What Curricular Designs and Strategies Accommodate Diverse Learners?

Mack D. Burke • Shanna L. Hagan • Bonnie Grossen

> **Everyone believes that to be a good teacher all you need is to love to teach, but no one believes that to be a good surgeon all you need is to love to cut.**
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> **—Adam Urbanski, Vice President, American Federation of Teachers**

Having a philosophy of education is not enough. Technical knowledge is required to successfully educate the range of diverse learners in today's schools, and educators must incorporate that technical knowledge into the design of instructional materials and tools.

The National Center to Improve the Tools of Educators (NCITE) strives to improve educational practices by advancing the quality of instructional materials. These tools include textbooks, videodisk programs, multimedia systems, and other curricular materials. Though many teachers focus on the nature of a tool (e.g., textbook vs. computer), we should focus not so much on the medium as the way we design instruction. NCITE has identified six features of instruction that efficiently accommodate and accelerate student learning.

In this article, we describe those features and include a brief review of the classroom research validating their implications for accommodating a diverse range of learners during general education instruction.

Principles of Instructional Design

Big Ideas

Students with special learning needs often have a hard time grasping core concepts and distinguishing insignificant details from important points. These students typically have fallen behind academically. We can teach *more information in less time* to students with learning difficulties by organizing instruction around big ideas. Big ideas are concepts and principles that facilitate the most efficient and broadest acquisition of knowledge across a range of examples.

Big ideas are not just major topics of a taxonomy. A big idea is knowledge that can be used over and over and over again. By organizing and prioritizing information around fundamental concepts, teachers use big ideas to efficiently maximize student learning because people can often best understand "small" ideas in relationship to larger, umbrella concepts.

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Here are some illustrations of how teachers may use big ideas to organize information in social studies and science (for additional examples of how to use big ideas and other principles in various subject-matter areas, see Kameenui & Carnine, 1998).

Social Studies Example. Carnine, Crawford, Harniss, Hollenbeck, and Miller (1998) described the big idea of organizing historical information as a *problem-solution-effect* format. They observed that all human efforts to solve problems seem to follow the same pattern. The effect of nearly every solution is that it creates a new problem. For example, inventing the automobile solved the transportation problem but had the effect of creating a pollution problem.

People and governments generally encounter problems related to either *economic* or *people rights* issues. Economic problems are associated with such basic needs as food, clothing, and shelter. People rights problems are typically associated with the need to achieve social, cultural, economic, and religious freedoms. Once students possess a thorough

understanding of historical problems, they can apply this information to identify solutions. In response to problems, groups and individuals tend to find solutions like moving, inventing things, dominating others, tolerating others, or making compromises.

As illustrated in a U.S. history curriculum (Carnine, Crawford, Harniss, & Hollenbeck, 1995), solutions to problems usually have three types of effects: (a) *the problem ends*, (b) *the problem continues*, or (c) *the solution causes a new problem*.

Science Example. Grossen, Carnine, Romance, and Vitale (1998) described *convection* as a big idea that teachers should use in earth science. The convection cell model in the center of Figure 1 represents the big idea. An in-depth understanding of convection allows people to predict changes in the earth. Surrounding the convection cell in Figure 1 (page 36) are various ways the principles of convection are at work around the earth.

Convection explains many of the dynamic phenomena occurring in the solid earth (geology), the atmosphere (meteorology), and the ocean (oceanography). Some convection interactions include plate tectonics, earthquakes, and coastal up-welling. In turn, the interaction of these phenomena in the earth and the atmosphere results in weathering and changes in landforms, the water cycle, El Niño (and La Niña), and climate in general.

Conspicuous Strategies

Efficient strategies characterize skillful problem solving. Expert problem solvers are often hard pressed to articulate the strategies they employ. Many times, experts are not even conscious of the strategies they use. Students with learning difficulties, however, frequently have problems applying what they have learned to solve complex problems and determining when and where to use strategies that teachers have taught (Dixon, Carnine, & Kameenui, 1996).

We recommend, therefore, that educators explicitly teach students discernible and distinct strategies. *Conspicuous strategies* are an approximation of the steps experts follow covertly (and, perhaps, subconsciously) while working toward similar goals.

When students write, they should have some knowledge of words indicating chronology, such as *first, then, next, after,* and *finally.*

For many students, conspicuous strategies may mean the difference between learning and not learning at all. For higher performing students, conspicuous strategies may mean the difference between learning something sooner rather than later. Effective strategy instruction starts with teaching a well-organized knowledge base of component concepts that shows students how to apply the big ideas of their relationships in observable, definitive steps, like using the scientific method, using cooperative learning methods, and learning why certain math rules work.

Primed Background Knowledge

Students with learning difficulties may lack prerequisite skills or may not understand the vocabulary that teachers use to introduce new information. Teachers must "prime" students with the necessary background knowledge. Teachers (and curriculum designers) should analyze the important big ideas to identify the component steps and concepts that allow students an in-depth understanding of the big idea or strategy.

Teachers can "prime" students in learning how to multiply fractions, for example, by preteaching the vocabulary of *numerator* and *denominator,* or by simplifying the directions. Instead of saying "*Write the product of the numerators over the product of the denominators,*" give this direction: "*Remember, top times top and bottom times bottom*." Researchers have found that using a simple verbal prompt that is free from jargon is effec-

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Figure 1. A Big Idea: The Convection Principle and Its Application

tive when combined with examples illustrating the multiplication of fractions (Kelly, Gersten, & Carnine, 1990).

Mediated Scaffolding

Students with diverse learning needs usually have difficulty working independently and may require extensive initial guidance. *Scaffolding* refers to the personal guidance, assistance, and support that a teacher, peer, or task provides to a learner.

Students who are just learning a strategy or big idea need assistance and support. As students become more proficient, the teacher removes the scaffolding. Forms of scaffolding include teacher modeling, extracting critical skills from text, and initially teaching skills in "contrived" (less demanding) contexts.

By removing scaffolding gradually, teachers encourage students to become independent learners. *Mediated scaffolding* provides a systematic transition from initial teacher-directed, modeled, structured, prompted practice within defined problem types to a more naturalistic environment of student-directed, unstructured, unpredictable problems that represent a wide range of problem types.

For example, teachers can convert independent writing activities to group activities, wherein students support one another. Teachers can also temporarily simplify writing tasks, such as using proofreading exercises.

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Judicious Review

Review occurs when students need to draw on and apply previously taught knowledge. The principles of effective review are generally crucial for students with special learning and curricular needs. Teachers must *judiciously plan and organize review* to facilitate better learning, longer retention, and better application. Review is not synonymous with "drill and kill." Judicious review should be (a) sufficient, (b) distributed over time, (c) varied, and (d) cumulative.

Sufficient Opportunities. Teachers should provide sufficient and continuous opportunities for students to apply a concept, until all students are likely to demonstrate mastery. The mere presentation of a definition or formula for density (i.e., *density is the amount of mass in a volume*) or a description of convection is insufficient. Students must have ample opportunities to apply the concept if they are to fully understand its relevance and utility. For example, teachers could ask students to apply their knowledge of density to the following contexts: predicting sinking and floating, predicting wind direction, explaining earthquakes, and explaining black holes and novas.

A program with too much repetitious review is easy to modify: Simply cut back for the students who need less. This is substantially easier than adding review for learners who need more opportunities to achieve mastery.

Review Distributed Over Time. Review that is distributed over time, as opposed

to entirely massed in one learning unit, contributes to long-term retention.

Publishers do a great service to teachers when they provide plentiful review with instructional tools; it is infinitely easier for teachers to simply skip review activities than to create additional ones if necessary. Programs with well-distributed review are far more efficient than those without it, and programs with built-in cumulative review promote strategic integration.

Varied Review. Students are more likely to use their learning in new contexts when teachers vary review (Grossen, Romance, & Vitale, 1994). Varied review should include new examples, but new examples of the same type as those used during initial instruction. When students practice previously taught skills, the types of review tasks teachers give them should represent the full range of potential applications they are expected to master.

Cumulative Review. Review should include not only the most recently learned material, but material from throughout the curriculum. Regardless, an instructional program should provide review of all previously learned concepts, including those that students learned before the current "unit."

Strategic Integration

In some cases, cumulative review may occur in a mixed, random order. Sometimes this salad-like review is the only option. Another option is to use strategic integration to connect old learning to more complex concepts.

Strategic integration requires careful planning so that connections between new knowledge and what a learner already knows and understands build into greater complexity. Many current programs are organized around units that teachers can use in almost any order. Although this design allows flexibility in choice of topics, it encourages a fragmented understanding of content. Curricular materials that use strategic integration to build a big idea must be taught in a carefully ordered sequence. Teachers should organize topics within content areas into parallel, overlapping strands; in this way, teachers can easily communicate connections of the subject, augment the presentation of big ideas, and use scaffolding to build new learning on a foundation of prior learning that no longer requires scaffolding.

Strategic integration provides additional instruction to link the old learning with the new learning for deeper understanding. To go back to our *convection* example, in earth science students need a planned sequence of instruction, including the definition of density, the effect of heat on density, the effect of changing densities on pressure, and so on. Teachers should plan and sequence instruction in these concepts so that students develop a full understanding of convection.

Six Ways to Accelerate Student Learning

The National Center to Improve the Tools of Educators (NCITE) has identified six features of instruction that efficiently accommodate and accelerate student learning.

1. Big Ideas

Big ideas are concepts and principles that facilitate the most efficient and broadest acquisition of knowledge across a range of examples.

A social studies example of a big idea: Human rights problems are associated with the need to achieve religious freedom; freedom of speech; equal protection under the law; and equal rights for women, minorities, and different social classes.

2. Conspicuous Strategies

Conspicuous strategies are an approximation of the steps experts follow covertly to solve complex problems and difficult tasks.

For example, the steps in the strategy for science inquiry are: (a) identify the variable to test, (b) create a condition that changes that variable, (c) keep the other variables the same, (d) gather data, and (e) interpret the outcome.

3. Primed Background Knowledge

Before understanding of new information can occur, necessary background knowledge must be taught or "primed." This requires teaching component steps and concepts that allow an in-depth understanding of a big idea or strategy.

For example, in writing instruction, if students are to write good narrative explanations, they should have some knowledge of words indicating chronology, such as *first, then, next, after,* and *finally.*

4. Mediated Scaffolding

Scaffolding refers to the guidance, assistance, and support that a teacher, peer, or task provides to a learner.

For example, in teaching reading comprehension, the teacher's frequent interspersed questions are a scaffold that can gradually be reduced as students become able to interact with text on their own.

5. Judicious Review

Judicious review should be (a) sufficient for initial learning to occur, (b) distributed over time, (c) varied for generalizability, and (d) cumulative.

An example of judicious review in math is incorporating review of addition, subtraction, multiplication, and division facts even when introducing new knowledge, such as fractions.

6. Strategic Integration

Strategic integration is the process where prior learning is integrated into more complex concepts.

For example, in beginning reading instruction, teachers can provide decodable text as students are learning letter-sound relationships to figure out words.

Note: For more specific examples in various subject-matter areas, see Kameenui & Carnine (1998).

Implications of Design Features on Practice

Designing instructional materials according to NCITE's six principles of instructional design is difficult. Educators are not accustomed to conceptualizing teaching or the design of instructional tools as a task requiring a level of engineering comparable to a building a flightworthy aircraft or structurally sound bridge. Many people believe that all teachers need is the right philosophy. As stated previously, however, teachers need tools to bring all their students along in the learning process.

Who should have the responsibility of designing effective instructional tools? It is unfair to place the burden of instructional design on teachers. Imagine if airplane pilots were expected to design their own airplanes. Yet many teachers are doing just this as they busily adapt inadequate commercial curriculums and instructional materials.

We contend that commercial developers must shoulder the burden of designing effective instructional tools. It is not unreasonable to expect that effective instructional tools be made available to teachers. Other professions rely on technical equipment for support. Should not teachers have professional support systems that provide them with reliable knowledge about teaching and quality products? Of course they should, and fortunately there is a substantial research base to verify the characteristics required to produce quality curricular materials.

The bridge between research and practice, however, will be built only if the educational marketplace demands quality. It is time that we look at the evidence on the effectiveness of a given curriculum before making decisions that affect the long-term educational welfare of students. The number of untested programs available on the market should cause most curricula to be suspect. Many of the latest fads or trends in education claim fantastic results or are advertised as being supported by research.

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Educators must critically examine the performance data on instructional materials. Recently, a number of studies have evaluated the combined effect on student learning of all the features described in this article, incorporated in one program. Findings from these studies indicated that instruction designed according to the principles identified from educational research by NCITE can often close the learning gap between students with disabilities and their general education peers (see the NCITE Web site for the synthesis on research about the six instructional design principles; see also Dixon et al., 1996; Grossen, 1997; Kameenui & Carnine, 1998). We hope that publishers will engage in this dialogue about features of effective tools, and will provide educators with the tools necessary to prevent school failure among all students.

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Mack D. Burke *(CEC Chapter #1111), Special Education Teacher, Kelly Middle School, 4J School District, Eugene, Oregon.* **Shanna L. Hagan** *(CEC Chapter #1111), Graduate Research Assistant; and* **Bonnie Grossen** *(CEC Oregon Federation), Research Associate , College of Education, University of Oregon, Eugene.*

Address correspondence to Mack D. Burke, 240 College of Education, University of Oregon, Eugene, OR 97403-5262 (e-mail: mburke@oregon.uoregon.edu).

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