Chapter 3: Curriculum Evaluation and Modification

Chapter 3 begins by emphasizing the need to closely scrutinize mathematics instructional materials before any purpose. Recommendations for the curriculum adoption process are presented, including a tool intended to assist with the process of screening instructional programs prior to closer examination. Topics related to the design of instructional programs are discussed in detail. A section focused on modifying mathematics curricula closes the chapter.

Learning Outcomes

3.1 Discuss the critical components of a curriculum adoption process.

3.2 Outline major topics that should be included in a curriculum evaluation.

3.3 Describe recommendations for modifying mathematics curricula.

Key Terms

Chapter 3 does not include any new key terms.

Suggested Assignment

Apply What You Learned

Four self-assessment questions appear at the end of the Chapter 3. These questions may be assigned as homework or classwork. Whole and/or small group discussions focused on these questions may be planned to develop understanding and uncover any misconceptions.

Quiz Questions

The following questions are suggested quiz questions for chapters one through three. Some, or all, of the questions may be used. Answers taken from the text follow. The phrase "Accept additional appropriate responses" appears in the answers of questions which may have additional answers that are not found in the text.

1. List the five areas that represent mathematical proficiency according to the National Research Council (2001).

2. List the five features presented in the text that represent instructional design elements essential to well-designed mathematics instruction.

3. Outline the general guidelines for sequencing the introduction of new skills.

4. What recommendations does the text make about alternative math strategies? Provide the rationale for these recommendations.

5. Describe the difference between introductory examples and discrimination examples.

6. Identify the two types of practice recommended in the text and describe the function of each.

7. Outline the steps in an effective error correction.

8. Describe the difference between correcting an error and diagnosing and remedying a pattern of errors.

9. The authors of the text recommend teaching easier skills before more difficult ones. How does this recommendation apply to language instruction in mathematics?

10. Why is excellent math instruction important? List at least three reasons provided in the text.

11. Describe the current performance of U.S. math students.

12. How do math students in the U.S. compare with international students?

13. Compare and contrast di and DI.

14. List at least five of the recommendations presented by Brophy and Good or Rosenshine and Stevens, both in 1986.

15. Describe Project Follow Through and its findings.

Quiz Answers

1. According to the National Research Council (2001), mathematical proficiency is represented by conceptual understanding, procedural fluency, strategic competence, adaptive reasoning, and a productive disposition.

2. The five features presented in the text that represent instructional design elements essential to well-designed mathematics instruction are: the sequence of skills and concepts, explicit instructional strategies, preskills, example selection, and practice and review.

3. The following are three general guidelines for sequencing the introduction of new skills:

1. Teach preskills for a strategy before teaching the strategy.
2. Teach easier skills before more difficult ones.
3. Separate the introduction of information or strategies that students are likely to confuse.

4. The text recommends that teachers select the most generalizable, useful, and explicit strategies to teach their students. The selected strategies should draw attention to the relationships among the mathematical skills and concepts being taught. Some instruction

programs recommend that students develop a number of alternate strategies for the same problem. Rather than developing understanding of the underlying concepts, the introduction of alternative strategies often confuses students.

5. Introductory examples are examples of the most recently introduced type of problem. Discrimination examples are previously introduced types of problems that are similar to the most recently introduced type of problem. The purpose of including discrimination examples is to provide students with practice in determining when to apply the recently learned strategy and when to apply previously learned strategies.

6. The text recommends providing massed practice and distributed practice. Massed practice is frequent practice on a particular skill until mastery is reached. Distributed practice is long-term, systematic practice of a previously mastered skill.

7. Most error corrections occur during group instruction and follow a procedure of model, lead, test, and delayed test. Diagnosis is the process of determining the cause of a pattern of errors. Remediation is the process of reteaching a skill to prevent future errors. An error correction immediately follows the mistake a student makes during teacher-direct instruction and requires minimal diagnosis because the teacher knows exactly which question was missed. A diagnosis, on the other hand, consists primarily of an analysis of the errors students make on independent work.

8. Effective error corrections follow the procedure of model, test, and delayed test. The teacher begins by modeling the correct response. Next, the teacher presents the same task again without providing any assistance. The teacher then provides the delayed test by returning to the beginning of the original task and presenting the entire task again.

9. Although precise terminology is critical to mathematics, it is not necessary to teach precise, mathematically correct definitions initially; rather it is important to provide students with the language that will permit them to take part in math instruction. For example, the following definition for the area of a rectangle, although correct, contains difficult vocabulary concepts and initially is not very useful to students: “To find the area of a rectangle, multiply the length times the width resulting in an answer of square units.” In contrast, applying the guideline of “easy before more difficult,” we recommend introducing the area of a rectangle as “the number of squares it takes to cover the rectangle.” Using student-friendly math vocabulary, appropriate to students’ age and skill level, results in clear communication and promotes understanding.

10. Answers may include the following:

- It is a gateway to higher education as well as to success in many other career paths.
- A great deal of evidence points to the conclusion that math competence is related to level and quality of employment.
- Those with strong math skills can access numerous exciting career options in the new economy, while those who have weak math skills can be limited to fewer and less desirable career options.

- The relationship between high school students' math skills and their later earnings has grown stronger since 1976.
- During the 1990s, growth in employment in the math-intensive sectors of science and engineering tripled that in other areas of the economy.
- Math skills are required in everyday life for selecting purchases, managing finances, and understanding interest rates.
- Math skills are related to patients' health behaviors and outcomes, their understanding of medical issues, and their implementation of treatments.
- Mathematic competence is increasingly recognized as being important for the economic success of the nation.

11. The National Assessment of Educational Progress (NAEP) measures the performance of American students in a variety of content areas (National Center for Education Statistics [NCES], 2015). Students in grades 4 and 8 are assessed in mathematics every 2 years. The 2015 NAEP results revealed that 49% of fourth graders and 57% of eighth graders failed to meet proficiency standards. This represents a worse performance than was seen only 2 years earlier. The situation is dire for underrepresented groups. For example, 87% of Black and 81% of Hispanic eighth graders were not proficient in math in the 2015 assessment (NCES, 2015). Similarly, students with disabilities experience very poor math outcomes. Results on the NAEP indicate that 84% of fourth-grade students with disabilities and 92% of eighth-grade students with disabilities were not proficient in mathematics.

12. International comparisons consistently show that American students lag behind other industrialized countries in math proficiency. The Organization for Economic Cooperation and Development (OECD) administers the PISA test every 3 years in 65 countries to evaluate 15-year-olds' performance in reading, mathematics, and science (OECD, 2014a). The 2012 PISA math results indicate that the United States ranked 27th among the 34 OECD member nations assessed (OECD, 2014b). Additionally, U.S. math scores were below the average of math scores calculated from all 65 countries assessed, and 25% of students in the United States tested below the basic proficiency level established by the PISA. The 2015 PISA focused primarily on science, although data related to mathematics were obtained. The overall mathematics results indicate that students in the United States continued to perform below average compared to the other industrialized nations (OECD, 2016). The results of the PISA indicate that U.S. students struggle with real-world math problems, mathematical modeling, geometry, and mathematical literacy.

13. When stated in lowercase letters, direct instruction is an instructional strategy that includes:

1. Content presented in small steps.
2. Explicit teacher modeling or explanation.
3. Guided student practice with gradually faded support.
4. Use of feedback including explicit corrections of errors.

5. Independent practice including cumulative review.

When the term is written as a proper noun with capital letters ("Direct Instruction"), it primarily refers to instructional programs that include all the features of direct instruction (note the lowercase) and also have additional instructional design features, as described in Chapter 1 that make them even more effective for teachers and students. Commercially developed Direct Instruction (capital letters) programs organize the content around generalizable strategies that students can use to solve a wide variety of problems, and they implement detailed principles of clear communication to ensure that these generalizable strategies are conveyed effectively to students—including those at risk. Direct Instruction programs also include features to increase student engagement such as unison student responding and signals to coordinate those responses.

14. Brophy and Good's recommendations:

- Students should receive frequent opportunities to respond to questions, and they should get clear feedback about the correctness of their responses.
- Skills should be mastered to overlearning, with new ones gradually phased in while old ones are being mastered.
- Both progress through the curriculum and pacing within specific activities should be brisk, producing continuous progress achieved with relative ease (small steps, high success rate).
- Individual progress should be closely monitored so that all students, especially struggling students, are checked, receive feedback, and achieve mastery.

Rosenshine and Steven's recommendations:

- Present new material in small steps, with student practice after each step.
- Give clear and detailed instructions and explanations.
- Provide a high level of active practice for all students.
- Ask a large number of questions, check student understanding, and obtain responses from all students.
- Guide students during initial practice.
- Provide systematic feedback and corrections.
- Provide explicit instruction and practice for seatwork exercises and, where necessary, monitor students during seatwork.

15. Project Follow Through, a federal education project, was implemented beginning in the late 1960s and was the largest organized experiment in the history of education. It involved nearly 100,000 students in 170 communities across the country and cost nearly $1 billion (Watkins, 1997). The goal of Project Follow Through was to identify models of instruction that could close the gap in academic achievement between economically disadvantaged students and those from higher-income families. Researchers tested nine instructional models including Direct Instruction. Each was implemented in at least three schools, and each model school was paired with a similar control school. Outcome measures included three domains:

(a) basic academic skills such as word knowledge, spelling, and math computations; (b) cognitive outcomes such as reading comprehension, math concepts, and math problem solving; and (c) affective outcomes such as responsibility and self-esteem.

Direct Instruction was the only model that demonstrated large positive effects in all three domains. The data indicate that Direct Instruction can be effective with students who are economically disadvantaged and that it can improve not only basic skills but also complex cognitive and affective outcomes. Students taught using the Direct Instruction model significantly outperformed students taught using the other models. In fact, the Direct Instruction students performed close to the 50th percentile, an outstanding feat considering the 50th percentile is the median for students of all income levels in the United States.