Part I

What Teachers Need to Know About Development

Chapter 2 Cognitive Development

Chapter 3 Personal-Social Development: The Feeling Child

Allison Wendler is a school psychologist who provides psychological and educational assessment as well as behavior management consultation to two elementary schools, one middle school, and one senior high school. She spends one day a week at each school and reserves Fridays for catching up on report writing. Today is Friday, and she is discussing some of her cases with Darrell Walker, another psychologist.

Allison: You know, it would be a good thing if every teacher could have experience teaching at the elementary, junior, and senior high levels. Maybe that would give teachers a developmental perspective on learners.

Darrell: What do you mean?

Allison: Well, yesterday I was consulting with a kindergarten teacher. She has this boy in her class who has nighttime enuresis and wets his pants during the day. She was very concerned about it and felt it was a sign that he might be emotionally disturbed.

Darrell: And, Ms. Freud, what did you say?

Allison: I tried to explain that enuresis is not unusual, even for 5-year-olds. Kids get over it. I mean, how many twelfth-graders are wearing Pampers?

Darrell: You're not just saying let the kid grow out of it, are you? After all, most kids his age don't have that problem.

Allison: I know that, and we should do something about it, but you need to put the problem in perspective. Don't blow it up into something it isn't.

Darrell: OK, I see your point. If kindergarten teachers had more contact with older kids, maybe they would understand how quickly kids get over it.

Allison: Exactly. Now take the middle school teachers. I sometimes get referrals from sixth-grade teachers about kids who aren't adjusting. They don't finish their work, or they act out in class. These are problems, but transitions between schools can be tough on learners, and some teachers don't know how different schools can be. What seems like a behavior problem may really be an adjustment problem.

Darrell: So what you're saying is that different levels of schooling place different demands on learners, and understanding that might help teachers put a sixth-grader's adjustment problems in perspective.

Allison: Exactly. Some learning and behavior problems may not be what they seem when viewed from a developmental perspective. Some learners are less ready for the demands of a new grade or level of schooling than others and need more time and understanding to adjust.

Darrell: I see your point. Say a kid isn't ready to learn certain academic or social skills. The teacher blames the child or the lack of instruction at an earlier grade.

Allison: And another thing—if teachers could work with children of all ages they would see the whole range of problems almost every learner goes

through. Then they'd be able to separate developmental or adjustment problems from more serious problems.

During the first weeks and months of teaching, many of your thoughts will focus on your learners. You will ask "Who are they?" "What can they do?" and "How much can they learn?" At this time, you will strive to understand who your learners are, what tasks they can perform, and at what level to aim your instruction (Borich, 1993, 1995; Bullough, 1989; Fuller, 1969). This is a time when you will get to know your learners as individuals and will start to recognize the kinds of tasks that can promote their individual growth and development. To do this, you will need information about your learners' cognitive and affective development. In Part I of this text we will provide you with a developmental perspective that can help you plan and implement instruction during your first weeks and months of teaching.

One area in which developmental knowledge can influence your teaching is the expectations you hold for your learners. As a teacher, you will be continually questioning whether your classroom goals and objectives are appropriate for your learners. You will want to know not only whether a particular skill is appropriate to a learner's cognitive ability, but also how much time will be required to learn it. Knowledge about a child's particular developmental level, prior developmental achievements, and the next developmental hurdles to be crossed will help you decide what to teach and how to teach it.

Developmental knowledge can also help you teach learners who are experiencing learning and adjustment problems. Developmental psychology can help you identify the many forces that affect growth, maturation, learning, and development and that affect your learners' behavior. It can also make you more understanding of the varieties of behavior you will find among learners.

In Chapter 2 we begin our study of child development with an overview of the principal developmental themes that will be addressed in the following chapter and throughout this text. We start by placing these themes in the broader context of growth, maturation, and learning to provide a developmental perspective on classroom learning and to introduce major cognitive developmental theories that will become the focus of subsequent chapters. We will also learn about the important changes in the intellectual and language development of learners that allow them to acquire information, think about the world around them, solve important problems, and control their own behavior and learning.

Your appreciation of the thinking child, gained in Chapter 2, will be expanded in Chapter 3 with an understanding of the feeling child. In Chapter 3 we will highlight the important components of personal-social development and discuss your role in enriching the emotional and social lives of your learners.

Chapter 2

Cognitive Development

This chapter will help you answer the following questions about your learners:

- How will developmental knowledge help me set appropriate expectations for my learners?
- How will an understanding of my learners' problems affect my efforts to help them?
- Can I expect my learners to continually improve their social and intellectual skills, or will they change by developmental leaps?
- How will I know if my learners are developmentally ready for what I teach?
- What role does active involvement in classroom activities by my learners play in enhancing cognitive development?
- What adjustments must I make in the learning expectations and activities of my learners when they are in the concrete operational stage of cognitive development?
- Approximately when can I expect most of my learners to be able to reason logically and abstractly?
- How will I know that my lessons include important facts, discriminations, concepts, rules, and strategies that the learner needs to master developmental tasks?

- Have I met my learners' needs for sufficient conversation, public reasoning, shared problem solving, and cooperative projects?
- Should most of my instruction be targeted below, at, or slightly above my learners' current level of skill?
- In what ways can I enhance the language development of my learners and improve their thinking ability?
- How will learning to ask questions enhance my learners' cognitive and language development?

In this chapter you will also learn the meanings of these terms:

accommodation

adaptation

assimilation

behavioral schemata

clinical method

concrete operational stage

developmental stage

developmental theories

equilibrium

formal operational stage

hypothetico-deductive reasoning

language acquisition device

laws of conservation

mediation

nature/nurture question

object permanence

operational schemata

organization

pragmatics

preoperational stage

schemata

sensorimotor stage

symbolic schemata

zone of proximal development

The following portrait of a learner named Maricela illustrates many of the principles of growth and development we will study in this and the following chapter. Let's learn a little about Maricela, starting with her very first days of life.

Portrait of Maricela

From her earliest days, Maricela showed unusual powers of concentration. She would stare for long periods at her mother's face or at light patterns on the ceiling above her as she nursed. As she grew older and learned to hold and manipulate things, she would repeat the same actions hour after waking hour.

Her parents were worried at first that her development might not be normal, since she was born two weeks prematurely and weighed only 5 pounds 6 ounces. However, Maricela's older brother, Aaron, who was 15, and her older sister, Alicia, who was 12, both weighed only about 6 pounds at birth, so the doctor assured her parents that there was nothing to worry about.

Both Maricela's parents work. Her mother, Ellene, had not worked while Maricela's brother and sister were growing up. But when Alicia started the seventh grade, Ellene decided it was time to resume her career. When Maricela was 3 months old, her mother placed her in day care. It was a difficult decision, one her mother and father considered carefully.

Maricela showed normal development during her infancy. Although she never crawled, she started walking at about the age of 13 months. Maricela said her first words at 10 months and began speaking in rudimentary sentences when she was about a year and a half old. She formed a strong attachment to her mother despite the fact that someone else took care of her on weekdays. At day care, she formed normal attachments with the other children in her peer group and gave every indication of being a happy, self-assured individual.

At about the age of three and a half, Maricela began to show that she could recognize shapes and colors. When blocks of varying geometric shapes and colors were placed in front of her, she would readily distinguish triangles, diamonds, and even rectangles from squares and parallelograms. She could even identify shades of different colors.

Her favorite activity was putting together a wooden puzzle of the United States. She could identify the states by name. By her fourth birthday, her parents would amaze their friends and relatives by asking Maricela questions (without the puzzle map present) such as “Which state is below Illinois?” “Which state is between California and New Mexico?” Maricela’s fascination with shapes and patterns was evident even when she was a small child.

Maricela continued to be a bright, alert, happy, and enthusiastic child throughout her early childhood and preschool years. Her development went so smoothly during this time that her parents were unprepared for the problems that began at the end of kindergarten.

Maricela began complaining of frequent stomachaches and feelings of nausea for which no physician could offer a medical explanation. Most of

the physicians her parents took her to provided the same conclusion about the basis of her physical complaints: anxiety.

The summer between kindergarten and first grade was calm and relaxing, and Maricela seemed to be her old self again. But the physical complaints and nausea returned at the start of first grade. A school counselor suggested that Maricela might be developing school phobia and counseled her parents to bring her to school in the morning, even if Maricela complained that she was sick. Similarly, the counselor advised Maricela's teachers to keep her in class and not send her to the nurse's office unless her problem seemed serious. This appeared to have some beneficial effect, as the physical complaints decreased.

At a parent conference in November, Maricela's teacher suggested that her parents might be pressuring her to do well in school and that this was the source of her anxiety. Maricela's older brother and sister had gone to the same school and were good students. Maricela's parents assured the teacher that they were not that type of parents. During the conference Maricela's mother mentioned that she too had experienced the same physical problems throughout most of grade school.

As Maricela grew older other problems emerged. When she changed schools in the seventh grade, her grades plummeted and her behavior became erratic. She experienced a severe loss of self-esteem and developed numerous symptoms, such as difficulty sleeping, poor appetite, frequent aches, pains, and nausea, which her doctor diagnosed as signs of depression. He prescribed a mild antidepressant, which improved Maricela's mood but also made her feel lethargic. After several months of taking the medication, she stopped, against the advice of both her physician and her mother.

She got into frequent arguments with her teachers, and rarely completed her schoolwork or homework. She seemed to lose all interest in school. Her appearance, heretofore always neat, was haggard and unkempt. Despite numerous parent-teacher conferences and frequent visits to the school counselor, nothing seemed to be able to reverse Maricela's academic, social, and personal downward slide.

When it was time for her to go to high school, Maricela told her mother that she wanted to drop out. She said she hated school, had no friends, and was picked on by teachers because she looked, dressed, and acted differently. Her parents found an alternative high school, which she agreed to attend. However, the school was too unstructured for Maricela, and after two years she had accumulated only enough credits to be a second-semester freshman. At 17, Maricela faced more than three years of high school before she would receive a diploma. She dropped out, moved into an apartment with friends, and got a job as a salesclerk in a department store.

Living away from home eventually had some beneficial results for Maricela, who realized she would not improve her job possibilities if she didn't complete high school. She enrolled in a GED program and eventually entered a community college program in early childhood education. Maricela was excited about her courses and the possibility of working with young children. She threw herself into her studies with the same fervor and dedication she had displayed for puzzle maps as a preschooler.

Maricela received an associate in arts degree from the community college and worked for several years in a local day care center. Having decided that she would like to become the director of a day care center

some day, she enrolled in a university and is now pursuing a degree in early childhood education.

Basic Questions About Maricela's Development

Developmental psychologists study changes that occur in learners like Maricela from birth to death. They examine the physical, social, language, and cognitive characteristics of learners at different ages and ask questions such as these: How do 6-year-olds and 12-year-olds differ in the ways that they learn, make friends, and get along with adults? Why do some 8-year-olds learn to reason abstractly in the third grade while others don't do so until the fourth grade? Which life stages present particular difficulty for learners?

A variety of theories attempt to explain why learners display certain characteristics or traits at some periods and not at others. These theories help us understand why a learner like Maricela might be a happy, well-adjusted child at one point in her life and an unhappy, anxious child at another. In general, **developmental theories** try to explain why children change in the ways they do and why they differ from one another.

`While there are several prominent theories of child development, each seeks to answer three fundamental questions (Bee, 1995):

1. Do children display similar patterns of physical, intellectual, language, and emotional development as they mature, or do the differences outweigh the similarities? In other words, is there one typical road to development, or are there many unique paths?
2. What are the major influences on learner development? Are the major forces affecting developmental change the result of environmental circumstances? Or are the forces that exert influence over learner development primarily internal and determined at birth?

3. What is the best way to conceptualize developmental change? Is it primarily quantitative, characterized by a sequential, cumulative, hierarchical learning of increasingly complex physical, intellectual, and social skills? Or is the nature of developmental change primarily qualitative, characterized by stages, transition points, and developmental leaps?

The answers to these questions will help you understand learners as they develop. They also provide a context for a better understanding of the learning difficulties that some of your students may encounter. Before describing the theories that have developed from these questions, let's examine more closely the issues raised by them.

Is There One Typical Road to Development or Are There Many Unique Paths?

Was Maricela's development typical? Was her memory for puzzles and recognition of shapes a predictable developmental phenomenon or a unique gift? Was her fear of school an expected individual difference that does not suggest a psychological problem? When do differences become problems?

Do you expect your learners to follow similar patterns of development? Will they show certain physical, cognitive, and social skills at about the same age? Do most learners begin to use language at 11 to 14 months, have the cognitive skills necessary to begin school at age 5 or 6, become able to reason abstractly at age 10 or 11, and reach sexual maturity by the time they are teenagers? Many of your learners will have various things in common: age, language, culture, economic circumstances, family makeup, and school experiences. Naturally there will be regularities or commonalities in their growth and development. Developmental psychologists have acquired a wealth of information about these regularities, many of which we will discuss in this and the following chapter.

But each of your learners also has a unique background, special abilities, and prior learning experiences, such as culture, language, and family child-rearing practices. Each has certain unique expectations about your classroom and about you as a teacher. The learners will react in a variety of ways to what you say and do in the classroom. In this chapter and the next we will discuss some of the ways in which learners differ in language development, rate of learning, skill in getting along with others, self-esteem, and aggression.

Developmental Patterns

The question of whether development is mainly similar or unique from one individual to another has been debated by developmental psychologists for decades (Bee, 1995; Shaffer, 1993). In general, theorists who have focused their research on physical, language, and cognitive development emphasize the common or regular features of development that all children tend to show as they grow and mature (Bee, 1995).

For example, Gesell (1928, 1954) observed children at various points in the life span to determine at which ages they walked, said their first words, jumped, and displayed other behaviors. From his work came the construction of developmental norms. *Developmental norms* represent similarities in the traits or behaviors of learners as they grow and develop. The behaviors depicted in Figure 2.1 were constructed from just such developmental norms. Charts such as this make you aware of expected patterns of growth and alert you to potential developmental problems.

Piaget (1959, 1963) and other developmental psychologists have constructed similar expectations for cognitive growth. Piaget (whose work we will study in detail later in this chapter) has identified the sequences and stages at which learners can be expected to display certain cognitive skills.

Individual Differences

Other developmental psychologists, particularly those working in the areas of personality and social development, have been more interested in individual differences. *Individual differences* are the variations we observe among members of any group in a particular characteristic, such as temperament, energy level, friendship patterns, and parent-child attachment. Gerald Patterson (1975, 1980) studied the different patterns of aggressive behavior developed by individual children. Willard Hartup (1989) examined the development of friendship patterns in children. Susan Harter (1988, 1990) studied the reasons behind the substantial differences in self-esteem among children and adolescents. In general, these theorists emphasize that development differs more often than it is similar. They underscore that patterns of development vary significantly from culture to culture, from family to family, and even among members of the same family (Shaffer, 1993). They caution against making developmental predictions based on developmental norms such as those shown in Figure 2.1.

Why This Question Is Important for Teachers

As a teacher, you will meet an unfamiliar group of learners at the start of each school year. Your learners will have certain expectations for how they should behave toward you and toward one another. And you will have expectations for how much your students will learn, how rapidly they will learn it, and how long they will retain the information and skills you teach them. You will also expect your learners to be sociable, confident, and committed to the instructional goals of your classroom.

You will want your expectations to be appropriate for the entire class as well as for each individual. For example, expecting a 6-year-old to reason

abstractly could lead to frustration on both your part and the part of the learner. On the other hand, your awareness that sixth-graders who are just entering middle school often need a period to adjust would probably prevent you from referring students for counseling unnecessarily. Your understanding of which developmental changes are common to all children, and which differ from learner to learner, will influence the kinds of expectations you have for your learners and your behavior toward them.

In addition to its effect on your expectations, your understanding of development will help you interpret differences in the learning and social behavior of your learners. Some of your children will be outgoing; others will be shy and withdrawn. Some learners will comply with rules and requests; others will resist your authority. Most of your students will learn what you teach in the time allotted, but some will not.

At what point do these differences become cause for alarm? If you expect all learners to learn and behave similarly, you may see abnormality rather than normal individual or cultural differences. But if you have no knowledge of developmental norms, you may fail to recognize a pattern of abnormal behavior at the most opportune time to deal with it. The developmental knowledge you acquire from Part I of this text will help you develop a framework with which to interpret the differences you will observe among learners.

What Are the Major Influences on Learner Development?

Were the major influences on Maricela's development built into her at birth, or did they come from her life experiences? Was Maricela's anxiety a trait inherited from her mother or a problem caused by school and family experiences? Was her lack of commitment to school after seventh grade an inevitable unfolding of a genetically programmed problem or a reaction to some change in her life?

The Nature/Nurture Question

Developmental psychologists refer to questions such as these as the **nature/nurture question.** Those who emphasize the *nature* side of the question stress that a child's pattern of development is built in, or genetically programmed before birth. While not denying that the environment plays an important role in determining how someone behaves, psychologists who take the nature side of the debate argue that common patterns of development and certain individual differences are partially or wholly controlled by the genetic code received from the parents. To support their views, such psychologists point to studies of identical twins reared apart, which indicate that a large part of intelligence and temperament may be inherited.

Those who take the *nurture* side of the debate argue that a learner like Maricela developed primarily as a result of influences or experiences after birth. They point to such factors as family makeup and child-rearing practices, health and nutrition, family social and economic status, and school quality as important determinants of Maricela's cognitive and social development. Psychologists on the nurture side of the question often cite studies of adopted children, which show that the IQs of adopted children and their nonrelated siblings are surprisingly similar. However, it would be difficult to find a psychologist today who takes a strong position on either side of the debate. Most believe that both nature and nurture—both heredity and environment—play important roles in development. Although there is no conclusive answer to the relative influence of nature and nurture on development, this issue has important implications for teaching. Let's see what they are.

Why This Question Is Important for Teachers

As a teacher, you will work with learners who display a variety of learning and behavior problems. If you teach elementary school learners, you may encounter children who, despite all efforts, find it difficult to learn to read or to use math concepts. Or you may work with learners who can't seem to sit still or follow simple rules. In any middle-school class, you may encounter learners who have developed intense anxieties about reciting before a group or taking an exam. High school learners may experience not only anxiety but also depression.

When faced with children who display learning, emotional, or behavioral problems, you must decide how to provide help or support. You will ask what caused the problems, what can be done in a classroom to ameliorate them, and how you can best prioritize your time and energy to meet the needs of both individual learners and the entire group.

The nature/nurture question will become extremely significant for you when you attempt to answer such questions. For example, influenced by what you read in the popular press, you may believe that learning ability or temperament is largely inherited. Therefore, when faced with children who have difficulty memorizing facts, understanding concepts, or solving problems, you may attribute the problem to low native intelligence. As a result, you may not look for other reasons for poor school performance, such as low teacher expectations, poorly sequenced instruction, or lack of prerequisite learning skills. Similarly, if you view school anxiety, adolescent depression, or a short attention span as inherited conditions, you will be unlikely to examine the ways in which you can support and help a student during a difficult period.

Some educators place too great an importance on the genetic basis of learner problems; others deny that genetics is significant in determining individual differences in intelligence, learning ability, or personality development. In fact,

behavioral geneticists have assembled a large body of evidence affirming that nature plays an important role in both cognitive and personality development (Plomin & Rende, 1991). Teachers who deny this influence may place unrealistic expectations for academic achievement or social behavior on their learners.

What Is the Best Way to Describe Developmental Change?

Examine Figure 2.1 again and notice the orderly sequence of physical, cognitive, language, and social development. The typical child sits up unassisted before she begins to stand. She learns to walk before she runs or rides a bicycle. In cognitive development, the typical infant can think about only those objects he can touch or see. As he matures, he develops the ability to think about things that are not immediately present, to imitate actions after he observes them, and to classify objects by both color and shape. Similarly, in social development children typically show a gradually increasing ability to play alongside peers, play cooperatively, develop friendships, and take another's point of view.

Developmental psychologists who have examined this seemingly orderly pattern of developmental change differ on the best way to describe it. Some believe that development consists of incremental, cumulative, quantitative change in physical capabilities and in cognitive, language, and social skills. The child's bones grow stronger, muscles acquire more mass, the brain develops more cells. The child acquires more information and has more experiences, which allow her to think in increasingly complex ways. The child's vocabulary grows, and her speaking ability becomes more sophisticated. At 2 years she has no friends, but at 8 years she has many. In other words, as the child grows and develops she gets better at thinking, reading, writing, speaking, and making friends.

Development viewed in this way has three principal attributes (Worrell & Stilwell, 1981). It is a *continuous* acquisition of new skills as the child moves

from one learning context to another. Development is also *cumulative,* in that the child acquires new skills and adds them to previously learned skills to form more complex ones. Finally, development is *hierarchical,* since more complex skills cannot be learned before the prerequisite, less complex skills have been mastered. The child cannot learn long division unless he has previously learned subtraction. The child cannot learn to ride a bike until she has learned to balance.

Moreover, the fundamental learning processes that underlie developmental change are the same for learners of different ages. In other words, toddlers, preschoolers, and elementary and secondary school learners acquire new skills in essentially the same way. From this perspective, the development of new behavior is less dependent on the child's particular age or stage than on her mastery of the necessary prerequisite skills and exposure to learning opportunities in the environment.

Other developmental psychologists, however, believe that at different points in a child's development there are pronounced *qualitative* changes in how the child perceives the world, learns, and thinks about himself and others, or in how the child's brain or body functions. Piaget, for example, argues that older children and younger children actually approach tasks and learn in different ways.

Psychologists who view development as qualitative change are often referred to as *stage theorists.* These theorists, two of whom we will study in this chapter and the next (Piaget and Erikson), have identified discrete **developmental stages** and defined them in terms of the typical or average age at which they can be expected to begin and end. As a child moves from one stage to another, whether in terms of cognitive, language, or social development, not only will she show a change in skills (quantitative change) but, more importantly, her neurological functioning and thinking will undergo a change. At this new stage of development the child is a qualitatively different person.

Bee (1995), for example, views development as consisting of alternating periods or stages of rapid development followed by periods of calm and consolidation. She refers to the periods of rapid growth as *transitions.* She and other developmental psychologists (Achenbach, 1990) describe transitions as times when the child is particularly vulnerable to certain kinds of stressors from the environment (such as peer group pressure). For example, Bee believes there are two important transitions during the first 18 months of life (see Figure 2.1). One occurs at 2 months, when a major change in brain function signals a change in mother-child interaction patterns. A second transition occurs sometime between the seventh and ninth months, when the child begins to experience separation anxiety, move about independently, and communicate meaningfully with the mother.

Table 2.1 describes some major transitions that occur in the course of development. Knowledge of these transitions can often help teachers evaluate a student's behavior. For example, recall that Maricela had particular difficulties when she started kindergarten and again when she entered junior high school. As Table 2.1 shows, both of these periods are major transitions.

Why This Question Is Important for Teachers

Just as the nature/nurture debate is of interest to teachers, so too is the question whether development is best conceptualized as quantitative or qualitative change. Teachers might understandably ask the following questions of the stage theorist:

- If development is characterized by qualitative changes at different ages, is the best approach with a child who shows social or behavior problems to just let him or her grow out of it?

- Are the increasing negativism and resistance to authority that characterize some children as they enter adolescence best viewed as an inevitable developmental milestone?
- How should educators and parents deal with the depression and decrease in self-esteem that sometimes occur as a child enters adolescence?
- Do all children experience transitions or upheavals, or do only some experience turbulence followed by periods of calm?
- How much does culture (nurture) affect the ages at which transitions occur?

Teachers might also ask the following questions of those developmental psychologists who hold that development is characterized primarily by quantitative
change:

- Are there any emotional or behavioral problems that children are more likely to develop at certain points in their lives than at others?
- Are learners more vulnerable to the effects of family disruption, changes in school routines, or the loss of a close friend at some ages in comparison with others?
- Does a major physiological event like puberty, or a major cognitive event such as the ability to deal with abstract symbols, signal a stressful period for the learner during which certain emotional or conduct problems might arise?
- Are there points in a learner's development where certain changes occur that should affect the types of academic and social goals we have for learners?

- Can we attribute some of the behavior problems that learners exhibit when they enter elementary school or junior high school to a lack of learning important social skills and their prerequisites?

These questions and the issues raised by them get at the heart of why developmental knowledge and a developmental perspective on learners are important for teachers. Different theories of child development try to address these questions and resolve the issues they pose in different ways. In the remainder of this chapter and the next we will illustrate the power of those theories in describing important elements of cognitive and social development.

Cognitive Development

As we saw in Figure 2.1, the field of child development encompasses physical, language, cognitive, and personal-social development. Much of a learner's physical and language development has already occurred before he enters your classroom. Therefore, you will make your greatest impact on your learners' cognitive and social development. We turn now to specific theories of cognitive development, as well as to practical ideas you can use to facilitate your learners' cognitive development.

Let's illustrate the concept of cognitive development with an example of two learners at very different developmental stages.

It's field day at Sims Elementary School. Keith Harlow, a fifth-grade teacher, is serving drinks at the refreshment stand. Waiting is a 5-year-old kindergartner, **Nirbay.** Next to him is Ola, an 8-year-old second-grader.

Nirbay: I'd like a can of grape drink.
Ola: Me too.

Mr. Harlow grabs two identical cans of grape drink and reaches for the plastic cups. He picks the last of the shorter, wider cups and opens a new box of taller, narrower cups. He pours Nirbay's drink into the short cup and empties Ola's identical can into the taller cup.

Nirbay: She got more than me.
Mr. Harlow: No, she didn't. The drinks came from the same size cans. See? (He shows both empties to Nirbay.)
Nirbay: But hers is up to here. Look where mine is. She got more.
Ola (in exasperation): No, I didn't. The two cans are the same. Your cup is just wider. Can't you see?
Nirbay: She got more! I want what she got!
Mr. Harlow: OK, Nirbay, just a minute.

Mr. Harlow takes a cup like Ola's and pours Nirbay's drink into it. The levels of the drinks are now the same.

Mr. Harlow: Here, Nirbay. Is that better?
Nirbay (with a satisfied look and a glance at Ola): Uh huh! Now we're the same.

Did Nirbay and Ola have a misunderstanding, or was Nirbay just a bit slow? That question misses the point of this typical scene. Nirbay isn't stubborn or intellectually slow. He simply reasons differently than Ola. Nirbay's reasoning is tied to what he can see, but Ola's is not. She can reverse or play back in her mind how much space the fluid occupied before it was poured into the cup. She thinks qualitatively differently than does Nirbay, who, in a short time, will reason as she does.

As a teacher, you will be making choices about the types of learning you expect of your students, the activities to help bring about this learning, and the

assessment techniques that show whether learning has occurred. These choices will be based on your assumptions about your learners' knowledge, understanding, and reasoning about what they see and hear. The strategies you select for teaching and testing will be most effective if they match the cognitive or thinking skills of your learners.

Cognitive development refers to changes in how children remember what they see and hear, think about problems they encounter, predict what might happen in the future, comprehend what they read, understand the similarities and differences between different objects and ideas, and create solutions for problems that puzzle them. In other words, the study of cognitive development involves understanding how children's mental skills and abilities change over time.

Many different theories attempt to explain changes in children's understanding of the world they see, the assumptions they make about it, and the logic they use to make sense of it. In this section we will describe the theory of Jean Piaget, present current research that has enhanced and extended Piaget's theory, and consider some of its limitations. We will end this chapter with a discussion of language development and its contribution to cognitive growth.

Theory and Method of Jean Piaget

Piaget's research involved the intensive observation of individual children (primarily his own) as they grew from birth through adolescence. We refer to this style of research, which uses observation to record the behavior of a few individuals in everyday, natural settings, as the **clinical method.** A psychologist who uses the clinical method systematically observes individual children as they interact with people and objects, generates hypotheses to interpret or explain what is observed, and asks oral questions (in the case of children who can use and

understand language) to investigate each child's thinking and problem-solving behavior.

Using this method, Piaget described how infants are born with only a few innate movements and sucking and crying reflexes to guide their behavior. Yet in a relatively short time, their physical movements become increasingly goal directed; they learn how to crawl, walk, talk, and overcome obstacles to get what they want. Soon they become planners and problem solvers; before long, they can speak and reason abstractly. Piaget was particularly interested in the cognitive development that allows for and promotes these changes. He speculated that each child was busily constructing and organizing an elaborate network of ideas and concepts, which he called cognitive structures, or *schemata*.

Schemata: Cognitive Structures for Thinking About the World

Piaget hypothesized that immediately after birth, as the child groped, cried, and sucked, he or she did so purposefully. What Piaget observed were not random movements, but rather the infant's goal-directed attempts to make sense of the world. As a child learns how to turn her head to find her mother's breast, bring her hands to her mouth, or grasp objects and suck on them, she is actually creating mental or cognitive structures that allow her to think about, organize, and make sense of experiences.

Piaget used the term **schemata** to describe these cognitive structures. Schemata (the singular is *schema*) are patterns of thought or behavior. We might also think of them as concepts or strategies that influence how the child sees the world and interacts with it.

Schemata are analogous to the software programs that allow computers to perform various tasks. A child's brain contains certain programs, or routines, that allow him to grasp objects; think about objects, events, or experiences; and

perform logical operations like sequencing, matching, adding, or subtracting. Thus, computers and infants have schemata, as illustrated in Figure 2.2. The difference is that the computer's routines are programmed into it, while the child constructs schemata for herself.

Piaget identified three types of schemata through which children act upon the world, represent the world in their minds, and perform mental operations: behavioral (or sensorimotor), symbolic, and operational schemata.

Behavioral (Sensorimotor) Schemata. **Behavioral schemata** are patterns of action or sequences of behavior that the child uses to explore and respond to objects in her environment. When the infant sees a mobile above her crib and purposefully swats at it to make it move, she is using a behavioral schema. Likewise, when the child grasps a bottle with both hands and brings it to her mouth, she is using a schema. In both of these instances, the infant does not think of the mobile or the bottle as an object that has an existence all its own. Rather, each is an object that is acted upon according to a behavioral schema. Behavioral schemata are most important during the first year of life.

Symbolic Schemata. At some point during the second year, children can think about objects, events, and experiences. **Symbolic schemata** allow the child to represent objects without the need to perform some type of action on them. The child can think about a pretzel he would like to eat, a truck he would like to play with, or a parent he would like to be held by.

Operational Schemata. By the time children enter first grade, they can perform **operational schemata,** logical operations or mental activities on objects or events, the results of which lead to some logical outcome. For example, a 6-year-old can order objects by size, perform simple mathematical calculations in her

head, or imagine what a log of clay that was originally shaped like a ball would look like in its original form. She can perform these intellectual operations because of operational schemata that she has created out of experiences with concrete objects during the first five or more years of life.

How Schemata Are Constructed and Changed

According to Piaget, cognitive development is the lifelong process through which learners construct and modify their own personal computer programs or schemata. They are able to do this under the guidance of two major innate intellectual functions: organization and accommodation. Two additional functions, adaptation and assimilation, allow learners to carry out the process of accommodation. Let's see how learners use all these processes.

Organization. **Organization,** as the word implies, occurs when the child combines existing schemata to form new and more complex schemata. For example, when the infant combines her looking, reaching, and grasping schemata in such a way that she gets hold of a bottle and brings it to her mouth, she has organized a new schema—visually directed reaching.

Organization of existing schemata into higher-order, more complex, and more interrelated structures occurs throughout the life span. Children who learn how to use scissors to cut out shapes, use a pencil to form letters, or coordinate various movements to ride a two-wheeler or make a basketball layup are organizing simpler behavioral schemata to form more complex ones. Likewise, the child who mimics the actions of his father shaving in the morning organizes simpler symbolic schemata for the purpose of imitating an action that he finds interesting, amusing, or useful. Finally, the child who can arrange blocks

according to size or rocks according to weight is organizing already existing symbolic schemata into more complex schemata.

Adaptation. As children grow and develop, they are constantly encountering new objects, new information, or new experiences that impel them to think about or act on their environment in new ways. **Adaptation** is the intellectual function that allows them to meet these new demands, whether they occur at home, in school, or on the playground. Children adapt to these new requirements as a result of two complementary processes called *assimilation* and *accommodation.*

Assimilation. When children try to make sense of new information or new experiences using existing behavioral, symbolic, or operational schemata, they are engaged in a process of **assimilation.** In other words, assimilation involves making sense of what is new by relating it to what is familiar.

Accommodation. **Accommodation** occurs when children succeed in modifying existing schemata in order to make sense of or account for new events, information, or experiences. For example, suppose that a child has developed a symbolic schema for “truck” as anything big with wheels that moves. She sees a van for the first time and calls it a truck. Daddy says, “Yes, that’s a truck.” The child *assimilates* the characteristics of a van into her truck schema.

But a few days later, the child sees a train and again says “truck.” This time Daddy corrects her, saying, “No, that’s a train.” According to Piaget, this creates a state of disequilibrium—the child’s cognitive equilibrium or balance is upset as a result of encountering new information that cannot be assimilated into an existing schema. In order to restore her cognitive balance or **equilibrium,** the child must modify her truck schema to accommodate a new category of experience—a train.

She may do this by adopting the term used by her father—*train.* Figure 2.3 illustrates the complementary processes of assimilation and accommodation.

The lifelong process of cognitive development is a continuous cycle that consists of creating schemata, enriching those schemata by assimilating new but cognitively compatible knowledge, and then altering those schemata by including new categories of experience through the process of accommodation. The creation of these new cognitive structures is guided by the two innate intellectual functions of organization and adaptation. Figure 2.4 illustrates the cyclical nature of cognitive development.

Piaget's Stage Theory of Cognitive Development

Piaget believed that the process of cognitive development unfolds through four distinct and qualitatively different stages. Figure 2.5 depicts these stages, and Table 2.2 summarizes the child's important accomplishments at each stage.

According to Piaget, these stages form an invariant developmental sequence; in other words, all children progress through them in precisely the same order and without skipping stages. Moreover, each stage is qualitatively different from the one that follows it. This means that the child must learn a unique set of schemata at each stage in order to enter the next stage.

The Sensorimotor Stage (Birth to 2 Years).

At birth, the beginning of the **sensorimotor stage,** children have only a few simple reflexes (sucking, grasping, looking) to help them satisfy biological needs such as hunger. At the end of this stage, these same children can move about on their own, solve simple problems in their heads, search for and find toys and other objects that are hidden from view, and even communicate some of their thoughts to parents and peers.

Between 4 and 8 months of age, infants learn that they can make things move by banging and shaking them, which is why babies of this age love to play with

rattles. Sometime between the eighth and twelfth months, they figure out how to get one thing (like a bottle) by using another (for instance, by knocking a pillow away). Between 12 and 18 months, children can represent hidden objects in their minds. They search for what they want, even when they can't see it. At the end of this period, children are beginning to use images to stand for objects. For example, a 2-year-old places her doll inside a dollhouse and imaginatively reconstructs her doll's view of the miniature rooms and furniture. This ability, called **mediation,** is an extremely important achievement, because it frees the child from the need to think about only those objects she can see around her. A child who can mediate can think about the whole world.

Current Research. Piaget lacked today's sophisticated research techniques and scientific equipment for studying early cognition. Today researchers can study the preferences of infants by tracking their eye movements, and they can use sophisticated techniques to teach infants how to manipulate their environments (for example, suck on a bottle more vigorously to see or hear more interesting sights and sounds). This research has shown that infants gain a sense of the stability of objects (called **object permanence**) much earlier than Piaget estimated—at about 4 months (Baillargeon, 1987). Meltzoff (1988) showed 9-month-old infants a video of an adult playing with toys unfamiliar to the infants. A day later, the infants imitated the adult's actions they had seen. This suggests that deferred imitation (a form of mediation) is present almost a year earlier than Piaget expected it to occur.

Although Piaget appears to have underestimated the ability of infants to take in information, store, organize, remember, and imitate it, he appears to have described correctly the sequences by which these skills develop. Furthermore, his view of the infant as a "mini-scientist" who acts on the world and builds theories about it is very much consistent with current research findings.

The Preoperational Stage (2 to 7 Years). The **preoperational stage** builds on the accomplishments of the sensorimotor stage. Piaget postulated that a radical or qualitative change occurs at this time: the emergence of symbolic thought. We saw that toward the end of the sensorimotor period children are able to manipulate images in their heads, as shown by their ability to mediate. During the preoperational stage, they develop the ability to use symbols: they can make one thing (an image, an object, or an action) stand for something else. For example, during the preoperational period, children can make a horse out of a broom, a daddy out of a doll, or a truck or train out of a block of wood. Later (between 3 and 4 years), they play parts or roles: doctor and patient, mommy and daddy, good guys and bad guys, bus driver and passengers. Complex language, another example of the use of symbols, also emerges during this period.

Piaget emphasized that the emergence of true symbolic thought during the preoperational stage is not simply a quantitative, additive change. Rather, it is a drastic, quantum leap into a new cognitive realm, which, as Flavell (1985, p. 82) puts it, “seems nothing short of miraculous.” In fact, most of Piaget’s research on the preoperational period is devoted to describing this remarkable achievement in minute detail.

You may be puzzled by the term “preoperational.” Operations, for Piaget, are mental actions that obey logical rules. When children arrange objects in sequence from smallest to largest, they are engaged in an operation. When they add 7 plus 8 to get 15, and realize that 15 minus 8 is 7, they have performed an operation. In the episode at the beginning of this section, Ola performed an operation when she explained that the shape of a container has no effect on the amount of the liquid that fills it. According to Piaget, children like Nirbay, who are between the ages of 2 and 7, are not ready to carry out such operations because they have not yet acquired an understanding of the laws of conservation.

Conservation is a term used to describe a child's understanding that the quantity or amount of something remains the same regardless of its original size or shape. For example, picture a child with two identical clear plastic cups of a soft drink in front of him, each cup filled to the same level, as illustrated in Figure 2.6. Pour the contents of one cup into a shallow, clear plastic bowl and pour the contents of the other cup into a tall, narrow container. Then ask the child to point to the container that has more of the drink. The child who consistently solves this type of problem correctly is said to understand the **laws of conservation.** Conservation tasks can involve solids, liquids, and continuous quantities, as shown in Figure 2.6.

Piaget has shown that children in the preoperational stage of cognitive development lack schemata to solve conservation tasks. At this stage children's reasoning is dominated by what they see. Thus, children at this stage of development typically respond to this conservation task by saying that the taller glass has more, even though nothing was added to the liquid as it was being transferred from one cup to another. As they have more and more experience playing with blocks, clay, water, and containers, children gradually alter these schemata and are able to demonstrate conservation. But this doesn't occur until they enter the concrete operational stage of development. Piaget believed that instructional attempts by adults to speed up the development of conservation schemata before the child is ready are likely to fail.

Piaget focused most of his theorizing about the preoperational stage on the child's use of symbols. Much of what he said about children during this stage focused on what they *can't* do: They can't yet consider the perspective of another (they are egocentric); they can't yet perform operations such as conservation of liquids (as Nirbay could not do); and they can't yet understand the concept of class inclusion (that the class of all dogs is different from but included within the

class of animals). While the child in this stage understands that there are animals other than dogs, she doesn't understand that all dogs are animals.

Finally, the preoperational child cannot yet reason from the particular to the general, or vice versa. Instead, he reasons from particular to particular (Piaget called this *transductive reasoning*). For example, if you ask a preoperational child why it gets dark at night, he'll probably tell you "Because that's when we go to bed"; if you are driving in a car and ask the child why the trees are moving, she'll say "Because the car is moving." The child cannot yet formulate a general rule about natural phenomena or generalize beyond her immediate experience (she is *egocentric*). The cognitive structures required to perform all these operations develop during the preoperational stage.

Current Research. As with the sensorimotor stage, researchers are discovering that preoperational children are more cognitively capable than Piaget thought. Donaldson (1978), Bower and Wishart (1972), Chandler, Fritz, and Hala (1989), and Gelman and Ebeling (1989) all concluded that children around the ages of 3 and 4 are not as egocentric as Piaget suggested.

Researchers have shown that the difficulties children have with some of Piaget's classic experiments largely result from a lack of understanding of the researcher's questions. When researchers take pains to ensure that children understand these tasks, preoperational learners show that they can take the perspective of another; that is, they can begin to imagine what another viewpoint is like. Researchers such as Gelman (1972) and Bijstra, van Geert, and Jackson (1989) have shown that operations such as conservation of liquids can be performed by preoperational children. Waxman and Gelman (1986) report that children as young as 4 can understand class inclusion.

Current research on children's cognitive abilities during the preoperational period suggests two conclusions: (1) Piaget may have underestimated what some children can do during the preoperational stage; and (2) in order to exhibit more and varied abilities at this stage, researchers must first eliminate distractions, give clues, and ensure that children understand their directions. While children's thinking is still largely dominated by what they see at this time, they can be taught to be less egocentric (Bee, 1995).

The Concrete Operational Stage (7 to 11 Years). Those who intend to teach at the kindergarten or first-grade level will work with learners just as they enter the **concrete operational stage.** According to Piaget, this is the time when children become less dominated by appearances and acquire the schemata to understand arithmetic, think in symbols, classify objects into categories (like animal, vegetable, or mineral, or by color and shape), and understand the relationships between uppercase and lower- case letters. It is no wonder that formal education begins in so many societies around the world at this age.

The key accomplishments at this stage involve the learner's ability to perform operations or rules that involve mediation of words and images and to modify these mediators to reach a logical conclusion. Table 2.3 summarizes the major operations that children are capable of performing during this stage of cognitive development.

Of all the operations children can perform during the concrete operational stage, Piaget placed greatest importance on reversibility. *Reversibility* is the understanding that one's thinking processes can be reversed. For example, a first-grader understands that her model of a puppy, which was formerly a ball of clay, can be made back into a ball. A second-grader understands that 6 marbles added to his pile of 8 marbles makes a total of 14 marbles and that he can then create a pile

of 8 marbles by taking 6 away from the 14. The child who grasps the basic reversibility of actions can understand other operations, such as the laws of conservation, inference, and hierarchical classification.

Implications for Teachers. Elementary school learners are far better problem solvers than are preschoolers. They can arrange objects in order; sequence numbers properly; classify objects by color, size, or shape; understand rules for both mathematics and classroom behavior; and think about both the past and the future. Nevertheless, concrete operational learners cannot perform these operations with things they cannot see or touch. In other words, their logic works only in concrete situations. Their mental operations are not yet ready for the realm of abstract ideas.

One way to illustrate this is to show an 8-year-old three dolls of ascending height whose names are Elleni, Carlos, and Aster. Show the child that Aster is taller than Carlos, and that Carlos is taller than Elleni, and the child will easily figure out that Aster is taller than Elleni. But present only a verbal description of the three dolls, and the child will have great difficulty determining the height of the first doll relative to the third doll. Thus K through 4 teachers should teach using concrete, hands-on activities that provide examples of more general rules and concepts. The accompanying box, *Teaching Concrete Operational Learners*, gives some specific examples.

Current Research. Researchers have confirmed Piaget's conclusions about the sequence and timing at which children acquire the various concrete operations and have shown that children between the ages of 7 and 11 rarely exhibit deductive logic but are adept at inductive reasoning (Tomlinson-Keasey, Eisert, Kalle, Hardy-Brown, & Keasey, 1978). However, there is much debate about what causes these changes. Piaget emphasized that children, particularly at this stage,

act as amateur scientists and discover the rules of operations largely on their own, using the functions of organization and adaptation. He said little about the contributions of social influences, such as peers and culture, to cognitive development. We will explore this perspective shortly, when we present the social nature of learning as formulated by Lev Vygotsky, an influential Russian developmentalist.

The Formal Operational Stage (12 Years and Older). Ola, the concrete operational thinker we introduced at the beginning of this section, has a question for her 16-year-old brother.

> **Ola:** Why do my dinosaur toys get smaller when I put them underwater in the bathtub?
> **Rashid:** Because light rays coming from your eyes to the water slow down and bend when they enter water. Water is more dense than air. Water makes light rays travel differently. That's why things look smaller.
> **Ola:** But why do they look smaller?
> **Rashid:** They don't shrink. You understand that, don't you?
> **Ola:** Yeah. I know that because when I take them out of the water they're the same size [Ola has reversible thought]. I just don't understand why they look smaller.

Rashid, who is in the **formal operational stage** of cognitive development, can take an abstract principle like "light waves travel at different speeds through substances of different density" and apply this to understanding a particular phenomenon, such as the shorter appearance of objects under water. This is an example of *deductive reasoning,* something his younger sister may not be able to do for several years.

According to Piaget, the major accomplishment of learners as they enter the formal operations stage is the development of a new and more powerful set of rules for thinking about the world: formal operations. Two features of formal operational thought that provide a new and more powerful set of rules for thinking are the ability to pose hypotheses and draw conclusions from observation (**hypothetico-deductive reasoning**) and the ability to ask "if-then" questions (*propositional thought*). These skills allow learners, beginning in middle school, to think about *possible* events, not just actual ones. They can speculate about what it might be like to go to college, and debate ethical and moral dilemmas, such as "Is it ever justifiable to take another human life?" They can think through complex if-then relationships, such as "If all animals have four legs, and if this table has four legs, then is this table an animal?" While Piaget asserted that these types of formal operations begin to develop during this period, they are not acquired all at once. Rather, they continue to emerge throughout the teenage years, with the greatest accomplishments occurring at about age 15.

Current Research. Most current research in formal operations focuses on three questions: (1) Do all children reach formal operations? (2) Are young children capable of abstract reasoning? and (3) Are there any higher stages of intellectual development? (Bee, 1995; Berk, 1993; Shaffer, 1993).

Do all children reach formal operations? Try giving the following test to some of your friends:

Premise 1: If there is a knife, then there is a fork.

Premise 2: There is not a knife.

Question: Is there a fork?

The correct answer to this question is "maybe." The wrong answer is "no." However, 40 to 60 percent of college students fail formal operational problems

such as this one (Keating, 1979). Why? It appears that much of formal operational thought is situation specific. In other words, although college students and adults are capable of hypothetico-deductive reasoning, they tend to be better at it in the fields with which they are familiar. Thus physics majors are better able to demonstrate formal operations when dealing with physics problems than are psychology majors, who in turn are better at abstract reasoning in their discipline than are English majors, and so on (DeLisi & Staudt, 1980).

Are young children capable of abstract reasoning? Research indicates that concrete operational children can be taught abstract reasoning. For example, they can be taught how to solve propositions, such as the knife-and-fork task. Furthermore, training improves such performance (Hawkins, Pea, Glick, & Scribner, 1984). These training effects, however, are transitory. Specific training in propositional thinking lasts longer and generalizes more readily to new tasks when the trainees are in the formal operational stage (Greenbowe et al., 1981).

Are there higher stages of intellectual development? Although Piaget asserts that formal operations represents the apex of cognitive thought, Patricia Arlin (1975, 1977) disagrees. She believes that great thinkers like Einstein, Freud, and Piaget operate in a higher cognitive dimension in which they reconceptualize existing knowledge and reformulate it to come up with unique ways of thinking about the world. She calls this the *problem-finding stage* of cognitive development.

Piaget's Legacy

Piaget’s insight and imaginative ideas about children have influenced how we think about cognitive development and, in particular, about child development. From Piaget’s painstaking observations, we have learned that children think

qualitatively differently at various stages of development and that these stages depend on the quality of the learner's experiences with the world around him. We are indebted to Piaget for the following beliefs about children and their development and learning:

1. All learning and cognitive development spring from the child's encounters with the surrounding world. Learning requires active involvement, both physical and mental, with those surrounding conditions.
2. The child is very much the agent of his or her development. Children build their own cognitive structures; they are not simply programmed at birth to think or act in certain ways.
3. Children do not passively receive knowledge in the form of facts, concepts, or procedures and amass it in their brains. Rather, they organize and transform it as they adapt new knowledge to existing cognitive structures.
4. Children think differently about the world than do adults. Although some of their perceptions may be viewed as "mistakes," they are based on a coherent way of perceiving reality, which is influenced by the schemata present at the time. Thus, the child's way of thinking changes over the course of development. Adults, therefore, should not view a child's logical errors as resulting from either an inability to think or a lack of previous learning.

Criticisms of Piaget's Theory

Developmental psychologists of different theoretical persuasions have raised two questions: (1) How do learners move into a new stage? and (2) Are there

social influences on learning? In this section, we consider how two other theories, Gagné's intellectual skills hierarchy and Vygotsky's sociocultural theory, have expanded on, and in some areas contradicted, Piaget's work.

Gagné's Intellectual Skills Hierarchy. One limitation of Piaget's theory of cognitive development is that it does not explain how children move into the next stage. Are certain maturational changes necessary? Do certain skills have to be learned? To give you a greater appreciation of this criticism, let's examine a viewpoint that does appear to explain development through the stages.

Gagné's (1968, 1970, 1985) primary research interest was learning, not development. However, he applied his ideas about learning to explain how children develop cognitively. Because he approaches cognitive development as a learning theorist, his perspective has been called a developmental learning theory. Gagné (1968) views intellectual skills or cognitive capabilities as learned behaviors. This is in marked contrast to Piaget, who views intellectual skills as cognitive structures. From Gagné's perspective, the changes that take place as learners move through Piaget's developmental stages result from the accumulation of learned intellectual skills or capabilities, not altered schemata. School learners appear more capable at age 17 than at age 7 because they have learned more intellectual skills, not because they have better differentiated cognitive structures. Thus, the changes we see in learners as they acquire intellectual skills and master developmental tasks result from the cumulative effects of learning. Age and maturation are important only in that they allow the learner more opportunities to learn new things.

Gagné's position is that cognitive development proceeds continuously as the learner encounters new situations and new people. As the learner matures, people expect different things of her and interact differently with her. As a result, she can

learn new behaviors such as language, walking, climbing, skating, and reading. This development is not only continuous but also cumulative. As children encounter new experiences, they add those experiences to prior experiences to form new behaviors. Earlier learned behaviors provide the foundation for later learned behaviors. Simpler learned behaviors form the basis of more complex learned behaviors.

This focus on the importance of prior learning experiences leads Gagné to another attribute of development. Development is *hierarchical:* new learning is dependent on mastery of prerequisite skills. A child must learn to keep his balance before he can ride a bike; he must learn to subtract before he can learn to divide. For Gagné, learning a new skill depends not on age or stage of development, but rather on the degree to which the learner has mastered prerequisite skills. In Chapter 4 we will return to Gagné's developmental learning theory, and in Chapter 9 we will see how it can be used to design lessons and units.

Vygotsky's Sociocultural Theory. A second limitation to Piaget's theory is that it does not recognize the social context in which learning occurs. According to Piaget, brain maturation (combined with a learner's ability to experiment with a rich and varied environment) should lead children everywhere to reach concrete operations. Thus, Piaget has been criticized for failing to recognize that children grow up in varied social contexts that affect their experiences and the structure of their cognitive worlds. Lev Vygotsky's (1962) sociocultural theory has brought this oversight to the attention of developmental psychologists.

You've undoubtedly been told that a thorough knowledge of your students is essential for teaching them. But what is it, exactly, that you must know or understand about your learners to deal with their learning problems and promote their intellectual development? For Vygotsky the answer was straightforward: you

must understand how learners think about the world and how this thinking evolves. Learners come to your classroom and encounter your lessons with certain experiences, information, concepts, and ways of thinking. Your goals and objectives may be easily assimilated into their schemata. Or, as we have studied, a process of disequilibrium, accommodation, and equilibrium may have to take place before the learner can grasp what you are teaching. While Piaget emphasized what the learner does on his or her own to alter or accommodate existing schemata to new experiences, Vygotsky focuses on what learners and adults (or peers) do together to promote learning and development.

The Role of Culture and Social Relationships. The theme of Vygotsky's work is that a learner's cognitive development takes place in a social context. Throughout their lives learners are surrounded by parents, siblings, relatives, friends, teachers, and fellow students. They communicate with one another, stimulate one another, learn from one another. Parents and teachers, in particular, are more knowledgeable and skilled than learners and promote their development by reading to them, explaining to them, and conversing with them. Friends and fellow learners demonstrate and explain new ideas and practices. Television, books, and movies also play an important role in the development of new intellectual skills.

Learners acquire knowledge about their culture and history from their encounters with adults, peers, and the media. This cultural knowledge includes shared beliefs, ways of viewing the world, patterns of interacting with people, and language. Therefore, cognitive development, as Vygotsky views it, is a child's increasing mastery over the culturally determined developmental tasks imposed by social agents (adults and peers). This increasing mastery may not take place in stages, as Piaget would have us believe. Nor may the principal agent of this

change be the child acting as the lone investigator of the environment. Rather, the learner's cognitive development and mastery of intellectual skills may be linked primarily to his or her interactions with other people.

This linkage takes place on two levels. At the social level, the learner interacts with parents, teachers, or peers and learns the specific knowledge, beliefs, attitudes, and patterns of thinking and reasoning that are important in his culture or community. He learns language, a sense of humor, styles of conversing with people, approaches to thinking about and solving problems, and beliefs about religion, nature, and historical events.

At the next level, cultural and historical knowledge is transformed into schemata within the learner, much as Piaget would predict. At this level the child gradually learns to master developmental tasks involving reading, math, and science and learns to solve them independently because she has practiced such tasks under adult guidance. Thus, children internalize the routines or programs they use to interpret the world and master developmental tasks through their social relationships. The principal mechanism responsible for this cognitive development, according to Vygotsky, is social interaction.

The Zone of Proximal Development. In describing the process of cognitive development, Piaget used the metaphor of balance. A state of imbalance is created when a learner encounters something that cannot be assimilated into an existing schema. This state of imbalance is gradually returned to a state of balance through accommodation and assimilation.

Vygotsky's term for the area in which cognitive development takes place is the **zone of proximal development.** This zone encompasses a range of skills or abilities bounded on one side by what the learner can do independently and on the other side by the skills that the learner needs adult assistance to perform. For any

learners, there are as many “zones of proximal development” as there are developmental tasks to master.

For example, let’s take the area of beginning reading. Assume that a child can independently read all consonant-vowel-consonant (cvc) words, such as *pat, mat, net,* and *get.* He can also read words that have two vowels together (cvvc), such as *raid* and *bead,* but only with adult assistance. Without assistance, he will not attempt to read words that begin with consonant blends, such as *flat* or *shut.* Thus, his zone of proximal development includes all those word-recognition skills between reading one-syllable cvc words and one-syllable cvvc words. Figure 2.7 equates the zone of proximal development to that part of a baseball field in which the batter is most likely to get a hit. Some parts of the field are too far removed (too difficult) given the batter’s current skill level, while others are too close (too easy). The teacher’s job is to “pitch the ball”—to stimulate the learner with materials and content—in such a way that the learner scores a “hit”—delivers a correct response—at or slightly above his current level of functioning. The zone of proximal development has also been called the *zone of maximum response opportunity* (Borich, 1996) to emphasize that it provides the learner with the opportunity to climb to the next rung of the learning ladder.

Vygotsky sees cognitive development taking place within the zone of proximal development when adults present instruction just above the learner’s independent functioning level but not at a level that frustrates the learner. The zone gradually shifts upward as the learner masters new skills. In this manner, the learner and teacher gently pull and push each other in a student response–teacher reaction sequence that helps the learner climb to the next rung of the learning ladder. Thus cognitive development within the zone of proximal development involves continuously learning new skills, rather than arriving at a discrete new stage.

Neo-Piagetian Theory

Piaget's work continues to be challenged and refined. Neo-Piagetian theory, which originated in the 1960s, retains several of the ideas of the classic Piagetian system, extends some ideas, and alters others (R. Case, 1992). One contribution made by some neo-Piagetians has been to refine Piaget's concept of *vertical décalage.* Piaget used this term to describe how the sequence of substages at each level of development parallels the sequence of substages at other levels. Several theorists have developed this concept further, proposing that the same number of steps are completed at each major developmental stage, and that all steps are accomplished in the same sequence for each stage (Case, 1985; Fischer, 1980; Mounoud, 1986).

Another contribution made by neo-Piagetian theorists is that the "upper limit" of a child's cognition is influenced by the individual's maturational level and available working memory. Piaget left undeveloped the idea that specific biological factors play a large role in determining the upper limits of development. Similarly, many neo-Piagetians acknowledge that individual differences govern both the way in which children use their working memories and the way in which their thinking matures (R. Case, 1992; Lautrey, DeRibaupierre, & Rieben, 1987). Although these theorists have supported much of Piaget's work, others have questioned his ideas of cognitive development.

Summary

The greatest value of cognitive developmental theories for teachers is their ability to help us understand learning problems (Tharinger & Lambert, 1990). Piaget's, Gagné's, and Vygotsky's views enrich our developmental perspective on children's problems and provide a realistic context for them. For example, when a child is unable to master important academic or social tasks, you can use all of

these theories to pinpoint the developmental tasks that are necessary before the child *can* learn. The accompanying box, *Using Developmental Theories to Analyze Learning Problems,* poses specific questions to ask from each developmental perspective.

Language Development

Earlier in this chapter we described cognitive development as the learner's increasing ability to gain freedom from stimulus control through the use of mediation. We mentioned that one of the most important tools for mediation is language. Language development plays an important role in cognitive development because it provides the symbols and rules that help us think, problem solve, and be creative.

Allowing us to be better thinkers is not the only function that language development serves. Language helps learners regulate their own behavior. It also allows learners to communicate with others and thus negotiate what they want and need from their environment. Learners often find themselves in new and challenging situations in which they must be understood and, in turn, understand others in order to have their needs met. As language ability develops, learners become better able to communicate with a wide variety of listeners in a variety of social contexts.

In this section, we will discuss what teachers can do to enhance these three important functions of language: thinking, self-regulation, and communication. We will also describe what makes up language, and summarize the most important explanations for how it develops. Following this discussion, we will study the effects of bilingualism and nonstandard dialects on the development of language competence.

What Are Language and Language Development?

Language is more than just a collection of sounds. Linguists (Bloom, 1973) use the term *language* to refer to the following features of a communication system:

1. Language is a system of symbols. Words stand for things. Whether it is made up of particular combinations of sounds or gestures (as in sign language), a language system uses symbols to refer to people, places, events, and things. It is primarily these symbols, which children first begin to use between 8 and 12 months, that allow them to engage in symbolic thought when they are 18 to 24 months old.

2. Language is a system of rules. Words are used together in certain ways to produce meaningful phrases and sentences. We typically call these arrangements syntax or grammar. All speakers of any given language understand the rules, or grammar, of that language. This common grammar results in mutual understanding.

3. Language is generative or creative. Learners can create an infinite number of phrases, sentences, and expressions that enhance their ability to organize what they see, problem solve, and synthesize information to create original ways of interpreting their world.

Recall from Figure 2.1 that language development is characterized by the child's slow but steady learning of sounds, gestures, words, rules, sentences, and the generative or creative powers of language. In addition to learning sounds, symbols, and the rules of language, the child also learns the cultural rules for when and how to use them. This "know-how" knowledge is often referred to as **pragmatics,** or the practical side of language. Pragmatics includes knowledge of how to get someone's attention, how and when to change from formal to informal

speech, when to ask for certain things, and in general knowing how to be a good conversationalist.

How a Child Develops Language Competence

Language development occurs so gradually that we often take it for granted. Yet when we reflect seriously on the language development process, it is a wonder that it happens at all. Think for a moment about the difference between the informal language the toddler and preschooler hear on the playground and the language they eventually use in writing and speaking formally. We rarely, in normal conversation, speak to children in complete sentences, and we often use incorrect grammar. We often fail to complete our thoughts, and we add all sorts of qualifiers and parenthetical expressions to what we say. Pinker and Prince (1988) point out that the sounds, phrases, and sentences that children hear in no way allow them to infer the rules for speaking them. We do not teach children the rules of language in the same way we teach them rules for addition, subtraction, or classroom behavior. How, then, do children learn language?

There are two principal explanations for how we gradually acquire the sophisticated rules of language: learning theory, which emphasizes the role of reinforcement and imitation, and biological theory (called the nativist theory when applied to language development), which emphasizes the role of genetics. An interactionist perspective on language development that combines elements of both theories is currently gaining acceptance.

Learning Theory.

Behaviorists assert that learning language is simply a process of hearing sounds, imitating them, and being reinforced for doing so. When these sounds are incorrect, a listener (usually the parent), guides or prompts the child to make correct utterances. Grammatically correct language, then, is gradually shaped by listening to and being corrected by others.

There are some problems with this perspective. First, children spontaneously produce sentences they have never heard or had modeled for them—imagine, for example, a 3-year-old telling her mother that her dinosaur would like to have some spaghetti for lunch. Second, a lot of what children hear is grammatically incorrect, yet they eventually learn correct rules of grammar without feedback or reinforcement. Finally, some of the mistakes children make, such as saying "goed" for "went" or "runned" for "ran" are incorrect generalizations of rules they probably never heard in the first place. This final problem is what originally led to the nativist view of language development.

Nativist Theory. Noam Chomsky (1965, 1975, 1986, 1988), an influential linguistic scholar, proposes that humans are innately wired for language. He postulates that humans are born with a built-in **language acquisition device** (LAD). The LAD (which Chomsky now refers to as a universal grammar) is an innate neurological process that is programmed to pick up the regular features of any language the child is exposed to (whether Swahili, Farsi, French, or Mandarin). The particular language that learners hear is filtered through this system and coded or stored as rules. These rules are then passed on to the listener as his or her language. Figure 2.8 shows how this process works.

Linguists have posed challenges to Chomsky's perspective. For example, much of a toddler's initial language utterances follow no known grammatical rules. A 2-year-old is just as likely to say "cookie Daddy" as "Daddy cookie." Postulating a LAD that abstracts rules of language and passes them on to the child appears to ignore this phenomenon (Maratsos, 1983). In addition, language competence develops far more gradually and slowly than nativist theory would have us believe.

The Interactionist Perspective. Presently, linguists and developmental psychologists concerned with language development hypothesize that children are born with certain innate abilities that predispose them to acquire varying degrees of language competence (Bohannon & Warren-Leubecker, 1989). These abilities, when combined with an environment rich in language and other experiences, can result in learners with high degrees of language competence. In contrast, environments that offer the child little language stimulation and other enriching experiences may impede the development of language competence. Thus, the learning and nativist theories conjointly explain variations in how language develops.

How Teachers Can Promote Language Development

Earlier we said that language development enhances overall cognitive development by making children better thinkers and mediators, better communicators, and better regulators of their own cognitive and social behavior. Although your learners will have mastered most of the rules of language by the time they enter first grade, there are, nevertheless, significant teaching activities that can promote language development and enhance these three important outcomes. Let’s explore some of these language development strategies.

How Teachers Can Enhance Mediation. As we have discussed, language provides the symbols and rules that help us think. Consequently, the more precise, elaborate, and complex a child’s language expressions are, the more sophisticated will be her mediation or thinking abilities. Teachers can enhance mediation ability principally by promoting an expanded vocabulary and more complex syntactic development.

In elementary school, teachers can help their learners acquire new words and define words more precisely. This, in turn, will help learners see more clearly the relationships between words and concepts. For example, defining a bicycle as a means of transportation helps a child understand its relationship to a car, truck, or boat. These relationships would not be evident if a child's definition of *bicycle* were "something with wheels and a chain." Thus, teachers can promote both language development and cognitive development by helping learners understand the critical attributes of concepts like "bicycle," "shirt," and "cheese" rather than seeing them only in terms of their appearance or function.

In high school, mediation can be enhanced by helping learners understand both the literal and metaphorical meanings of words. For example, ask learners to explain the different ways in which a poet and an engineer might describe a bridge. What different meanings does the word then have? Such exercises help learners to think and reason in terms of metaphors and analogies and to see patterns and relationships in the world around them that may not be readily apparent.

How Teachers Can Enhance Communication. Children and adolescents must know how to use language to get what they want and need (*pragmatics*). One important example of pragmatics is knowing how to ask questions to get information. Many educators consider question-asking an important skill in cognitive development because it enables children to obtain important information as well as to regulate their own learning (Henderson & Swanson, 1977).

Researchers have found that teaching question-asking skills to school-age children results in increased participation in class discussions (Blank & Covington, 1965), in a better ability to get the teacher's attention when help is needed, and in

improved problem solving (Rosser & Nicholson, 1984). The accompanying box, *Teaching Question-Asking Skills*, gives an example of how to go about it.

In addition to teaching early elementary school learners the pragmatic skill of asking questions, teachers can model for them how to phrase expressions that make it more likely a request will be granted. For example, teachers can demonstrate how to phrase a request more politely when the first one didn't obtain the result intended. For junior high and high school learners, teachers can demonstrate the pragmatics of persuasion and argument to help learners become more successful debaters.

How Teachers Can Enhance Self-regulation. Language not only helps learners think and communicate; it also helps them control or monitor their own behavior. According to Vygotsky (1962), language helps children think about their own actions and plan what they will do. He views such *covert* or private speech as the foundation of all higher cognitive processes, including voluntary attention, planning, problem solving, and self-reflection.

You can improve learners' self-regulatory skills by pointing out the special demands of tasks, such as writing, problem solving in math, and even focusing on a task when the classroom has many distractions. You then can teach learners how to use private speech, either in the form of questions or assertive statements ("I can do this! I'll just follow the method I learned."), or to help themselves persist at their work, check their own progress, and praise themselves for a job well done.

How Does Learning Two Languages Affect Cognitive Development?

Nearly 3 million school-age children speak a language other than English at home (Berk, 1993). Many of these learners are considered to have limited English proficiency (LEP). Consequently, theoretical and practical questions are

continually being asked about whether LEP students should be exposed to two languages during their preschool and early elementary school years, whether bilingualism promotes or impedes language and cognitive development, and how children can best acquire a second language.

There are basically two ways for children to become bilingual: (1) by acquiring both languages simultaneously, or (2) by learning the second language after mastering the first. Research has shown that either method results in normal language competence in both the language used at home and in the second language (Reich, 1986). Thus, parents and teachers need not fear that bilingualism adversely affects language competence. Moreover, a growing body of research suggests that bilingualism promotes overall cognitive development. Research by Hakuta, Freidman, and Diaz (1987) indicates that bilingual children, in comparison with monolingual children, show superior performance on tests of analytical reasoning, concept formation, and cognitive flexibility. Other research shows that learners who are fluent in two or more languages have a better knowledge of language structure and detail, understand that words are arbitrary symbols for actions, and can better detect grammatical errors in written and spoken communication (Bialystok, 1986; Galambos & Goldin-Meadow, 1990).

Finally, on the issue of how best to teach a second language, there seem to be some clear trends. Table 2.4 describes five different types of bilingual programs, and Figure 2.9 demonstrates the emphasis each type places on the learner's native language. Neither submersion in the second language nor immersion programs have been found as effective as maintenance and transition programs for teaching English to nonnative speakers (Bee, 1995; Padilla et al., 1991; Willig, 1985). In both maintenance and transition programs, learners are instructed in basic skills in their native language during the first and second years of school but are also exposed to the second language in the same classroom. Both

languages are then maintained for several years before the child is expected to perform entirely in the second language in school.

Cognitive Development and Nonstandard English

All languages, including dialects and other forms of nonstandard English, are equally complex and equally capable of being used for cognitive mediation and problem solving (Dillard, 1972; Henderson, Swanson, & Zimmerman, 1974; Tharp, 1989). Linguists have demonstrated that languages cannot be ranked in terms of intellectual sophistication. Consequently, intellectual impairment or slow cognitive development cannot result from the primary language that a learner speaks, regardless of how nonstandard that language is.

In this chapter we studied how children grow and mature cognitively. With this cognitive development theory as background, we turn now to describing how children master important affective developmental tasks. In Chapter 3 we will see how learners acquire a healthy attitude about themselves, form successful relationships with peers and adults, and behave ethically and morally. We will also study how learners develop and improve self-esteem and learn prosocial behaviors through a process called social cognition.

Summing Up

This chapter introduced you to the growth and development of learners. Its main points were these:

- Developmental psychologists study changes that occur in the physical, social, language, and cognitive characteristics of learners at different ages. They describe changes in how children grow, think, speak, and relate to one another and attempt to explain these changes.

- Developmental psychologists typically are concerned with three fundamental questions about human growth: (1) Is there one road to development, or are there many unique paths? (2) Are the forces that influence learner development internal or environmentally determined? (3) Is development best characterized by sequential, cumulative, and hierarchical changes, or by stages, transition points, and developmental leaps?
- The nature/nurture question refers to whether development results from the unfolding of an inherited genetic makeup or from the experiences and environments we encounter.
- The principal contributions of the cognitive developmental theory of Piaget were the detail with which he observed children's developmental changes and his conception of qualitative (as opposed to quantitative) differences in how children of different ages think and problem solve.
- Schemata are developed under the guidance of two innate intellectual functions: organization and adaptation.
- According to Piaget, the lifelong process of cognitive development involves creating and enriching schemata by assimilating new but compatible knowledge or by altering them to include incompatible knowledge through the process of accommodation.
- Piaget proposes that every child passes through four distinct and qualitatively different stages: sensorimotor (ages 0–2), preoperational (ages 2–7), concrete operational (ages 7–11), and formal operational (ages 11–up).
- Gagné stated that the child becomes better able to think, reason, and problem solve as he or she gets older as a result of being taught increasingly complex learning hierarchies.
- The principal theme of Vygotsky's developmental theory is that a learner's cognitive development takes place in a social context.

- The zone of proximal development encompasses the range of skills or abilities bounded on one side by the skills the learner can do independently and on the other side by the skills that a learner needs adult assistance to perform.
- Three important functions of language are to provide (1) symbols and rules that help one think, problem solve, and be creative; (2) promote cognitive strategies, the exercise of self-control, and self-monitoring; and (3) provide the means by which one can obtain what is wanted and needed from the environment.
- Language is a communication tool that includes a system of symbols, a system of rules, and a generative (expandable) or creative function.
- The language acquisition device (LAD) is a neurological process programmed to code and store the rules of any language.

For Discussion and Practice

*1. How could your understanding of the nature/nurture question help you better explain a student's behavior?

2. Using some examples of your own, explain the difference between quantitative changes in behavior and qualitative changes. Which do you believe is the better explanation for how we change and develop?

*3. Describe two developmental changes in the behavior of children that led Piaget to believe that development was qualitative and progressed in stages.

*4. Describe what is meant by schemata, and provide an example at each of Piaget's four stages of development.

*5. Describe what is meant by organization and adaptation.

*6. Consider an area of content in your teaching field and describe how a learner would use the processes of organization and adaptation to acquire new information.

*7. Identify the primary accomplishments and limitations of Piaget's developmental stage theory.

*8. Vygotsky creates a different metaphor than Piaget to describe the context in which cognitive development takes place. What is his metaphor and how does it apply to the classroom?

*9. Identify the primary accomplishments of Vygotsky's theory of cognitive development.

*10. In your own words, how does Vygotsky's perspective on development differ from those of Piaget and Gagné?

*11. Describe the interactionist perspective, which combines the learning theory and nativist theory approaches to language acquisition. Give an example of how this broader perspective could account for some forms of language acquisition that cannot be explained by either the learning or the nativist approach alone.

*12. Using examples from your own teaching field, indicate different teaching strategies that could be used to (1) enhance your learners' mediation or thinking abilities and (2) encourage self-regulatory activities that would help your learners reflect on their own behavior.

*13. What are the differences between true bilingual instruction, total immersion, and English as a second language instruction?

Suggested Readings

Berns, Roberta M. (1993). *Child, family, community.* Fort Worth: Harcourt Brace Jovanovich. This is written for parents, teachers, and other professionals who routinely work with children. It is particularly strong in articulating the influence of family and community on children's development.

Cowan, P. A. (1978). *Piaget with feeling.* New York: Holt, Rinehart and Winston.

After reading Piaget himself, there is no better guide than this to appreciating his insight and imagination.

Pinker, S. S. (1994). *The language instinct.* New York: Morrow. A fascinating and

convincing account of the nativist view of language development, written by a disciple of Noam Chomsky. An extremely lively and readable introduction to developmental linguistics.

Schaffer, Davis R. (1993). *Developmental psychology* (3rd ed.). Pacific Grove, CA: Brooks Cole. This book provides a comprehensive overview of many of the most important aspects of child development. It is a particularly good source of information in the area of cognitive development.

Vygotsky, L. S. (1986). *Thought and language.* Cambridge, MA: MIT Press. Why

the Soviet Union suppressed publication of this book, we will never know! After making the effort to understand his ideas, you'll appreciate his current popularity.

Developmental theories. Theoretical approaches for explaining the process of human development. The four major theories are biological, learning, cognitive-developmental, and psychoanalytic.

Learners have many things in common with one another: a shared language, culture, and socioeconomic factors. They also have experienced unique child-rearing practices, family makeup, learning experiences, and special abilities.

Figure 2.1
Simultaneous developments from birth through adolescence.

How will developmental knowledge help me set appropriate expectations for my learners?

Nature/nurture question. A longstanding debate about the relative importance to development of genetic influences and environmental factors.

How will an understanding of my learners' problems affect my efforts to help them?

Children experience periods of relative calm followed by periods of physical and emotional upheaval as they grow into adulthood.

Developmental stage. A period of development during which a person’s physical, mental, or psychological functioning is different from the periods preceding and following it.

Can I expect my learners to continually improve their social and intellectual skills, or will they change by developmental leaps?

Table 2.1

Major Developmental Transitions

Age	Description
2 months	Change in brain function resulting from an increased number of connections between neurons results in increased social interaction with the infant's primary caretaker; manifested in smiling and cooing
7–9 months	Beginnings of separation anxiety and stranger anxiety; child can now move around independently and communicate meaningfully; may suddenly manifest fear of being put to bed alone
18–24 months	The beginning of the "terrible twos" as the child becomes increasingly willful and driven; important advances in language and cognitive development occur; the child can now maintain her attachment to parents merely by thinking about them
5–7 years	The beginnings of logical thought: the child can see the world from other people's perspectives
12 years	The major physiological and emotional changes that accompany puberty; augmented by increased cognitive and social demands
Teenage years	Negativism and resistance to change, similar to that experienced during the terrible twos; increased incidence of depression and low self-esteem; increased cognitive and social demands

Children are growing, thinking, feeling individuals. Various theories of development have arisen that try to explain and organize information about these developmental domains.

How will I know if my learners are developmentally ready for what I teach?

Clinical method. Research that studies a small group of subjects in everyday, natural settings.

Piaget believed that the primary stimulus to cognitive development comes from the child's own attempts to make sense of new experiences.

Figure 2.2
The computer and the newborn infant share some of the same characteristics of cognitive structures.

Schemata. Elaborate cognitive structures or networks made up of ideas and concepts that are used to interpret one's environment and guide behavior.

Behavioral schemata. Patterns of action or sequences of behavior that the child uses to explore and respond to objects in her environment.

Symbolic schemata. The mental representations of objects, events, and experiences without the need to perform some type of action on them.

Operational schemata. Mental operations performed on objects or events, the results of which lead to some logical outcome.

Organization. As a form of information processing, ordering and systematizing new information so that one can remember and use it efficiently.

Adaptation. As identified by Piaget, a central drive of humans to adapt to the world as they experience it.

Assimilation. Expanding or enriching cognitive structures with new information or perceptions.

Accommodation. Altering or adjusting cognitive structures affected by new information.

Equilibrium. The result of accommodation; the restoration of cognitive balance by altering cognitive structures to take into account new data.

Figure 2.3
Both assimilation and accommodation maintain or restore cognitive balance.

Sensorimotor stage. The first of Piaget's stages of cognitive development, characterized initially by only reflex actions but later by the learning of object permanence and the beginnings of internal cognitive mediation.

Mediation. Thinking that uses symbols to represent objects or events in one's environment.

Object permanence. The knowledge that objects that are not currently visible (such as a car that has passed) still exist. This knowledge typically develops when a child has reached 6 months.

Figure 2.4

Altering schemata to assimilate new but cognitively compatible knowledge (top) or altering schemata to include incompatible knowledge (bottom) and restore equilibrium.

Figure 2.5

Piaget's concept of stages of cognitive development at various chronological age ranges.

Preoperational stage. The second of Piaget's stages of cognitive development; characterized by egocentrism and the increasing ability to mediate, but with a continued dependence on immediate experience.

Table 2.2

Piaget's Stages of Cognitive Development

Stage	Approximate Age	Characteristics
Sensorimotor	0–2 years	Begins to make use of imitation, memory, and thought Begins to recognize that objects do not cease to exist when they are hidden Moves from reflex actions to goal-directed activity
Preoperational	2–7 years	Gradual language development and ability to think in symbolic form Able to think operations through logically in one direction

		Has difficulty seeing another person's point of view
Concrete operational	7–11 years	Able to solve concrete, hands-on problems in logical fashion Understands laws of conservation and able to classify and seriate Understands reversibility
Formal operational	11–15+years	Able to solve abstract problems in logical fashion Thinking becomes more scientific Develops concerns about social issues, identity

Source: Piaget's Theory of Cognitive Development, 3rd ed., by B. J. Wadsworth. New York: Longman Publishers USA. Copyright © 1984 by Longman Publishers USA. Reprinted with permission.

Laws of conservation. The understanding that changes in certain properties of an object (e.g., shape) do not change other properties of the object (e.g., mass).

What role does active involvement in classroom activities by my learners play in enhancing cognitive development?

Figure 2.6
Different ways of determining whether a child has acquired the concept of conservation.

Concrete operational stage. The third of Piaget's cognitive developmental stages, characterized by an understanding of the laws of conservation and a readiness to engage in other mental operations using concrete stimuli.

What adjustments must I make in the learning expectations and activities of my learners when they are in the concrete operational stage of cognitive development?

Table 2.3

Major Characteristics of the Concrete Operational Stage

Operation	Explanation	Example
Decentration	Concrete operational learners gain freedom from stimulus control: they can consider several features of a task rather than focus on only the one most obvious.	Ola recognizes that a change in one aspect of the grape drink (its depth) is compensated by a change in another aspect (its width).
Reversibility	Learners can mentally go through a series of steps to solve a problem and then reverse their thinking to return to the starting point.	Ola understands that if 7 baseball cards plus 8 new cards makes 15, then 15 minus 8 equals 7.
Conservation	Learners understand that objects remain the same in fundamental ways regardless of changes in shape or arrangement.	Ola sees a row of 10 green buttons and a row of 10 red buttons of equal length. If the spacing between the red buttons is increased so the row becomes longer, Ola realizes that there is still the same number of buttons.
Hierarchical classification	Learners can flexibly group and regroup objects into hierarchies of classes and subsets.	Ola sorts her baseball cards by team. Then she re-arranges them by position played.

Seriation	Learners use a plan to guide their arrangement of objects by height, weight, or age.	Ola weighs her rocks and arranges them in order lightest to heaviest. Then she rearranges them from from smallest to largest.
Transitive inference	Learners can seriate (arrange) objects mentally. After comparing A with B and B with C, they can infer the relationship between A and C.	Ola saw George's stack of baseball cards and noticed that he had more than she did. She now sees that Terry has fewer cards then she does. She tells Terry, "George has more cards than you."

Applying Your Knowledge:
Teaching Concrete-Operational Learners

Teaching Classroom Rules. Explain your classroom rules first by having learners role-play lining up properly to leave for lunch, demonstrate changing from one learning center to another, or model how to work and play with materials. Concrete operational learners will internalize rules most quickly if they actually perform the activities involved.

Teaching Values. Stage classroom minidramas to teach values to concrete operational learners. For example, have them role-play accepting of learners with disabilities, asking for permission before using someone's property, or the appropriate reaction when someone says something mean. Provide examples and demonstrations of appropriate actions *before* introducing the general principles from which they are derived.

Teaching Mathematical Concepts. Teach place value, or addition and subtraction facts, by having children work with manipulatives. For example, have them discover the answer to 8plus6 by performing the operation with beans or pasta shapes. Have the entire class collect acorns, then have them arrange all the acorns in groups of tens, the tens in groups of 100, and so on. Let the children see what 100 or 1,000 acorns looks like.

Formal operational stage. The fourth and final of Piaget's developmental stages, characterized by abstract thinking, logical reasoning, and other forms of higher-order conceptualization.

Hypothetico-deductive reasoning. The ability to pose hypotheses and draw conclusions from observations.

Approximately when can I expect most of my learners to be able to reason logically and abstractly?

Formal operational learners have complex thinking skills and can use learning strategies. This allows teachers to use learning techniques involving role-playing, debates, the design of experiments, and logical analysis to enhance their learners' cognitive development.

How will I know that my lessons include important facts, discriminations, concepts, rules, and strategies that the learner needs to master developmental tasks?

Culture and social relationships are major stimuli to cognitive development. According to Vygotsky, cognitive development is characterized by a learner's increasing mastery of important cultural tasks presented by adults and peers.

Have I met my learners' needs for sufficient conversation, public reasoning, shared problem solving, and cooperative projects?

Zone of proximal development. Vygotsky's metaphor describing the range of skills and abilities bounded by what a learner can do independently and what a learner needs adult assistance in performing.

Should most of my instruction be targeted below, at, or slightly above my learners' current level of skill?

Figure 2.7
The zone of proximal development is the zone that, if stimulated by you, will bring a learner's response to the next level of refinement.

Applying Your Knowledge:

Using Developmental Theories to Analyze Learning Problems

Ask the following questions when analyzing specific learning problems according to each theorist's view of development.

Piaget

- Does the child have the necessary schemata to learn the task he or she is given? Are the material and techniques appropriate for the child's developmental level?

- Is the learner just entering a particular developmental stage and therefore not yet able to perform the task? Am I assuming that the learner has attained certain knowledge, concepts, and rules that he or she may not have?
- Has the child had sufficient opportunity to explore the material and actively manipulate it both cognitively and physically? Is the child in the process of accommodating new experiences to past knowledge and therefore in need of time to acquire the necessary schemata?
- Are my expectations for the learner unrealistic, given his or her age and developmental history?
- Are the material and experiences too unfamiliar or irrelevant to the child's existing schemata and prior experiences to create the disequilibrium necessary for new learning to occur?

Gagné

- What assumptions have I made about what the learner already knows or can do before I begin instruction? Is there evidence from past performance that these assumptions are valid?
- Has the child received instruction in the necessary prerequisite skills?
- What cognitive demands or prerequisites are being placed on the learner by these instructional tasks?
- Do my lessons include important facts, discriminations, concepts, rules, or strategies that the learner will need in order to master subsequent tasks in the hierarchy?

Vygotsky

- Has my instruction been focused within the child's zone of proximal development? Is the child bored because he has already mastered these skills or frustrated because they are beyond what he can be expected to learn?

- Has the child's learning been too solitary? Have I met the learner's social learning needs by allowing for sufficient conversation, public reasoning, shared problem solving, and cooperative projects?
- Have I been expecting the learner to acquire knowledge that is incompatible with his or her culture? Do I use instructional methods that are culturally unfamiliar, irrelevant, or contradictory? (We will explore this issue in Chapter 15.)

Pragmatics. The cultural rules of language usage.

Language acquisition device. A built-in neurological device programmed to pick up the regular features of any language or communication.

Figure 2.8
The language acquisition device (LAD).

In what ways can I enhance the language development of my learners and improve their thinking ability?

How will learning to ask questions enhance my
learners' cognitive and language development?

Applying Your Knowledge:

Teaching Question-Asking Skills

Following is an example of how a teacher can promote question-asking skills in young children.

Margie: Laura and Norbert, look at this picture. Ask me some questions about it.

Laura: Why does the man look scared?

Margie: Good question! Because he's falling off his horse. Ask another question.

Norbert: How come he isn't using a saddle?

Margie: Good question! Because he likes riding bareback. Ask me another question.

Laura: What would happen if he falls into the cactus?

Margie: I like that question! The cactus spines would hurt him.

Source: Swanson & Henderson, 1977, pp. 349–350.

Table 2.4

Bilingual Programs

Type of Programs	**Description**
Maintenance	Help students become proficient in English while retaining and strengthening their native language. Used primarily at the elementary level, maintenance programs conduct most of the instruction in the learner's native language while maintaining close links with the child's home and non–English-speaking community. This approach usually requires large numbers of nonDEnglish learners within the school who speak the same native language and a teacher team with at least one bilingual member. Students enrolled in a maintenance program often move to a transitional program after a year or two.
Transitional	Aim to promote proficiency in English and use the student's first language as a vehicle for accomplishing this as quickly as possible. Unlike maintenance programs, transitional programs use the native language only as an aid for learning English. Transitional programs typically last two or three years, sometimes providing only a short time in which to prepare learners for the English-only classroom.

Immersion	Teach English by placing non–English-speaking learners in an English-only environment with a teacher who speaks the native language. The teacher uses the learner's native language only as an adjunct, when misunderstandings occur. Although this approach can help some learners rapidly acquire English, it can also create discontinuities between home and school, especially if the child no longer chooses to speak the native language in the home. In both immersion and submersion programs, the authority of non–English-speaking parents as significant others can be weakened.
Submersion	Place students in a classroom where only English is spoken and most students are native English speakers. Typically, the teacher makes little or no attempt to use the learner's native language as either an instructional or a communication tool. Because of the lack of engagement with the learner's native language, submersion programs can be the most disruptive to the learner's native culture and home life. They are used largely because they are among the least expensive for teaching the nonnative learner.
English as a Second Language (ESL)	Sometimes used in place of or in addition to bilingual programs at the later elementary and high school levels. Their primary focus is on remediating specific problems nonnative speakers have in learning English (for example, vocabulary, syntax, pronunciation) in the context of mostly English-only instruction. ESL classes do not teach English in the context of subject matter content, as do other types of programs, but instead are "pullout" programs, which remove learners from another class for one or more periods of the school day. The disadvantage is that students miss some instruction in the regular classroom or in another subject for part of the school day.

Questions marked with an asterisk are answered in the appendix.