CHAPTER

7

Diagnostic and Formative Assessments

KEY CONCEPTS

1. Diagnostic assessment is conducted to identify what knowledge and skills a student has mastered and potential reasons for nonmastery. Six approaches to diagnostic assessment are each based on a different definition of a learning "deficit."
2. Formative assessment is a cycle: Students and teachers focus on a learning target, evaluate current student work against the target, act to move the work closer to the target, and repeat the process. Unlike diagnostic assessment, formative assessment seeks to identify both strengths and weaknesses and involves both students and teachers. Six formative assessment strategies include sharing learning targets and criteria for success, giving feedback, fostering student self-assessment and goal setting, asking effective questions, and helping students ask effective questions.

IMPORTANT TERMS

concept mapping
learning progression
passing score
student self-assessment
surface feature

Some authors consider diagnostic assessment and formative assessment as two separate practices, one that takes place before instruction and one during instruction. Our perspective is that the older term *diagnostic assessment* and the newer term *formative assessment* are getting at a similar idea. Diagnostic assessment puts the emphasis on the teacher understanding the status of student learning for the sake of planning instruction. Formative assessment puts the emphasis on the students, as well as teachers, understanding the status of learning, for the purpose of identifying next steps to take for improvement (Assessment Reform Group, 2002). Consequently, a timing distinction does not seem completely useful.

In this chapter, we present six approaches to diagnosing learning difficulties, which teachers will find useful for ferreting out problems in enough detail to address them specifically in lesson plans. Next, we present six formative assessment strategies that can be implemented during the course of instruction and involve students in decisions about their learning.

DIAGNOSTIC ASSESSMENT

Diagnostic assessment of learning difficulties serves two related purposes: (1) to identify which learning targets a student has not mastered and (2) to suggest possible causes or reasons why the student has not mastered the learning targets. The emphasis is on learning deficits, that is, remediation of what the student does not know. Different approaches to diagnosis provide different levels of detail about students' deficits in learning. They also differ in the degree to which they emphasize identifying the targets not mastered or possible reasons why. We discuss six approaches here. Figure 7.1 illustrates each of the first four approaches with a specific example and serves as a tool for comparing the approaches. The last two approaches, illustrated later, are more in line with cognitively oriented instructional psychology.

FIGURE 7.1 Examples of how different approaches to diagnostic assessment interpret the same student's performance.

Examples of items along with responses of a hypothetical student

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
17	15	43	337	654	43	63	562	667
−12	−13	−32	−226	−423	−25	−57	−453	−374
5	2	11	111	231	×22	×14	×111	×313

Total score for subtraction = 5/9 or 56%. Percentile rank = 18

Approach 1. Profile of strengths and weaknesses

The score on the subtraction subtest shown above is compared to the scores on other subtests such as addition, multiplication, division, etc. A profile of strengths and weaknesses in arithmetic is created for each student.

Example: The score of five correct has a percentile rank of 18 and is lower than other subtest scores.

Interpretation of the results: The student is weak in subtraction.

Approaches 2 and 3. Prerequisite hierarchy combined with mastery of specific objectives

The items above may be derived from a hierarchy of prerequisite arithmetic skills and the mastery of each skill in the hierarchy is assessed.

Example:	***Hierarchy of Skills***	*Score*
(4)	Subtract 3-digit numbers requiring borrowing from either tens' or hundreds' place. [Items (h) and (i)]	0/2 or 0 %
(3)	Subtract 2-digit numbers with borrowing from tens' place. [Items (f) and (g)]	1/2 or 50 %
(2)	Subtract two 2-digit and two 3-digit numbers when borrowing is not needed. [Items (c), (d), and (e)]	3/3 or 100 %
(1)	Subtract 2-digit numbers when numbers are less than 20. [Items (a) and (b)]	2/2 or 100 %

Interpretation of the results: The student has mastered the prerequisite Objectives 1 and 2, but has not mastered Objectives 3 and 4. Instruction should begin with Objective 3.

Approach 4. Identifying Errors

The subtraction item(s) that the student answered incorrectly are studied and the student's errors are identified.

Example: The student's responses to Items (f), (g), (h), and (i) are wrong. These are studied to identify the type(s) of errors the student made.

Interpretation of the results: The student is not renaming (regrouping) from tens' to units' place and from hundreds' to tens' place.

Approach 1: Profiling Content Strengths and Weaknesses

In this approach, a deficit is defined as a student's low standing, relative to peers, in a broad learning outcome area in a subject. For example, a student may have less ability in subtraction and division than in addition and multiplication compared to peers. A school subject—say, elementary arithmetic or elementary reading—is subdivided into areas, each of which is treated as a separate trait or ability. *KeyMath*™*-3 Diagnostic Assessment* (Connolly, 2007), for example, divides mathematics into three areas (basic concepts, operations, and applications) and 10 subareas (numeration, algebra, geometry, measurement, data analysis and probability, mental computation and estimation, addition and subtraction, multiplication and division, foundations of problem solving, applied problem solving) and assesses a student in each area. Results are reported as a profile of strengths and weaknesses over the 10 subareas. As is typical of tests in this category, strengths and weaknesses are interpreted in norm-referenced ways: A student with a "weakness" is significantly below the norm. Percentile ranks (discussed in Chapter 17) are the primary type of norm-referenced score used in this context.

Strengths This approach to diagnostic assessment is most useful to give you a general idea about students' performance in subareas of a subject matter. It fits with the intentions many states have of making large-scale test data "formative."

Weaknesses If the set of items that a test has to indicate performance on a particular standard contains only a handful of items or tasks, the subtest scores probably will be unreliable. As a result, the students' strengths and weaknesses may be exaggerated or masked by chance errors of measurement.

Note that this approach does not tell you about attainment of particular learning goals in the absolute sense; rather, it gives relative strengths and weaknesses within the group. Diagnosis with such tests provides you with only general information about where their problems lie. It is much like saying, "The treasure lies to the north." The information is helpful, but it leaves you with a lot of work to do before the treasure can be found.

A good educational diagnostician will use the initial test results to formulate hypotheses concerning students' difficulties. You confirm or reject these hypotheses by following up and gathering additional information. Thus, although the initial profile of strengths and weaknesses may be unreliable, the final diagnosis will be much more reliable.

Approach 2: Identifying Prerequisite Deficits

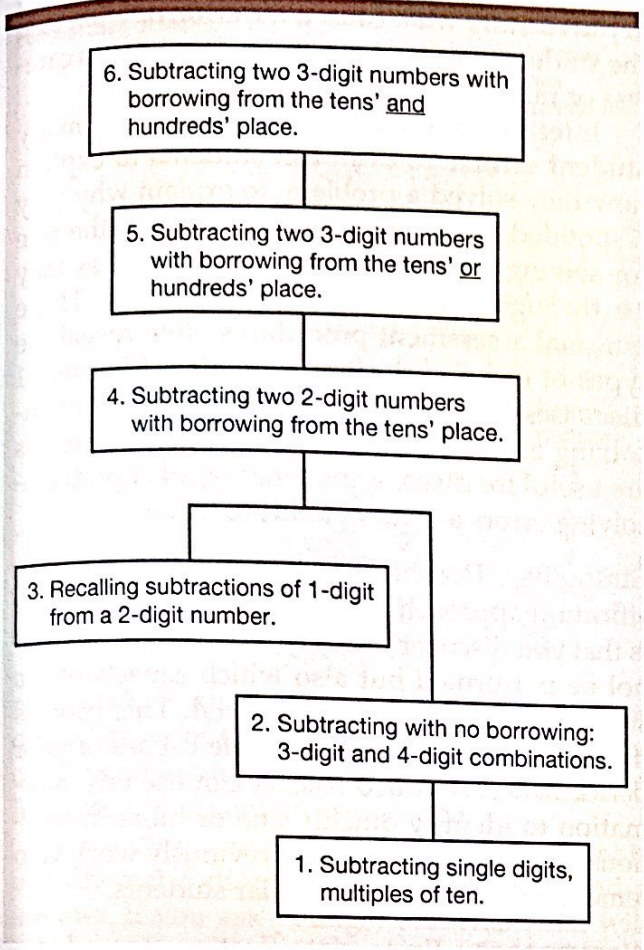
In this approach, a deficit is defined as a student's failure to have learned concepts and skills necessary to profit from instruction in a course or a unit. Select one learning objective the student must be able to perform. Analyze it to identify the prerequisites a student must learn in order to achieve it. For each prerequisite identified, repeat the same analysis, generating a hierarchy of prerequisite performances. Once you have created the hierarchy, assess each student with several items for each of the prerequisites identified. At a minimum, use four or five items per prerequisite in the hierarchy.

This backward analytic procedure identifies critical prior learning, the lack of which could cause students problems in subsequent learning. The difference between this approach and the previous one is that here you focus on whether each prerequisite was learned rather than on the pattern of profile strengths and weaknesses. Your interpretation of results is criterion-referenced rather than norm-referenced. Figure 7.2 shows an example of a learning hierarchy for computational subtraction.

Strengths This approach very specifically identifies skills that students need to learn before they are ready to be taught new learning targets. A hierarchy suggests the sequence for teaching the prerequisites. Assessments of prerequisite knowledge and skills are most helpful when you know very little about the students, especially when you expect large differences in their mastery of the prerequisites. Once you know each student's command of the prerequisites, you can tailor your teaching to meet his or her needs.

Weaknesses This approach is limited by the care and accuracy with which you analyze the learning requirements of your curriculum. If you do not identify the proper prerequisites, your assessment will lack validity. Further, in a continuous-progress curriculum, the distinction between prerequisites

FIGURE 7.2 Prerequisite hierarchy of a subtraction unit.



and "regular learning" is arbitrary, based more or less on instructional convenience.

The learning theory underlying this approach is a building-block approach, in which prerequisite performances build one on another to facilitate the learning of new targets. It is not clear that this building-block approach to learning is an appropriate teaching strategy for all subjects and for all students. Further, it does not provide information about *how* students understand or conceptualize their prerequisite knowledge.

Approach 3: Identifying Objectives Not Mastered

In this approach, a deficit is defined as a student's failure to master one or more end-of-instruction learning goals. Most so-called formative uses of state test data are in this category, for example, as results are used to group students as "below basic" on particular standards. Short tests assess each objective. The difference between this approach and the identifying prerequisite deficits approach is that here you assess only the objectives that are the outcomes of the unit or the course, not the prerequisite objectives.

The diagnostic information you want to obtain from this approach is a list of learning objectives that students have and have not mastered. For each teaching unit, identify and write statements of the learning objectives that are the main outcomes of the unit or the course. For each learning objective, design four to eight test items. If possible, have another teacher review each item and rate how closely it matches the learning objectives. Revise the items as necessary to obtain a closer match. Assemble the items into a single assessment instrument if the list of learning objectives is relatively short (less than six). Otherwise, depending on the students' educational development, you may need to divide the assessment into two or more instruments. For ease of scoring, keep all the items that assess the same objective together in one assessment.

Set a "mastery" or passing score for each learning target. A frequently used **passing score** is 80 percent (or as near as you can come to this with the number of items you have for assessing a learning target). There is no educational justification for 80 percent, however. The important point is not the exact value of the passing score or passing percentage. Rather, it is the minimum level of knowledge a student needs to demonstrate with respect to each learning objective to benefit from further instruction. This amount may vary from one objective to the next. Use your own judgment, remembering that setting a standard too low or too high results in misclassifying students as masters or nonmasters.

Administer the assessment to the students, then separately score each learning objective. Prepare a class list and chart in which you can record the students' scores on each objective. This system lets you identify students with similar deficits. Students should receive remedial instruction on these objectives.

Strengths Diagnostic assessments based on specific objectives are appealing because they (a) focus on specific and limited learning goals to teach, (b) communicate learning goals in an easy-to-understand form, and (c) focus your attention on students' observed performance. These features make assessment easier, instructional decision making simpler, and public accountability clearer.

Weaknesses Objectives-based diagnostic assessments are generally plagued with measurement error, primarily because the assessments tend to have too few items per objective. If you use a diagnostic assessment to decide whether a student has "mastered" an objective, evaluate its quality using an index such as percentage agreement, rather than a traditional reliability coefficient. Percentage agreement is discussed in Chapter 4. Consistency of classification (i.e., of mastery or nonmastery) is the main focus, rather than consistency of students' exact scores.

The objectives approach to diagnostic assessment has other serious limitations. The results give you little information about how to remediate the deficits you discover. As for identifying prerequisite deficits, this approach does not provide information about *how* students understand or conceptualize their knowledge. Further, a student's knowledge base is seen as a simple sum of previously learned specific behaviors.

Approach 4: Identifying Students' Errors

In this approach, a deficit is defined as the type(s) of errors a student makes. The goal is to identify student errors, rather than making a simple mastery-nonmastery decision about overall performance on a particular objective. Examples of errors are failure to regroup when "borrowing" in subtraction, improper pronunciation of vowels when reading, reversing *i* and *e* when spelling, and producing a sentence fragment when writing. Once you identify and classify a student's errors, you can attempt to provide instruction to remediate them.

Accurate error identification takes considerable experience and skill. Further, there may be more than one cause for an error. Consider the subtraction problems in Figure 7.1, for example. An inexperienced or unskilled teacher may not recognize the possible cause of the student's mistakes. Oftentimes, such teachers will say the student was "not careful" or "made careless errors." However, students' errors are rarely careless or random. Rather, *students' errors are often systematic.* Students may apply a rule or a procedure consistently in both appropriate and inappropriate situations. For instance, in Figure 7.1, the student appears to have consistently applied this rule: "Subtract the smaller digit from the larger digit." This rule works for problems (a) through (e), but does not work for problems (f) through (i). *It is important, therefore, that you consider every error a student makes as having some systematic cause.* Try to identify what caused the error, or what rule the student is using, before you dismiss it as careless or random.

Interviewing students helps uncover many student errors. You can ask students to explain how they solved a problem, to explain why they responded the way they did, to tell you the rule for solving the problem, or to talk aloud as they go through the solutions to problems. These informal assessment procedures often reveal the types of errors a student is making. Chapter 11 discusses higher-order thinking and problem-solving assessment. Those assessment strategies are useful for discovering what types of problem-solving errors a student tends to make.

Strengths The chief advantage of the error classification approach over the objectives approach is that you discover not only *that* an objective cannot be performed but also which aspects of the student's performance are flawed. This process narrows your search for possible causes of poor performance. A skilled teacher can use this information to identify quickly one or more instructional procedures that have previously worked to remediate the error with similar students.

Weaknesses Error classification procedures have some drawbacks. Students make many different kinds of errors, and frequently students demonstrate the same error for different reasons, so remedial instruction could be misdirected. Also, the amount of individual assessment and interpretation required seems prohibitive, given the amount of instructional time available. More serious, however, is the problem that if diagnosis only classifies errors, it still fails to identify the thinking processes a student has used to produce the errors. Just knowing the type of error (failing to borrow in subtraction) does not tell you the appropriate knowledge structures and cognitive processes a student needs to reach the desired outcome.

Approach 5: Identifying Student Knowledge Structures

In this approach, a deficit is defined as a student's inappropriate or incorrect mental organization of concepts and their interrelationships. A shortcoming of the diagnostic assessment approaches already mentioned is their strong ties to the **surface features** of subject-matter information and problem solving. Diagnosis should focus

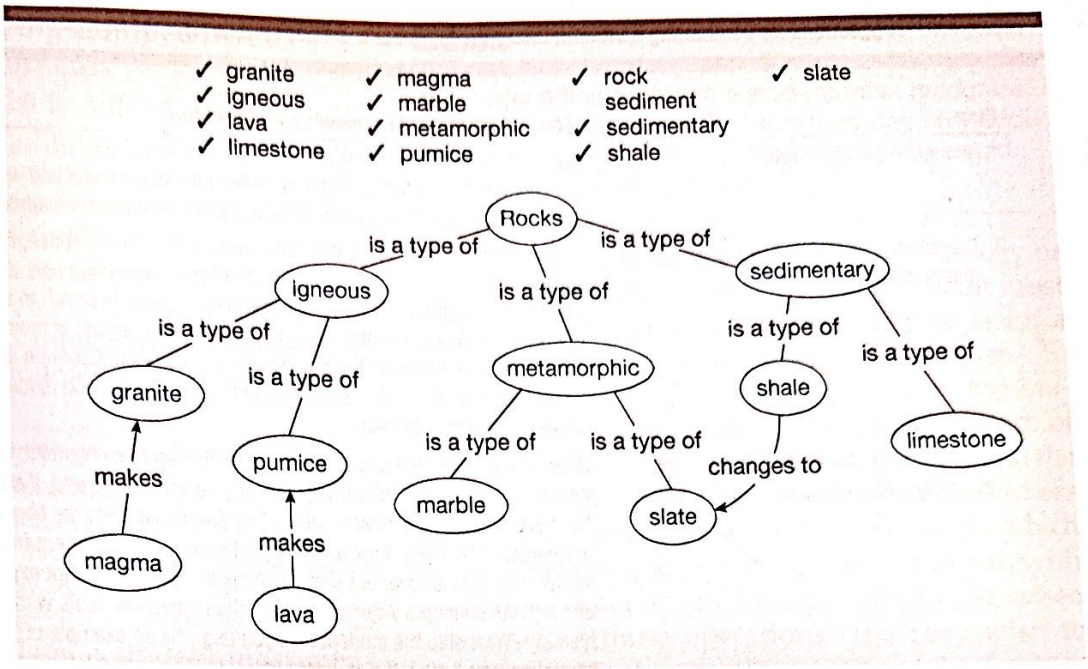


FIGURE 7.3 Hypothetical example of a student's concept map of rocks.

more on how students perceive the structure or organization of that content and how they process information and knowledge to solve problems using that content knowledge.

One example of preinstructional assessment is our Chapter 6 discussion of a cold drink and a sweater. If you ask younger students what will happen to the temperature of a bottle of cold soft drink when it is wrapped up in a wool sweater, many will say that the sweater will warm the drink. In their schemata, "sweater" is something that Mother tells you to put on to keep warm. Thus, even though you may explain things clearly, they do not believe that a sweater has insulating properties that will keep a cold drink cold. You must relate the new concepts to students' current schemata and help them reconstruct their knowledge structures, so they understand how keeping their bodies warm and keeping the soft drink cold are linked by the concept of insulation. To believe it, they need to understand the principles of insulation and how a sweater works as an insulator.

Several methods are used to assess students' knowledge structures. These methods share the common perspective that as individuals become more proficient, their knowledge becomes more interconnected, more deeply organized, and more accessible. Probably the one most commonly used in classrooms is **concept mapping**. A concept map is a graphic way to represent how a student understands the relationships among the major concepts in the subject. An example of how a student might organize concepts related to a science unit on rocks is shown in Figure 7.3.

Notice that this concept map shows that the student has fairly well-organized knowledge of this unit's concepts. However, some important concept linkages are missing. For the most part, the student understands the concepts hierarchically (e.g., *granite* and *pumice* are included in the category called *igneous*, which is a type of *rock*). The student shows only one connection that is related to change or transformation of specific rocks or categories of rocks (*shale* changes to *slate*). The student can't fit into the map the concept *sediment* and so doesn't know that sediment can form *shale* or *limestone*. Other linkages are missing, too: Igneous rocks can weather and transform into sediment and sedimentary rocks; sedimentary rocks can form metamorphic rocks, which in turn can weather and return back to sedimentary rocks; and limestone can change into marble.

Suggestions for how to capture a student's concept map are given in Figure 7.4. For this task, the teacher shows a student the list of concepts at the top of Figure 7.3 and works with the student individually, following the procedure described in Figure 7.4, to create the concept map. As each concept is used in the map, it is crossed off the list.

As you can see from the example, using this approach to diagnosing requires individually assessing students, thoroughly knowing the subject so you can identify where a student has a missing link, and using considerable judgment when interpreting the resulting concept map. The

FIGURE 7.4 Suggestions for conducting a student interview to create a concept map useful for assessment.

Step	The focus of your interviewing and probing
1. Identify major concepts	Give the student a few of the major concepts in the area you are probing. You could put these on cards. Ask the student to tell you about these concepts and some of the other things about which they make the student think. Write every concept the student mentions in a list.
2. Create an arrangement of the concepts to match the student's thinking	Use a large sheet of paper. Ask the student which of the concepts (including the ones you initially showed on the cards) is the major or most important one. If the student does not identify one as the major one, ask the student to pick one with which to start. Write this concept in the middle of the page. Ask the student to select another that is most closely related to the one on the page. Write this near the one already on the page. Continue asking for the ones nearest to the central one. Write these around the central concept. Continue with the remaining concepts, asking where they belong.
3. Establish how the student relates the concepts to one another	Begin with the central concept, work with the nearest ones to it, one at a time, and take each pair in turn. Ask the student whether the two are related and, if so, why or how they are related. Connect the related concepts with a line. Do not connect the concepts the student says are unrelated, even if you think they should be. Assure the student frequently that you are not looking for a correct answer but that you seek to help the student explain how he or she is thinking about these concepts. After connecting the related concepts with a line, write on the line the type of relationship the student tells you (e.g., "is an example of," "is a," "causes," "is part of," "it makes it go," etc.). If a student just says, "They are related," probe further to understand what the relationship is.
4. Give feedback to the student and rearrange the map	Show the student the map so far. Talk about the arrangement. Give feedback to the student, explaining what the map tells you about the student's thinking, and ask if this is correct. Rearrange the map so that it better represents the student's thinking and understanding of the concepts. Talk about each concept and its relationships. Add new concepts if the student mentions them and determine how they are linked to the mapped concepts. Redraw the map if necessary.
5. Elaborate the map to show new concepts, linkages, and examples	Further discuss the rearranged map with the student. Ask the student to tell you more: What else does the student know about these concepts, what are some examples, why are the concepts related, etc.? Incorporate this new information into the map then add branches and expansions as necessary to depict the student's thinking.
6. Explore cross-linkages and complex relationships	Go over the map drawn to this point with the student. Ask the student about the pairs of concepts previously unconnected and about the connections of new concepts mentioned in Step 5. Ask the student if he or she thinks three or four concepts should be connected together and why. Record these complex relationships.
7. Give feedback to the student and rearrange to make the final map	Show the map to the student and discuss with the student what the map tells you about the student's thinking. Ask the student if this is accurate and rearrange the map to make it more accurately describe the student's organization of the concepts. Stop here if you have sufficient detail to understand the student's organization of the concepts. Otherwise, repeat Steps 5 and 6.

validity of your judgments improves if you corroborate your assessment of a student's "missing links" with other evidence about how the student understands the concepts, such as problem-solving tasks and the student's essays and class responses. Also, keep in mind that there may be more than one correct way to relate the information; more than one schema may be correct.

Strengths This diagnostic approach focuses your attention on how a student thinks about the concepts and their interrelationships. It gives you some insight into how the student sees the concepts organized and, perhaps, how they might be related to other concepts and procedures a student has learned. These insights may help you explain why students are making errors, or why they are having difficulty solving problems.

Weaknesses These procedures are experimental. We do not know the degree to which the results are valid, or whether different teachers would reach the same diagnosis for the same student. The way a student reacts to the teacher and the interviewing situation may drastically affect the results. Be cautious, therefore, when you interpret the results.

Approach 6: Identifying Competencies for Solving Word Problems

In this approach, a deficit is defined as a student's inability to perform one or more of the components necessary to solve a word problem. Solving word problems comprises a significant number of learning outcomes in social studies, mathematics, and science. A word problem is a short verbal account of a more or less realistic situation that requires students to use the given information to answer a question. Consider the following word problem:

Example

A bus is carrying 38 passengers. It stops at a bus stop, where 23 passengers get off the bus and 11 other passengers get on. How many passengers are on the bus as it pulls away from this bus stop?

To solve this problem, a student must mentally process it using knowledge from long-term memory in several ways (Mayer, Larkin, & Kadane, 1984):

1. *Translation*—The student must understand each statement in the problem. This kind of assessment requires a student to use factual and linguistic knowledge. To assess linguistic knowledge, focus your questions on the key terms and key phrases students must understand to translate the statement into a mental model of the problem.

Example

For example, in the preceding problem, a student must understand the concepts of *bus*, *carrying passengers*, *bus stop*, *get off the bus*, *get on the bus*, and *pulls away from this bus stop*. Linguistically, the student has to understand the meaning of the question, "How many passengers are on the bus as it pulls away from this bus stop?" Ask questions like: "What does 'pull away' mean in this sentence?"

2. *Understanding*—The student must form a mental representation or model of the problem. In other words, the student must use schematic knowledge to recognize how the problem fits into a general framework to identify the type of problem it is. (See Chapter 12 for a discussion of schemata.) To assess schematic knowledge, ask students questions to see if they know which rules or principles they must use to solve the problem.

Example

In the preceding problem, a student must recognize that this is an arithmetic problem involving only addition and subtraction. Ask: "What operations would you use to solve this problem?"

3. *Planning*—The student must form a strategy or plan for solving the problem. The student must use strategic knowledge. (See Chapter 11 for a discussion of assessing solution strategies.) To assess strategic knowledge, focus on the students' ability to identify the proper sequence of steps or the proper processes needed to reach the answer. For arithmetic word problems, teachers should determine whether students know which numbers to use, which operations to use with those numbers, and which order to use when applying those operations. You may wish to show students several sequences and ask which is the appropriate one for the given problem. All the numbers in the alternative solution strategies should relate to the word problem at hand.

Example

A student must recognize that to know how many passengers are on the bus as it leaves the bus stop, you must subtract from the 38 on the bus those 23 who got off at the stop and add to that remainder the 11 who got on at the stop. Arithmetically, the strategy is (38 − 23) + 11. (*Note:* Many problems may have more than one correct strategy.) Ask: "What number sentence would you write to solve this problem?"

4. *Execution*—The student must use an appropriate algorithm (procedure) and carry out the calculations or steps properly. The student must use algorithmic knowledge. To assess algorithmic knowledge, craft an item that presents the proper sequence and the proper numbers. The focus is on whether students can follow the algorithm without the context of the word problem. To avoid clueing the students as to the proper schema and strategy, present the algorithmic item after you have completed questioning for linguistic, schematic, and strategic knowledge.

Example

The student must be able to correctly arrive at 26 as the number of passengers on the bus as it leaves the bus stop. Ask students to calculate (38 − 23) + 11 = ____.

The diagnosis in this approach is to identify students who are unable to solve word problems and whether their deficits lie in linguistic and factual knowledge, schematic knowledge, strategic knowledge, and/or algorithmic knowledge. Your remedial instruction focuses on teaching students to use the type of knowledge in which they are deficient.

Strengths This approach is most appropriate when you have word problems that are solved by applying a formula or a set of arithmetic operations in an algorithm. These include arithmetic word problems (such as money, time, rate, and cost), word problems in algebra, statistics word problems, social studies word problems involving mathematics, and science word problems. The framework you use to interpret the diagnosis (linguistic, schematic, strategic, and algorithmic knowledge) can be applied consistently across many categories of problems. The framework also suggests how you could remediate a student's deficits.

Weaknesses This approach requires many items per knowledge category to ensure sufficient reliability. The procedure is time-consuming. Patterns you observe for one type of problem (e.g., money) may not emerge in other problem types (e.g., time). This fact makes diagnosis less valid if you try to generalize student deficits across problem types. The validity of the approach also depends heavily on how well you are able to identify key phrases, appropriate schemata, and appropriate strategies for solving the problems. If multiple strategies for problem solving are appropriate, you must be careful to allow students to express these and not confuse the diagnosis by discounting them.

MyLab Education Self-Check 7.1

MyLab Education Application Exercise 7.1: Interpreting Diagnostic Information

FORMATIVE ASSESSMENT

While the main purpose of diagnostic assessment is to support remediation of learning deficits, the main purpose of formative assessment is to support learning at all levels, improving on strengths as well as remediating weaknesses. In fact, another term for *formative assessment* is *assessment for learning*. And while the main emphasis in diagnostic assessment is to provide information for teacher planning, the main emphasis in formative assessment is to involve students in both generating and using assessment information.

Formative assessment cycles assessment information back into the learning process itself. Effective formative assessment is based on sharing learning goals with students and places a high value on appropriate teacher feedback and **student self-assessment**. Helping teachers develop effective formative assessment skills is the most cost-effective strategy for raising student achievement known today (Wiliam, 2007). This is because of its "double-barreled" nature, namely, that formative assessment addresses student cognitive and motivational needs at the same time.

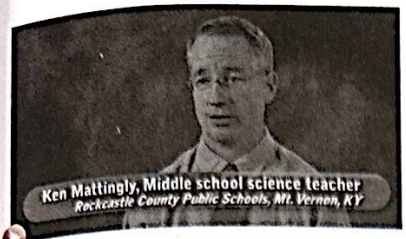
When we say formative assessment is a cycle, we mean the following: Students and teachers focus on a learning target, evaluate current student work against the target, act to move the work closer to the target, and repeat the process. This three-step process is an oversimplification, but it is a useful pattern to keep in mind for teaching and assessment (Sadler, 1983, 1989; Hattie & Timperley, 2007). In fact, if you had to only learn one thing about teaching, you might choose this cycle. From a student's point of view, the cycle is as follows:

- What am I aiming for?
- How close am I now?
- What else do I have to do to get there?

Teachers can obtain formative assessment information by talking with students, observing them working, or looking at the work itself. Similarly, students can obtain formative assessment information by monitoring either their work processes or products. All formative assessment strategies are systematic ways of collecting evidence about work processes or products and using the resulting evidence to improve the work and further learning.

MyLab Education Video Example 7.1

These elementary school teachers describe the differences in both student learning and teacher planning that come with implementing formative assessment. In this video, they use the term "assessment for learning." Notice how their comments show that the most powerful strategy, and the foundation for all other formative assessment strategies, is making sure students understand their learning target for every lesson.



MyLab Education

Video Example 7.2

These secondary school teachers describe how the formative learning cycle makes a huge difference in their instructional planning and their students' learning. Notice how they describe that formative assessment (assessment for learning) helps shift students' focus from getting a good grade to understanding and learning and improves student motivation to learn.

Figure 7.5 provides examples of formative assessments classified according to the types of learning targets and activities to which they are suited. Examples of how to use the results of these formative assessments are also given. If the assessment information is not used, it cannot be formative, because it cannot advance student learning.

Formative assessment is student-centered, but it starts with the teacher's vision. First, you need to have the learning outcomes clear in your own mind. This is not always as straightforward as it sounds. We once did an evaluation of a professional development program to teach middle school teachers how to assess reading. The middle school teachers had all been trained as English teachers, and their main areas of study had been literature and writing. Of course, they knew what "reading" was, but they didn't understand learning goals in reading well enough to help the students who reached middle school needing basic reading instruction. Without a detailed understanding of the outcomes themselves, what they did with poor readers in their classroom was just "make them read" more, and their assessments indicated the students were—no surprise—poor readers. The professional development program divided reading outcomes into five areas: oral fluency, comprehension, strategy use, higher-order thinking, and motivation. The idea was that the program could then offer assessment techniques for each of the five areas. According to teachers' evaluation interviews, the single best thing the program gave them was not the assessment techniques, but a clearer definition of what it meant to be a good reader. Students began to improve as their teachers became better able to show them what they needed to work on (fluency, comprehension, and so on).

Second, you have to communicate the target to students in ways that they understand. Typically, writing your objective on the board is not enough. Sometimes communicating your goals will involve showing students instead of telling them. For example, silent reading works better in elementary classrooms in which the teacher models silent reading, shares the books she reads, and talks about why she liked them than in classrooms in which the teacher uses silent reading time to catch up on paperwork.

Third, the students have to engage. If you have been successful at communicating a learning target, you will have also helped students see why it is important for them to expend effort to reach it. This can be because of interest ("this topic is cool!") or academic, for example, when students are convinced to learn to write term papers in high school, so they can do what is required in college. It can be because students want to be able to do something you or other adults can do, or something their older peers can do. Sometimes several of these motivations occur at the same time. For any given learning target, there will be a mixture of motivations in your class. For example, one student may be interested in a particular topic and another simply convinced that it is an important school target.

Formative assessment is not used for grading. Students need—and deserve—an opportunity to learn before they are graded on how well they have learned. Formative assessment is used before instruction, to find out where students are, and during instruction, to find out how they are progressing. Formative assessment can be used after instruction and summative assessment, but if it is, the students should have the opportunity to revise their work to reflect their new learning. Formative assessment is informational, not judgmental. Students are free to pay attention to figuring out how they are doing and what they need to work on without worrying about a grade. Make formative assessment a part of your teaching. Plan your instruction in ways that provide opportunities for individual students to make formative decisions about their own learning.

Student self-assessment fosters both achievement and motivation. The effects of good formative assessment on achievement have been reported to be as much as 0.40 to 0.70 standard deviations—the equivalent of moving from the 50th percentile to the 65th or 75th percentile on a

FIGURE 7.5 Examples of formative assessment.

Type of learning target	Formative assessment techniques	Use of results
Learning targets involving concepts	Students reflect on previous learning, attitude, and interest	Extending class discussion Selecting appropriate and interesting class activities Identifying and correcting misconceptions Building on previous knowledge (using no more review than is necessary)
Writing (e.g., descriptive, narrative, persuasive, or expository paragraph)	Peer editing Self-assessment and teacher conference	Revising Future writing Reflecting on why the revision is better than the first draft
Learning math tables, spelling words, and other "facts"	Students predict what study strategies (e.g., flash cards) will work best for them and keep track of what works for them quiz by quiz Students record what they "know" and "don't know," gradually moving the "don'ts" into the "know" category as they progress	Students adjust own study strategies Students see exactly what they know and don't know, and they have control over moving their own knowledge
Science or social studies content from textbooks	Students summarize reading in their own words, meet with a peer, and discuss how their summaries are alike/different Students make lists of vocabulary or concepts they feel they understand and those they find difficult	Extending class discussion Focus studying for unit test
Learning targets involving seatwork	Students have a "teacher alert" on their desks, turned to the happy face or the green light when they're understanding and the sad face or red light when they need teacher help	Individual assistance in a "just in time" fashion, focused on the student-perceived source of difficulty
Learning targets involving classwork	Instead of questioning individual students, all students "vote" their answer, so you can scan the class for understanding Younger children can answer yes-no questions as a group by standing ("Stand up if you think that a soda wrapped in a sweater will get warm.") Older students can use answer cards for multiple choice questions, use electronic answer pads, or write one-minute responses on 3 × 5 cards	Adjust pacing of class instruction Adjust content of class instruction Extending class discussion Identifying and correcting misconceptions Building on previous knowledge (using no more review than is necessary) Understanding where all or most of the class is, not just a few students who have been called on
Learning targets involving projects or assignments graded with rubrics	Students look at examples of previous students' work across a range of quality levels and discuss what makes the work of that quality Students "translate" the rubrics into their own words to make them "kid-friendly" evaluation tools Peer assessment of drafts or partial products Self-assessment and teacher conference	Improved understanding of the qualities of good work Revising and finishing the project or assignment Reflecting on the qualities of one's own work for use in future work
Learning targets involving skills (e.g., reading aloud, using the library or computer, writing)	Students set and record a goal and work toward it Teacher suggests a goal, shares with students Observe students in the process of working (e.g., using a microscope) as well as the finished assignment	Students either realize goal (and set another) or can state how far they have come and what they still need to work on Adjust instruction at the individual or group level, as needed

standardized test (Black & William, 1998b)—or may be somewhat lower, around 0.25 (Kingston & Nash, 2011). These effects exist at all levels—primary, intermediate, and secondary—and are especially noticeable among lower achievers, although there is wide variation by content area. For example, a recent meta-analysis of studies of formative assessment and writing (Graham, Hebert, & Harris, 2015) concluded: "We found that feedback to students about writing from adults, peers, self, and computers statistically enhanced writing quality, yielding average effect sizes of 0.87, 0.58, 0.62, and 0.38, respectively" (p. 523).

There are many reasons for the effectiveness of formative assessment, mostly based in constructivist and socio-cognitive theories of learning (Penuel & Shepard, 2016).

- Formative assessment helps teachers and students identify what students can do with help and what they can do independently.
- Participating in formative assessment is active learning, keeping students on task and focused on learning goals.
- Formative assessment, especially peer and self-evaluation, helps students with the social construction of knowledge.
- Formative assessment allows students to receive feedback on precisely the points they need in order to improve. It shows them what to do next to get better.

Motivational benefits of formative assessment are a little more complicated. Different students respond differently to the various aspects of the formative assessment process. Students who can size up their work, figure out how close they are to their goal, and plan what they need to do to improve are, in fact, learning as they do those things. Carrying out their plans for improvement not only makes their work better but also helps them feel in control, and that practice is motivating. This process, called self-regulation, has been found to be a characteristic of successful, motivated learners (Zimmerman & Schunk, 2011).

Below, we present six strategies for formative assessment as well as examples under each: sharing learning targets and criteria for success, feedback that feeds forward, student goal setting, student self-assessment, asking effective questions, and helping students ask effective questions (Moss & Brookhart, 2009). Other authors organize the same formative assessment concepts and processes into different numbers of strategies. Wiliam (2010, p. 31) lists five strategies: "clarifying, sharing, and understanding learning intentions and criteria for success; engineering effective classroom discussions, questions, and tasks that elicit evidence of learning; providing feedback that moves learners forward; activating students as instructional resources for one another; and activating students as the owners of their own learning." We know a professional developer in formative assessment who uses seven strategies. The number of strategies is not the important thing; the strategies are not theories, but simply ways of organizing teachers' formative assessment practices. The main point is having a workable repertoire of strategies that accomplish the formative assessment purpose: to have both students and teachers generate and use assessment information to advance learning.

Strategy 1: Sharing Learning Targets and Criteria for Success

"Learning target" is a term that is often used loosely to mean student-friendly phrasing of any intended learning outcome, goal, or objective. While this definition is true in a general sense, we have found that a much more specific use of the word "learning target" is most useful for formative assessment (Moss & Brookhart, 2012), namely, the learning target for one lesson.

A *learning target* for one lesson describes the intended lesson-sized learning outcome and the nature of the evidence that will determine mastery of that outcome, from a student's point of view. It is closely linked to the *performance of understanding*, the learning activity for the lesson that will accomplish three things: show the student what the learning target means, develop the student's capabilities at that learning outcome, and provide evidence of where the student is in relation to that learning outcome. It is also closely linked to the *criteria for success* that students and their teachers will look for as evidence of learning. A complete and effective lesson-level learning target has all three: a statement of the target, a performance of understanding—something the students will do, make, say, or write—and success criteria for examining the quality of learning demonstrated in that performance. Of course, a series of daily lesson learning targets must function together to lead the student to the larger learning goals. But student learning happens one lesson at a time, which is the reason for focusing learning targets at the lesson level.

To design a learning target, identify the essential content knowledge and skills, including reasoning skills, which you intend to teach in the lesson. Make sure the intended knowledge and skills are derived from, and help lead students to, both your curriculum goals and one or more state standards or Common Core State Standards in the content area and grade level you teach. Design the performance of understanding—what the students are going to do, make, say, or write during the lesson.

Then, state the learning target. Using language from the point of view of a student who has not yet mastered the target, describe what students should be aiming to *learn* as they work on their performance of understanding and how they will know how well

they are doing. Often, teachers begin learning targets with "I can" or "We are learning to."

Example

Learning Targets for One Lesson

- I can use exclamation marks.
- I can explain where and why the French settled in North America.
- We are learning to write a hypothesis that can be tested in an experiment.

To properly communicate a target, you need to share the criteria for good work. Otherwise, you and the students have no way to evaluate how close their work comes to being "good." You can do this by sharing criteria, for example, by giving students a copy of the scoring rubrics you will use to evaluate their final work. You can also show some examples of good work. Or, show some examples over a range of quality levels and let the students figure out what is "good" about the good work.

For some important assignments that you plan to use other years, ask some students if you can save a copy of their work to use in future classes. Most will be delighted. We know one teacher in Nebraska who saved "good example" copies of science notebooks each year to use with future students. She found that the quality level rose each year. Succeeding classes were able to grasp and meet, and then improve on, the standards of achievement shown in the notebooks.

MyLab Education

Video Example 7.3

In this video, a high school science teacher describes how her students "dissect" their learning targets to help them understand what it is they are trying to learn.

Strategy 2: Feedback That Feeds Forward

Armed with appropriate feedback, students should have what they need to improve. For mastery learning targets, this process is more short-term and immediate. (Practice today; find out what you need to work on; do better tomorrow.) For developmental learning targets like becoming a good writer, the process is longer. Students can take into account feedback on today's writing, but also on previous writing, when they write tomorrow. Feedback is such an important element of formative assessment that we devote a whole chapter (Chapter 8) to it.

Strategy 3: Student Goal Setting

As a formative assessment strategy, student goal setting refers to the goal the *student* is trying to learn or achieve, as opposed to a curricular or unit goal. Students will work more productively and learn more intentionally if they themselves are focused on something specific that they understand is important to learn. As you teach students to set realistic, achievable goals, you are also teaching them the skills they need to be self-regulated learners.

Teach students to set goals that are neither too hard nor too easy but "just right"—the Goldilocks principle. Teach students to set goals that are not too specific ("I will learn the names of three different types of clouds"), nor too long-term ("I will learn how to predict the weather"), but again, just right. Then have students select the strategies they will use to reach the goal, use those strategies, and use assessment information to monitor their progress. Give students feedback along the way.

Examples

Student Goals and Strategies

- This week I read 52 words a minute. Next week I want to read 58 words a minute and have better expression. I will practice reading out loud to my parents for 10 minutes every night.
- I always approach my science work by trying to memorize facts. For this next unit, on Oceans, I am going to try to get better at explaining the *reasons* for the things we know about oceans. I will do this by asking "why" each time I learn a new term or concept and see how many of the reasons I can find out. At the end of the unit, I will see how many of my new concepts I can explain.

Notice that the goal-setting examples and strategies discussed here are all content-based. It is a misconception to think of goal setting as a free-standing "study skill." Students' learning goals are specific to the content area they are in, and the kinds of goals students set will differ a bit by subject. Notice also that the goal-setting examples here describe something students want to learn. It is not productive to set goals in terms of a

score (e.g., "I want to get an A" or "I want to get a 95"). This is not student goal setting in the formative assessment sense. The reason is that the evidence needed in this case does not carry any message about where the student is with regard to a learning target and where the student should go next. Knowing I "sound like a robot" when I read helps me decide on a learning strategy ("try to sound more like a person reading a book to someone"). Conversely, knowing that I have scored at the B level doesn't give me any information on what to do to get an A.

Strategy 4: Student Self-Assessment

Sometimes, student goal setting arises out of episodes of student self-assessment. Students should have the opportunity to assess their own learning. Teach students effective self-assessment techniques; for many students, they don't come naturally. Most students will not automatically reflect on their own work in the manner that you intend. For example, if you ask a student, "What did you learn?" without providing any guidance on what to do, many will copy the title of the assignment: "I learned two-digit subtraction," or "I learned how a bill becomes a law." Offer opportunities for students to apply criteria to their own work in progress, discuss their work with peers, and reflect on their work after its completion.

Many self-assessment activities involve putting student or teacher observations on paper where they are easy to see and then discuss. For example, some teachers routinely use reflection sheets. Or, some have students indicate by red light/green light or happy/sad faces on their work whether they are certain or uncertain about their understanding. It is easier to see and interpret a red light than to try to guess from students' expressions that they don't understand.

MyLab Education

Video Example 7.4

Revisiting and reflecting upon the learning target for the day's lesson can help students debrief at the end of a lesson and get a sense of where they are in their learning. This video provides a third grade example.

Rubrics with clear performance-level descriptions can be helpful for student self-assessment. Even with good rubrics, however, students need instruction and practice in comparing their own work with the description in the rubric. Students can work together to compare their work to the learning targets. Teachers should provide a "safe" atmosphere for this, where criticism is seen as constructive and part of the learning process. That is an important lesson in itself.

There are some developmental differences in student use of self-assessment. Younger children may focus on neatness and other surface characteristics of work when they first do self-evaluation (Higgins, Harris, & Kuehn, 1994). With instruction and practice, children can learn to focus on the learning target (Ross, Rolheiser, & Hogaboam-Gray, 2002).

Narrowing the gap between the student performance and a learning goal may not be a smooth process. Depending on the scope of the learning goal, you may need additional rounds of the formative assessment process for that goal. For example, students may write a series of essays in high school, each one benefiting from preceding teacher feedback and self-evaluations. No matter the scope of the accomplishment, students should be able to see their work getting closer to the goal and should understand what specific feedback, insights, and learning strategies they used that helped them close the gap. This is an empowering cycle.

We saw an especially striking contrast of the benefits of teaching self-assessment in two first-grade classrooms in a school district in Pennsylvania. All students wrote reflection sheets to include in portfolios. One of the two first-grade teachers saw that her students had just filled in blanks on the reflection sheet, for example, writing "Adding 5s" in the blank after "What did you learn?" because that was the title of the assignment sheet. She asked her students follow-up questions to stimulate further thinking (questions like "What did you learn to do when you add 5s?") and gradually got more reflective answers (such as "You get 5 or 0 in the ones place" or "I learned I [already] know it"). The other first-grade teacher just passed out the reflection sheets like worksheets, because the evaluation required it. Most of her students stayed in the "copying" phase. The difference between these classes was quite apparent to those of us who got to see both.

Here is an example of both student self-assessment and goal setting. The graph in the first

panel of Figure 7.6 spanned the whole 10-week project. The reflection sheet in the second panel of Figure 7.6 was for just one of the weeks—in this example, the second week—of the project. Notice that this self-assessment and goal setting changed what might have been a rote memory task, memorizing multiplication facts, and enhanced it. Students used analytical and metacognitive skills as they monitored and adjusted their own work.

Example

Student Self-Assessment and Goal Setting

The "minute math" project was part of third graders' learning the multiplication facts from one to 10. Students took a timed, 5-minute test of 100 facts every Friday. Then, they predicted and graphed what they would score the next week, set a goal (besides the score; for example, to learn the eight and nine tables better), and selected strategies (e.g., use flash cards) to reach that goal. The next week, they took the timed test again and graphed their score, compared it with their predicted score and their goal, and set a new goal for the next week. Figure 7.6 shows one student's graph and a portion of her goal sheet for one week.

The goal the student set for her learning was "the nines and eights," by which she meant memorizing the facts for multiplying by eight and nine. This is a goal about *learning*, not scoring. The student's "scoring goal" is part of her plan of action.

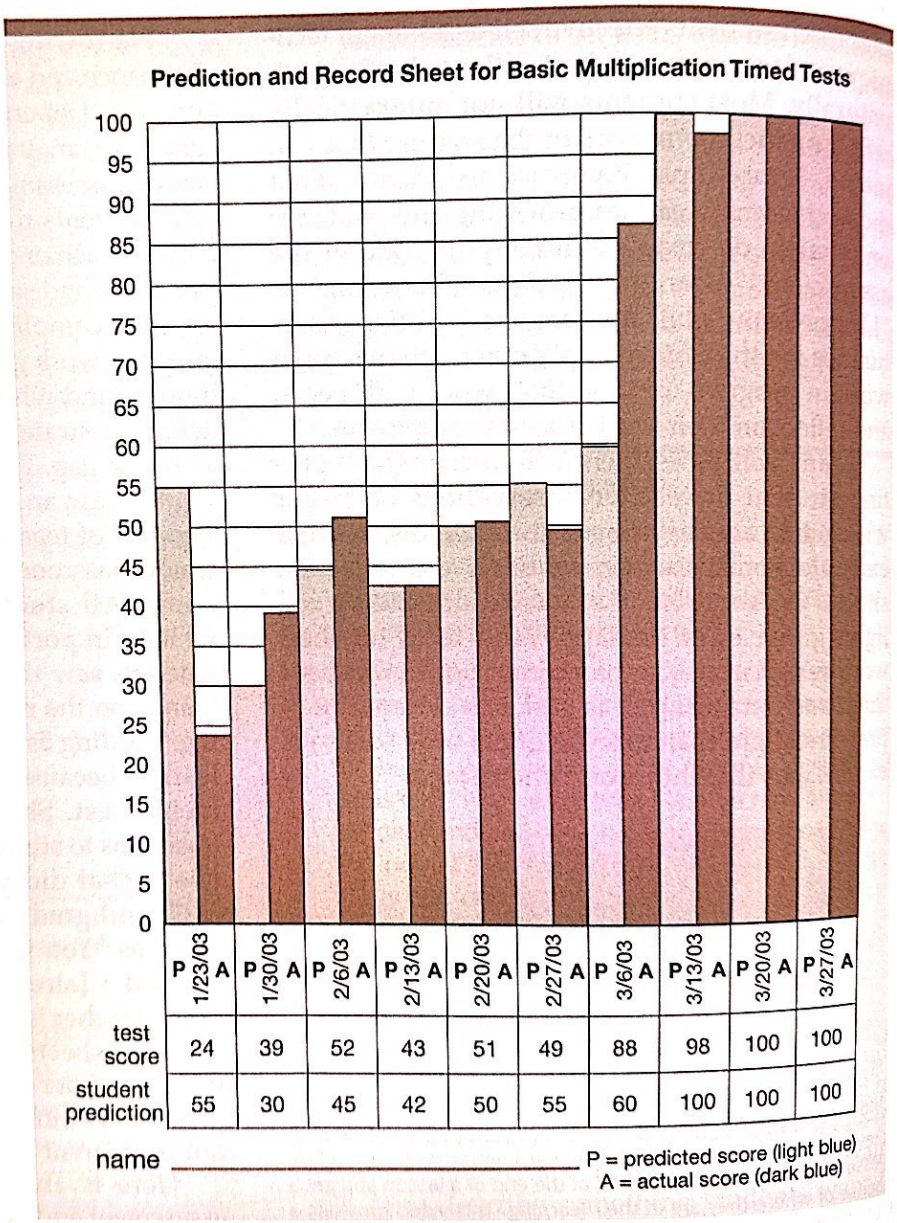


FIGURE 7.6 **Example of student self-assessment and goal setting: Minute math.**

FIGURE 7.6 (*Continued*)

GPAR

Name _____ Date 1-30-03

GOAL-What do you want to learn?
The nines and eights.

LOCATION- Right now I can do 35 facts in five minutes.

PLAN- My goal is to get 43 / 100 facts on my next test. I need to improve in 3 days

ACTION- When will you begin?
Starting Today I will use these study strategies to improve. (study flashcards, play multiplication games, study with parents, etc.)
singing songs and games

I will use these problem solving strategies to improve by Monday. (write a number sentence, use repeated addition, draw a picture, make a model, array)
you bet i will improve

RESULTS- Did you follow through with your plan? What happened? Did you see improvements?

Note: GPAR means Goal, Plan, Act, Reflect
Source: Patricia Pozza. Used by permission.

Some of the students in this class had to be coached to write learning goals, not just scoring goals. This student had a plan, which was basically to enthusiastically endorse all of the strategies her teacher suggested. Over time, students like this one can be coached to focus their plans and strategies. Notice that in the short term, her strategies worked—her performance rose the next week—and in the long term, she achieved her general goal of learning all her multiplication facts.

Strategy 5: Asking Effective Questions

Asking effective questions is a formative assessment strategy because as students respond, student thinking becomes visible. Teachers and students have evidence of what students are understanding and what they are able to do with their knowledge.

Effective questioning requires attention to both content and process. As to the content of the questions, effective questions are open-ended; that is, they invite a range of responses as opposed to one correct answer or one set of correct answers. Asking

thoughtful, open questions requires planning; you are not likely to come up with good ones "on the fly." Plan questions that ask students to think about the content under study and use it to solve a problem or suggest alternatives of some sort.

Examples

Open-Ended Questions That Elicit Student Thinking

- What community organizations can you think of that help people work together?
- What rule can you write that would help you decide whether something is a chemical change or a physical change?
- Why do you think the main character didn't want to leave her home town?

Effective questioning also requires attention to the manner in which the questions are asked. When you ask students questions, make sure that everyone has a chance to be called on. Use a random calling method. Elementary school teachers often write each student's name on a popsicle stick, then draw randomly each time. This technique ensures that a good sample of students is selected, not just students who are volunteering—those students usually either know the answers or enjoy attention, or both. Other random calling methods use numbers, playing cards, and the like. If students know there is a realistic chance they will be called on, they will be more likely to think about the question. It isn't necessary to do random calling every single time you talk with students, of course, but it is necessary if you want to be able to interpret student responses as representative of the class, that is, when you are using questioning as a formative assessment strategy.

Once you ask a question, wait for the student to answer. Typically, teachers wait only a few seconds before moving on to another student. Questions that require thought take more time than that for students to answer. Finally, break out of the pattern of "Initiate-Respond-Evaluate," in which the teacher calls on a student, hears the response, and evaluates it, then calls on another student and repeats the process. Ask students to respond to each other, using question extenders like the examples below.

Examples

Question Extenders to Help Students Respond to and Extend the Ideas of Their Peers

- Barry, what did you think of when you heard Tori's ideas?
- Think about what Tori just said. What other information might we want to know to help us think about that?
- Sarah, can you tell me if you *agree*, *disagree*, or *have something to add* to Tori's ideas?

In the process of drawing out student thinking, you will be generating evidence that both you and the students can use to assess their understanding and to identify next steps in learning.

Strategy 6: Helping Students Ask Effective Questions

Teacher talk is much more common in most classrooms than student talk. To manage their own learning, students have to learn to identify what questions they have and articulate them. They need to realize that learning means getting your questions answered. There are many ways to help students ask effective questions. Two of the most common are teaching students about different kinds of questions, so they can analyze their own questions and learn to ask better ones, and using question starters. All strategies to help students ask effective questions require that you give students practice at asking and answering their own questions.

To teach students about different kinds of questions, you need to develop a shared language. Even young children can learn the difference between "in the book" and "in my head" questions. These are the two main categories in the Question-Answer Relationships (QAR) scheme (Raphael & Au, 2005). "In the book questions" are literal questions whose answer can be found in the text, while "in my head" questions require inferences from the text or connections from one's own life and experiences. "In the book" questions can be further subdivided into "right there" and "think and search" questions, depending on whether the answer is in one location or must be compiled from several places in the text. "In my head" questions can be further subdivided into "author and me" questions that require inferences or connections to textual elements and "on my own" questions about students' backgrounds with topics or themes that do not require textual connections (for example, in a story about a dog, an "on my own" question might be, "Who can tell me about their dog?").

Some teachers teach students about open and closed questions. Open questions have the possibility of multiple good answers. Closed questions

have one right answer or set of right answers. Students' responses to other students' open questions generate deeper evidence about student understanding that can go further in informing students' thinking about where they are going, what they already know, and what they should do next.

When students know about different kinds of questions, they can be coached to ask more open-ended questions that require thinking and give better evidence of their understanding than closed questions. Having a shared language to describe the questions helps in this process. Below is an example of using students' understanding of question types to ask effective questions and demonstrate their thinking

Example

Helping Students Ask Effective Questions

A high school social studies teacher taught his students about open and closed questions. Then, each time he assigned a textbook chapter for students to read, he did not assign the questions at the end of the chapter. Rather, he asked students to write five open and five closed questions about the text and answer them. He asked that students focus their questions on what they thought were the most important concepts, events, or people in the chapter (as opposed to questions about the first five facts in the chapter, for example). Students became more involved in the reading, were eager to find out what other students would say in answer to their questions, and in the process both students and teacher received evidence about students' understanding and application of concepts.

Some teachers we have known are very creative in their use of student questioning. One elementary teacher had students write six open-ended questions about a story they had read and write them on a paper pattern that, when cut out and folded, formed a cube (like a big dice). Students rolled their cubes and asked each other the questions that landed face-up. In this process, students shared their understanding of the story, and both the teacher and students got lots of evidence of what that understanding was. This same strategy could be used for understanding nonfiction texts, for example articles and chapters in science or social studies as well.

LEARNING PROGRESSIONS

Experience or study will teach you the common misconceptions your students are likely to have along the way as they learn a particular concept. Knowing these, you will be able to more meaningfully evaluate performance levels and suggest next steps. **Learning progressions** are developmental sequences that describe typical progress in understanding or skill in a particular domain (Gong, 2008; Heritage, 2008; Hess, 2007).

Formative assessment works best when it is used in the context of a continuum, a vertical "picture" of what it means to learn or progress in a domain. This concept is very different from the approach to learning goals and objectives taken by most state standards and most curriculum materials (Heritage, 2008). A learning progression maps student progress in *learning*, not in accomplishing the teaching- and activity-based "goals" that sometimes form the learning aims for lessons or units of instruction.

Different researchers have taken slightly different approaches to learning progressions. Forster and Masters (2004) used progress maps that described typical growth in an area of learning, which can be used by both classroom teachers and system evaluators to situate student learning on a continuum based in classroom instructional work. Wilson and Draney (2004) described a system of progress variables—specific understandings and skills at a level of detail appropriate for classroom—that could be aggregated to the more general descriptions required for judgment of achievement of a state standard or curriculum goal.

An example of a learning progression in reading and writing is found at the website for the New Zealand Ministry of Education (http://literacyprogressions.tki.org.nz/). Others have made more specific learning progress variables, for example, in understanding forces and motions (Wilson & Draney, 2004). Learning progressions have been developed more in some curriculum areas than in others.

A major insight for formative assessment that learning progressions have given us is to focus on the "big picture" of learning, viewing students' work as points along a developmental continuum. This process will help remove the blinders that can come with focusing too narrowly on students' successes or difficulties with a particular lesson activity, which is a real issue for classroom teachers whose instruction is, by definition, activity oriented.

Find a learning progression in your area, or construct a draft of one with colleagues, and see

how mapping your students in this way helps you be more visionary in your selection of appropriate instruction and in giving appropriate feedback. Many teachers find, when trying to give feedback, that identifying what's wrong with a student's work and suggesting how to fix it comes much easier than identifying strengths in a student's work and suggesting how to build on them. Using a learning progression approach helps you see good work done in an assignment as more than an end of the road.

A COHERENT ASSESSMENT SYSTEM

Learning targets are the hub that connects

- assignments (which in embodying the learning targets serve to communicate them to students and to afford practice on them),
- teacher formative feedback and student self-assessment (which apprise the student of where he stands in relation to the learning targets and what he should do next),
- summative assessment (which evaluates the results of student efforts against the learning targets), and
- scoring criteria (which form the basis for teacher feedback and student self-assessment, and also can express the results of assessment in a symbol system designed to describe quality levels on the learning targets).

We have discussed the importance of assessments and scoring criteria matching learning targets, at both the content and cognitive levels, as a validity issue. The same principle of alignment holds for any classroom assignment, what we have called performances of understanding. Students will interpret what you ask them to "do" (their assignments) as what you want them to learn. Thus, all assignments, not just assessments, must embody the learning targets.

So, for example, if the learning target is for students to write descriptive paragraphs, the assignments should include practice writing descriptive paragraphs. Formative feedback on these should be based on your criteria for "good" descriptive paragraphs. Students should have the opportunity to use the feedback. Finally, they write a descriptive paragraph that is graded according to those same criteria.

Formative assessments give you information about how long to "form" and when to "sum." When students' work gets close to the learning target, they are ready to demonstrate achievement on summative assessment. Students whose formative assessments show they don't need more practice, when classmates still do, can do enrichment work related to the learning target or use their time for some other work.

SYSTEMATIC RECORD KEEPING

Keep records of the important results of formative assessment, not for grading, but to keep yourself organized. For example, you should know what sort of feedback you have given, over time, to a student on a particular skill (e.g., writing). You can design your own class, individual, or group record-keeping sheets for specific purposes. You may wish to use a computer spreadsheet or database program. Or your school may choose to subscribe to a formative assessment system (e.g., LSI Tracker, http://www.learningsciences.com/lsitracker/) that stores learning targets and success criteria keyed to standards, record student achievement at the lesson level based on a variety of evidence, and produce summary reports for lessons, units, and students.

Keeping records will help ensure that you are systematic and have an opportunity to observe all students on all the behaviors or skills you have decided are important. You will be able to see for which students you have observed target behaviors or skills and make a point to observe the rest of them. Also, making notes will result in more complete and organized information than if you relied on your memory. Use patterns of observations to decide what each student needs, or what the group needs. If no natural opportunity to observe a skill presents itself, you may have to create one.

How many observations you want to see before you identify a pattern or draw conclusions will vary. For example, a kindergarten teacher might want to make sure she observes each child holding a pencil correctly at least five different times. A high school biology teacher might want to observe each student preparing a slide correctly at least twice.

MyLab Education Self-Check 7.2

MyLab Education Application Exercises 7.2: (2 exercises) Analyzing Formative Assessment Episodes

CONCLUSION

This chapter has described diagnostic and formative assessment, both of which help inform teacher planning. Formative assessment should be directly helpful to students as well as teachers. It should help them decide about what and how to study, how to approach problems and other assignments, and how to develop learning strategies that work for them. In the next chapter, we focus on feedback, one of the most powerful formative assessment strategies.

EXERCISES

1. For a subject you teach or plan to teach, craft a diagnostic assessment procedure for Approaches 1, 2, 3, and 4. If there is time, try each approach with students who are experiencing learning difficulties. Revise your assessment procedure based on these student trials. Share the final versions of your assessment procedures with others in your course.
2. Each of these statements describes an instructional decision-making situation. Read each statement and decide the approach(es) to diagnostic assessment that may provide needed information.
   a. A teacher wonders whether Larissa missed several arithmetic story problems because she doesn't know her number facts.
   b. Trinh missed several addition computational problems involving mixed decimal fractions. His teacher wonders whether Trinh is counting the number of decimal places in each addend and using this count as the basis for placing the decimal point in the final answer.
   c. Lou missed several whole-number arithmetic problems involving carrying (regrouping). His teacher wonders whether Lou has not remembered to add his "carries" to the sum of the digits in the next column.
   d. Janet is a slow reader who frequently misses comprehension questions following a passage. Her teacher wonders whether Janet has reading reversals that cause her to misread some words in the passage.
3. For each of the following assessment activities, identify at least one formative use for the information the teacher will get from it. You may use Figure 7.5 to help you.
   a. Students set a "help" button on their desk to let the teacher know they're having trouble during math practice.
   b. Students get together in pairs to read and critique each others' reports on a planet.
   c. Students write new vocabulary words on flash cards and use a recipe box to file words into three categories: "know cold," "know most of the time," and "don't know."
   d. At the end of each social studies class, students write "one question I still have" on a 3 × 5 card and turn it in as their "ticket" out of class.
4. Identify the formative assessment strategy in use in each of the following assessment activities.
   a. An elementary math teacher shows her students a box and says, "You already know how to find the area of each of the sides of the box. Today we will learn to find how much space is available *inside* the box. That is called volume. You will know you can do it when you can find the volume of boxes of different sizes."
   b. Elementary students use a rubric for oral expression in reading. Each day for a week, they mark their level of oral expression, in their own judgment and as measured by the rubric, in order to get ready for a graded assessment on oral expression the following week.
   c. A high school civics teacher asks her class, "Who do you think is going to win the mayoral election?" She asks students to explain their reasoning and respond to their classmates' arguments. She listens to the student discussion and decides the students understand very well the effects of the media on elections and need some work on understanding the effects of local history and politics on elections.
   d. A high school science teacher has students design laboratory tests to compare the properties of water samples from different sources. He asks them to brainstorm a list of chemical and physical properties that they think might differ among the samples, turn them into questions (e.g., "How does the electrical connectivity of these samples compare?"), and then decide which ones they will test and what they expect to learn from doing it.