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CHAPTER NINE

Grouping, Differentiation, and Technology

CHAPTER OUTLINE

LEARNING OUTCOMES

At the end of this chapter, you should be able to:

- **9.1** Describe different types of grouping used to accommodate achievement differences
- **9.2** List several ways to differentiate instruction for diverse learners
- **9.3** Identify types of programs for students placed at risk of academic difficulties
- **9.4** Describe how technology can be used effectively in education
- **9.5** Describe how grouping, differentiation, and technology influence intentional teaching

CHAPTER OUTLINE (CONTINUED)

Mr. Arbuthnot is in fine form. He is presenting a lesson on long division to his fourth-grade class and feels that he's never been so clear, so interesting, and so well organized. When he asks questions, several students raise their hands; when he calls on them, they always know the answers. "Arbuthnot, old boy," he says to himself, "I think you're really getting to these kids!"

At the end of the period he passes out a short quiz to see how well his students have learned the long-division lesson. When the papers are scored, he finds, to his shock and disappointment, that only about a third of the class got every problem right. Another third missed every problem; the remaining students fell somewhere in between. "What went wrong?" he thinks. "Well, no matter, I'll set the situation right in tomorrow's lesson."

The next day, Mr. Arbuthnot is even better prepared, uses vivid examples and diagrams to show how to do long division, and gives an active, exciting lesson. He uses an interactive whiteboard to illustrate the key concepts. Even more hands than before go up when he asks questions, and the answers are usually correct. However, some of the students are beginning to look bored, particularly those who got perfect papers on the quiz and those who got none right.

Toward the end of the period, he gives another brief quiz. The scores are better this time, but there is still a group of students who got none of the problems correct. He is crestfallen. "I had them in the palm of my hand," he thinks. "How could they fail to learn?"

To try to find out what went wrong, Mr. Arbuthnot goes over the quiz papers of the students who missed all the problems. He immediately sees a pattern. By the second lesson, almost all students were proceeding correctly in setting up the long-division problems. However, some were making consistent errors in subtraction. Others had apparently forgotten their multiplication facts. Their problems were not with division at all; the students simply lacked the prerequisite skills.

"Well," thinks Mr. Arbuthnot, "at least I was doing great with some of the kids." It occurs to him that one of the students who got a perfect paper after the first lesson might be able to give him some idea how to teach the others better. He asks Teresa how she grasped long division so quickly.

"It was easy, "she says. "We learned long division last year!"

USING YOUR EXPERIENCE

CRITICAL THINKING List all of the ways in which Mr. Arbuthnot could be more effective in addressing student individual differences. Then list all of the ways in which he is effective in addressing student needs.

COOPERATIVE LEARNING Work with a group of four or five classmates. Pass a sheet of paper around the group, and ask each member to write down an idea to help Mr. Arbuthnot become more effective in addressing students' needs. After one idea is added, the sheet is passed to the next person in the group, who adds an idea and passes the sheet along, and so on. Share some of these ideas with the class.

WHAT ARE ELEMENTS OF EFFECTIVE INSTRUCTION BEYOND A GOOD LESSON?

InTASC 2
Learning Differences

InTASC 3
Learning Environments

InTASC 5
Application of Content

InTASC 7
Planning for Instruction

InTASC 8
Instructional Strategies

As Mr. Arbuthnot learned to his chagrin, effective instruction takes a lot more than good lectures. He gave a great lesson on long division, yet it was appropriate for only some of the students: those who had the needed prerequisites but had not already learned long division. To make his lesson effective for all of the students, he needed to adapt it to meet their diverse needs. Furthermore, the best lesson in the world won't work if students are not motivated to learn it or if inadequate time is allotted to enable all students to learn.

If high-quality lectures were all that mattered in effective instruction, we could probably just find the best lecturers in the world, record their lessons, and show the videos to students. But if you think about why video lessons would not work very well by themselves, you will realize how much more is involved in effective instruction than simply giving good lectures. First, the video teacher would have no idea what students already knew. A particular lesson might be too advanced or too easy for a particular group of students. Second, some students might be learning the lesson quite well, whereas others would be missing key concepts and falling behind. The video teacher would have no way of knowing which students needed additional help and, in any case, would have no way of providing it. There would be no way to question students to find out whether they were getting the main points and then to reteach any concept they had missed. Third, the video teacher would have no way of motivating students to pay attention to the lesson or to really try to learn it. If students failed to pay attention or misbehaved, the video teacher could not do anything about it. Finally, the video teacher would never know, at the end of a lesson, whether students had actually learned the main concepts or skills.

This analysis of video teaching illustrates why you must be concerned with many elements of instruction in addition to the presentation of information. You must know how to adapt your instruction to the students' levels of knowledge. You must motivate students to learn, manage student behavior, group students for instruction, and assess the students' learning.

To help make sense of all these elements of effective instruction, educational psychologists have proposed models of effective instruction. These models explain the critical features of high-quality lessons and how they interact to enhance learning.

Carroll's Model of School Learning and QAIT

One of the most influential articles ever published in the field of educational psychology was a paper by John Carroll titled "A Model of School Learning" (1963, 1989). In it, he describes teaching in terms of the management of time, resources, and activities to ensure student learning. Carroll proposes that learning is a function of (1) time actually spent on learning and (2) time needed to learn. Time needed is a product of aptitude, prior knowledge, and ability to learn; time spent depends on clock time available for learning, quality of instruction, and student perseverance.

Slavin (1995b) described a model focusing on the alterable elements of Carroll's model, those that the teacher or school can directly change. It is called the **QAIT model**, for quality, appropriateness, incentive, and time.

1. ***Quality of instruction.*** The degree to which the presentation of information or skills helps students easily learn the material. Quality of instruction is largely a product of the quality of the curriculum and of lesson presentation.
2. ***Appropriate levels of instruction.*** The degree to which the teacher makes sure that students are ready to learn a new lesson (that is, have the necessary skills and knowledge to learn it) but have not already learned the lesson. In other words, the level of instruction is appropriate when a lesson is neither too difficult nor too easy for students.
3. ***Incentive.*** The degree to which the teacher makes sure that students are motivated to work on instructional tasks and to learn the material being presented.
4. ***Time.*** The degree to which students are given enough time to learn the material being taught.

For instruction to be effective, each of these four elements must be adequate. No matter how high the quality of instruction, students will not learn a lesson if they lack the necessary prior

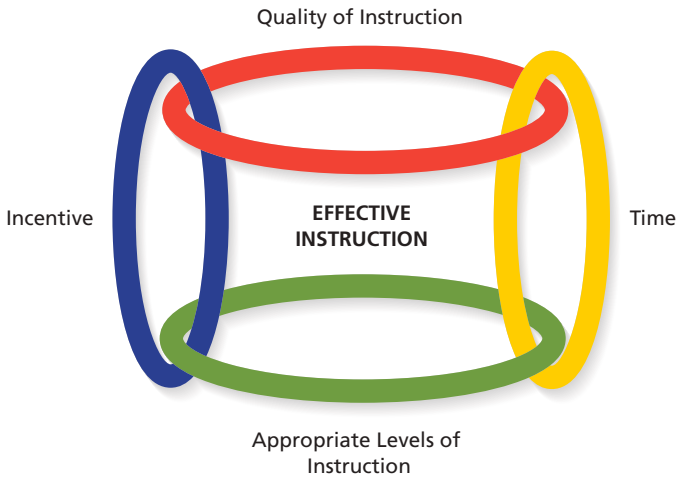


FIGURE 9.1 • The QAIT Model

Each of the elements of the QAIT model is like a link in a chain, and the chain is only as strong as the weakest link.

skills or information, if they lack the motivation, or if they lack the time they need to learn the lesson. However, if the quality of instruction is low, then it makes no difference how much students already know, how motivated they are, or how much time they have. Figure 9.1 illustrates the relationships among the elements in the QAIT model.

QUALITY OF INSTRUCTION Quality of instruction refers to the set of activities most people first picture when they think of teaching: lecturing, calling on students, discussing, helping students with seatwork, and so on. Involving peers as peer tutors or cooperative learning partners may add to quality of instruction. Technology (such as videos, computer graphics, interactive whiteboards, or other digital content) may contribute to the quality of instruction, as can hands-on experiences, laboratory exercises, or computer simulations. When instruction is high in quality, the information presented makes sense to students, interests them, and is easy to remember and apply.

The most important aspect of quality of instruction is the degree to which the lesson makes sense to students, which you ensure by presenting material in an orderly, organized way. You need to relate new information to what students already know. You need to use examples, demonstrations, pictures, and diagrams to make ideas vivid for students. You might use such cognitive strategies as advance organizers and memory strategies. Sometimes a concept will not make sense to students until they discover it or experience it themselves or until they discuss it with others. Engaging students with the content, through cooperative activities, creation of new products, simulations, games, or technology, can help make lesson concepts understandable and memorable for students.

APPROPRIATE LEVELS OF INSTRUCTION Perhaps the most difficult problem of classroom organization is the fact that students come into class with different levels of prior knowledge, skills, and motivation, as well as with different learning rates (Tomlinson, 2008). This was Mr. Arbuthnot's main dilemma. Student diversity requires teachers to provide appropriate levels of instruction. Teaching a class of 30 students (or even a class of 10) is fundamentally different from one-to-one tutoring because of the inevitability of differences among students that affect the success of instruction. You can always be sure that if you teach one lesson to the whole class, some students will learn the material much more quickly than others. In fact, some students might not learn the lesson at all; they might lack important prerequisite skills or adequate time (because to give them enough time would waste too much of the time of students who learn rapidly). Recognition of these instructionally important differences leads many teachers to search for ways of individualizing or differentiating instruction, adapting instruction to meet students' different needs, or grouping students according to their abilities. Some of the solutions typically used to accommodate individual differences in learning rates create problems of their own that could be more serious than the ones they are meant to solve (Willingham & Daniel, 2012). For example, you might give all students materials appropriate to their individual needs and allow students to work at their own rates, perhaps using computer-assisted instructional software designed for this

purpose. This solves the problem of providing appropriate levels of instruction, but it creates serious new problems of managing the activities of 20 or 30 students doing 20 or 30 different things. Alternatively, you might group students within a relatively narrow range of abilities (e.g., Redbirds, Bluebirds, and Yellowbirds). However, this creates problems, too, because when you are working with the Redbirds, the Bluebirds and Yellowbirds must work without supervision or help, and students in the low groups may feel stigmatized and may lack positive behavioral models.

Adapting to individual needs may require adjusting the pace of instruction so that it is neither too fast nor too slow. For example, you should ask questions frequently to determine how much students have grasped. If the answers show that students are keeping up with the lesson, you might move along a little more rapidly. But if students' answers show that they are having trouble keeping up, you might review parts of the lesson and slow down the pace, or provide additional instruction at another time for students who are not keeping up.

INCENTIVE Thomas Edison wrote that "genius is one per cent inspiration and ninety-nine per cent perspiration." The same could probably be said of learning. Learning is work. This is not to say that learning isn't or can't be fun or stimulating—far from it. But it is true that students must exert themselves to pay attention, to conscientiously perform the tasks required of them, and to study; moreover, students must somehow be motivated to do these things. This incentive, or motivation, might come from characteristics of the tasks themselves (e.g., the interest value of the material being learned), from characteristics of students (such as their curiosity or positive orientation toward learning), or from rewards provided by the teacher or the school (such as praise, recognition, grades, or certificates).

If students want to know something, they will be motivated to exert the effort necessary to learn it. This is why there are students who can rattle off the names, batting averages, number of home runs, and all sorts of other information about every player of the Chicago Cubs but know little about science or history or math. To such students, baseball facts are of great interest, so they are willing to invest substantial effort to master them. Some information is naturally interesting to some or all students, but you can do much to create interest in a topic by arousing students' curiosity or by showing how knowledge gained in school can be useful outside of school. For example, baseball fans might be much more interested in learning about understanding proportions if they realized that this information is necessary for computing batting averages.

Connections 9.1
The rewards and general principles of motivation are discussed throughout Chapter 10.

However, not every subject can be made fascinating to all students at all times. Most students need some kind of recognition or reward if they are to exert maximum effort to learn skills or concepts that might seem unimportant at the moment but will be critical for later learning. For this reason, schools use praise, feedback, grades, certificates, stars, prizes, access to fun activities, and other rewards to increase student motivation.

Connections 9.2
Principles of classroom management and discipline are discussed throughout Chapter 11.

TIME The final element of the QAIT model is time. Instruction takes time. More time spent teaching something does not necessarily mean more learning; but if instructional quality, appropriateness of instruction, and incentive are all high, then spending more time on instruction will pay off in greater learning. The amount of time available for learning depends largely on two factors. The first is *allocated time*, the amount of time that you schedule for instruction and then actually use to teach. The other is *engaged time*, the amount of time students pay attention to the lesson. Both kinds of time are affected by classroom management and discipline strategies. If students are well behaved, are well motivated, and have a sense of purpose and direction, and if you are well prepared and well organized, then there is plenty of time for students to learn whatever you want to teach. However, many factors, such as interruptions, behavior problems, and poor transitions between activities, eat away at the time available for learning.

HOW ARE STUDENTS GROUPED TO ACCOMMODATE ACHIEVEMENT DIFFERENCES?

InTASC 2
Learning Differences

From the day they walk into school, students differ in their knowledge, skills, motivations, and predispositions toward what is about to be taught. Some students are already reading when they enter kindergarten; others need much time and support to learn to read well. When starting a new lesson, you can usually assume that some students already know a great deal about the lesson's

content, some know less but will master the content readily, and some might not be able to master the content at all within the time provided. Some have the prerequisite skills and knowledge to learn the lesson, whereas others do not. This was Mr. Arbuthnot's problem: Some of his students were not ready to learn long division, whereas others had already learned it before he began. Some of his students lacked the basic multiplication and subtraction skills crucial for long division. Others learned it during the first lesson and did not need the second. If Mr. Arbuthnot stopped to review multiplication and division, he would be wasting the time of the better-prepared students. If he set his pace of instruction according to the needs of his more able students, those with learning problems might never catch up. How can Mr. Arbuthnot teach a lesson that will work for all of his students, who are performing within the normal range but differ in prior knowledge, skills, and learning rates?

Connections 9.3
To learn more about student differences in general intelligence, specific aptitudes, and abilities and learning styles, see Chapter 4.

Accommodating instruction to student differences, or *heterogeneity*, is one of the most fundamental problems of education and often leads to politically and emotionally charged policies (Atkins & Ellsesser, 2003). One solution, which some advocate, is simply to retain more children in a grade until they meet grade-level requirements. Many states, for example, are now requiring that children who are not reading at grade level by third grade be required to repeat the grade (Robelen, 2012). Some countries outside of North America attempt to deal with the problem of student differences by testing children at around 10 to 12 years of age and assigning them to different types of schools, only one of which is meant to prepare students for higher education. In the United States, a similar function is sometimes carried out by assignment of secondary students to college preparatory, general, and vocational tracks, in which students are assigned to a specified curriculum sequence within which they take all their academic courses. This **tracking** rapidly diminished in the 1980s and 1990s, but instead, most secondary schools place students in ability-grouped classes by subject area. In theory, a student may be in a high-level math class but in a middle- or low-level English class (Lucas & Gamoran, 2002). Many secondary schools allow students, in consultation with counselors, to choose the level of each class, perhaps changing levels if a course turns out to be too difficult or too easy. All of these strategies, which result in students' attending classes that are more or less homogeneous in performance level, are forms of **between-class ability grouping**. The predominant form of ability grouping in middle, junior high, and high schools, it is also sometimes used in elementary schools.

Another common means of accommodating instruction to student differences in elementary schools is **within-class ability grouping**, as in the use of reading groups (Bluebirds, Redbirds, Yellowbirds) that divide students according to their reading performance. The problem of accommodating student differences is so important that many educators have suggested completely individualized instruction so that students can work at their own rates, which has led to the creation of individualized computer-assisted instructional programs.

Each of the many ways of accommodating differences among students has its own benefits, but each introduces its own problems, which sometimes outweigh the benefits. Some student differences can be easily accommodated (Jackson & Lambert, 2010; Pollock, Ford, & Black, 2012; Tomlinson, 2014). For example, you can support different learning styles by augmenting oral presentations with visual cues—perhaps writing on a whiteboard or showing pictures and diagrams to emphasize important concepts (Mayer, 2008a). You can accommodate other differences in learning styles by varying classroom activities, as in alternating active and quiet tasks or individual and group work. You can sometimes work with students on an individual basis and adapt instruction to their learning needs—for example, by reminding impulsive students to take their time or by teaching overly reflective students strategies for skipping problematic items so that they can complete tests on time.

Differences in prior knowledge and learning rates are more difficult to deal with. Sometimes the best way to deal with these differences is to ignore them and teach the whole class at a single pace, perhaps offering additional help to low-achieving students and giving extra extension or enrichment activities to students who tend to finish assignments rapidly (see Guskey, 2011; Tomlinson, 2014). You can consciously vary the examples and questions used to accommodate a range of students in each lesson (Small, 2010). You can let students who do poorly on tests or other assignments redo them until they achieve adequate performance (Wormeli, 2011). Appropriate use of cooperative learning methods, in which students of different performance levels help each other,

can be an effective means of helping all children learn (Cohen & Lotan, 2014; Slavin, 2013; Webb, 2008). Some subjects lend themselves more than others to a single pace of instruction for all. For example, it is probably less important to accommodate student achievement differences in social studies, science, and English than in mathematics, reading, and foreign languages. In the latter subjects, skills build directly on one another, so teaching a heterogeneous class at one set pace might do a disservice to both low and high achievers; low achievers might fail because they lack prerequisite skills, and high achievers might become bored at what is for them a slow pace of instruction.

Between-Class Ability Grouping

Connections 9.4
Programs for students who are gifted and those who have special needs are discussed in Chapter 12.

Probably the most common means of dealing with instructionally important differences is to assign students to classes according to their abilities. This between-class ability grouping can take many forms. In most middle and high schools, students are grouped separately by ability for each subject, so a student might be in a high-performing math class and an average-performing science class. In high schools, between-class ability grouping may be accomplished by course placements. For example, some seventh, eighth, and ninth graders take Algebra I, whereas others who do not qualify for Algebra I take general mathematics. Elementary schools use a wide range of strategies for grouping students, including many of the patterns found in secondary schools. Often, students in elementary schools are assigned to a mixed-ability class for homeroom, social studies, and science but regrouped by ability for reading and math (Lucas & Gamoran, 2002). Elementary schools are less likely than secondary schools to use ability grouping between classes but more likely to use ability grouping within classes, especially in reading (Chorzempa & Graham, 2006). At any level, however, the establishment of separate special-education programs for students with serious learning problems is one common form of between-class ability grouping, as is provision of separate programs for students who are academically gifted and talented.

Certification Pointer
For teacher certification tests, you may be asked to describe the strengths and weaknesses of between-class ability grouping. You should know that research does not support most forms of between-class ability grouping.

RESEARCH ON BETWEEN-CLASS ABILITY GROUPING Despite the widespread use of between- class ability grouping, research on this strategy does not support its use. Researchers have found that although ability grouping might have slight benefits for students assigned to high-track classes, these benefits are balanced by losses for students in low-track classes (Ireson & Hallam, 2001; Oakes, 2005; Slavin, 1987b, 1990).

ON THE WEB

The National Association for Gifted Children's position statement on ability grouping can be found at nagc.org. Also see NEA's Research Spotlight on Academic Ability Grouping (nea.org).

Why is between-class ability grouping so ineffective? Several researchers have explored this question. The primary purpose of ability grouping is to reduce the range of student performance levels that teachers must deal with so they can adapt instruction to the needs of a well-defined group. However, grouping is often done on the basis of standardized test scores or other measures of general ability, rather than according to performance in a particular subject. As a result, the reduction in the range of differences that are actually important for a specific class may be too small to make much difference (Oakes, 2005). Furthermore, concentrating low-achieving students in low-track classes seems to be harmful because it exposes them to too few positive role models. Many teachers do not like to teach such classes and might subtly (or not so subtly) communicate low expectations for students in them (Weinstein, 1996). Studies find that teachers actually do not make many adaptations to the needs of students in low-ability groups (Ross, Smith, Lohr, & McNelis, 1994). Several studies have found that the quality of instruction is lower in low-track classes than in middle- or high-track classes. For example, teachers of low-track classes are less enthusiastic and less well organized, teaching more facts and fewer concepts than teachers of high-track classes (Gamoran, Nystrand, Berends, & LePore, 1995; Oakes, 2005; Raudenbush, Rowan, & Cheong, 1993). Low-track classes are more likely to have novice teachers (Kalogrides & Loeb, 2013). Instruction in untracked mixed-ability classes more closely resembles teaching in high- and middle-track classes than that in low-track classes.

Perhaps the most damaging effect of tracking is its stigmatizing effect on students who are assigned to the low tracks; the message these students get is that academic success is not within their reach (Oakes, 2005). Students in lower-track classes are far more likely to become delinquent and truant and to drop out of school than are students of similar ability in middle-track or mixed placements (Oakes, 2005). Although these problems certainly exist in part because students in low-track classes are low in academic performance to begin with, this cannot be the whole story. For example, students who are assigned to the low track in middle or junior high school experience a rapid loss of self-esteem. Slavin and Karweit (1982) found that fifth- and sixth-graders in urban elementary schools were absent about 8 percent of the time. When these same students entered the tracked junior high school, absenteeism rose almost immediately to 26 percent, and the truancy was concentrated among students assigned to the bottom-track classes. The change happened too rapidly to be attributed entirely to characteristics of students. Something about the organization of the junior high school apparently convinced a substantial number of students that school was no longer a rewarding place to be.

One of the most insidious aspects of tracking is that low-track classes are often composed predominantly of students from lower socioeconomic backgrounds and from minority groups, whereas upper-track classes are more often composed of children from higher socioeconomic levels (Kalogrides & Loeb, 2013). A study by Yonezawa, Wells, and Serna (2002) found that even in high schools where students were theoretically given a "free choice" of academic levels, African American and Latino students disproportionately ended up in low-level classes. The creation of groupings that are so often associated with social class and race is impossible to justify in light of the lack of evidence that such groupings are educationally necessary.

Although individual teachers can rarely set policies on between-class ability grouping, it is useful for you to know that research does not support this practice at any grade level, and tracking should be avoided whenever possible. This does not mean that all forms of between-class grouping should be abandoned, however. For example, there is probably some justification for acceleration programs, such as offering Algebra I to mathematically talented seventh-graders or providing advanced placement or college classes in high school (see Chapter 12). Also, some between-class grouping is bound to occur in secondary schools, because some students choose to take advanced courses and others do not. However, the idea that having high, middle, and low sections of the same course enhances student achievement has not been supported by research. Mixed-ability classes can be successful at all grade levels, particularly if other, more effective means of accommodating student differences are used, such as within-class ability grouping, tutoring or other extra help for low achievers, and cooperative learning strategies, in which students work in mixed-ability groups.

Connections 9.5
Cooperative learning strategies are described in Chapter 8.

Untracking

For many years, educators and researchers have challenged between-class ability grouping at all levels. A number of guides to untracking and examples of successful untracking have been published (e.g., Burris, Heubert, & Levin, 2004; Fahey, 2000; Kugler & Albright, 2005; Oakes, Quartz, Ryan, & Lipton, 2000). **Untracking** recommendations focus on placing students in mixed-ability groups and holding them to high standards but providing many ways for them to reach those standards, including extra assistance for students who are having difficulty keeping up (Burris, Heubert, & Levin, 2006; Hubbard & Mehan, 1998). Appropriate forms of cooperative learning and project-based approaches have often been recommended as a means of opening up more avenues to high performance for all children (Slavin, 2013). Yet the road to untracking is far from easy, especially in middle and high schools (Cooper, 1998; Oakes et al., 2000; Rubin, 2003). In particular, untracking often runs into serious opposition from the parents of high achievers. Oakes and colleagues (2000) and Wells, Hirshberg, Lipton, and Oakes (1995) have pointed out that untracking requires changes in thinking about children's potentials, not only changes in school or classroom practices. Teachers, parents, and students themselves, these researchers claim, must come to see the goal of schooling as success for every child, not as sorting students into categories, if untracking is to take hold (Oakes et al., 2000). This change in perception is difficult to bring about; perhaps as a result, the move toward untracking is proceeding slowly at the secondary level (Hallinan, 2004).

Connections 9.6
Various forms of cooperative and project-based learning are described in Chapter 8.

Regrouping for Reading and Mathematics

Regrouping is a form of ability grouping often used in the elementary grades. In regrouping plans, students stay in mixed-ability classes most of the day but are assigned to reading and/or math classes on the basis of their performance in these subjects. For example, at 9:30 a.m. the fourth-graders in a school may move to different teachers so that they can receive reading instruction appropriate to their reading levels. One form of regrouping for reading, the **Joplin Plan**, regroups students across grade lines. For example, a reading class at the fourth grade, first semester reading level may contain third-, fourth-, and fifth-graders.

One major advantage of regrouping over all-day ability grouping is that students spend most of the day in a mixed-ability class. Thus, low achievers are not separated out as a class and potentially stigmatized. Perhaps for these reasons, regrouping plans, especially the Joplin Plan, have generally been found to increase student achievement (Gutiérrez & Slavin, 1992; Slavin, 1987b).

Within-Class Ability Grouping

Another way to adapt instruction to differences in student performance levels is to group students within classes, as is typical in elementary school reading classes. For example, a third-grade teacher might have the Rockets group using a 3–1 (third-grade, first-semester) text, the Stars group using a 3–2 (third-grade, second-semester) text, and the Planets group using a 4–1 (fourth-grade, first-semester) text.

Within-class ability grouping is very common in elementary reading classes (Chorzempa & Graham, 2006). Within-class ability grouping is rare in subjects other than reading or mathematics. In reading, teachers typically have each group working at a different point in a series of texts and allow each group to proceed at its own pace. In many math classes the teacher presents a lesson to the whole class and then meets with two or more ability groups, while other students are doing seatwork, to reinforce skills or provide enrichment as needed. In a strategy called mastery learning, teachers assemble a group for additional instruction after they have given a lesson, formatively assessed students, and identified those who are not meeting a mastery standard (typically, 80 percent correct) (Guskey, 2010). After "corrective instruction," teachers test again, hoping students will meet the mastery standards.

Certification Pointer
You may be asked on your teacher certification test to describe a technique for grouping students within a reading class to meet a wide range of student reading abilities.

RESEARCH ON WITHIN-CLASS ABILITY GROUPING Research on the achievement effects of within-class ability grouping has taken place largely in elementary mathematics classes. Most such studies have found that students in the ability-grouped classes learned more than students in classes without grouping (Slavin, 1987b). Students of high, average, and low achievement levels seem to benefit equally from within-class ability grouping. One study by Mason and Good (1993) found that teachers who flexibly grouped and regrouped students according to their needs had better math achievement outcomes than those who used permanent within-class groups. Surprisingly, there is little research on the effectiveness of reading groups, and that which does exist shows few benefits (Nomi, 2010).

The research suggests that small numbers of ability groups are better than large numbers (Slavin & Karweit, 1984). A smaller number of groups has the advantage of allowing more direct instruction from the teacher and using less seatwork time and transition time. With only three groups, seatwork time rises to at least two-thirds of class time. Teachers who try to teach more than three reading or math groups might also have problems with classroom management. Dividing the class into more than three groups does not decrease the magnitude or range of differences within each group enough to offset these problems (see Hiebert, 1983).

One interesting study by Chmielewski, Dumont, & Trautwein (2013) found that whereas top-track students had higher self-concepts than low-track students, the opposite was the case in within-class grouping, suggesting that within-class grouping does not have the stigmatization effect often seen in between-class grouping.

The main point to be drawn from research on within-class ability grouping is not that it is desirable but that if some form of grouping is thought to be necessary, grouping within the class is preferable to grouping between classes.

Retention

One of the most controversial issues in education is whether low-achieving students should be required to repeat grades. Approximately 3.5 percent of U.S. first-graders were retained in 2008–2009, and then 1 percent to 2 percent in each of grades 2 through 8 (Warren & Saliba, 2012). This means that about 14 percent of students are retained at some point before high school (Warren, Hoffman, & Andrew, 2014). Several states have recently passed highly controversial laws that require third-graders who are not reading at grade level to repeat a grade (Robelen, 2012), and this may be increasing retention rates in those states.

Proponents of holding back low-achieving students argue that this gives such students a "gift of time" to catch up and sets clear standards that they must strive to achieve. Students being considered for retention are usually given the opportunity to catch up in summer school or to receive other assistance leading to promotion, and it may be that the threat of retention brings many students into such services (March, Gershwin, Kirby, & Xia, 2009; McCombs, Kirby, & Mariano, 2009). Opponents note that students who are held back lose motivation; in fact, having been retained is one of the strongest predictors of dropping out (Allensworth, 2005; Jimerson, Anderson, & Whipple, 2002). Retention is disproportionately high among male students who are members of minority groups and/or come from disadvantaged homes (Beebe-Frankenberger, Bocian, MacMillan, & Gresham, 2004; Robelen, Adams, & Shah, 2012). There are also serious questions about whether tests used in many retention decisions are sufficiently reliable and valid (Penfield, 2010).

Is retention beneficial or harmful? In the short term, holding students back usually increases scores in a given school or district, not because students are learning more but because they are older when they take the test. For this reason, states and districts often report "dramatic gains" on state tests right after instituting a new policy of holding students back unless they meet a given test standard (Bali, Anagnostopoulos, & Roberts, 2005; McGill-Franzen, & Allington, 2006). In long-term studies, however, students who were retained typically end up learning less, or certainly no more, than similar low achievers of the same age who were not retained (Allensworth & Nagaoka, 2010; Burkam, Logerfo, Ready, & Lee, 2007; Hong & Raudenbush, 2005; Hong & Yu, 2007; Hughes, Kwock, & Im, 2013; Roderick & Nagaoka, 2005). The advantage that retained students initially have over their younger classmates tends to fade away within a few years (Allen, Chen, Willson, & Hughes, 2009; Moser, West, & Hughes, 2012).

The best solutions to the problems of low-achieving students involve neither retention nor "social promotion" (promoting students without regard to their levels of achievement). Instead, such children should be given special attention, diagnosis, and intensive interventions, such as tutoring, until their achievement falls within the normal range (Benson, 2014; Vaughn, Bos, & Schumm, 2014). An extra year of education is a very expensive intervention—for that amount of money, students can be given much more effective assistance (Reeves, 2006; Slavin, Lake, Davis, & Madden, 2011).

MyEdLab **Self-Check 9.1**

MyEdLab **Video Analysis Tool 9.1** Go to MyEdLab and click on the Video Analysis Tool to access the exercise "Differentiated instruction: grouping."

WHAT ARE SOME WAYS OF DIFFERENTIATING INSTRUCTION?

InTASC 2
Learning Differences

InTASC 8
Instructional Strategies

As alternatives to ability grouping, many proven strategies exist to improve the achievement of struggling students. This gets directly to the main problem that grouping is intended to solve. The array of proven approaches is particularly broad in reading, where many quite different approaches are known to be effective with struggling readers (Connor, Alberto, Compton, & O'Connor, 2014; Galuschka, Ise, Kreick & Schulte-Körne, 2014; Slavin, Lake, Davis, & Madden, 2011; Wanzek et al., 2013).

The problem of providing all students with appropriate levels of instruction could be completely solved if schools simply assigned each student his or her own teacher. Not surprisingly, studies of one-adult–one-student tutoring find substantial positive effects of tutoring on student

achievement (Slavin, Lake, Davis, & Madden, 2011). One major reason for the effectiveness of tutoring is that the tutor can provide **differentiated instruction**, tailoring instruction precisely to a student's needs. If the student learns quickly, the tutor can move to other tasks; if not, the tutor can figure out what the problem is, try another explanation, or simply spend more time on the task.

There are situations in which tutoring by adults is feasible and necessary. Cross-age peer tutors (older students working with younger ones) can also be very effective (Thurston et al., 2012). In addition, educational innovators have long tried to simulate the one-to-one teaching situation by individualizing instruction. Teachers have found a variety of ways to informally accommodate the needs of different learners in heterogeneous classrooms (Tomlinson, 2014b; Tomlinson & Moon, 2013). Individualized instruction methods, in which students work at their own level and pace, were popular in the 1960s and 1970s, and this type of instruction continues in many forms of computer-based instruction. Differentiation strategies are discussed in the following sections.

Differentiated and Personalized Instruction

Differentiated instruction (Doubet & Hockett, 2015; Parsons, Dodman, & Burrowbridge, 2013; Silver, Jackson, & Moirao, 2011; Tomlinson, 2014b; Tomlinson & Moon, 2013) adapts the content, level, pace, and products of instruction to accommodate the different needs of diverse students in regular classes. The philosophy behind differentiated instruction emphasizes that all children can reach high standards, but some may need tailored assistance to do so. Recently, the related term *personalized instruction* has been widely used. It adds an emphasis on adapting to students' interests, values, and circumstances (Dobbertin, 2012; Powell & Kusuma-Powell, 2012; Richardson, 2012; Wolk, 2010). Computers are frequently central to personalized or differentiated instruction, as they can provide the same learning content in many ways and at many levels, and can help teachers keep track of all students' progress (Grant & Basye, 2014; Gura, 2016).

For an example of personalization, you might ask a diverse class to write a biography of Gandhi but to provide materials on Gandhi at different reading levels. Or you might create a common math test for a heterogeneous class but include a few "challenge questions" for students with stronger preparation in math. During seatwork, you might focus on students known to have difficulties with prerequisite skills or provide them preteaching on those skills before class; for example, before a unit on decimals, you might arrange an extra session to review fractions with students who are not solid with the fraction concepts central to decimals.

Part of the idea of differentiation is that even though all students need to reach the same goals, some will take more time and others less time to do so. Differentiated classes may give students opportunities to redo projects on which they have done poorly, rather than just receive low grades (Guskey, 2011; Tomlinson & Moon, 2013; Wormeli, 2011).

Differentiation and personalization are increasingly being provided by means of digital devices. This topic is discussed further later in this chapter .

Peer Tutoring

InTASC 3
Learning Environments

Students can help one another learn. In **peer tutoring**, one student teaches another. There are two principal types of peer tutoring: **cross-age tutoring**, in which the tutor is several years older than the student being taught, and same-age peer tutoring, in which a student tutors a classmate (Topping, Duran, & Van Keer, 2015). Cross-age tutoring is recommended by researchers more often than same-age tutoring—partly because older students are more likely to know the material, and partly because students might accept an older student as a tutor but resent having a classmate in that role. Sometimes peer tutoring is used with students who need special assistance, in which case a few older students might work with a few younger students. Other tutoring schemes have involved, for example, entire fifth-grade classes tutoring entire second-grade classes (Thurston, Tymms, Merrell, & Conlin, 2012). In these cases, half of the younger students might be sent to the older students' classroom, while half of the older students go to the younger students' classroom. Otherwise, peer tutoring may take place in the cafeteria, the library, or another school facility.

Peer tutoring among students of the same age can be easier to arrange and has also been found to be very effective (Rohrbeck et al., 2003). Among classmates of the same age and performance level, reciprocal peer tutoring, in which students take turns as tutors and tutees, can be both

practical and effective (Fantuzzo, King, & Heller, 1992; Greenwood, Terry, Utley, Montagna, & Walker, 1993; Mathes, Torgeson, & Allor, 2001; Van Keer & Vanderlinde, 2013).

Adequate training and monitoring of tutors are essential. For a practical guide to peer tutoring, see Topping, Duran, & Van Keer, 2015. Some studies have found greater achievement gains for tutors than for tutees (Rekrut, 1992)! As many teachers have noted, the best way to learn something thoroughly is to teach it to someone else.

Connections 9.7
For more on reciprocal teaching, see Chapter 8.

ON THE WEB

For articles and resources on peer tutoring, visit the Peer Tutoring Resource Center at peertutoringresource.org and the Center for Effective Collaboration and Practice at cecp.air.org.

Tutoring by Teachers

One-to-one adult-to-child tutoring is one of the most effective instructional strategies known, and it essentially solves the problem of appropriate levels of instruction. The principal drawback to this method is cost. However, it is often possible to provide adult tutors for students who are having problems learning in the regular class setting. Tutoring is an excellent use of school aides (Brown et al., 2005; Madden & Slavin, 2015; Vadasy, Sanders, & Tudor, 2007); some school districts hire large numbers of paraprofessionals precisely for this purpose. In fact, research has found few achievement benefits of classroom aides unless they are doing one-to-one tutoring (see Slavin, 1994). Volunteers who are willing to work every day and who are carefully supervised and trained in phonetic approaches can also improve student learning, though not usually as much as paraprofessionals (Morrow-Howell et al., 2009; Roskosky, 2010; Tingley, 2001).

There are some circumstances in which one-to-one tutoring by teachers is particularly justifiable, despite the cost, such as for first-graders who are having difficulty learning to read. Failing to learn to read in the lower grades of elementary school is so detrimental to later school achievement that an investment in tutors who can prevent reading failure is worthwhile. A recent review of research on programs for struggling readers in the elementary grades found substantial positive effects of a variety of tutoring and small-group interventions (Slavin, Lake, Davis, & Madden, 2011).

A program called **Reading Recovery** (Lyons, Pinnell, & DeFord, 1993) provides one-to-one tutoring from specially trained teachers to first-graders who are not reading adequately. This program has been found to bring most children placed at risk to adequate levels of performance and can have long-lasting positive effects. Reading Recovery is used in thousands of elementary schools in the United States, Canada, the United Kingdom, and other countries. Although there is little disagreement that Reading Recovery has a positive effect on the reading success of first-graders who are at risk (see May et al., 2015; Pinnell et al., 1994; Slavin, Lake, Davis, & Madden, 2011), there are conflicting findings on the maintenance of these gains beyond first grade. A major long-term evaluation of Reading Recovery in London found strong immediate effects that had faded away by the time the children were 10 years old (Hurry & Sylva, 2007). There have also been questions about the cost-effectiveness of Reading Recovery (Hiebert, 1996; Shanahan, 1998) and about whether positive effects for small numbers of first-graders represent the best use of limited funds for an entire age group of children (see Hiebert, 1996; Schacter, 2000). However, if you see Reading Recovery as a starting point for a series of interventions designed to get at-risk children off to a good start, rather than as a cure that lasts forever, then there is no question that it greatly improves reading performance at a critical period in children's development.

In addition to Reading Recovery, several other programs have successfully used certified teachers, paraprofessionals, and even well-trained and well-supervised volunteers to improve the reading achievement of first-graders (Morris et al., 2000; Slavin, Lake, Davis, & Madden, 2011). A phonetic tutoring program called Reading Rescue has produced substantially better outcomes for first-graders than either a small-group remedial program or no intervention (Ehri, Dreyer,

THEORY INTO PRACTICE

Effectively Using Peer Tutoring Methods to Meet Individual Needs

Peer tutoring is an effective way to improve learning for both tutee and tutor, and no one doubts the value of this strategy for meeting individual needs within a classroom. However, it takes more than simply pairing off students for peer tutoring to result in improved learning.

To establish a tutoring program, recognize that specific skills need to be developed in both the tutors and the tutees. Whether the tutors are same-age peers, older students, or even adults, use care in selecting tutors. Consider not only the knowledge base of the tutors (i.e., their proven proficiency with the subject matter) but also their ability to convey knowledge clearly.

Typically, training will include basic instruction in modeling, prompting responses from tutees, using corrective feedback and praise/reinforcement, alternating teaching methods and materials (i.e., using multisensory methods), and recording and reporting progress. Students who receive tutoring need to be clear about their role in this process. It would be counterproductive to force any student into a tutorial relationship. Therefore, initially select only students who express a willingness to work with a tutor. Steadily make tutoring a part of the natural learning activities within a classroom or an entire school. Tutees and tutors should understand that the goal of the activity is to have each tutee reach a clear understanding of the concepts, not merely complete an assignment. To augment the preparation, you might want to use various role-playing activities during the training process. Demonstrate appropriate forms of instruction, feedback, reinforcement, and so on; then allow the participants to practice under supervised conditions. Corrective feedback within this controlled environment will allow you to feel more confident as the tutor–tutee pairs work together without your direct supervision.

Flugman, & Gross, 2007). An Australian program that used a combination of curricular reform, Reading Recovery tutoring, family support, and other elements showed significant effects on first-graders' reading performance (Crévola & Hill, 1998). A follow-up of a tutoring program for second- and third-graders found lasting effects on some reading measures eleven years later (Blachman et al., 2014).

One-to-one tutoring is nearly always very effective, and tutoring models that use structured phonetic methods are much more effective than other tutoring methods (Blachman et al., 2004; Brown, Morris, & Fields, 2005; Ehri et al., 2007; Slavin et al., 2011; Wanzek et al., 2013). Programs that supplement one-to-one or small-group tutoring by paraprofessionals with specially designed computerized content are particularly effective (Chambers et al., 2008, 2011; Madden & Slavin, 2015). Phonetic programs delivered by paraprofessionals with or without computers are almost as effective as tutoring given by certified teachers (Jenkins, Peyton, Sanders, & Vadasy, 2004; Markovitz et al., 2014; Vadasy, Sanders, & Tudor, 2007). Smaller positive effects have been found in studies of phonetic tutoring to groups of three to eight children (Hempenstall, 2008; Mathes et al., 2003, 2005).

Volunteers can be effective as tutors, but effects are smaller than those achieved with paraprofessionals (Jacob, Armstrong, & Willard, 2015; Morrow-Howell et al., 2009). A lot of time is required for the recruitment, training, and supervision of volunteers, but using them may help build community connections. Tutoring by adults, both individually and in groups of two or three, has also been found to be effective for primary-age students struggling in math (Fuchs et al., 2008).

Certification Pointer

For your teacher certification test, you will probably need to demonstrate your understanding of appropriate applications of cross-age tutoring. For example, you might be asked to identify the curricular goals for which cross-age tutoring would be appropriate, and how you would structure the tutoring so that it would be effective.

MyEdLab **Self-Check 9.2**

MyEdLab **Video Analysis Tool 9.2** Go to MyEdLab and click on the Video Analysis Tool to access the exercise "Differentiated instruction: materials."

WHAT EDUCATIONAL PROGRAMS EXIST FOR STUDENTS PLACED AT RISK?

Any child can succeed in school. Any child can fail. The difference between success and failure depends primarily on what the school, the parents, community agencies, and the child himself or herself do to create conditions that are favorable for learning (Thomas & Bainbridge, 2001). Before school entry we cannot predict very well which individual children will succeed or fail, but there are factors in a child's background that make success or failure more likely (on the average). For example, students who come from impoverished or chaotic homes, those who have marked developmental delays, and those who exhibit aggressive or withdrawn behavior are more likely to experience problems in school than are other students. These children are often referred to as **students at risk** (Boykin & Noguera, 2011). The term *at risk* is borrowed from medicine, in which it has long been used to describe individuals who do not have a given disease but are more likely than average to develop it. For example, a heavy smoker or a person with a family history of cancer might be at risk for lung cancer, even though not all heavy smokers or people with family histories of cancer actually get the disease. Similarly, a given child from an impoverished home might do well in school, but 100 such children are likely to perform significantly worse, on the average, than 100 children from middle-class homes. Boykin (2000) advocated using the term *placed at risk*, rather than *at risk*, to emphasize the fact that it is often an inadequate response to a child's needs by school, family, or community that places the child at risk. For example, a child who could have succeeded in reading if he or she had been given appropriate instruction, a reading tutor, or eyeglasses could be said to have been placed at risk by the lack of these services.

Before children enter school, the most predictive risk factors are related to their socioeconomic status and family structure. After they begin school, however, such risk factors as poor reading performance, grade repetition, and poor behavior become more important predictors of later school problems (such as dropping out) than family background factors (Hernandez, 2012).

Educational programs for students who are at risk fall into three major categories: compensatory education, early intervention programs, and special education. **Compensatory education** is the term used for programs designed to prevent or remediate learning problems among students who are from low-income families or who attend schools in low-income communities. Some intervention programs target infants and toddlers who are at risk to prevent possible later need for remediation. Other intervention programs are aimed at keeping children in school. Compensatory and early intervention programs are discussed in the following sections. Special education, discussed in Chapter 12, is designed to serve children who have more serious learning problems, as well as children with physical or psychological problems.

InTASC 2
Learning Differences

InTASC 10
Leadership and Collaboration

Connections 9.8
For more on factors such as poverty and limited English proficiency that might place students at risk of school failure, see Chapter 4.

Connections 9.9
To learn about factors such as problems of childhood and adolescence that might place students at risk of school failure, see Chapter 3.

Connections 9.10
Special education is discussed in detail in Chapter 12.

Compensatory Education Programs

Compensatory education programs are designed to overcome the problems associated with being brought up in low-income communities. Compensatory education supplements the education of students from disadvantaged backgrounds who are experiencing trouble in school or are thought to be in danger of having school problems. Head Start was designed to give preschool children from disadvantaged homes the skills they need for a good start in school. The largest compensatory education program, and the one that is most likely to affect regular classroom teachers, is **Title I**, a federally funded program that gives schools money to provide extra services for students from low-income families who are having trouble in school (see Borman, Stringfield, & Slavin, 2001; Manna, 2008).

Title I is not merely a transfer of money from the federal government to local school districts or schools. According to federal guidelines, these funds must be used to "supplement, not supplant" local educational efforts. This means that school districts cannot use the money to increase teachers' salaries or purchase ordinary supplies. Instead, funds must go directly toward increasing

the academic achievement of low achievers in schools that serve many students who are disadvantaged. Schools that serve very disadvantaged neighborhoods—neighborhoods in which at least 40 percent of the students qualify for free or reduced-cost lunch—can use Title I money to improve the school as a whole (but still not for basic costs, only for improving outcomes).

TITLE I PROGRAMS Title I programs can take many forms. Most often, a special Title I teacher provides remedial help to students who are experiencing difficulties in reading and, in many cases, in other subjects as well (Borman et al., 2001). However, Title I funds are also used to purchase technology, to provide professional development for teachers, and to hire paraprofessionals.

RESEARCH ON THE EFFECTS OF TITLE I Two major nationwide studies of the achievement effects of the programs offered under Title I were carried out in the 1980s and 1990s. The first, called the Sustaining Effects Study (Carter, 1984), found that Title I students did achieve better in reading and math than did similar low-achieving students who did not receive Title I services, but that these effects were not large enough to enable Title I students to close the gap with students performing at the national average. The greatest gains were for first-graders, whereas the benefits of Title I participation for students in fourth grade and above were slight.

The other major study of the effects of the compensatory services funded under Title I, called Prospects, also compared elementary and middle school children receiving compensatory education services both to similar children at risk who were not receiving services and to children who were never at risk. Prospects did not find any achievement benefits for children receiving Title I services (Puma, Jones, Rock, & Fernandez, 1993). A more detailed analysis by Borman, D'Agostino, Wong, and Hedges (1998) found similarly disappointing outcomes, although there were some positive effects for children who were less disadvantaged and for those who received services during some years but not others. However, the lowest-achieving students from the most disadvantaged backgrounds were not narrowing achievement gaps with agemates who were less disadvantaged.

Although the Prospects study did not find overall positive effects of receiving compensatory services, results were positive in some situations. One particularly influential factor was the degree to which Title I services were closely coordinated with other school services (Borman, 1997; Borman, D'Agostino, Wong, & Hedges, 1998). In other words, schools that closely integrated remedial or instructional Title I services with the school's main instructional program, and especially schools that used Title I dollars to enhance instruction for all students in schoolwide projects, obtained the best outcomes. This kind of integration contrasts with the traditional practice of sending low-achieving students to remedial classes where instruction is poorly coordinated with the classes they are leaving.

Although a review of many studies did find positive effects of Title I on average (Borman & D'Agostino, 2001; Borman, Hewes, Overman, & Brown, 2003), no one familiar with the data would argue that Title I impacts are large (Dynarski & Kaenz, 2015; Manna, 2008). However, the recent passage of the Every Student Succeeds Act (ESSA), which includes Title I, places far more emphasis than ever before on using Title I funds on proven programs and practices, such as comprehensive reforms, tutoring, and proven teaching methods. This may greatly improve the effectiveness of Title I (Slavin, 2013).

Early Intervention Programs

Connections 9.11
For more on prevention and early intervention, see Chapter 12.

Traditionally, Title I and other compensatory education programs have overwhelmingly emphasized remediation. That is, they typically provide services to children only after the children have already fallen behind. Such children might end up in special education or might be retained. It makes more sense to focus on prevention and **early intervention** than to focus on remediation in serving children placed at risk of school failure (see Chambers, Cheung, Slavin, Smith, & Laurenzano, 2010; Goodwin, 2012).

Programs that emphasize infant stimulation, parent training, and other services for children from birth to age 5 have been found to have long-term effects on the school success of students who are at risk. One example is Nurse-Family Partnerships, a program in which trained nurses visit impoverished new mothers to help them learn how to help their children develop physically, emotionally, and mentally (Miller, 2015). Another example is the Carolina Abecedarian program

(Campbell & Ramey, 1994), which found long-term achievement effects of an intensive program for children from low-income homes who receive services from infancy through school entry. The Perry Preschool program has also demonstrated long-term effects of an intensive program for 4-year-olds (Schweinhart & Weikart, 1998). Other programs have had similar effects (Chambers et al., 2010). In addition to such preventive programs, there is evidence that early intervention can keep children from falling behind in the early grades. For example, Whitehurst and colleagues (1999) found lasting effects of an early intervention program emphasizing phonemic awareness (knowledge of how sounds blend into words) and other preliteracy strategies.

Research on preventive strategies shows that children who are at risk can succeed if we are willing to give them high-quality instruction and intensive services early in their school careers (Slavin, 1997/1998). Early intervention also ensures that children who do turn out to need long-term services are identified early—and it ensures that those whose problems can be solved early are not needlessly assigned to special education (see Vellutino et al., 1996).

Comprehensive School Reform Programs

Comprehensive school reform (CSR) programs are schoolwide approaches that introduce research-based strategies into every aspect of school functions: curriculum, instruction, assessment, grouping, accommodations for children having difficulties, parent involvement, and other elements (Borman, Hewes, Overman, & Brown, 2003; Kidron & Darwin, 2007; Slavin, 2008a).

Many comprehensive school reform models were widespread in the 1990s and early 2000s, but by far the most widely used and extensively researched CSR program today is **Success for All** (Slavin, Madden, Chambers, & Haxby, 2009), a program that focuses on prevention and early intervention for elementary and middle schools serving disadvantaged communities. Success for All provides reading programs for preschool, kindergarten, and grades 1 through 8; one-to-one or small-group computer-assisted tutoring for struggling readers; family support services; and other changes in instruction, curriculum, and school organization designed to ensure that students do not fall behind in the early grades. Longitudinal studies of Success for All have shown that students in this program read substantially better than students in matched control schools throughout the elementary and middle grades, and that they are far less likely to be assigned to special education or to fail a grade (see Borman & Hewes, 2002; Borman et al., 2007; Muñoz, Dossett, & Judy-Gullans, 2004; Quint et al., 2015; Rowan & Correnti, 2009). In 2015–2016, Success for All was used in about 1,000 Title I schools in 46 states.

Other comprehensive reform programs focus on high schools. These include the Talent Development High School (Belfanz & Legters, 2011; MacIver et al., 2010), the Institute for Student Achievement (Academy for Educational Development, 2010; Bloom & Unterman, 2012; IMPAQ International, 2016), and Every Classroom, Every Day (Early et al., 2016).

After-School and Summer School Programs

Increasingly, Title I and other federal, state, and local education agencies are funding programs that extend learning time for students beyond the school day. Both after-school and summer school programs are expanding rapidly.

After-school programs typically combine some sort of academic activity, such as homework help, with sports, drama, and cultural activities (Cooper et al., 2000; Friedman, 2003; Neuman, 2010). Studies of after-school programs generally find that for such programs to enhance student achievement, they need to incorporate well-organized coursework, such as individual or small-group tutoring, to extend the academic day (Fashola, 2002; McComb & Scott-Little, 2003). However, reviews of research on the after-school remedial programs funded under supplemental educational services during the Bush administration did not show any consistent benefits of these programs (Chappell et al., 2011; Muñoz, Chang, & Ross, 2012).

Summer school sessions are also increasingly seen in schools, particularly as a last chance for students to avoid being retained in their grade. Summer school has long been advocated as a solution to the "summer loss" phenomenon, in which children from families that are low in socioeconomic status tend to lose ground over the summer, whereas middle-class students tend to gain (Cooper, Borman, & Fairchild, 2010). Research on summer school generally finds benefits for children's achievement (Borman & Boulay, 2004; David, 2010a; Smith, 2011/2012; Zvoch

THE INTENTIONAL TEACHER

Teaching in Light of Research on Grouping and Differentiation

Intentional teachers see students' needs, not texts, as the starting point for planning and providing instruction. They expect students to have varied areas of strength, and they plan instruction that meets the needs of individual students. They monitor student progress carefully and use resources beyond the classroom to meet the needs of students with varying capabilities.

- They consider how to balance the quality, appropriateness, motivation, and time factors in their lessons to maximize the success of all students.
- They use between-class ability grouping sparingly, if at all, and try to accommodate student differences in other ways.
- They orchestrate the use of tutoring, technology, and other supports to help struggling students succeed in the regular class, rather than counting on ability grouping, retention, or special education.
- They differentiate instruction to provide a variety of teaching styles, materials, and technologies to respond to the diverse needs of all students.
- They seek ways to use both cross-age and same-age peer tutoring to help all students learn.
- They seek ways to work with teachers, paraprofessionals, and volunteers to tutor struggling students so they can stay on track toward success.
- They make intelligent use of Title I and other compensatory education resources to prevent problems and improve teaching and learning.
- They promote the use of summer and after-school programs to extend learning time for all students, especially those having difficulties.

& Stevens, 2013). Studies by Kim (2006) and Allington et al. (2010) found that simply sending books home over the summer with fourth-graders, along with encouragement to read, increases their reading performance. However, larger, randomized evaluations of summer programs that just provide books to disadvantaged students do not find this outcome (Wilkins et al., 2012).

A review by Lauer and colleagues (2006) looked at the research on both types of out-of-school programs: summer school and after-school programs. They found small positive effects of out-of-school programs for reading and math when children who attended these programs were compared to those who did not. When the programs included tutoring, effects were much more positive. Effects were about the same for after-school as for summer school programs. The importance of these findings is the indication that struggling children can be helped by extending instructional time for them, especially if the additional time is used for targeted instructional activities.

MyEdLab **Self-Check 9.3**

HOW IS TECHNOLOGY USED IN EDUCATION?

Watch children of any age eagerly playing video games, sending text messages to their friends, or looking up information on the Internet. Adults who see this, or experience it themselves, ask themselves why the obvious power of technology, which is transforming every aspect of life, hasn't transformed education (Fisher, 2013; Maloy et al., 2014; Richardson, 2013; Roblyer, 2016;

TABLE 9.1 • Percent of U.S. Teens, Ages 13–17 Who Own Digital Devices

Desktop/laptop computer	87
Gaming console	81
Smartphone	73
Tablet	58
Basic cell phone	30

Source: Pew Research Center (2015). *Teen relationships survey*. Washington, DC: Author.

Rosen, 2011; Smaldino et al., 2015 Vander Ark, 2012). This is not to say that technology is not present in classrooms. Computers, interactive whiteboards, and all sorts of other technology are present to one degree or another in every school, and most middle-class children, at least, go home to an array of technology as well. Table 9.1 shows that as of 2015, 87 percent of all teens aged 13–17 had desktop or laptop computers, 73 percent had smartphones, and 58 percent had tablets (Pew Research Center, 2015). These numbers are going up rapidly, and as tablets and smartphones become more widespread, it is safe to say that universal access to the Internet is on its way. Digital devices are also becoming far more common in K–12 classrooms (Watson, Murin, Vashaw, Gemin, & Rapp, 2011). Yet only gradually is technology truly changing the core of teaching and learning in America's schools (Daccord & Reich, 2015; Lever-Duffy & McDonald, 2015; Pahomov, 2014; Pitler, Hubbell, & Kuhn, 2012; Roblyer, 2016; Sousa, 2016).

Not long ago, "technology in education" primarily meant computer-assisted instruction (CAI), methods in which students work on individualized, self-instructional content as a supplement to ordinary class instruction. CAI has been used for relatively short amounts of time each week, and perhaps not surprisingly, its impacts on student learning have been quite small (Dynarski et al., 2007; Cheung & Slavin, 2012b, 2013). However, there are now many quite different uses of technology in schools, and it no longer makes sense to ask, "What is the effect of technology on schools?" Instead, we have to look at what each application of technology makes possible, how it interacts with the burgeoning use of technology in homes and throughout society, and what the educational outcomes are for each type of application (Guernsey & Levine, 2015; Pitler, Hubbell, & Kuhn, 2012; Sousa, 2016). There is a tendency for school districts and government to invest in technology without a clear idea of how it will be used or what its outcomes are likely to be (Schneider, 2011). The remainder of this chapter discusses the main uses of technology in schools today, as well as the evidence on the learning outcomes found for each application).

InTASC 3
Learning Environments

InTASC 8
Instructional Strategies

MyEdLab
Video Example 9.1
Textbook author Bob Slavin discusses an experience visiting a school that served as a demonstration site for computers in education. Think about how computers were used in your classes when you were in grade school, and in high school. How do you see technology changing in schools, and what might you expect for the next 15 or 20 years?

ON THE WEB

The International Society for Technology in Education (ISTE) has developed standards for technology use in education. It provides guidance for teachers in the following areas:

- Facilitating and inspiring student learning and creativity
  - Designing and developing digital-age learning experiences and assessments
  - Modeling digital-age work and learning
  - Promoting and modeling digital citizenship and responsibility
  - Engaging in professional growth and leadership

There are widely respected ITSE standards for students (http://www.iste.org/standards/standards-for-students). See http://www.iste.org/standards/standards-for-teachers for ISTE National Educational Technology Standards for Teachers (NETS-T).

Useful information for students about computer etiquette can be found at ehow.com by typing "computer etiquette for kids" into the site's search engine.

There are now many types of technology applications in education. For example, teachers use technology in classroom teaching to plan instruction and present content to classes. Students use technology to learn and practice traditional subjects, explore, participate in simulations and games, communicate with others, and prepare papers and presentations. In addition, teachers and administrators use technology to accomplish administrative tasks, such as assessment, record keeping, reporting, and management (Gura, 2014; Roblyer & Doering, 2012; Thorsen, 2009). Examples of these three types of technology applications are described in the next sections.

Technology for Classroom Teaching

Teachers now routinely use digital technology to enhance their lessons to whole classes or groups of students.

COMPUTERS AND TABLETS Word processors, electronic spreadsheets, and presentation software are the most common electronic technologies utilized for preparing and delivering class lessons. You can use word processors for numerous traditional teaching tasks, such as preparing student worksheets, tests, rubrics, classroom signs, and posters. In addition, the "Review" tools in word processing enable you to provide individualized feedback through the use of "tracked changes" and "inserted comments." Simple desktop publishing features enable teachers to use color, graphics, and art to make texts appealing to students. The editing features of word processing programs make it easy for you to adapt documents to meet specific student needs.

Electronic spreadsheets organize and compute numerical data, producing charts and graphs to illustrate information. Spreadsheets are particularly helpful for teaching mathematics and science because they allow you to display numeric data visually, such as showing the impact of changes on variable values. They also make it easy to display students' work.

Teachers (and students) have available thousands of free and low-cost apps, for every imaginable purpose. For guidance on choosing good ones, see Ferlazzo, 2015. ISTE Standards for teachers: http://www.iste.org/standards/standards-for-teachers.

INTERACTIVE WHITEBOARDS AND ELECTRONIC RESPONSE DEVICES An **interactive whiteboard** is a large screen, visible to a whole class, on which it is possible to display anything that can be shown on a computer screen (Becker & Lee, 2009). Teachers or children can also write on the board and manipulate content that is already there, using either a finger or a special pen (depending on the brand). In addition, students can be provided with **electronic response devices**, or **clickers**, on which they can electronically answer your questions. You can then quickly assess which concepts your class has mastered and which concepts you need to spend more time teaching (Becker & Lee, 2009; Marzano, 2009).

Interactive whiteboards can help teachers solve the problems of orchestrating complex lessons. All lesson elements can be loaded into the computer and projected on the whiteboard, including PowerPoint slides, video clips, still pictures, letters, words, and other prepared content. Moreover, you can create, add to, or modify lessons using the vast digital resources available on the Internet. The whiteboard does not replace the teacher, but instead provides visual aids at the right time to facilitate teaching of exciting, varied, and effective lessons.

Studies of the impacts of the use of interactive whiteboards have found promising outcomes. Reviews by Pittard, Bannister, and Dunn (2003) and by Smith, Higgins, Wall, and Miller (2005) reported that research on interactive whiteboards shows positive effects of the approach on student learning.

A newer form of electronic response devices allows students to work on items at their own level and pace. For example, students in a math class who are working on decimal operations might be given on their handheld devices, problems focusing on fractions, fractional operations, and decimal place values. As they work through the problems, teachers get immediate information on the students' levels, progress, and errors, so they can target individual students or groups for additional help. Studies of this type of device have found positive effects on learning math (Sheard & Chambers, 2011) and grammar (Sheard, Chambers, Slavin, & Elliott, 2012).

Multimedia Teaching

Increasingly, technology is being used to combine text and visual content, such as animations or video. This multimedia approach has been found to enhance students' learning as long as the

text and visuals directly support each other (Höffler & Leutner, 2006; Reed, 2006). For example, adding diagrams or animations to show how lightning works has been found to enhance the text, but adding motivational but nonexplanatory text (such as a picture of an airplane being hit by lightning) can actually detract from learning (Mayer, 2008b, 2009). Studies of first-grade reading found that adding video content on letter sounds, sound blending, and vocabulary to teacher-led reading lessons significantly increases students' learning (Chambers et al., 2006, 2008). A review on storybook reading found that incorporating music and animation added to learning, but games did not (Takacs et al., 2015).

Technology for Learning

Connections 9.12
To learn about the use of computers for students with disabilities, see Chapter 12.

Technology is used for a wide variety of purposes to help students learn. The applications of learning technology fall into the following categories: word processing and publishing, spreadsheets and databases, computer-assisted instruction, the Internet, multimedia, integrated learning systems, and computer programming (Fishman & Dede, 2016; Roblyer & Doering, 2012; Thorsen, 2009). See Chapter 12 for a discussion of uses of technology specific to special education and mainstreaming (Lever-Duffy & McDonald, 2015).

WORD PROCESSING AND DESKTOP PUBLISHING One of the most common applications of computers, especially in grades 3 through 12, is **word processing** or **desktop publishing**. Increasingly, students are asked to write compositions on classroom computers. A key advantage of word processing over paper-and-pencil composition is the ease of revision (Hicks, 2015). In fact, there is evidence that automated feedback on compositions can improve writing and inquiry skills (Gerard et al., 2016; Roscoe & McNamara, 2013; VanLehn, 2011). Spell checkers and other utilities help students to worry less about mechanics and focus on the meaning and organization of their compositions. As writing instruction has moved toward an emphasis on the process of revision and editing, this capability has become very important. Word processing is probably the best-researched application of computers to instruction, and studies have shown that students who use computers write more, revise more, and take greater pride in their writing than do paper-and-pencil writers. Writing quality also tends to be somewhat better when students have access to word processors (Allen, Jacovina, & McNamara, 2015). This writing effect may be enhanced when each student has a laptop, instead of having to share a small number of computers (Lowther, Ross, & Morrison, 2003). Of course, word processing itself has become an essential skill in a vast range of occupations, so teaching students to use word processing programs (e.g., in high school business courses) has obvious value.

SPREADSHEETS As with word processing, **spreadsheets** in education are extensions of software widely used by adults. Spreadsheets can convert raw data into graphs, charts, and other data summaries so that students can easily organize information and see the effects of various variables on outcomes (see Figure 9.2). For example, a student could enter data for the number of daily visitors to Wilbur the pig in a petting zoo. By assigning a formula to a given column, the student could customize the spreadsheet program to total the number of visits to Wilbur by day of the week, time of day, age of visitors, and so forth. Changing any number automatically changes row and column totals. The spreadsheet program could then show the data in raw numeric form or convert the data into a graph. Students are increasingly using spreadsheets to record data from science experiments and to reinforce mathematics skills.

DATABASES A **database** is a computer program that keeps a lot of information available for reference or manipulation. Students can learn to search CD-ROM (ROM stands for read-only memory) databases such as encyclopedias, atlases, road maps, and catalogs to find information for a variety of instructional purposes. Databases of current information are readily available on the Internet. Databases of archived or current information can be particularly important in project-based learning because they may put a great deal of information within easy reach for open-ended reports and other projects.

In many databases, students can use **hypertext** and **hypermedia** to search a database (such as an encyclopedia) by clicking on a word or picture. This leads the student to related or more detailed information on a specific portion of the text (see Figure 9.3). Hypermedia can similarly provide pictures, music, video footage, or other information to illuminate and extend the information on a CD-ROM or online database. Hypermedia has exciting possibilities for allowing learners

FIGURE 9.2 • Example of a Spreadsheet and Resulting Graph

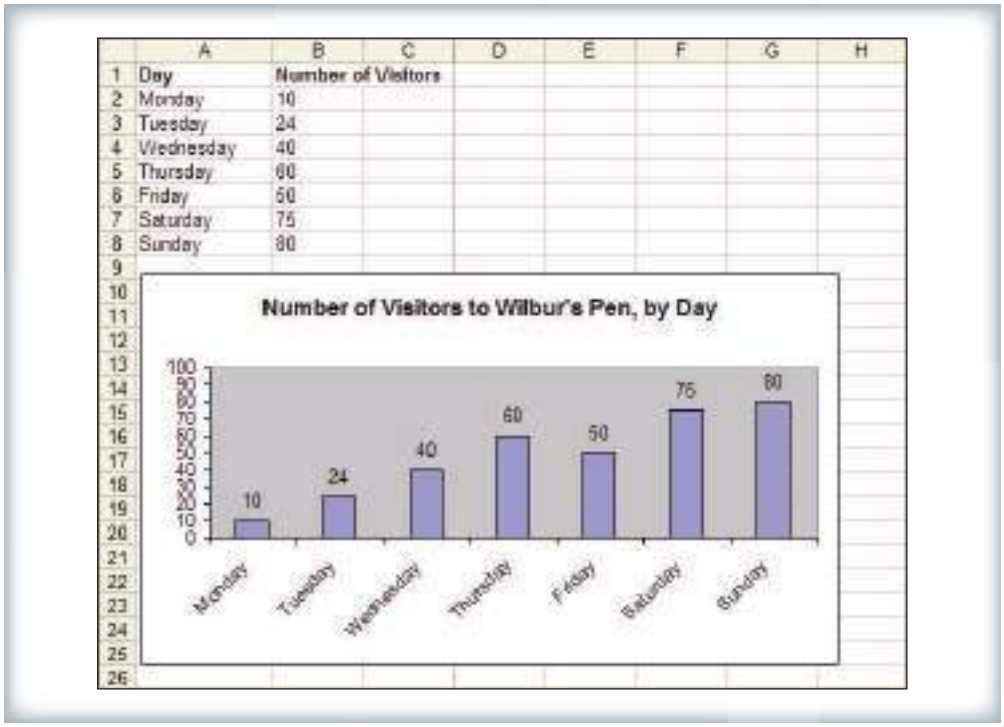


FIGURE 9.3 • Example of Hypertext

Source: www.whitehouse.gov/issues/technology.

to follow their interests or resolve gaps in understanding more efficiently than with traditional text, but so far, research on use of hypermedia finds limited and inconsistent effects on student learning that depend on both the type of material being studied and the nature of the learners (Kamil et al., 2000).

COMPUTER-ASSISTED INSTRUCTION Applications of **computer-assisted instruction (CAI)** range in complexity from simple drill and practice software to **complex problem-solving programs**.

DRILL AND PRACTICE One of the most common applications of computers in education is to furnish students with **drill and practice** on skills or knowledge. For example, many software programs provide students with practice on math facts or computations, geography, history facts, or science. Although computer experts often frown on drill and practice programs, calling them "electronic page turning," drill and practice programs used to replace independent seatwork have several major advantages, including immediate feedback, record keeping, appealing graphics, and variations in pace or level of items depending on the student's responses. This can increase students' motivation to do work that might otherwise be boring. Drill and practice programs should not be expected to teach by themselves, but they can reinforce skills or knowledge that students have learned elsewhere.

TUTORIAL PROGRAMS More sophisticated than drill and practice programs, **tutorial programs**, or "intelligent tutoring systems," are intended to teach new material and present appropriate correction and review based on the student's responses. The best tutorial programs come close to mimicking a patient human tutor. Increasingly, tutorial programs use speech and graphics to engage students' attention and present new information. Students are typically asked many questions, and the program branches in different directions depending on the answers, re-explaining if the student makes mistakes or moving on if the student responds correctly. Very sophisticated computer-managed programs that simulate the behaviors of expert human tutors are being developed and applied in a variety of settings (Roblyer, 2016), and several have shown positive outcomes in evaluations (e.g., Wijekumar et al., 2014). However, effects of intelligent tutorial programs on standardized tests have been quite small (Kulik & Fletcher, 2016).

INSTRUCTIONAL GAMES Most children are first introduced to computers through video games, and many educators (and parents) have wondered whether the same intensity, motivation, and perseverance that they see in children playing video games could be brought to the classroom (Ash, 2012b; Basye, Grant, Hausman, & Johnston, 2015; Carlson & Raphael, 2015; Gaydos, 2015; Goldman et al., 2013; Guernsey & Levine, 2015; Toppo, 2015). Many **instructional games** have been designed; most are simple extrapolations of drill and practice designs into a game format, but some are more creative. A review of research on digital games used in school found significant positive effects (Clark, Tanner-Smith, & Killingsworth, 2016), although another review, by Abdul Jabbar & Felicia (2015), emphasized that positive outcomes of gaming depend on integration with classroom goals and supports, and Takacs, Swart, & Bus (2015) found that games can be distracting in storybook reading.

The Internet for Students

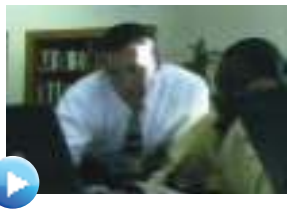
Perhaps the fastest-growing technology applications in U.S. schools involve the **Internet** (Roblyer & Doering, 2012). As shown in Table 9.2, the number of people in the world with Internet access is rising dramatically, from 5.8 percent of the world in 2000 to 46.4 percent in 2015. Internet

TABLE 9.2 • Numbers of World Internet Users, 1995–2015

YEAR	USERS	PERCENT OF WORLD POPULATION
1995	16 million	0.4%
2000	361 million	5.8%
2005	1 billion	15.7%
2009	1.8 billion	26.6%
2010	1.9 billion	28.8%
2011	2.2 billion	32.7%
2012	2.4 billion	34.4%
2015	3.4 billion	46.4%

Source: www.internetworldstats.com

access for schools, which is becoming virtually universal (Watson et al., 2011), gives schools access to vast stores of information, including databases on every imaginable subject, libraries throughout the world, and other specialized information. This information can be used to help students become active, creative learners (Gutierrez, 2013; Jackson et al., 2012). For example, students can use the Internet to do WebQuests, in which they search the Internet on a given topic or theme. The Internet can also enable students to communicate with peers in other schools, regardless of distance. Through this capability students can create international projects or carry out cooperative projects with other schools (Roblyer & Doering, 2012). Most schools have set up their own Web pages, and many have created their own virtual museums or encyclopedias by collecting and synthesizing information from many sources. Students can contribute to **wikis** (online encyclopedias), podcasts, and other virtual publications that give them authentic opportunities to communicate their work (Dlott, 2007; Ohler, 2006).



MyEdLab

Video Example 9.2

Mr. Dunleavy uses a WebQuest in his lesson on Edgar Allan Poe. Note how he points out to the students that part of their task is to understand why the computer and the Internet are important resources for the lesson.

EDUCATIONAL APPLICATIONS There are thousands of applications, or "apps," currently available on the Internet free or at low cost. These range from simple games to lesson ideas to whole courses. The problem for teachers, parents, and students who want to access these apps is in sifting through to find high-quality, appropriate content in the "digital Wild West." A guide to exploring the Internet for literacy programs was published by the Joan Ganz Cooney Center at Sesame Workshop (Guernsey & Levine, 2015).

SIMULATIONS As an interactive model of some sort of reality, **simulation software** allows students to operate within a simulated environment and, by doing so, to learn about that environment from the inside. For example, one of the earliest simulations, "Oregon Trail," gave students limited allocations of food, water, money, and horses. Students had to use these resources wisely to successfully move their wagon trains to the West. Modern simulations include Sim City Edu, Rise of Nations, Age of Mythology, Civilization, Zoo Tycoon, and Local Journey of the Zoominis (Gee & Levine, 2009). There is evidence that well-developed simulations can enhance learning (De Jong, 2011; Goldman et al., 2013).

Certification Pointer

A teacher certification question may ask you to suggest a strategy for using technology to help students learn various instructional objectives.

WEBQUESTS A **WebQuest** is like a simulation, with the additional element of having users seek information on the Web to enhance their ability to play their role or contribute to a discussion or combined product. For example, Global Education (globaleducation.edna.edu.au) allows students to take any of a variety of roles related to the expansion of the desert in Mongolia. In order to participate meaningfully, students need to do research to understand issues from the perspective they have taken on. In Urban Science (epistemicgames.org), middle school students learn about urban planning, economics, and social policy to plan a new city.

ON THE WEB

Resources that can help you effectively use simulations, games, and lessons to engage students with technology include Universal Design for Learning (cast.org), and Edutopia (edutopia.org).

Resources to help students to make their own videos include Animoto (https://animoto.com/education) and Capzles (www.capzles.com).

WebQuest (www.webquest.org) helps teachers create challenging tasks for students to complete using the Web.

Sites such as Zoho Doc (www.zoho.com/docs) provide students with word processors, presentation tools, and spreadsheets, to help them do their own reports.

Several sites advise students and teachers about ethical and responsible uses of the Internet. These include Common Sense Education (www.commonsensemedia.org), and the Center for Digital Ethics and Policy (www.digitalethics.org).

THEORY INTO PRACTICE

Helping Students Judge Internet Sources

The easy availability of information (and misinformation) on the Internet means that students need to become critical readers, able to judge the truthfulness, impartiality, and usefulness of the information they find (Abilock, 2012; Badke, 2009; David, 2009; Richardson, 2009). In general, online content is more trustworthy if it is from a reliable source, has citations from other reliable sources, and shows signs of having been edited and reviewed by others (Abilock, 2012). Concerns about the reliability and completeness of information on the Internet has led many schools to pay for digital encyclopedias (such as the digital Encyclopaedia Britannica), even though Wikipedia and other online sources are free (Ash, 2012a). Table 9.3A and 9.3B show information for students to use in evaluating research sources.

TABLE 9.3A • Determining Reliability of Online Sources

Usually, popular topics are checked by many people, but less popular topics are not. A wiki about a person or company might be written by that person or company, so watch out! Use this checklist to help you determine whether a site is reliable.

Author

- The site has a .gov or .edu ending
- The author or organization is clearly stated
- I can easily find information about the author
- The author is known and respected
- A contact phone number or mailing address is given

Sources

- Sources of the information are given
- Sources of pictures or photographs are given

Content

- There are no ads or spam on the page
- The site has been updated within the past three to six months
- The purpose of the site is to give facts, not opinions
- The text has no misspellings or errors in punctuation
- The website links to other credible websites

TABLE 9.3B • Likely Reliability of Information Sources by Domains

HOW DOES IT END?	WHO OWNS IT?	IS IT RELIABLE
.gov	The government	Yes
.edu	A university or college	Yes
.org	A nonprofit organization or special interest group	Most likely
.com .net .biz	A company or business	It might be trustworthy, but you should be careful. Always verify information found on these sites.

ON THE WEB

For examples of websites that provide information for WebQuests, see edhelper.com and http://webquest.org/.

MULTIMEDIA PROJECTS Students can be encouraged to make their own **multimedia** projects—an update of the old-fashioned group report (Palmer, 2015). In project-based multimedia learning, students design, plan, and produce a product or performance, integrating media objects such as graphics, video, animation, and sound. For example, one seventh-grade class created a social studies and science multimedia presentation about the Black Plague, integrating animations of how the plague virus attacks and the perspectives of 14th-century farmers (Basye, Grant, Hausman, & Johnston, 2015; Gura, 2016).

Students can use a wide array of graphics tools to create their multimedia presentations, including CD-ROMs, digital photos, concept mapping, and graphic organizers. **CD-ROM** and online databases include clip art, photographs, illustrations, music, and sometimes video. Students can use them to create multimedia reports, projects, or explorations that combine audio, video, music, and pictures. **Digital video** and **photographs** can be used as a stimulus for writing or to illustrate projects. For example, students might take digital video or photographs of animals on a field trip to the zoo. Back in the classroom, these serve as a reminder to students of what they saw and also are used to illustrate their reports on the trip.

INTEGRATED LEARNING SYSTEMS Schools often purchase **integrated learning systems**—entire packages of hardware and software, including most of the types of software described previously. Integrated learning systems provide many terminals that are linked to each other and to computers that you can use to monitor individual student work (Lever-Duffy et al., 2003). Web versions of integrated learning systems are also available and add the benefit of providing online learning to students who need alternative schooling options. Research on the effectiveness of commercial integrated learning systems has found modest positive effects on mathematics achievement (Cheung & Slavin, 2013; Dynarski et al., 2007; Slavin & Lake, 2008; Slavin, Lake, & Groff, 2009; Texas Center for Educational Research, 2007), but few effects on reading achievement (Cheung & Slavin, 2012b; Slavin et al., 2008; Slavin et al., 2009).

Web 2.0

Web 2.0 denotes the modern use of the World Wide Web that incorporates free collaborative online communication using a template for users to enter their comments and responses (Dunn, 2011; Knobel & Wilber, 2009; Reeves, 2009). The groups of people who communicate this way are referred to as *virtual communities* or *social networkers.*

WEBLOGS (BLOGS) Weblogs, commonly called blogs, are like online diaries, where authors, or bloggers, post their thoughts and opinions. You can find a sample blog and a tutorial on how to start a blog on blogger.com. In education, blogs can be used as online storage for assignments and projects, for resources the students will need to download, as readers' guides for classroom books, or as a place where students can create and post content.

WIKIS A wiki is a website where visitors can add or change the information on the site. *Wiki* is a Hawaiian word meaning "quickly." The most widely known example is Wikipedia (wikipedia.org), a free online encyclopedia written (and constantly updated) by volunteers who submit whole articles or edit existing articles. In the classroom, wikis can be used during group projects for online collaboration and organizing a group's arsenal of information. A wiki, or a contribution to an existing wiki, can be the outcome of a group, class, or school project (Reich, Murnane, &

Willett, 2012). You can reference sites such as WikEd (wik.ed.uiuc.edu) to access a wide variety of educational resources.

RSS FEEDS **RSS** stands for Real Simple Syndication or Rich Site Summary. RSS lets users know when something new is posted on a blog, wiki, or RSS-capable website in which they're interested. For example, Education Week (edweek.org) provides educational RSS feeds from its publications, online discussion, and blogs on many topics.

PODCASTS Podcasts are multimedia files available on the Internet for playback on computers and mobile devices. There are podcasts on many topics, including TV newscasts and college lectures. You can use podcasts in the classroom to supplement lessons you are teaching. One source is the Education Podcast Network (podstock.ning.com), which lists podcasts by grade level and subject area.

SOCIAL NETWORKING Social networking is the use of websites to communicate with or to meet others who share the same interests. Facebook and LinkedIn are examples. Social networking consumes a huge amount of time for children and adolescents, with effects that are only dimly understood (Grimes & Fields, 2012). The most obvious negatives, the opportunities for cyberbullying and access to inappropriate content, are discussed later in this chapter.

Instructional Television and Embedded Multimedia

An old technology, educational television, is being used in new ways (see Guernsey & Levine, 2015; Shore, 2008). Research has long established the learning benefits of watching educational television shows such as *Sesame Street* (Fisch & Truglio, 2000; Mares & Pan, 2013) and *Between the Lions* (Linebarger, Kosanic, Greenwood, & Doku, 2004). Research suggests that children who watch a lot of educational television become better readers, whereas those who watch a lot of noneducational television become worse-than-average readers (Ennemoser & Schneider, 2007; Wright et al., 2001).

In **embedded multimedia** (Chambers, Cheung, Madden, Slavin, & Gifford, 2006), brief segments of video content are threaded into lessons. In two large experiments, Chambers and colleagues (2006, 2008) found that adding to daily reading instruction 5 minutes of animations and puppet skits illustrating letter sounds and sound blending significantly increases children's reading performance. A review of research contrasting the use of animations and of static pictures in lessons found that students learn better from animated content (Höffler & Leutner, 2006).

ASSISTIVE TECHNOLOGY Assistive technology helps students with physical disabilities such as hearing loss or deafness, speech disorders, vision impairment, or limited dexterity, as well as learning or cognitive delay that impairs performance of target skills (Carpenter, Johnston, & Beard, 2015; Marchez, Fischer, & Clark, 2015). Some examples of assistive technology are adaptive keyboards, screen readers, and screen magnifiers. Assistive technology is discussed further in Chapter 12.

MyEdLab
Video Example 9.3
ZoomText is an example of assistive technology that enlarges computer print for students with vision impairment.

COMPUTER-ASSISTED TUTORING Children who need intensive tutoring for reading problems in the early elementary grades are often given one-to-one or small-group tutoring by teachers to help them get on track to success by third grade. Studies by Chambers et al. (2008, 2012) and Madden & Slavin (2015) found that adding structured, closely aligned computer software with teaching by paraprofessionals improved the outcomes of tutoring, making one-to-six teaching with a computer as effective as one-to-one without a computer.

TECHNOLOGY APPLICATIONS WHEN ALL STUDENTS HAVE INTERNET ACCESS A major revolution is taking place in technology applications in education. Up to recent times, technology use was severely restricted because expensive computers were available in the school only for a small proportion of students at any one time, and few students had computers at home. Because of these concerns, the use of computers in most schools was limited to rotating students through computer labs or computers at the back of the class. It was impossible for teachers to assign work at home that required Internet access.

Universal access to the Internet is already here in schools serving primarily middle-class populations, and it is coming fast in all schools. Two trends are accelerating universal access.

21ST CENTURY LEARNING

Mindful Use of Technology

Today, it is hardly necessary to teach most students to use basic computer technology. They are likely to be comfortable and proficient with computers already. However, it is increasingly important for teachers to design and implement lessons requiring students to engage in the mindful use of technology to find useful information, to learn new skills, and to create documents, designs, and other products. Mindful use of technology implies using critical reading skills to decide what is likely to be true and useful in a body of information, and using learning-to-learn skills to plan a search for information, organize what is found, evaluate the information and select from it, summarize knowledge, and create reports or other new materials based on the summaries. Technology makes libraries of information easily available, but it also allows and even encourages aimless meandering and mindless entertainment. Helping students use technology as a tool rather than a toy gives them essential skills for our times (Daccord & Reich, 2015; Evans, 2015; McTighe & March, 2015).

QUESTION

- Do you think a classroom discussion of students' negative Internet experiences would serve as a warning of what not to do, or do you think it would encourage students to experiment with technology in ways they hadn't thought of and potentially place them in harm's way?

One is the rapid spread of digital devices, especially smartphones and tablets, and the dropping cost of entry-level tablets. Second, school districts are hoping to replace expensive paper texts with (potentially) much less expensive e-texts (see Larson, 2015; Tomassini, 2012). When e-texts become widely available and fall in price, it will be cost-effective for schools to give electronic tablets to children instead of giving them paper texts (Journell, 2012; Tomassini, 2012).

BRING YOUR OWN DEVICE Many schools are experimenting with "bring your own device" (BYOD) policies, in which students are asked to bring whatever devices they have to school every day: tablets, smartphones, laptops, or other devices with access to the Internet (such schools have loaners for students who lack devices) (Johnson, 2012; Schad, 2014). The students then take them home, making digital homework possible. Teaching strategies that take advantage of universal access to the Internet include the following:

Blended Learning The strategies employed in **blended learning** combine ordinary teaching with a broad range of Internet applications (Patterson, 2012). These may include computer-assisted instruction or any number of other applications, which students work on in class, at home, or both. Evidence is unclear about the benefits of this approach (Frey, Fisher, & Gonzalez, 2013; Kist, 2015; Means et al., 2010; Nolan, Preston, & Finkelstein, 2012; Smith, 2013; Staker & Horn, 2012). Initial evaluations are not finding positive effects (Goodwin & Miller, 2013), but this may change as teachers learn to use flipping effectively (Moran & Young, 2015).

Flipped Classroom One form of blended learning is the **flipped classroom** (Ash, 2012a; Fulton, 2012; Moran & Young, 2015; Sams & Bergmann, 2013). In this type of learning, teachers prepare digital lessons and make them available to students online. Students are expected to view the lessons at home and perhaps send answers to questions digitally. The class time is then free for use on cooperative learning, project-based learning, or other activities that require the presence of

other students, as well as teachers. The school or home activities may also make extended use of technology for authoring reports, videos, or other productions, accessing information resources, or connecting with other students, perhaps far away (Bergmann & Sams, 2012). Experience with flipped classrooms, which are used largely in secondary schools, is revealing many problems. Not all students are able to learn traditional objectives on their own, so teachers still have to use class time to review and reinforce lessons. A major study of flipped learning in grades 5–6 math classes in England found no positive impacts of the approach (Villanueva, Rudd, Elliot, Chambers, & Blower, 2016).

Digital Homework When all students have Internet access at home, teachers can confidently assign homework that takes advantage of technology. This could be traditional homework that students send in to be automatically reviewed and corrected before class, or alternative types of homework, such as electronic reports and other creative activities. One growing application is called **Khan Academy** (Khan, 2012; Khan & Slavitt, 2013; Sparks, 2011b), a series of lessons in many subjects provided online at no cost. The lessons consist of explanations by a teacher, followed by exercises. Students proceed through the lessons at their own pace. An elaborate system of awards and badges rewards students' progress. Teachers may assign homework on Khan Academy or other programs to help students reinforce skills they may be weak on or as enrichment activities if they have mastered everything the class is currently doing.

Online homework facilitates diversity in students' assignments, not only by level (as in individualized programs such as Khan Academy) but also by interests. For example, students can select books for book reports from a much broader range of books than exists in their school, perhaps downloading books free from their local public library (Valenza & Stephens, 2012). Students can be asked to investigate science or social studies topics that interest them, using vast information resources throughout the world, and then to create multimedia reports.

Challenges of Integrating Technology

SETTING LIMITS

Cyberbullying Sad to say, bullying has always been a part of relationships among children. However, the advent of widespread access to technology has added to possibilities for bullying by making it easy to spread rumors, lies, embarrassing pictures, or insults about a schoolmate, while concealing their source. This behavior is called cyberbullying. **Cyberbullying** consists of threats or insults one person makes to another via instant or text messaging or over e-mail (Duggan, 2014; Englander, 2015; Hinduja & Patchin, 2011). For example, students may post insulting or damaging information about their victim(s) where others are sure to see it. In a study by Juvonen and Gross (2008), 72 percent of adolescents aged 12–17 reported experiencing cyberbullying. Students who are cyberbullied should be encouraged to print out the offensive messages as proof of their harassment and provide it to their teachers or principal. If possible, they should obtain the e-mail address of the bully. If students don't know who the bully is, it is recommended that they change their screen name and tell it only to trusted friends (Duggan, 2014; Englander, 2015; Hinduja & Patchin, 2011; Thorsen, 2009).

ON THE WEB

For information and resources to combat cyberbullying, see kidshealth.org's parent site, kids.usa.gov, cyberbullying.us, www.pewinternet.org/2014/10/22/online-harrassment, or stopcyberbullying.org.

Twenty-five percent of teens are abused digitally, which correlates to other kinds of dating abuse. For information on preventing digital sexual harassment during teen dating, see https://thatsnotcool.com/.

Cell Phones in Class The popularity of the cell phone for calling and sending text messages has had both positive and negative effects in the classroom (Trotter, 2009). On the positive side, the latest technology enables you to project instant messages onto a screen so the entire class can benefit from a teacher/student instant message exchange. Text messages can be archived, allowing students to later refer to links or to answers they've received. On the negative side, text messaging can be an in-class distraction, can transmit computer viruses, could potentially be used for cheating, and can be a forum for cyberbullying. Given these drawbacks, you need to set limits on the use of cell phones in the classroom.

Safety and Security of Students Students using the Internet can place themselves in harm's way, ranging from accidentally stumbling on inappropriate material to interacting with Internet predators. Simply by spending so much time on the Internet, many students inadvertently leave "digital footprints" that predators can use to contact them (Ferriter, 2011).

There are several ways to protect your students from viewing inappropriate material online (Online Safety and Technology Working Group, 2010). Although the best way to protect students is via responsible adult supervision, children can encounter objectionable material inadvertently, and Internet filtering software can help prevent many inappropriate sites from being viewed. In school applications involving the Internet, software can allow teachers to spot check students' messages and downloads, a good means of reducing students' access to inappropriate content and cyberbullying.

In addition, cybercrime, which is any illegal activity involving computers, is on the rise. Criminals now make more money via cybercrime than via drug-related crimes (Vamosi, 2005)! Even more frighteningly, studies have shown that one in five students received an online sexual solicitation in a one-year period, and that 29 percent of children provided their home address when asked (Bitter & Legacy, 2008).

Here are some general online safety guidelines that you can share with students to help them protect themselves from cybercrime and Internet predators:

- Never give out personal information to a person you've met online.
- Never, ever meet in person with someone you have met online.
- Never say anything you wouldn't want the world to hear, and never show any pictures online that you wouldn't want the world to see.
- Do not give out your user name or password, or any financial information whatsoever, in response to an e-mail, even if it appears to be initiated from a business whose name you recognize.
- Give out credit card or account information only over a secure website or telephone.

Table 9.4 lists some additional rules that students should follow to stay safe on the Internet.

TABLE 9.4 • Tips for Staying Safe on the Web

- Do not use your real name as your online screen or user name.
- Never share your passwords with anyone other than a parent or guardian.
- When you are finished, log out of any website that requires a password.
- Do not download anything from an unknown website.
- Never give out personal information, such as your full name, address, or phone number, or the name of your school.
- Don't know someone? Don't chat with them!
- Check the website's privacy settings before creating an online profile. An adult can help make sure your profile is secure and hidden from strangers.
- Never post pictures of yourself or others that you would not want your parents or teachers to see.

The Internet for Teachers

The Internet can provide rich resources for lesson planning. Teacher-related websites enable teachers to exchange information, support each other, share ideas, and problem-solve. Online resources for teachers include a variety of Web tools.

E-MAIL The advent of e-mail in the classroom has made it possible for teachers to communicate with each other and with parents quickly and easily. From an administrative perspective, e-mail can reduce the need for meetings because teachers can communicate via e-mail. Some schools use e-mail to take attendance.

DISCUSSION BOARDS A discussion board is similar to e-mail in that users respond to each other's comments, but on a discussion board an organizer provides topics for discussion on the initial screen, and then participants can choose the topic they wish to discuss. In this way, you can facilitate student debates on classroom-related issues and provide a forum for opinions.

WEB AUTHORING It is becoming common practice for teachers to post homework assignments, calendars, and general messages on a website for parents to access.

PROFESSIONAL DEVELOPMENT Technology is transforming professional development for teachers. PD content from one-hour inservices to year-long courses is now routinely offered online. Teachers participate in online chats and contribute to wikis as part of their professional growth (see Huber, 2010).

Technology for Administration

You can use a variety of technologies to accomplish the many administrative tasks associated with your work, such as grading, creating reports, writing class newsletters, extending invitations, and sending individual notes to parents. E-mail makes it easier for you to communicate with teaching assistants, administrators, parents, and others. Part of every teacher's job involves organizing, maintaining, and retrieving different types of data. This ranges from creating student rosters and logging students' contact information to tracking coverage of the district's language arts objectives (Archer, 2007). You can use portfolio assessment software to document student achievement. These programs allow you to collect and display the information when it comes time to report to parents.

As schools are being held more accountable for their students' achievements, school districts are using technology to monitor the progress of individual students, teachers, and schools via database management systems. In addition to tracking students' achievements, these management systems enable districts to monitor enrollment, attendance, and school expenditures. Data management software makes it easier for you to enter, retrieve, and update records and to create accurate, customized, professional reports for administrators or parents. You can track which students are mastering what content areas so that you can better target specific instruction to the students who need it most.

AUDIO AND VIDEO CONFERENCING Audio and video conferencing make it possible for groups of people, each in front of their respective computers, to see and hear each other anywhere in the world (Thorsen, 2009). This technology can eliminate the need for administrators to travel to as many meetings. In the classroom, conferencing allows students to witness historic moments or to discuss a topic they are studying with an expert who lives far away.

THE DIGITAL DIVIDE A persistent problem with technology in education is the "digital divide": the difference in technology access between advantaged and less advantaged students (Darling-Hammond, Zielezinski, & Goldman, 2014; Goodman, 2013; Johnson, 2015; Rideout & Katz, 2016). This difference exists both in access to digital devices (such as laptops, tablets, or smartphones), and in home subscriptions to broadband. Homework assignments that assume Internet access, flipped classrooms, and any other strategy that assumes Internet access run up against this problem. If only, say, 90 percent of students have Internet access, it might as well be 0 percent because teachers are unlikely to assign activities that 10 percent of students are not equipped to do.

Some schools deal with the broadband problem by sending home flashdrives containing content, but this limits the uses of the technology. Some schools allow students to use portable "hot spots." Others lend equipment to students who need it, or help parents contact organizations that help families gain access to high-speed, low-cost Internet service and computers. A national

organization that does this is Connect2Compete (/cox.connect2compete.org). Another, called Everyone On, provides information on local sources (http://everyoneon.org).

MyEdLab **Self-Check 9.4**

SUMMARY

What Are Elements of Effective Instruction beyond a Good Lesson?

Teachers must know how to adapt instruction to students' levels of knowledge. According to Carroll's Model of School Learning, effectiveness of instruction depends on time needed (a function of student aptitude and ability to understand instruction) and time actually spent learning (which depends on time available, quality of instruction, and student perseverance).

The QAIT model of effective instruction identifies four elements that are subject to the teacher's direct control: quality of instruction, appropriate level of instruction, incentive, and amount of time. The model proposes that instruction deficient in any of these elements will be ineffective.

How Are Students Grouped to Accommodate Achievement Differences?

Many schools manage student differences in ability and academic achievement through between-class ability grouping, tracking, or regrouping into separate classes for particular subjects during part of a school day. However, research shows that within-class groupings are more effective, especially in reading and math, and are clearly preferable to groupings that segregate or stigmatize low achievers. Untracking means placing students in mixed-ability groups. The students are held to high standards and provided with assistance in reaching those goals. Nongraded elementary schools combine children of different ages in the same classroom. Students are flexibly grouped according to their needs and performance levels.

What Are Some Ways of Differentiating Instruction?

Differentiation, peer tutoring, and tutoring by teachers are all methods for individualizing instruction. Research supports all of these solutions.

What Educational Programs Exist for Students Placed at Risk?

Students defined as at risk are any students who are likely to fail academically for any reason stemming from the student or from the student's environment. Such reasons are diverse and may include poverty.

Educational programs for students who are at risk include compensatory education, early intervention programs, and special education. Federally funded compensatory education programs include, for example, Head Start, which aims to help preschool-age children from low-income backgrounds achieve school readiness, and Title I, which mandates extra services to low-achieving students in schools that have many students from low-income families. Extra services include tutoring and continuous-progress plans.

Research supports the effectiveness of many prevention and intervention efforts such as Reading Recovery, and comprehensive school reform programs such as Success for All.

After-school and summer school arrangements are increasingly funded by federal, state, and local education agencies to extend students' learning time. Research is mixed regarding the effectiveness of compensatory education programs.

How Is Technology Used in Education?

Technology is used for many purposes in education. For example, teachers use technology, such as word processors, multimedia, and presentation software, for planning and presenting lessons.

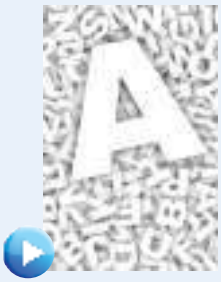
Students use technology, such as word processing and CD-ROM reference software, for learning and preparing presentations. Computer-assisted instruction in the form of drill and practice, tutorials, instructional games, simulations, and the Internet is widespread. Teachers and administrators use technology for administrative tasks. Research on computer-assisted instruction demonstrates small to moderate positive effects on achievement.

THE INTENTIONAL TEACHER

Teaching with Technology

Intentional teachers use technology to accomplish well-defined goals that they cannot accomplish as well without technology. They recognize that there is no magic in the machine, but that technology can enhance their teaching, assessment, planning, and record keeping and can help link students to information, resources, and other students. The teacher's task is not to hand out digital devices and hope for the best, but to plan-fully use the capabilities that technology affords to improve student outcomes.

- They may use technology to prepare exciting, engaging lessons, incorporating various visual media that intrigue and enlighten students, provide visual content to reinforce verbal learning, and help organize concepts for students.
- They may use technology to replace traditional worksheets, giving students immediate feedback and remediation, as well as accommodating students' learning levels and pace.
- They may use technology to assess students' understanding, both to inform students and to learn quickly how individual students, and the class as a whole, are advancing toward class objectives.
- They may use technology to enable students to prepare multimedia projects or reports, working in groups or individually.
- They may use technology to engage students in simulations, such as doing science experiments that would be difficult or impossible to perform in class.
- They may use technology to facilitate planning of lessons, including seeking content for lessons on the Internet.
- They may use technology to connect with other teachers elsewhere and share lesson ideas, content, and advice.



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Application Exercise 9.1

In the Pearson etext, watch a classroom video. Then use the guidelines in "The Intentional Teacher" to answer a set of questions that will help you reflect on and understand the teaching and learning presented in the video.

KEY TERMS

Review the following key terms from the chapter.

between-class ability grouping 217
blended learning 238
CD-ROM 236
compensatory education 225
computer-assisted instruction (CAI) 232
cross-age tutoring 222
cyberbullying 239
databases 231

SELF-ASSESSMENT: PRACTICING FOR LICENSURE

Directions: The chapter-opening vignette addresses indicators that are often assessed in state licensure exams. Reread the chapter-opening vignette, and then respond to the following questions.

1. How does Mr. Arbuthnot, the fourth-grade teacher in the chapter-opening vignette, incorporate John Carroll's Model of School Learning into his lesson?
   a. Mr. Arbuthnot tries to match the time spent on learning with the time students need to learn.
   b. Mr. Arbuthnot groups students according to their ability level.
   c. Mr. Arbuthnot expects students to learn the concepts of long division through group discussion and inquiry.
   d. Mr. Arbuthnot equates quality of instruction with quantity of instruction.
2. Imagine that Mr. Arbuthnot decides to divide his class into three groups: those who know long division, those who know some long division, and those who do not know long division. What type of ability group would he be using?
   a. Tri-grade ability grouping
   b. High–low ability grouping
   c. Within-class ability grouping
   d. Between-class ability grouping
3. In the opening of the vignette, Mr. Arbuthnot teaches an engaging lesson on long division and then gives students a quiz on the content learned. What type of evaluation is this?
   a. Norm-referenced
   b. Standardized
   c. Minimum competency
   d. Formative
4. Mr. Arbuthnot decides that he cannot work individually with all the students who have not yet mastered long division. He decides that some sort of tutoring might solve his problem. If he selects the type of tutoring that is most effective, according to research, which of the following will he use?

   a. Cross-age peer tutoring
   b. Same-age peer tutoring
   c. Tutoring by certified teachers
   d. Computer tutoring
5. Describe programs that exist for students placed at risk.
6. Explain how Mr. Arbuthnot could integrate technology into his teaching. What does the research on computer-based instruction say?

MyEdLab **Licensure Exam 9.1** Answer questions and receive instant feedback in your Pearson eText in MyEdLab.