DIRECT INSTRUCTION IN MIDDLE SCHOOL MATHEMATICS FOR STUDENTS WITH LEARNING DISABILITIES

ABOUT THE AUTHORS

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INTRODUCTION

The No Child Left Behind Act (NCLB) (2001) and the reauthorization of the Individuals with Disabilities Education Act (IDEA) (2004) place increasing academic expectations on youth and particularly on youth with disabilities. To address these rigorous educational demands, NCLB emphasizes the use of proven educational methods to promote positive academic outcomes, and access to the general education curriculum for all students (Educational Policy Research Reform Institute, 2002).

One of the most important methods of ensuring access to the general education curriculum for students with disabilities is through use of empirically validated instructional approaches. In fact, IDEA identifies the need to, "provide for appropriate and effective strategies and methods to ensure that students who are children with disabilities have maximum opportunities to achieve those standards and goals" (IDEA, 1997, Sec 651 (a)(6) (A), p. 12470).

One group of students that may challenge the implementation of new educational policies is youth with high incidence disabilities, such as those with learning disabilities (LD) (Gagnon & McLaughlin, 2004). This is particularly true concerning mathematics, where students with LD commonly experience problems such as focusing attention to key task variables (Kauffman, 2001), self-monitoring during problem solving (Montague, Bos, & Doucette, 1991), and self-management (Bricklin & Gallico, 1984; Gallico, Burns, & Grob, 1991). Additionally, students with LD typically function 1.8 grade levels behind their non-labeled peers in math (Wagner, 1995).

To address the challenge of effectively instructing students with LD in math, this Access Center Brief will focus on the use of direct instruction (*di*) with middle school students with LD. The *di* approach to instruction is a teacher-directed approach that emanates from a synthesis of correlational and empirical studies. These studies examined teaching behaviors that correlate with student learning (Rosenshine & Stevens, 1986).

WHAT IS THE DIRECT INSTRUCTION (DI) APPROACH?

Whereas Direct Instruction (DI) refers to a specific method of teaching that focuses on both "what" to teach (i.e., the design of the curriculum) and "how" to teach (i.e., specific teaching techniques), direct instruction (*di*) refers to more general teaching methods. Specifically, *di*

refers to teaching behaviors and organizational factors (i.e., the "how" to teach) that are associated with positive student learning outcomes (Tarver, 1992). Rosenshine and Stevens (1986) analyzed effective instructional practices teachers used and grouped them into six teaching functions: (a) review, (b) presentation, (c) guided practice, (d) corrections and feedback, (e) independent practice, and (f) weekly and monthly reviews. More recently, Rosenshine (1996) noted the importance of these teaching functions for helping learners perform independently on highly structured tasks, such as computational skills. "Two findings from that research that are most relevant to teaching are (1) the importance of teaching in small steps and (2) the importance of guiding student practice. In addition, a third finding, the importance of extensive practice, is shared with the research on cognitive processing" (Rosenshine, p. 264).

WHAT ARE THE SIX TEACHING FUNCTIONS?

The six teaching functions consist of the following:

- Review. The first teaching function involves starting each lesson with a review of previously learned skills, homework, and/or the prerequisite skills students will need for the target lesson. The review serves as an informal assessment for teachers to gauge whether students have the necessary prerequisite skills or if reteaching of the content is necessary prior to lesson delivery.
- Presentation. The second teaching function addresses the general techniques that positively correlate with presenting new material in a clear and organized manner. It is suggested that instructional delivery include the following components:
    (a) an overview of the lesson (e.g., verbally stating or listing the lesson goals)
    (b) teach the new skills at a fast rate to maintain student attention and in small increments to reduce student confusion
    (c) model the procedures via thinking aloud, using clear and consistent language
    (d) check for initial student understanding by asking questions, and provide repeated explanations or demonstrations as needed
    (e) Incorporate a variety of examples and teach to a level of mastery prior to advancing in the lesson (Rosenshine and Stevens, 1986; Rosenshine, 1996)
- Guided practice. Teacher-directed practice follows the initial demonstration and includes teacher supervision and guidance as students start to perform the new tasks. During this initial learning stage, it is expected that students will become "firm" with the material and reach a level of 80 % correct or greater. To obtain this level of success, instructional guidance should include:
    (a) A high number of factual questions (i.e., requiring specific responses) and process-based questions (i.e., requiring explanation of steps). Procedures should include individual and group responses to assess student understanding
    (b) Teacher prompts (e.g., verbal or written cues, anticipating and addressing frequent student errors) are provided to help students perform the task. The prompts are then gradually phased out as students assume more responsibility for completing the tasks independently
    (c) Teacher evaluation of student understanding based on frequent student responses. Teachers should also use specific corrective feedback as needed
- Corrections and feedback. As noted in the previous stages, including the review, presentation, and guided practice, corrective feedback is provided immediately to reduce student errors. Four types of student answers and suggested teacher responses are outlined below:

The student provides a(n):	The teacher:
• Quick, correct, and firm answer	• Moves on to a new question to maintain the pace of the lesson
• Accurate but hesitant answer	• Provides brief feedback ("correct") and an explanation of why the answer is correct
• Careless mistake	• Corrects student error and move on in the lesson to maintain the pace
• Inaccurate answer due to facts or process:	• Restates the question into simpler form, provides clues/prompts, and reteaches if necessary

- Independent practice. During independent practice, students perform the task while the teacher monitors performance and provides additional explanations or reteaching as needed. Initially, students will perform the task slowly as they think through the process with few errors (unitization stage) prior to performing the task with a higher level of accuracy and speed (automaticity stage). For student practice to be successful, it is important to maximize the time scheduled for independent student seatwork and to program for overlearning of the target skill (to a level of 95 % correct or greater). Rosenshine (1983) recommends the following guidelines for increasing student involvement during independent practice:
  (a) Programming for more demonstration and guided practice time than independent seatwork time to adequately prepare students to work independently
  (b) Providing structured support at the beginning of the independent practice (having the class perform the first two or three problems and checking the work prior to moving on)
  (c) Circulating among the class and monitoring student work by asking questions, checking answers, and giving brief instructions if needed. For more difficult material, Rosenshine (1983) suggests dividing instruction tasks involving many steps (e.g., 2 digit multiplication) into segments with multiple instructional and independent segments per period. For example, the teacher can demonstrate the first step in the algorithm, provide student practice and independent practice, and move on to the second step
- Weekly and monthly reviews. Weekly and monthly reviews are important for addressing maintenance of skills and for determining if reteaching is necessary. It is recommended that teachers provide frequent reviews for assessing the adequacy of the pace of instruction (i.e., too fast or slow). One approach is for mathematics teachers to provide a review of skills each Monday on the skills addressed the week prior and a monthly cumulative review the fourth Monday of each month (Good and Grouws, 1979).

EXAMPLE IN A SECONDARY MATH CLASS

The example below demonstrates a classroom lesson for an Algebra I general education class that includes students with LD. The teacher uses the direct instruction teaching functions to conduct a lesson on polynomials (monomial, binomial, and trinomial). The teacher, Ms. Lesma Forrester, who teaches at West Orange High School in Winter Garden, Florida, has over ten years of teaching experience in the U.S. and in other countries and has dual certification in math and in special education. Although the example emanates from observational data within a general education high school setting, teachers can use the same direct instruction teaching functions when teaching algebraic reasoning skills to students in lower elementary (i.e., with repeating patterns) and upper elementary and middle school (e.g., with growing patterns and early function concepts, variables and equations).

Teaching Function:	Classroom Example:
Review	• The lesson objectives and agenda are written on the board: Objective: Polynomial/Distributive Property; Today's Agenda: (1) Collect homework, (2) Discuss polynomials, (3) Students work in pairs on models, (4) Work on math activity sheet • Teacher asks to see homework; students ask questions on hard problems, such as $\frac{6\ (-2)\ (3)}{-6}$
Presentation	• The teacher first states the goal of the lesson and involves students: "We want to look at the definition of polynomial…does anybody have an idea what "poly" means as the prefix?" • The teacher presents the lesson in small steps using varied examples and nonexamples: (a) model monomial, (b) guided practice with monomial, (c) model binomial, (d) guided practice binomial, (e) model trinomial, and (f) guided practice with trinomial. For example, the teacher provides examples of numbers that have one quantity (i.e., 5, x, 3a, 1/5, 10/2), as well an example (5a + 5a) that can be written as one simplified term and nonexample (5a + 5b) that looks similar but differs by one attribute (the different variables). The teacher probes students to determine the number of terms of each example, which leads to a discussion ("What is the prefix for two?") and the definition of each group ("This polynomial that has two terms is called a binomial. The polynomial with one term is called a monomial").
Guided Practice	• The teacher asks students many questions to actively involve students in learning and to assess understanding: "5a + 5b, why is this not an example of one quantity?"; "Could I have some examples of one quantity using subtraction?" (e.g., 3x – 4x) • The students and teacher generate additional examples of monomials (e.g., 5b, 6a, 7a, 3x – 4x), binomials (e.g., 6m + 6b, 10h +10i, 10h + 12i, 7y – 2x), and trinomials (e.g., $x + 2x^2 + 4x^3$, $4x^2 + 3x^2 + 6x$)
Feedback and Correction	• The teacher provides positive and corrective feedback and student prompts (e.g., "So very good, one has an exponent"; "Very good, this one is a binomial"; "Why not?").
Independent Practice	• Teacher asks students to write five different examples per type of polynomial and monitors student performance (circulates the classroom). • The students work together in small groups as the teacher monitors their performance. The teacher mentioned that, because of the class size, it is important to have students assist one another at this point in the lesson. This also allows her to assist more than one student at a time, as she answers questions from each group. • The teacher also noted the effectiveness of having students assist one another during independent practice because they provide information to each other in their own "language." The teacher reported that the language her students use to explain mathematics is more effective than her

	"professional language." Rosenshine (1983) also noted the effectiveness of this approach, "Presumably, the advantages of these cooperative settings come from the social value of working in groups and the cognitive value gained from explaining the material to someone and/or having the material explained (p. 348).
Weekly and Monthly Review	• The teacher provides a cumulative review of problems for homework. The teacher stated the importance of review for monitoring student understanding and for assessing if students meet the criterion level of 80 % correct or greater. The teacher noted the occasional need to review the material the following day.

As illustrated in the example, *di* is a practical and effective approach for teachers, as they assist students with LD in mathematics. The teacher used the six teaching functions noted by Rosenshine and Stevens (1986) to provide the necessary support and structure to students, thereby increasing their opportunity to access the general education curriculum.

"I'm not afraid to recognize that my lesson can blow up in my face. It happens, for whatever reason, and if it happens, all I have to do is take it in stride and just turn around and re-evaluate and go again. This is what I do. Re-evaluating and doing what I need to do, and I take any idea, strange ideas sometimes, digging deep within my soul to find new approaches."

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