obtain a high positive correlation between self-efficacy and achievement, the next study might be an experiment that attempts to raise students' self-efficacy for learning and determine whether such an increase produces higher achievement.

A limitation of correlational research is that it cannot identify cause and effect. A positive correlation between self-efficacy and achievement could mean that (a) self-efficacy influences achievement, (b) achievement influences self-efficacy, (c) self-efficacy and achievement influence each other, or (d) both self-efficacy and achievement are influenced by other, nonmeasured variables (e.g., parents, teachers). To determine cause and effect, an experimental study is necessary.

Experimental Research. In *experimental research* the researcher changes one or more (independent) variables and determines the effects on other (dependent) variables. The experimental researcher could form two groups of students, systematically raise self-efficacy beliefs among students in one group and not among students in the other group, and assess achievement in the two groups. If the first group performs better, the researcher might conclude that self-efficacy influences achievement. While the researcher alters variables to determine their effects on outcomes, she or he must hold constant other variables that potentially can affect outcomes (e.g., learning conditions).

Experimental research can clarify cause–effect relations, which helps us understand the nature of learning. At the same time, experimental research often is narrow in scope. Researchers typically study only a few variables and try to minimize effects of others, which is difficult to do and often unrealistic. Classrooms and other learning settings are complex places where many variables operate at once. To say that one or two variables cause outcomes may overemphasize their importance. It is necessary to replicate experiments and examine other variables to better understand effects.

Qualitative Research. The *qualitative research* (*descriptive research*) paradigm is characterized by intensive study, descriptions of events, and interpretation of meanings. The theories and methods used are referred to under various labels including qualitative, ethnographic, participant observation, phenomenological, constructivist, and interpretative (Erickson, 1986).

Qualitative research is especially useful when researchers are interested in the structure of events rather than their overall distributions, when the meanings and perspectives of individuals are important, when actual experiments are impractical or unethical, and when there is a desire to search for new potential causal linkages that have not been discovered by experimental methods (Erickson, 1986). Qualitative research is varied and can range from analyses of verbal and nonverbal interactions within single lessons to in-depth observations and interviews over longer periods. Methods may include observations, use of existing records, interviews, and think-aloud protocols (i.e., participants talk aloud while performing tasks). It is not the choice of method that characterizes this approach—all of the

aforementioned methods could be used in correlational or experimental studies—but rather the depth and quality of data analysis and interpretation.

A qualitative researcher might be curious about how self-efficacy contributes to the development of skills over time. She or he might work with a small group of students for several weeks. Through observations, interviews, and other forms of data collection, the researcher might examine how students' self-efficacy for learning changes in relation to skill refinement in reading, writing, and mathematics.

Qualitative research yields rich sources of data, which are more intensive and thorough than those typically obtained in correlational or experimental research. This model also can raise new questions and fresh perspectives on old questions that often are missed by traditional methods. A potential limitation is that qualitative studies typically include only a few participants, who may not be representative of a larger population of students or teachers. This limits generalization of findings beyond the research context. Another limitation is that data collection, analysis, and interpretation can be time consuming and therefore impractical for students wanting to graduate and professors wanting to build their publication records! Nonetheless, as a research model, this paradigm offers a useful approach for obtaining data typically not collected with other methods.

Laboratory and Field Research. *Laboratory research* is conducted in controlled settings, whereas *field research* is conducted where participants live, work, or attend school. During the first half of the 20th century, most learning research was conducted on animals in laboratories. Today most learning research is conducted with people, and much is done in field settings. Any of the preceding research models (experimental, correlational, qualitative) can be applied in the laboratory or the field.

Laboratories offer a high degree of control over extraneous factors that can affect results, such as phones ringing, people talking, windows to look out of, and other persons in the room who are not part of the study. Light, sound, and temperature can be regulated. Laboratories also allow researchers to leave their equipment set up over lengthy periods and have all materials at their immediate disposal.

Such control is not possible in the field. Schools are noisy, and often it is difficult to find space to work. There are numerous distractions: Students and teachers walk by, bells ring, public announcements are made, and fire drills are held. Rooms may be too bright or dark, cold or warm, and used for other purposes so researchers have to set up equipment each time they work. Interpreting results in light of these distractions can be a problem.

An advantage of field research is that results are highly generalizable to other similar settings because studies are conducted where people typically learn. In contrast, generalization of laboratory findings to the field is done with less confidence. Laboratory research has yielded many important insights on learning, and researchers often attempt to replicate laboratory findings in the field.

Whether the laboratory or the field is employed depends on such factors as the purpose of the research, availability of participants, costs, and how the results will be used. With the laboratory control is gained but some generalizability is lost, and vice versa with the field. In the field, researchers try to minimize extraneous influences so that they can be more confident that their results are due to the variables they are studying.

ASSESSMENT OF LEARNING

Because learning is inferential we do not observe it directly but rather through its products—what learners say and do. Researchers and practitioners who work with students may believe that students have learned, but to be more certain they must assess learning's outcomes.

Assessment involves "a formal attempt to determine students' status with respect to educational variables of interest" (Popham, 2014, p. 8). In school, the educational variable of interest most often is student achievement in different areas (e.g., reading, writing, mathematics, science). Although student achievement always has been critical, its importance was underscored by the federal government's No Child Left Behind Act of 2001 (Shaul & Ganson, 2005). This act had many provisions, among the most significant being the requirements for annual testing of students in grades 3 through 8 and again in high school in reading and mathematics and for school systems to show increases in students making adequate yearly progress in these subjects. More recently, the *Common Core State Standards for English Language Arts and Mathematics* (National Governors Association Center for Best Practices and Council of Chief State School Officers, 2010) have been adopted by many states. These standards ensure that accountability for student learning will continue to receive attention.

Two points are noteworthy with respect to this text. Although accountability often leads to testing being the means of assessment, the latter includes many measurement procedures besides testing (described below). Researchers and practitioners want to know whether learning has occurred, and there may be procedures other than testing that provide evidence of student learning (Popham, 2014). Second, students' skills in content areas often are the learning outcomes assessed, but researchers and practitioners may also be interested in other forms of learning. For example, they may want to know whether students have learned new attitudes or self-regulation strategies or whether students' interests, values, self-efficacy, and motivation have increased as a result of content learning.

This section covers ways to assess outcomes of learning. These methods include direct observations, written responses, oral responses, ratings by others, and self-reports (Table 1.3).

Direct Observations

Direct observations are instances of student behavior that we observe to assess whether learning has occurred. (Direct observations are contrasted with reported observations, where others inform us that they observed instances of student behavior.) Teachers employ direct observations frequently. A chemistry teacher wants students to learn laboratory procedures. The teacher observes students in the laboratory to determine whether they are implementing the proper procedures. A physical education instructor observes students dribble a basketball to assess how well they have learned the skill. An elementary teacher gauges how well students have learned the classroom rules based on their class behavior.

Direct observations are valid indexes of learning if they are straightforward and involve little inference by observers. Direct observations work best when the desired behaviors can be specified and then the students are observed to ascertain whether their behaviors match the standards.

Table 1.3
Methods of assessing learning.

Category	Definition
Direct observations	Instances of behavior that demonstrate learning
Written responses	Written performances on tests, quizzes, homework, papers, and projects
Oral responses	Verbalized questions, comments, and responses during learning
Ratings by others	Observers' judgments of learners on attributes indicative of learning
Self-reports	People's judgments of themselves
■ Questionnaires	Written ratings of items or answers to questions
■ Interviews	Oral responses to questions
■ Stimulated recalls	Recall of thoughts accompanying one's performances at given times
■ Think-alouds	Verbalizing aloud one's thoughts, actions, and feelings while performing a task
■ Dialogues	Conversations between two or more persons

A problem with direct observations is that they focus only on what can be observed and therefore bypass the cognitive and affective processes that underlie actions. For example, the chemistry teacher knows that students have learned laboratory procedures but she or he does not know what the students are thinking about while they are performing the procedures or how confident they are about performing well.

A second problem is that, although observing a behavior indicates that learning has occurred, the absence of appropriate behavior does not mean that learning has not occurred. Learning is not the same as performance. Many factors other than learning can affect performance. Students may not perform learned actions because they are not motivated, are ill, or are busy doing other things. We have to rule out these other factors to conclude from the absence of performance that learning has not occurred. That requires making the assumption—which at times may be unwarranted—that since students usually try to do their best, if they do not perform, they have not learned.

Written Responses

Learning often is assessed based on students' *written responses* on tests, quizzes, homework, term papers, and reports. Based on the level of mastery indicated in the responses, teachers decide whether adequate learning has taken place or whether additional instruction is needed because students do not fully comprehend the material. For example, assume that a teacher is planning a unit on the geography of Hawaii. Initially the teacher assumes that students know little about this topic. A pretest given prior to the start of instruction will support the teacher's belief if the students score poorly. The teacher retests students following the instructional unit. Gains in test scores lead the teacher to conclude that learners have acquired some knowledge.

Their relative ease of use and capacity for covering a wide variety of material makes written responses desirable indicators of learning. Today many written responses are recorded electronically using forms of technology (e.g., computers, clickers). We assume that written responses reflect learning, but many factors can affect performance of behavior even when students have learned. Written responses require us to believe that students are trying their best and that no extraneous factors (e.g., fatigue, illness, cheating) are operating such that their written work does not represent what they have learned. We must try to identify extraneous factors that can affect performance and cloud assessments of learning.

Oral Responses

Oral responses are an integral part of the school culture. Teachers call on students to answer questions and assess learning based on what they say. Students also ask questions during lessons. If their questions indicate a lack of understanding, this is a signal that proper learning has not occurred.

Like written responses, we assume that oral responses are valid reflections of what students know, which may not always be true. Further, verbalization is a task, and some students may have problems translating what they know into oral expressions due to unfamiliar terminology, anxiety about speaking, or language difficulties. Teachers may rephrase what students say, but such rephrasing may not accurately reflect the nature of students' thoughts.

Ratings by Others

Another way to assess learning is for individuals (e.g., teachers, parents, administrators, researchers, peers) to rate students on the quantity or quality of their learning. These *ratings by others* (e.g., "How well can Tim solve problems of the type $52 \times 36 = ?$" "How much progress has Olivia made in her printing skills in the past 6 months?") provide useful data and can help to identify students with exceptional needs (e.g., "How often does Matt need extra time to learn?" "How quickly does Jenny finish her work?").

An advantage of ratings by others is that observers may be more objective about students than students are about themselves (self-reports, discussed next). Ratings also can be made for learning processes that underlie actions (e.g., comprehension, motivation, attitudes) and thereby provide data not attainable through direct observations; for example, "How well does Seth comprehend the causes of World War II?" But ratings by others require more inference than do direct observations. It may be problematic to accurately rate students' ease of learning, depth of understanding, or attitudes. Further, ratings require observers to remember what students do and will be distorted when raters selectively remember only positive or negative behaviors.

Self-Reports

Self-reports are people's assessments of and statements about themselves. Self-reports take various forms: questionnaires, interviews, stimulated recalls, think-alouds, and dialogues.

Questionnaires present respondents with items or questions asking about their thoughts and actions. Respondents may record the types of activities they engage in, rate their perceived levels of competence, and judge how often or how long they engage in them (e.g., "How long have you been studying Spanish?" "How difficult is it for you to learn geometric theorems?"). Many self-report instruments ask respondents to record ratings on numerical scales ("On a 10-point scale, where 1 = low and 10 = high, rate how good you are at reducing fractions.").

Interviews are a type of questionnaire in which an interviewer presents the questions or points to discuss and the respondent answers orally. Interviews typically are conducted individually, although groups can be interviewed. A researcher might describe a learning context and ask students how they typically learn in that setting (e.g., "When the French teacher begins a lesson, what are your thoughts? How well do you think you will do?"). Interviewers may need to prompt respondents if replies are too brief or not forthcoming.

In the *stimulated recall* procedure, people work on a task and afterward recall their thoughts at various points during the task. Interviewers query them (e.g., "What were you thinking about when you got stuck here?"). If the performance was video recorded, respondents subsequently watch the recording and recollect, especially when interviewers stop the recording and ask questions. It is desirable that the recall procedure be accomplished soon after the performance so that participants do not forget their thoughts.

Think-alouds are procedures in which students verbalize their thoughts, actions, and feelings while working on a task. Verbalizations may be recorded by observers and subsequently scored for level of understanding. Think-alouds require that respondents verbalize; many students are not used to talking aloud while working in school. Talking aloud may seem awkward to some, and they may feel self-conscious or otherwise have difficulty expressing their thoughts. Investigators may have to prompt students if they do not verbalize.

Another type of self-report is the *dialogue*, which is a conversation between two or more persons while engaged in a learning task. Like think-alouds, dialogues can be recorded and analyzed for statements indicating learning and factors that seem to affect learning in the setting. Although dialogues use actual interactions while students are working on a task, their analyses require interpretations that may go beyond the actual elements in the situations.

The choice of self-report measure should match the purpose of the assessment. Questionnaires can cover a lot of material; interviews are better for exploring a few issues in depth. Stimulated recalls ask respondents to recall their thoughts at the time actions took place; think-alouds examine present thoughts. Dialogues allow for investigation of social interaction patterns.

Self-report instruments typically are easy to develop and administer; questionnaires are usually easy to complete and score. A problem can arise when inferences have to be drawn about students' responses. It is essential to have a reliable scoring system. Other concerns about self-reports are whether students are giving socially acceptable answers that do not match their beliefs, whether self-reported information corresponds to actual behavior, and whether young children are capable of self-reporting accurately. By guaranteeing that data are confidential, researchers can help promote truthful answering.

A good means of validating self-reports is to use multiple assessments (e.g., self-reports, direct observations, oral and written responses). There is evidence that beginning around the third grade self-reports are valid and reliable indicators of the beliefs and actions they are designed to assess (Assor & Connell, 1992), but researchers need to use self-reports cautiously to minimize potential problems.

Assessment Issues

Given the current educational emphasis on accountability, there are issues that should be addressed in assessment. This section discusses issues involving assessment criteria and value-added assessment.

Assessment Criteria. Regardless of the method of assessment there are three criteria that are important: reliability, validity, and absence of bias (Popham, 2014).

Reliability involves consistency of assessment (Popham, 2014). This means that the assessment will produce comparable results if given on different occasions with no intervening events that could influence learning. For example, a reliable algebra test is one that will produce similar results for each student if given in the morning and again in the afternoon of the same day, where students have had no exposure to the material in between test occasions. Reliability is important because unreliable assessments affect research results and lead researchers to draw erroneous conclusions.

Validity refers to the extent that evidence supports the accuracy of interpretations about students (Popham, 2014). Validity pertains not to assessments themselves but rather to their interpretations. When students are assessed in some content area (e.g., reading) or psychological variable (e.g., interest), researchers draw conclusions about students based on their scores. Thus, if a student scores low on an interest assessment, researchers want to be confident in concluding that this student's interest is low. Validity is important for research because if a test purports to measure one variable but actually measures something different, then researchers will make incorrect interpretations of the results.

A third criterion is *absence of bias,* defined as an assessment being free of qualities that offend or penalize students because of their group characteristics (e.g., gender, ethnicity, religion; Popham, 2014). Absence of bias is important because when bias exists it can skew results (raise or lower) due to students' personal characteristics. Thus, questions on a mathematics test that involve soccer might favor students who are familiar with the game even though that has nothing to do with the mathematical knowledge presumably being assessed.

Value-Added Assessments. Value-added assessments have gained popularity in education. A *value-added assessment* is one that attempts to determine the causes of students' learning progress (Popham, 2014). Students' prior achievement and background variables (e.g., socioeconomic status, gender) are statistically controlled to isolate the role of instructional variables (e.g., school, teacher) on learning progress. The "value added" aspect then is the gain attributed to school or teacher, which presumably provides a measure of effectiveness. This measure can be used by school systems as a basis for evaluations and funding.

Although value-added assessments are popular, they contain some problems. Learning is affected by many variables, only some of which are under the school's and teacher's control. It is difficult to attempt to statistically control all potentially relevant ones. Another issue is that it is risky to ascribe student progress to schools or teachers because those assessments only provide estimates of their contribution. These assessments also take a limited view of learning by equating it with achievement, but as explained earlier, achievement is a performance measure and may not fully reflect learning.

If value-added assessments are used, it is better to employ them to track students' progress over a longer time rather than at only one point in time (Anderman, Anderman, Yough, & Gimbert, 2010). Monitoring individual students' growth and progress could help teachers better differentiate instruction according to needs, which also could yield motivational benefits for students (Anderman et al., 2010). Further, diversified assessments that contain many indicators of student learning (e.g., tests, papers, class participation) should provide a more accurate picture of learning. Tests should be designed and their results reported so as to accurately capture each student's mastery of each curricular learning objective (Wiliam, 2010), which requires that tests reflect the criteria of reliability, validity, and absence of bias.

RELATION OF LEARNING AND INSTRUCTION

Theories and research findings help to advance the field of learning, but their ultimate contribution must be to improve teaching. Although it may seem odd, historically there was little overlap between the fields of learning and instruction (Shuell, 1988; Sztajn, Confrey, Wilson, & Edgington, 2012). One reason may have been that these fields traditionally were dominated by persons with different interests. Most learning theorists and researchers have been psychologists. Much early learning research used nonhuman species. Animal research has benefits, but animals do not allow for proper exploration of instructional processes. In contrast, instruction was the domain of educators, who were primarily concerned with directly applying teaching methods to classrooms and other learning settings. This applied focus has not always lent itself well to exploring how learning is affected by instructional variations.

A second reason derives from the idea that teaching is an art and not a science like psychology. As Highet (1950) wrote: "[This book] is called *The Art of Teaching* because I believe that teaching is an art, not a science. It seems to me very dangerous to apply the aims and methods of science to human beings as individuals" (p. vii). Highet stated, however, that teaching is inseparable from learning. Gage (1978) noted that the use of "art" in reference to teaching is a metaphor. In fact, teaching as an art can undergo the same type of scrutiny and scientific investigation as any other type of art, including drawing, painting, and musical composition.

A third possible reason stems from the idea that different theoretical principles may govern the two domains. Sternberg (1986) contended that cognition (or learning) and instruction require separate theories. This may be true for learning and instruction by themselves, but as Shuell (1988) noted: "Learning from instruction differs from traditional

conceptions of learning and teaching considered separately" (p. 282). Researchers today view learning from instruction as involving an interaction between learners and contexts (e.g., teachers, materials, setting). Sequencing of material, for example, affects learners' cognitive organizations and development of memory structures. In turn, how these structures develop affects what teachers do. Teachers who realize that their instruction is not being comprehended will alter their approach; conversely, when students understand material that is being presented, teachers are apt to continue with their present approach. As the opening scenario makes clear, learning theories have to be adapted to fit particular instructional contexts.

Fourth, traditional research methods may be inadequate to study instruction and learning simultaneously. Much learning research has used experimental methods in which some conditions are varied and changes in outcomes are determined. Teaching methods often are held constant across changes in variables, which negates the dynamic nature of teaching. In education, *process–product research* conducted in the 1970s and 1980s related changes in teaching processes (such as number and type of questions asked, amount of warmth and enthusiasm displayed) to student products or outcomes (e.g., achievement, attitudes; Pianta & Hamre, 2009). Although this research paradigm produced many useful results, it neglected the important roles of teacher and student thoughts. Thus, we might know which type of questions produce higher student achievement, but not why they do so (i.e., how questions change students' thinking). Process–product research also focused primarily on student achievement at the expense of other outcomes relevant to learning (e.g., expectations, values). In short, a process–product model is not well designed to examine how students learn.

Fortunately, the situation has changed. Researchers increasingly are viewing teaching as the creation of learning environments that assist students in executing the cognitive activities necessary to develop skills and reasoning abilities (Floden, 2001). Researchers are examining student learning by observing teaching during content instruction, especially in schools and other places where people typically learn (Pellegrino, Baxter, & Glaser, 1999; Pianta & Hamre, 2009). Researchers today are more concerned with analyzing teaching patterns rather than discrete teaching behaviors (Seidel & Shavelson, 2007). Children's learning has received increased attention (Siegler, 2000, 2005), and more research is being devoted to how what is learned in school is related to what skills are important outside of school (Anderson, Reder, & Simon, 1996).

Researchers of different traditions accept the idea that instruction and learning interact and are best studied in concert. A promising development is to determine students' learning trajectories, or the paths they might take from their starting points to the intended learning goal (Sztajn et al., 2012). Teachers then can combine their knowledge of these trajectories with contextual factors to make instructional decisions. Instructional research can have a profound impact on learning theories and their applications to promote student learning (Glaser, 1990; Pianta & Hamre, 2009).

A goal of this text is to help you understand how learning theory and educational practice complement each other. Learning theory is no substitute for experience. Theory without experience can be misguided because it may underestimate the effects of situational factors. When properly used, theory provides a framework to use in making educational decisions.

Conversely, experience without theory may often be wasteful and potentially damaging. Experience without a guiding framework means that each situation is treated as unique, so decision making is based on trial and error until something works. Learning how to teach involves learning what to do in specific situations.

Theory and practice affect each other. Many theoretical developments eventually become implemented in classrooms. Contemporary educational practices—such as cooperative learning, reciprocal teaching, and differentiating instruction for individual learners—have strong theoretical underpinnings and research to support them. Although learning research results at times conflict with common instructional practices (Rohrer & Pashler, 2010), research on learning should continue to have an effect on educational practices.

Educational practice also influences theory. Experience can confirm theoretical predictions or suggest revisions. Theories are modified when research and experience present conflicting evidence or suggest additional factors to include. Early information processing theories were not directly applicable to school learning because they failed to consider factors other than those connected with the processing of knowledge. When cognitive psychologists began to study school content, theories were revised to incorporate personal and situational factors.

Educational professionals should strive to integrate theory, research, and practice. We must ask how learning principles and research findings might apply in and out of school. In turn, we should seek to advance our theoretical knowledge through results of informed teaching practice.

CRITICAL ISSUES FOR LEARNING THEORIES

Most professionals accept in principle the definition of learning given at the outset of this chapter, but there is less agreement on many learning issues. Some key issues are discussed in this section (Table 1.4). These issues are addressed in subsequent chapters as different learning theories are discussed. Before considering these issues, however, a short explanation of behavior and cognitive theories provides a background against which to frame learning theories and a better understanding of learning principles.

Behavior theories view learning as a change in the rate, frequency of occurrence, or form of behavior or response, which occurs primarily as a function of environmental factors (Chapter 3). Behavior theories contend that learning involves the formation of associations between stimuli and responses. In Skinner's (1953) view, a response to a stimulus is more likely to occur in the future as a function of the consequences of prior responding: Reinforcing consequences make the response more likely to occur, whereas punishing consequences make it less likely.

Behaviorism was a powerful force in psychology in the first half of the 20th century. These theories explain learning in terms of observable phenomena. Behavior theorists contend that explanations for learning need not include internal events (e.g., thoughts, beliefs, feelings), not because these processes do not exist (because they do—even behavior theorists have to think about their theories!), but rather because the causes of learning are observable environmental events.

Table 1.4
Critical issues in the study of learning.

- How does learning occur?
- How does memory function?
- What is the role of motivation?
- How does transfer occur?
- How does self-regulated learning operate?
- What are the implications for instruction?

In contrast, *cognitive theories* stress the construction of knowledge and skills, the development of mental structures and memory networks, and the cognitive processing of information and beliefs. Learning is an internal mental phenomenon inferred from what people say and do. A central theme is the mental processing of information: its construction, acquisition, organization, coding, rehearsal, storage in memory, and retrieval from memory. The theories covered in Chapters 4 through 8 are cognitive, as are the principles discussed in later chapters.

These two conceptualizations of learning have important implications for educational practice. Behavior theories imply that teachers should arrange the environment so that students can respond properly to stimuli. Cognitive theories emphasize making learning meaningful and taking into account learners' perceptions of themselves, others, and learning environments. Teachers need to consider how instruction affects students' thinking during learning.

How Does Learning Occur?

Behavior and cognitive theories agree that differences among learners and in the environment can affect learning, but they diverge in the relative emphasis they give to these two factors. Behavior theories stress the role of the environment—specifically, how stimuli are arranged and presented and how responses are reinforced. Behavior theories assign less importance to learner differences than do cognitive theories. Two learner variables that behavior theories consider are *reinforcement history* (the extent to which the individual was reinforced in the past for performing the same or similar behavior) and *developmental status* (what the individual is capable of doing given his or her present level of development). Thus, cognitive handicaps will hinder learning of complex skills, and physical disabilities may preclude acquisition of motor behaviors.

Cognitive theories stress the role of situations and environmental conditions as influences on learning. Instructional explanations and demonstrations serve as environmental inputs for students who, with practice and feedback, construct knowledge and learn. Cognitive theories contend that instructional factors alone do not fully account for students' learning. What students do with knowledge—how they attend to, rehearse, transform, code, store, and retrieve it—is critically important. The ways that learners process knowledge determine what, when, and how they learn, as well as what use they will make of the learning.

Cognitive theories emphasize the role of learners' thoughts, beliefs, attitudes, and values. Learners who doubt their capabilities to learn may not properly attend to the task

or may work halfheartedly on it, which retards learning. Such learner thoughts as "Why is this important?" or "How well am I doing?" can affect learning and need to be considered in instructional planning.

How Does Memory Function?

Learning theories differ in the role they assign to memory. Some behavior theories conceive of memory in terms of neurological connections established as a function of behaviors being associated with external stimuli. More commonly, theorists discuss the formation of habitual ways of responding with little attention to how these behavior patterns are retained in memory and activated by external events. Most behavior theories view forgetting as caused by lack of responding over time.

Cognitive theories assign a prominent role to memory. Information processing theories equate learning with *encoding*, or storing knowledge in memory in an organized, meaningful fashion. Knowledge is retrieved from memory in response to relevant cues that activate the appropriate memory structures. Forgetting is the inability to retrieve knowledge from memory caused by interference, memory loss, or inadequate cues to access information. Memory is critical for learning, and how information is learned determines how it is stored in and retrieved from memory.

One's perspective on the role of memory has important implications for teaching. Behavior theories posit that periodic, spaced reviews maintain the strength of responses in learners' repertoires. Cognitive theories place greater emphasis on presenting material to be learned in such a way that learners can organize it, relate it to what they know, and remember it in a meaningful fashion.

What Is the Role of Motivation?

Motivation can affect all phases of learning and performance (Chapter 9). Behavior theories define *motivation* as an increased rate or probability of occurrence of behavior, which results from repeating behaviors in response to stimuli or as a consequence of reinforcement. Skinner's (1968) operant conditioning theory contains no new principles to account for motivation: Motivated behavior is increased or continued behavior produced by reinforcement. Students display motivated behavior because they previously were reinforced for it and because effective reinforcers are present.

In contrast, cognitive theories view motivation and learning as related but not identical. One can be motivated but not learn and one can learn without being motivated. Cognitive theories emphasize that motivation can help to direct attention and influence how knowledge is constructed. Although reinforcement can motivate students, its effects on behavior are not automatic but instead depend on how students interpret it. When reinforcement history (what one has been reinforced for doing in the past) conflicts with present beliefs, people are more likely to act based on their beliefs (Bandura, 1986; Brewer, 1974). Research has identified many cognitive processes that motivate students; for example, goals, social comparisons, self-efficacy, values, and interests. Teachers need to consider the motivational effects of instructional practices and environmental features to ensure that students remain motivated to learn.

How Does Transfer Occur?

Transfer refers to knowledge and skills being applied in new ways, with new content, or in situations different from where they were acquired (Chapter 6). Transfer also explains the effect of prior learning on new learning—whether the former facilitates, hinders, or has no effect on the latter. Transfer is critical, for without it all learning would be situationally specific. Transfer lies at the heart of our system of education (Bransford & Schwartz, 1999).

Behavior theories stress that transfer depends on identical elements or similar features (stimuli) between situations. Behaviors transfer (or *generalize*) when the old and new situations share common elements. Thus, a student who learns that $6 \times 3 = 18$ should be able to perform this multiplication in different settings (school, home) and when the same numbers (6 and 3) appear in a similar problem format (e.g., $36 \times 23 = ?$).

Cognitive theories postulate that transfer occurs when learners understand how to apply knowledge in different settings. How information is stored in memory is important. The uses of knowledge are stored along with the knowledge itself or can be easily accessed from another memory storage location. Situations need not share common elements.

Instructional implications of these views diverge. From a behavioral view, teachers should enhance the similarity between situations and point out common elements. Cognitive theories supplement these factors by emphasizing that students' perceptions of the value of learning are critical. Teachers can address these perceptions by including in lessons information on how knowledge can be used in different settings, by teaching students rules and procedures to apply in situations to determine what knowledge will be needed, and by providing students with feedback on how skills and strategies can benefit them in different ways.

How Does Self-Regulated Learning Operate?

Self-regulated learning refers to the process whereby learners systematically direct their thoughts, feelings, and actions toward the attainment of their learning goals (Zimmerman & Schunk, 2001; Chapter 10). Researchers of different theoretical traditions postulate that self-regulated learning involves having a purpose or goal, employing goal-directed actions, and monitoring strategies and actions and adjusting them to ensure success. Theories differ in the mechanisms postulated to underlie students' use of cognitive, metacognitive, motivational, and behavioral processes to regulate their activities.

From a behavior theory perspective, self-regulated learning involves setting up one's own contingencies of reinforcement; that is, the stimuli to which one responds and the consequences of one's responses. No new processes are needed to account for self-regulated behavior, which includes learners self-monitoring, self-instructing, and self-reinforcing.

Cognitive researchers emphasize mental activities such as attention, planning, rehearsal, goal setting, use of learning strategies, and comprehension monitoring. These theorists also stress motivational beliefs about self-efficacy, outcomes, and perceived value of learning (Schunk, 2001). A key element is *choice:* For self-regulated learning to

occur, learners must have some choice in their motives or methods for learning, time spent learning, criterion level of learning, the setting where learning occurs, and the social conditions in effect (Zimmerman, 1994, 1998, 2000). When learners have few choices, their behaviors are largely externally regulated rather than self-regulated.

What Are the Implications for Instruction?

Theories attempt to explain various types of learning but differ in their ability to do so (Bruner, 1985). Behavior theories emphasize the forming of associations between stimuli and responses through selective reinforcement of correct responding. Behavior theories seem best suited to explain simpler forms of learning that involve associations, such as multiplication facts, foreign language word meanings, and state capitals.

Cognitive theories explain learning with such factors as knowledge construction, information processing, memory networks, and student perceptions and interpretations of classroom factors (teachers, peers, materials, organization). Cognitive theories are more appropriate for explaining complex forms of learning, such as solving mathematical word problems, drawing inferences from text, and writing essays.

But commonalities often exist among different forms of learning (Bruner, 1985). Learning to read is fundamentally different from learning to play the violin, but both benefit from attention, effort, and persistence. Learning to write term papers and learning to throw the javelin may not appear to be similar, but both are promoted by goal setting, self-monitoring of progress, feedback from teachers and coaches, and motivation to achieve.

Effective teaching requires that we determine the best theoretical perspectives for the types of learning we deal with and their implications for teaching. When reinforced practice is important for learning, then teachers should schedule it. When learning problem-solving strategies is important, then we should study the implications of information processing theory. A continuing challenge for researchers is to specify similarities and differences among types of learning and identify effective instructional approaches for each.

SUMMARY

The study of human learning focuses on how individuals acquire and modify their knowledge, skills, strategies, beliefs, and behaviors. Learning represents an enduring change in behavior or in the capacity to behave in a given fashion, which results from practice or other experiences. This definition excludes temporary changes in behavior due to illness, fatigue, or drugs, as well as behaviors reflecting genetic and maturational factors, although many of the latter require responsive environments to manifest themselves.

The scientific study of learning had its beginnings in the writings of such early philosophers as Plato and Aristotle. Two prominent positions on how knowledge is acquired are rationalism and empiricism. The psychological study of learning began late in the 19th century. Structuralism and functionalism were active schools of thought at the beginning of the 20th century with such proponents as Titchener, Dewey, and James, but these positions suffered from problems that limited widespread applicability to psychology.

Theories provide frameworks for making sense of environmental events. Theories serve as bridges between research and educational practices and as tools to organize and translate research findings into recommendations for educational practice. Types of research include correlational, experimental, and qualitative. Research may be conducted in laboratories or in field settings. Common ways to assess learning include direct observations, written and oral responses, ratings by others, and self-reports. Assessments should satisfy the criteria of reliability, validity, and absence of bias. Value-added assessments track students' learning progress and can be used as a basis for differentiating instruction according to student needs.

Learning theory and educational practice often are viewed as distinct, but in fact they complement and help refine one another. Neither is sufficient to ensure good teaching and learning. Theory alone may not fully capture the importance of situational factors. Practical experience without theory is situationally specific and lacks an overarching framework to organize knowledge of teaching and learning.

Behavior theories explain learning in terms of observable events, whereas cognitive theories also consider the cognitions, beliefs, values, and affects of learners. Theories of learning differ in how they address critical issues. Some of the more important issues concern how learning occurs, how memory functions, the role of motivation, how transfer occurs, how self-regulated learning operates, and the implications for instruction.

FURTHER READING

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