EDUCATIONAL PSYCHOLOGY: A PROBLEM BASED APPROACH

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Elizabeth A. Jordan, University of British Columbia
Marion J Porath, University of British Columbia

0-205-35912-4 Exam Copy ISBN
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sample chapter 3

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In this chapter, contemporary theories of learning and cognitive development are presented. Each theory provides an approach that is useful in certain educational contexts. This chapter includes theories that are relevant to the practice of teaching. Teachers are accountable to parents, administrators, and school boards (Photo 3.1). Understanding why, as a teacher, you should base some instruction on one theoretical approach and some on another is essential in making informed professional decisions.
Piaget and the Cognitive Revolution

Contemporary theories of cognition owe their origins to the cognitive revolution of the 1970s, when a new discipline, cognitive science, began to describe the mechanisms of thinking in detail and search for explanations for how the mind works (Gardner, 1985; Larkin, 1994). Since the cognitive revolution, research in educational psychology has concerned itself to a much greater degree with how the mind works in real-world settings. Research came out of the lab and into schools and classrooms and addressed several variables:
This type of research related directly to the learner and the learning environment. Studies examined how the brain and mind function in a variety of circumstances, as well as in the social context of education.

**Critical Response to Piaget’s Theory of Development**

Piaget defined broad stages of development, each characterized by a certain type of thought. (These stages were described in Chapter 2.) According to Piaget (Photo 3.2), during each stage children were believed to master certain abilities as a result of constructing the type of thinking associated with the stage. During the concrete operational period, for example, children acquired logical operations such as class inclusion, one-to-one correspondence, and the conservation of number, weight, and volume. Piaget believed that each of these operations shared the same logical characteristics. He reasoned that competence in executing these operations stemmed from the emergence of a general capability—concrete operational thinking. In other words, once children entered a new stage, they became capable of doing the sort of thinking associated with this stage within a variety of contexts.

Piaget believed that a child makes a transition to a new stage when his or her current mental structures no longer explain events in their world. A state of disequilibrium results, and children are motivated to restore equilibrium in their thinking. That is, they construct a new way to conceptualize events, and thus they adjust their way of thinking to new circumstances (Case, 1985). This involves equilibration—balancing one’s thinking.

**Disequilibrium: A Turning Point** One author recounts the following story of Duncan, whom you met before when he had trouble understanding that Daisy could be the name of a flower as well as a dog’s name.

“At 4 years old, Duncan was the youngest of the group of eight boys in the neighborhood. They all tended to get along quite well, and Duncan was tolerated within the group, even though he was seen as a baby. When they all arrived in the kitchen wanting something to drink, I would get out my mismatched set of glasses and start pouring juice or milk. Part of the tradition that developed was the older boys singling out ‘Duncan’s glass.’ The glass was tall and narrow, while theirs were a bit shorter but wider. It was crucial to this group of boys that when I finished pouring juice all the levels be the same.

For the longest time, Duncan was quite pleased with this arrangement. He didn’t even notice that the boys laughed as they deliberately handed him ‘his glass.’ One day, however, Duncan became aware that something was going on around him, but he wasn’t sure exactly what. Shortly after this, he asked one of the older boys what they were laughing at. Ken replied, ‘Look stupid, you don’t have the same amount as we do because the glass is tall and skinny.’ Duncan stared at the glass for a long time as he worked to figure out what all of this meant.”

At this moment, Duncan’s understanding was being challenged within a social context. This was a turning point in his understanding of the world—what Piaget would call disequilibrium.
Achieving Equilibrium  The process of equilibration takes time because the
type of thinking involved is very broad—it provides the “big picture” of concep-
tual understanding—and because children must do their own reflection and con-
struction to achieve equilibrium. Consider the 5-year-olds in Paley’s (1986)
kindergarten classroom who wanted to measure a rug for a class play. The chil-
dren had a notion of how measurement worked and used their classmates as the
“units” with which to measure the rug. They found that repeated measurement
with children lying end to end did not always work. After much discussion, the
children concluded that their classmate Warren was just the right size for a “rug
measurer.” They resisted the teacher’s attempts to introduce formal units of
measurement.

*Teacher:* So this rug is ten rulers and two dolls long? (*Silence.*) Here’s
something we can do. We can use one of the rulers over
again, this way.

*Eddie:* Now you made another empty space.

*Teacher:* Eddie, you mentioned a tape measure before. I have one
here. (*We stretch the tape along the edge of the rug, and I show the
children that the rug is 156 inches long. The lesson is done. The next
day Warren is back in school.*)

*Wally:* Here’s Warren. Now we can really measure the rug.

*Teacher:* Didn’t we really measure the rug with the ruler?

*Wally:* Well, rulers aren’t really real, are they? (Paley, 1981, pp. 15–16)
While the children had acquired a fundamental idea, that units of measurement are needed, they were not yet “disequilibrated” enough to begin thinking about the formal conventions of measurement in our society. Their methods were appropriate to them and made far more sense than conventional approaches to measurement. This is a good example of why it is important for a teacher to understand children’s thinking. By about age 7, after experience with and reflection on situations in which measurement is important, the children will likely be ready to incorporate standard units of measurement into their thinking.

Adolescent Thinking: Becoming Specialists As children grow older and adopt social and cultural conformities (e.g., they want to look good in front of their peers or do what adults expect), these moments of disequilibrium become harder to spot. However, teachers often notice on school assignments how this lack of understanding is a drawback to learning the prescribed curricula. A grade 8 teacher was shaking her head and had no idea what to do with students who were having major problems drawing maps correctly. Some students just couldn’t get the spatial understanding necessary to place cities, mountains, and rivers in appropriate, proportionally correct alignment. This is an ideal example of the mismatch that often occurs when teachers are confronted with curricular topics that may not match the student’s level of cognitive development. The challenge for many teachers is to be sure they are cognizant of the level of thinking that the topic requires (e.g., concrete or abstract) and then adjust their teaching strategies in such a way that the students grasp the basic understanding necessary to accomplish classroom tasks. This is called *curriculum matching* and will be discussed in more detail later.

Strengths of Piaget’s Theory

Piaget’s theory was strong in that it emphasized several points:

- **Lower-order thinking contributes to more complex, or higher-order, thought.** So Wally and his classmates, in the preceding example, having experimented with and discussed the advantages and disadvantages of different ways of measuring things (lower-order thought), acquired an important foundation for more complex (higher-order) ways of thinking about measurement.

- **Development takes time.** Certain kinds of conceptual understanding can be achieved only once a child has constructed the kind of logical reasoning required for this understanding. Similarly, children can only profit from certain types of experiences once they are developmentally ready (Case, 1985).

- **The individual plays an active role in achieving understanding.** Thus, children do not simply receive knowledge from adults or older children in a way that necessarily makes sense to them; rather, their minds must be actively engaged with knowledge for it to be meaningful to them.

Building on Piaget’s Theory: A Neo-Piagetian Approach

As more research examined children’s acquisition of Piagetian thinking, a number of problems surfaced. Researchers found that the categories of abilities believed to be typical of a certain type of thinking actually bore little relationship to each other. Proficiency in concrete operational tasks such as conservation,
classification, and seriation was not necessarily achieved at the same time, as would have been expected given Piaget’s predictions. Children who scored well on one task might receive a low score on others.

All these developmental tasks were believed to depend on the broad capability of concrete operational thought—a child who could accomplish one task should have been able to accomplish the others. The inconsistency in the patterns of performance raised questions about Piaget’s theory.

**Staggered Skill Acquisition** Additionally, some children acquire particular abilities over a number of years, whereas Piaget believed that these abilities should emerge all at once. Researchers have shown that children grasp ideas about the conservation of number at about 6 years of age, but do not understand the conservation of liquid volume tasks until 7 or 8 years old or the conservation of weight tasks until the age of 9 or 10 (Case, 1985).

Studies also found that children could think in fairly complex ways at younger ages than Piaget had described. For example, Piaget showed preschool children a model of mountains, houses, and people and asked them to predict what someone would see from various places. They were unable to describe what someone would see from different vantage points. Piaget thus believed that preschoolers were incapable of perspective taking. Margaret Donaldson (1978), on the other hand, found that when teddy bears at a tea party were the context, preschoolers were quite capable of taking a perspective other than their own.

**Emphasis on Scientific Reasoning** Piaget also conceived of children as “little scientists” (Astington, 1993). The image evoked by Piaget was that of a child individually and consciously engaged in scientific experimentation by conducting intellectual experiments with little input from others. Piaget was interested in general patterns in the development of intelligence and knowledge—the “big picture” of thinking—rather than in how individuals are influenced by context (Ginsburg, 1997).

Similarly, the tasks Piaget devised to assess thinking reflected a scientific frame of reference. These tasks had an obvious link to science and mathematics instruction, but the implications for other areas of the curriculum were not so clear. Educational psychologists raised important questions (Photo 3.3):

- How does modeling thought processes in scientific and mathematical terms translate to understanding how children acquire the abilities to read, write, draw, understand their social worlds, and understand themselves?
- How do we explain development in those children whose logical–mathematical thinking is weak, but whose abilities in other areas are strong?

**Multiple Paths to Learning** Toward the end of his career, Piaget (1972) did consider that there might be other ways of developing intellectually than those that he had mapped out. He recognized that specialization in development that begins to take place in adolescence might mean that formal thinking takes different forms in different people. That is, an adolescent might be able to think in a hypothetical–deductive way for English class, but not necessarily in science.

The possibility of individualized paths of learning may help explain the rather discouraging finding that many adults do not acquire formal operational thinking, as measured by Piagetian tasks (Crain, 2000). In a number of studies, only half of the participating adolescents and young adults demonstrated formal thought (Larivée, Normandeau, & Parent, 2000). However, if opportunities are offered to demonstrate formal thinking in ways other than the logical–mathe-
matical mode and in ways that are gender sensitive, more learners are judged as able to think hypothetically (de Lisi & Staudt, 1980; Peskin, 1980). Early studies of Piagetian thinking foreshadowed research on cultural and gender differences in achievement, a topic we discuss in Chapter 6.

**Hypothetical Thinking**  Middle school teachers see clear evidence of students’ struggles to think hypothetically. Their students are in a transitional stage between concrete and formal thinking. Like the social studies teacher who wondered how to help students with map drawing, teachers of all subjects find transitions between concrete and formal thinking a challenge to their teaching and ingenuity.

Often students struggle, not quite understanding the material, as they work through assignments. From the concept of metaphors in English to understanding density in science, students are forced to think abstractly and hypothetically. These formal concepts are, at first, barriers to students’ thinking. One author remembers, “I once told a group of 10- and 11-year-olds to ‘pull up their socks’ when they were misbehaving. However, they all immediately did just what I’d asked—pulled up their socks. On another occasion, we had a guest speaker who mentioned that we all probably have ‘skeletons in our closets.’ The children looked extremely scared.” With time, equilibration, and opportunities to demonstrate their thinking in different ways, however, conceptual structures may be developed that allow students to move into the next stage (formal level) of thinking. Figure 3.1 shows eighth graders’ use of metaphors. It is apparent that the students are transitional in their understanding; there is a grasp of the concept, but it is usually expressed in fairly concrete ways.

**Postadolescent Stages of Development**  Piaget’s (1972) later thinking also included the possibility of development beyond adolescence, a possibility with obvious implications for postsecondary education. Contemporary researchers
have focused on the nature and course of development in adulthood, finding that thinking becomes more reflective as adults come to understand the complexity of many issues and the conditional nature of knowledge (see, e.g., Alexander & Langer, 1990; Arlin, 1989; Commons, Demick, & Goldberg, 1996). Further development in adulthood also has implications for secondary education. Just as elementary teachers think ahead to the kinds of demands their students will face in high school, so secondary teachers can think ahead to the demands their students will face in the worlds of postsecondary education, work, serious relationships, and child rearing.

Building on Piaget’s Theory: Neo-Piagetian Approaches to Development

Some psychologists and educators have left Piaget’s work behind entirely, while others maintain the view that development is stagelike and that there are characteristic ways of thinking associated with each stage. The latter group of theorists, in analyzing Piaget’s work, has evolved new ways of viewing developmental stages. Their work is known as neo-Piagetian (see, e.g., Case, 1992; Demetriou &...
Efklides, 1988; Fischer, 1980; Halford, 1993.) This work has built on the strengths of Piaget’s theory, drawing on contemporary educational psychological research in information processing and the social and cultural context of development.

Kurt Fischer and Robbie Case are two neo-Piagetian theorists whose work is relevant to understanding the ways in which children and adolescents think. Both theorists and their colleagues investigated the way children’s understanding developed over time and conducted their investigations in a broader context than that used by Piaget. Fundamental to their work, however, was the principle that stages of development build on each other, a distinctly Piagetian notion. Fischer and Case added to this notion more detailed analyses of how reasoning unfolds across levels of competence. They also informed these analyses by considering developmental contexts like experiences at home, level of education, and social and cultural factors.

**Fischer’s Roles and the Importance of Context**

Fischer, Hand, Watson, Van Parys, and Tucker (1984) studied how children of different ages acted out parental and occupational roles. Four-year-olds demonstrated a *behavioral role,* focusing on the actions typical of each role. This sort of role is evident in preschoolers’ play in the “house corner” or “dress-up center” in their classrooms as they imitate the actions of parents or story characters (Photo 3.4). Six-year-olds in Fischer et al.’s study acted out a “true role” in which internal motivation was considered, but limited to a single role. This level of understanding of role is evident in the following anecdotes.

**Six-Year-Olds  A Limited Understanding of Roles.** Todd arrived at the door of his first-grade classroom in tears, unable to understand how his mother could have taken a job. As far as he was concerned, she had a job already: she was his mother. How could she be his mother *and* a nurse? Vivian Paley (1981) noted the same

![PHOTO 3.4](image)

Young children typically focus on the behaviors that characterize a particular role.
sort of understanding in her kindergarten students when they decided that soaking beans overnight was the reason they didn’t grow. Overnight was too long and someone needed to be there, at school, to oversee the soaking.

The children preferred not to think of me or the beans in another place. I had soaked the beans in the classroom and that is where the beans—and I—belonged. The children could not envision my life away from school and had difficulty coordinating events in the classroom with those in my house. (p. 57)

Ten-Year-Olds An Understanding of Multiple Roles. In contrast, 10-year-olds display an understanding that one can have multiple interacting roles at once. A parent can be both a doctor and a Girl Scout leader at the same time, for example. In the school context, by the end of their elementary school experience, not only can children envision other roles for their teachers (Fischer et al., 1984), but they can also understand and appreciate that the teachers have lives outside school. One author remembers the day in sixth grade when her teacher, a Catholic nun, mentioned an incident that occurred when the Sister had been a child. “I distinctly remember coming to a complete ‘stop,’ with the clear understanding that this nun had been a child at one time. Looking back I think it had never entered my mind that this person had had a life outside the school and convent. To me, the nuns had always just been there.”

Case’s Substages of Development

Like Kurt Fischer, Case (1985, 1992) broke down the broad stages defined by Piaget into substages. Both Fischer and Case noted that children’s thinking changes incrementally during the periods of early childhood, middle childhood, and adolescence. Thus, while a broad descriptor of thinking characterizes each of these periods (much like Piaget described preoperational, concrete operational thinking, and formal operational thinking), within each stage notable changes take place.

In thinking about what motivates others to act the way they do, children between the ages of about 5 and 11 understand that other people have intentions (Case, 1996; Goldberg-Reitman, 1992). Their thought during this broad stage of development can be described as intentional (McKeough, 1992). However, there are noticeable differences between a 6-year-old’s and a 10-year-old’s intentional thinking.

- **Six-year-olds** simply coordinate an action and its underlying motivation (e.g., a peer hit someone because he was angry at having his ball taken away).
- **By 10 years of age**, children have a more general understanding of why people behave as they do. They can give more complex explanations involving two or more underlying motivations. For example, they might say that a peer hit someone because he was angry and frustrated and that people sometimes react like this when they are upset.

Knowing how an understanding of others develops can help teachers understand situations that arise on the playground or in learning groups. Children in the primary grades have a much more rudimentary understanding of others’ intentions than do upper elementary and middle school students. They need to be supported in acquiring more sophisticated knowledge of motivations for actions. (This topic is covered in more depth in Chapter 4.)
Comparison of Piagetian and Neo-Piagetian Theories

The examples just presented concern social cognition, or knowledge about the social world. They highlight important differences between Piaget’s work and that of neo-Piagetian theorists.

Piaget: Structure of the Whole  
Piaget believed in a structure d’ensemble (structure of the whole), a general structure of mind that influenced one’s thinking in a variety of contexts. As discussed earlier, once adolescents acquired the structure of the whole of formal operational thinking, they were believed to be able to apply this across subject areas.

Neo-Piagetians: Development of Multiple Structures  
Neo-Piagetians retained the idea of structure, but theorized that we develop a number of such structures. Case’s research group has investigated several of these (see Case, 1992; Case & Okamoto, 1996):

- Social understanding (including understanding of self and others)
- Mathematical understanding
- Scientific understanding
- Understanding of spatial relationships

So, rather than developing one way of thinking at each stage of development that shapes how we understand various aspects of our world, we develop along a number of different pathways, each with unique characteristics. This view of development has important educational implications.

- Children and adolescents differ from each other in their rates of development in mathematics, reading, science, and other areas of the school curriculum.
- Each child or adolescent also has his or her unique developmental profile. An adolescent may be much better at English than math, for example.

Table 3.1 summarizes the differences between Piagetian and neo-Piagetian views of development and the respective educational implications of these differences.

Educational Implications

Knowing the differences in conceptual understanding for various subject areas allows teachers to design meaningful learning experiences for their students.

A Conceptual Approach to Teaching

When we attempt to discover how our students understand key concepts, we can use what we learn to make meaningful links to the curriculum. For example, a student may possess social skills like taking turns and requesting permission to use classroom materials, yet still not have the conceptual understanding that “glues” these skills together. That is, in situations that require some understanding of others’ motivations, the student just doesn’t appear to get the concept that thoughts and actions are related, so he or she may not use social skills appropriately.

In planning instruction, keeping key conceptual understanding at the center of our thinking can help in unifying learning activities. It leads to education that consists of and results in meaningfully related knowledge, rather than isolated skills. Later in this chapter, we present more on this idea in a discussion of what
TABLE 3.1
Comparison of Piagetian and Neo-Piagetian Views of Development

<table>
<thead>
<tr>
<th>Age/stage relationship</th>
<th>Piagetian</th>
<th>Neo-Piagetian</th>
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<tbody>
<tr>
<td>Four broad stages—infancy, early childhood, middle childhood, adolescence</td>
<td>Four broad stages—infancy, early childhood, middle childhood, adolescence</td>
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<tr>
<th>Qualitatively different type of thinking at each stage</th>
<th>Neo-Piagetian</th>
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<tbody>
<tr>
<td>Broadly defined: Sensorimotor, preoperational, concrete operational, formal operational. Stage transitions not well explained.</td>
<td>Each stage broken down into substages and type of thinking described in detail. Transitions between stages described and explained.</td>
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<tr>
<th>Higher stages include and build on earlier stages</th>
<th>Neo-Piagetian</th>
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<tbody>
<tr>
<td>New stage of thought builds on and incorporates the type of thinking previously demonstrated.</td>
<td>Each stage and substage builds on and incorporates earlier forms of thought. This happens separately in different domains of thinking.</td>
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<tr>
<th>Effect of new stage of thought</th>
<th>Neo-Piagetian</th>
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<tbody>
<tr>
<td>New way of thinking applied to all situations (“structure of the whole”)</td>
<td>Different domains have independent developmental trajectories. Form of thought is parallel across domains, but content differs.</td>
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<th>View of the child</th>
<th>Neo-Piagetian</th>
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<tbody>
<tr>
<td>Child as scientist or logician</td>
<td>Child as user of cultural tools, processor of information, and problem solver</td>
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<tr>
<th>Recognition of individual differences</th>
<th>Neo-Piagetian</th>
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<tr>
<td>Little; more interest in universal forms of thought</td>
<td>Roles of experience, motivation, instructional support, socioeconomic status, and culture recognized. Inter- and intra-individual differences considered.</td>
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</tbody>
</table>

1Case (1985).

it means to be an expert at something. For now, let’s use the mental number line as an example of a core understanding.

**Development of Mathematical Understanding: The Number Line**

One important goal of education is to help children acquire mathematical understanding, or numeracy. Knowing how children’s conceptual understanding of mathematics develops is critical for planning appropriate instruction. Case (1992; Case & Okamoto, 1996) described the core feature of a mathematical structure as the “mental number line.”

Picture a numbered line in your head that allows you to understand that if you have 3 objects and someone gives you 4 more you have moved forward along the line to 7. Conversely, if you lose 2 of those objects, you move backward on the line.
to 5. The mental number line (Figure 3.2) captures concepts in mathematics that are critical to achievement in early mathematics curricula. The mental number line also helps children compare quantities and understand the nature of mathematical notation, in general, to develop number sense. If the mental number line is well understood in early childhood, children have a sound foundation on which to develop more complex, related understandings that also can be explained by the number line structure. These include rational numbers (fractions, percentages, and decimals) and functions (e.g., Kalchman & Case, 1998; Moss & Case, 1999).

If children enter school with no understanding of the mental number line, they are at risk of failure in mathematics (Griffin, Case, & Siegler, 1994). Unfortunately, many children of poverty enter school without this understanding (Case, Griffin, & Kelly, 1999). When children are given number line training by engaging in activities that develop their knowledge of the number line, they not only greatly improve in their number line knowledge, but also in their overall mathematics achievement (Griffin & Case, 1996). Children who engage in real-world “take-away” operations, such as counting backward for a pretend rocket blast-off, build a conceptual understanding of subtraction (Griffin & Case, 1996). Similar work that builds conceptual bridges for children and adolescents as they learn about rational numbers and functions results in mathematical knowledge that is well understood and applied fluently to a variety of problems (Kalchman & Case, 1998; Moss & Case, 1999).

Mathematics: Using a Conceptual Approach

Using children’s experiences with percentages, such as school marks, sales tax, and the number ribbon displayed when a computer file is being transferred, Joan Moss developed a curriculum for fractions, decimals, and percentages that used children’s prior knowledge, experience, and conceptual understanding (Moss & Case, 1999). Rather than simply covering the curriculum as presented in the textbook, Moss uncovered children’s conceptual understanding.

Elementary mathematics curriculum generally presents fractions first, followed by decimals and percentages. Children have meaningful experiences with percentages, but not fractions and decimals (Moss & Case, 1999). Therefore, children learned percentages first; then their understanding of percentage is used as a basis for teaching decimals and fractions. The following example illustrates the effectiveness of a conceptual approach to teaching rational numbers.

In response to the question, “Another student told me that 7 is 3/4 of 10. Is it?” a child who was taught using the conceptual approach answered, “No, because one half of 10 is 5. One half of 5 is 2 1/2. So if you add 2 1/2 to 5, that would be 7 1/2. So 7 1/2 is 3/4 of 10, not 7.”
In contrast, a child taught using textbook exercises responded, “No... 7 is not right because it is an odd number so 6 would be right.” Notice the quality and the depth of the first response; it reflects a conceptual understanding of elementary mathematics.

In some instances, teachers are challenged to understand the way children “have concepts.” Emma, a third-grade teacher, struggled to understand the nature of the problems one of her students, Sammy, was having in math. Her attempts to match curriculum and instruction to his way of understanding were not succeeding (see Problem-Based Scenario 3.1).

Fostering Expertise

Another useful framework for thinking about how knowledge of development translates to practical educational considerations is the novice–expert distinction. Research in this tradition shares certain characteristics with contemporary developmental theory:
Novices have simpler knowledge structures than those of experts, which are complex (Bereiter & Scardamalia, 1986). Novices not only have less information to work with than experts, but they tend to have this information “in pieces” (diSessa, 1988).

Experts have integrated, cohesive knowledge. Because experts’ knowledge is well organized, they acquire and remember new knowledge effectively. New knowledge is also retrieved and used efficiently (Spoehr, 1994).

Using a Novice–Expert Framework

Applied research done within the novice–expert framework shows that if we teach only skills we create more proficient novices (Bereiter & Scardamalia, 1986), rather than experts who understand at a meaningful, conceptual level. In fact, a focus on skills alone can lead to cumulative deficits in achievement, because children never get the chance to understand and appreciate underlying concepts (Griffin et al., 1994; Meichenbaum & Biemiller, 1998). Novices say things like “I don’t get it” and “I’m stuck” or ask questions like “Can you show me how to do this?” These comments and questions indicate that they have only a superficial understanding of what they are learning. Even this superficial understanding may be partial at best. Experts, on the other hand, ask questions such as “I’ve done problems like this before and I think I’m going wrong here. Could you have a look and give me a clue?”

This is not to say that skills are unimportant. Rather, without a conceptual support for skills, knowledge remains fragmented. One author calls this an educational overlay. That is, it is a set of skills learned at school that never gets incorporated into our thinking in a meaningful way. All of us have educational overlays that were often learned for tests and then quickly discarded or forgotten. The reason they were discarded was that they had no meaning.

Meichenbaum and Biemiller (1998) noted additional important differences between experts and novices:

- A degree of familiarity with the situation and motivation. Experts do best in familiar situations because they process information efficiently (Meichenbaum & Biemiller, 1998).

These differences also are important from the point of view of instruction. Children need to be helped and supported to be interested expert learners (Bereiter & Scardamalia, 1986). The discussion of the importance of a supportive learning environment and the motivation to learn is continued in Chapters 8 and 9.

Conceptual Bridging

Conceptual bridging is an instructional approach that teaches both skills and conceptual understanding (Griffin et al., 1994; McKeough, 1992). This approach includes activities that are based on understanding children’s conceptual development in a domain and the sequence of this development. By knowing children’s current level of conceptual understanding and the next step in the developmental sequence, a conceptual bridge can be built between these levels of understanding.

This approach requires analysis of the material to be learned, in addition to honoring learner’s ways of understanding. For example, Moss and Case (1999) taught rational numbers to fourth-graders in reverse order to the traditional
textbook presentation (percentages, decimals, fractions, rather than fractions, decimals, percentages) based on the following analysis:

- Children have intuitions about proportions and numbers to 100 by the fourth grade. Beginning with percentages rather than fractions allows them to coordinate these intuitions.
- Children are familiar with number ribbons on computers that show percentages.
- Comparison of ratios with different denominators, a complex and unfamiliar task, is postponed until children have had the opportunity to develop their own ways of calculating and comparing.
- It is easier to compute fractional or decimal equivalents for percentages than to do the opposite. Beginning with percentages allows a solid foundation for understanding the equivalence of rational numbers.
- Children have experience with percentages (e.g., sales tax, price reductions).

(Moss & Case, 1999)

Using Students’ Intuitive Knowledge

Hunt and Minstrell (1994) described an approach to teaching introductory high school physics that takes students’ intuitive knowledge of the natural world as the starting point. “We see instruction as fostering reconstruction of understanding and reasoning, rather than as the memorization of correct procedures and answers” (Hunt & Minstrell, p. 56). Hunt and Minstrell incorporated a number of constructivist principles into their instruction:

- Honoring students’ understandings as starting points for instruction
- Bridging the gap between “students’ physics” and “scientists’ physics” (p. 51)
- Teaching as conversation, that is, talking to students about their ideas and using these ideas as points of departure for instruction or opportunities to consolidate their understanding

Teachers can have conversations with their students that will lead to better understanding of how students think, as well as to instruction that is more appropriately matched to students’ needs (Arlin, 1990) (Photo 3.5). Think back
to the group of kindergarteners who could only measure a rug when Warren was at school (Paley, 1986). When her attempts to introduce formal measurement failed, their teacher had conversations with the children to help her understand their conceptions of measurement. Similarly, rather than just teaching her students how to compute averages, a fifth-grade teacher probed their understanding of averages, starting with the question “What is an average anyway?” (Arlin, p. 83). The students’ responses allowed her to see their misconceptions and to engage them in discussion about the concept. She did not correct misconceptions, but instead had the children experiment to test their ideas. This approach allows children to develop a solid understanding of concepts and become intellectually autonomous (Kamii; as cited in Arlin).

In another example, an eighth-grade science class was studying the Earth’s rotation. It was a windy day, and one of the students commented, “You can really see it spinning today.” This comment could be viewed as funny or completely lacking in understanding. Instead we can view it as a starting point for instruction—showing respect for the student’s thinking and also optimizing the chances for successfully moving the student to a more sophisticated level of understanding. Some guidelines for “listening to what the children say” (Paley, 1986) in conversations about academic subjects and social relationships are summarized in Figure 3.5.

The guidelines in Figure 3.5 may also help you think about how you would approach the situations presented in Problem-Based Scenarios 3.2 and 3.3. Both situations are highly emotional and culturally influenced. The scenarios also present situations that are rarely discussed in teacher education. They require thoughtful consideration not only of children’s points of view, but also of your own ideas and beliefs.
Problem-Based Scenario 3.2

Student: Sara
Teacher: Greg

It was 8:30 in the morning and Greg Norris had been at school since 7 organizing the day. Marked exercise books were in their slots, the kids’ artwork was framed and ready to hang, science materials were set up for the afternoon, and test booklets and answer sheets were all set for the district assessment scheduled for the morning. All fourth-graders were taking a reading achievement test this year as part of a district literacy initiative.

A soft tap on the door interrupted Greg’s thoughts about how his pupils would cope with the unfamiliar process of lengthy group testing. Anna O’Neill, teacher librarian at Mountainview Elementary, approached his desk. She was obviously very upset.

“Greg, Toni Desrosiers just came in to tell me she wouldn’t be able to help out in the library for awhile. Sara was with her. Greg, I can’t believe it. Sara just told me her daddy died last night. Toni said it was a heart attack. Sara won’t be back in school until next week.”

Greg sat in a state of shock. What a terrible thing for Sara and her mom. What could he do to support Sara? What should he do? How should he break the news to Sara’s classmates? He had never had to deal with death in his 7 years of teaching or, for that matter, in his own life.

Apply

■ What do theories of cognitive development tell you about how Sara may understand death?
■ How is the concept of a “community of learners” relevant to supporting Sara?
■ You decide to write your ideas about breaking the news to Sara’s classmates and show them to a senior colleague. What will you write and how will you justify it to your colleague?

Problem-Based Scenario 3.3

Student: Alice
Teacher: Ruth

Driving along and hearing the news broadcast about the TV star who had committed suicide last night, Ruth knew that there would be problems today in school. Alice was a ninth-grade student who adored this star. Her entire locker was covered in pictures and memorabilia. Every episode of the show was taped and replayed continuously. It was the kind of adoration Ruth remembered seeing on old tapes of Elvis Presley shows.

Walking down the hall toward her room, Ruth encountered Mary Winters, who taught in the room next to hers. Mary told Ruth she had just had a talk with “that foolish girl, Alice,” who was “sitting in the corner crying.” Mary said, “I just told her, it’s a movie star, get up and go to your class.” As Mary waved her hand in Alice’s direction, she said “Anyway, she didn’t react—maybe you can get her to move.” With that Mary walked to her room.

Ruth just stood there. Alice was sitting in the corner by the lockers, curled in a fetal position, sobbing. A couple of girls were standing near Alice, but they didn’t seem to know what to do either. Ruth could hear Alice telling the girls that this person didn’t have to commit suicide. If he had come to her, she would have loved him. It was affecting the whole group of girls. Now that additional damage had been done and the bell was about to ring, what would she do with Alice? And what about the other girls? And Mary!?

Apply

■ What should Ruth do to help Alice?
■ Should Ruth use the same approach to support the other girls?
■ What should Ruth do about Mary’s reaction to Alice?
Concept Mapping

The examples of developmentally based instruction just given are from mathematics and science, subjects in which the developmental progression of fundamental concepts is relatively clear. Spoehr (1994) noted that conceptual organization in the humanities is less clear. Rather than make reference to universal laws, as in science and mathematics, teachers can help students search for patterns of knowledge and foster “discrimination and informed judgment about the relationships between parts of the knowledge base” (p. 79).

One example of fostering this type of thinking is through concept mapping (Figure 3.6). For example, students might read a number of poems written in the 1960s and look for common themes and modes of expression. In the humanities, the “conceptual neighborhood” (Spoehr) is a useful way of defining central conceptual knowledge.

Teachers often engage their students in webbing or mapping to help them reflect on key concepts and construct their own organizing frameworks. Brownlie, Close, and Wingren (1990) provided helpful guidelines for teachers to use in supporting students to map concepts (Table 3.2):

- Read examples of visually based text to the students. For example, Brownlie et al. used an image from a sixth-grade science text: “See the tarantula . . . Feel the fangs . . . exoskeleton . . . Notice the stinger . . . punctured abdomen . . . See the female . . . large . . . The male is lighter . . .” (p. 91).
- Have the students then write down their thoughts about the topic.
- Once their thoughts are in writing, have them use this text to create a map of the concepts.

The central objective of developmentally based instruction is “tuning the learning environment to the knowledge to be conveyed as well as to the learning capabilities of the students” (Larkin, 1994, p. xii). In accomplishing this objective,
you achieve an “optimal match” between school and the learners’ minds (Donaldson, 1979).

Implicit in the developmentally based approaches discussed in this chapter is the important role of the learning environment and how it is matched to learners’ capabilities. The sociocultural approach to learning and development offers a theoretical perspective that assigns primary importance to the environment. This perspective has its roots in the work of Vygotsky (see Chapter 2). A central tenet is that social interaction is a critical component in learning.

### Sociocultural Psychology and Education

The sociocultural approach to development, like cognitive psychology, is a product of the 1970s revolution in the study of cognitive development (Gauvain, 2001). The approach evolved because the social and cultural context of cognitive development was perceived to be missing in previous accounts of intellectual development. Piaget’s work, particularly, was criticized as focusing too much on individuals and not enough on the environment in which they developed.

Research in non-Western cultures (e.g., Cole, Gay, Glick, & Sharp, 1971) and the writings of Vygotsky were influential in highlighting the roles of social and cultural contexts in development and learning (Gauvain, 2000). (see Info Byte 3.1). Sociocultural psychologists believe that structures of mind are first constructed socially and then reconstructed by the individual (Scardamalia, Bereiter, & Lamon, 1994). In contrast, Piaget emphasized the role of individual mental activity in constructing knowledge.

### Socially Shared Cognition

As discussed in Chapter 2, an important concept in Vygotsky’s theory is the zone of proximal development. Starting from the child’s or adolescent’s level of  

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**TABLE 3.2**

<table>
<thead>
<tr>
<th>Guidelines for Concept Mapping</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Read an image created from an experience, text, or topic sequence.</td>
</tr>
<tr>
<td>2. Talk to a partner about how it felt being “in the topic.”</td>
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<tr>
<td>3. Exchange impressions with the entire class.</td>
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<tr>
<td>4. Write for five minutes to show, not tell, what has been learned.</td>
</tr>
<tr>
<td>5. Listen to drafts and build criteria for effective writing.</td>
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<tr>
<td>6. List the “big ideas” of the text.</td>
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<tr>
<td>7. Choose two important ideas to begin the concept map.</td>
</tr>
<tr>
<td>8. Link these ideas with a word that shows the context of the text, the connection between the ideas, and/or an application of the information.</td>
</tr>
<tr>
<td>9. Map and link the “big ideas,” crossing out the ideas used as they are connected into the map.</td>
</tr>
<tr>
<td>10. Make cross-links between words.</td>
</tr>
<tr>
<td>11. Work with a partner or individually to list “big ideas” and to create a concept map.</td>
</tr>
</tbody>
</table>

*Source: Based on Brownlie, Close, and Wingren, 1990, p. 99.*
understanding, the emphasis is on how far the individual can progress with assistance. Taking a dynamic view of development, Vygotsky emphasized the role of the culture, particularly that of adults and capable peers, and the tools used in the culture in shaping knowledge. Current applications of Vygotsky's perspective focus on socially shared cognition. This focus is evident in Brown and Campione's (1994) approach to education.

**Distributed Expertise in Communities of Learners** The social nature of learning takes the form of distributed expertise. Children become experts in an area, and their knowledge is then combined with others' knowledge to make a whole. They teach their material to others and prepare questions for a test that all will take. “The essence of teamwork is pooling varieties of expertise” (Brown & Campione, 1994, p. 235).

**Zones of Proximal Development** Brown and Campione conceived of the classroom as composed of “multiple zones of proximal development through which participants can navigate via different routes and at different rates” (p. 236) (Photo 3.6). Scaffolding learning through a zone of proximal development can be accomplished through interactions with adults and children, “but it can also include artifacts such as books, videos, wall displays, scientific equipment, and a computer environment intended to support intentional learning” (Brown & Campione, 1994, p. 236).

**Incorporating Individual Variation** In a community of learners, children learn from adults and other children; adults also learn from children. Students’ questions and prior knowledge give meaning to curriculum. For example, fifth- and sixth-graders were asked the following questions about a unit in biology: Do large amounts of DDT depress immune function? If a human has malaria, can it be transmitted? Can a baby get it inside the body [of its mother]? (Brown & Campione, 1994, p. 242). These questions informed the design of the biology unit.

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**Info Byte 3.1**

As we combine words to describe complex ideas, such as combining social and cultural into sociocultural, it helps us to clearly understand the individual terms. Society (“socio”) refers to people, in general, living within a community. This community can consist of many layers that may be seen as divisions within the larger group. For example, we often hear about socioeconomic status. This term refers to societal layers that have been divided on economic, educational, and/or occupational characteristics. Culture refers to behaviors and beliefs that are passed down from one generation to the next within a group of people. Culture can transcend the layers often found within a society. In societies where there are many different cultures, celebrations are enjoyed by people who are not originally from a specific culture. A local newspaper published a picture of people lining the streets for the traditional Dragon Dance celebrating Chinese New Year. The smiling faces in the picture reflected a number of different races and ethnic backgrounds. Thus, the term sociocultural is meant to reflect the combined community in which learners live. It is the larger, multiethnic, and diverse community that shares many traditions and ideas.

**PHOTO 3.6**

Different opportunities for learning allow individual students to master concepts at their own pace, within their own zone of proximal development.
For teachers, distributed expertise can be seen as a creative opportunity to design effective classroom experiences that challenge all the students. Even when students appear to have similar capabilities, there may be individual variations that require an inventive lesson design and classroom organization. Consider Tim’s experience as presented in Problem-Based Scenario 3.4.

**Socially Meaningful Activities**

The sociocultural approach focuses on “socially meaningful educational activities” (Moll, 1990, p. 8) that emphasize the underlying meaning of an educational

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**Problem-Based Scenario 3.4**

**Student:** Harry  
**Teacher:** Tim

Tim sat down in the staff room to eat his lunch and grab a welcome cup of fresh coffee, a treat since most of the coffee sat for long periods of time. He had picked up the papers from his mailbox and used this quiet time to sort through the barrage of memos. It was the one from Marie, the school counselor, that caused him to stop and think. How was he going to run his tenth-grade history class now?

**Apply**

- How should Tim accommodate Harry’s learning disability in his history class?

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FIGURE 3.7

Figure 3.8 appears on page 96.
activity (e.g., literacy as the comprehension and communication of meaning) (Moll). The sociocultural perspective makes a critical and important distinction between basic skills and basic activity (Cole & Griffin, as cited in Moll). Basic activity concerns a much deeper level of meaning than basic skills. This distinction is similar to the novice–expert distinction discussed earlier.

Central Role of the Learner Along with the constructivist approach outlined in this text, educational applications of sociocultural theory emphasize the central role of the learner. In a school community in Salt Lake City, children, parents, and teachers collaborate in planning educational activities (Rogoff, Bartlett, & Turkanis, 2001). That is, learning is a natural extension into the community, not something that only happens in a school with a teacher. Moreover, mutual learning takes place; children, parents, and teachers all learn from each other.

Community of Learners Rogoff et al. (2001) emphasize, though, that a community of learners is more than “a collection of people who are learning” (p. 9):

In our sense, “community” involves relationships among people based on common endeavors—trying to accomplish some things together—with some stability of involvement and attention to the ways that members relate to each other. In other words, a community of learners develops “cultural” practices and traditions that transcend the particular individuals involved, such as expected ways of handling conflicts and interpersonal issues and crises, as well as traditions for celebrating turning points and successes. (Rogoff et al., 2001, p. 10)

For a community of learners to function effectively, there must be mutual understanding among all participants in education—teachers, students, and parents. Tim, the grade 10 teacher you met previously, deliberated the complexities of establishing shared meaning after receiving feedback from parents about his efforts to incorporate distributed expertise in his classroom. This follow-up to Tim’s initiatives is presented in Problem-Based Scenario 3.5.

Problem-Based Scenario 3.5

Student: Tim
Teacher: Harry

Tim closed the door of his car with a sigh. It had been a long day, extending into Parent’s Night. He was finally headed home at 10 P.M., but with more questions than answers. Earlier in the term he had changed around some of his teaching techniques to accommodate Harry, who had a learning disability, and two other students with learning problems. Tim had been feeling pretty proud of himself. Harry’s grades and participation had improved, along with the two other students, and the class seemed to be moving along well. But tonight several parents spoke to him regarding what they saw as a “watering down” of the curriculum. This had taken him by surprise. The parents were concerned that the students were not learning the kinds of skills and background
In this chapter, you saw how theories grew and changed as our knowledge of development, behavior, teaching, and learning became more sophisticated. You also saw how many theories are used to explain the complex process of development. No one theoretical perspective can explain the complexity of human development and learning. Rather, as teachers, you need to understand a variety of theories so that you can make informed educational decisions about each student’s needs.

- Neo-Piagetian theory describes the central conceptual understandings that are important for school success. For example, children’s understanding of others’ roles and the number line are critical to their broader understanding of social roles and relationships and concepts learned in elementary mathematics.

- Both conceptual understanding of a subject and related skills are necessary for expert understanding.

- Conversations with students can help you understand their perspectives on different concepts. These perspectives provide a valuable foundation for designing your instructional approaches.

- Classrooms described as communities of learners pool individual expertise to create learning environments where adults and children learn from each other and the artifacts of their culture. Meaningful educational activities are stressed.
A Metacognitive Challenge

You should now be able to reflect on the following questions:

- What do I know about children’s thinking and how it develops?
- What do I know about adolescents’ thinking and how it develops?
- What do I know about the social context of learning?
- How do my knowledge of thinking and the social context of learning help me to teach the learners in my classroom?
Artifacts for Problem-Based Scenarios

FIGURE 3.3 ■ Sammy’s Math Worksheet
Hi Emma,

Sorry to have missed you after school today. I dropped by to talk to you about Sammy. You know what a struggle it's been to make a breakthrough in math. It continues to be, but I just had to tell you that we did some activities in the resource room today - making change, etc. in a "play store" context. Sammy was an absolute star. As far as planning how much to spend and figuring out change, he really knows his stuff. I'll try to catch you in the next couple of days. We should talk about this!!

Jack

***************************************************
Jack Blythe
Resource Room Teacher
White Plains Elementary

From: jblythe@sd10.whiteplains.ks.us (Jack Blythe)
To: Emma Anderson eandersen@sd10.whiteplains.ks.us
Subject: Sammy
Date: Tuesday, October 25, 2001
FIGURE 3.8 ■ Artifact for Problem-Based Scenario 3.4

<table>
<thead>
<tr>
<th>MEMORANDUM</th>
</tr>
</thead>
</table>
| To: Tim Roland  
From: Marie Howe  
Re: Harold Williams |

Tim,

I just got the results back from some testing done on Harry. You should know that there seems to be a language processing difficulty that is causing most of Harry’s academic problems. He has a very hard time processing oral language. This means that it takes a lot of his energy to understand what is being said to him in a structured situation, like a classroom. He has few difficulties in social situations, so that isn't any problem. Since this is considered a Learning Disability we will be giving him extra help in the Resource Room. What this means in the classroom is not to expect him to be able to listen to lecture material and take notes at the same time.

I will get back to you later with more details.

Marie

P.S. Would you mind sitting on a School-Based Team?