Current Practice ALERTS

Sponsored by: Division for Learning Disabilities (DLD) and Division for Research (DR) of the Council for Exceptional Children

A focus on: **Explicit Instruction in Mathematics**

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What is Explicit Instruction?

In this *Current Practice Alert,* we examine the effectiveness of explicit instruction for improving mathematics outcomes for students with learning disabilities (LD). Explicit instruction is "a structured, systematic, and effective methodology for teaching academic skills. It is called explicit instruction because it is an unambiguous and direct approach to teaching that includes both instructional design and delivery procedures" (Archer & Hughes, 2011, p. 1). We use explicit instruction synonymously with direct instruction to refer to instruction that incorporates the following teaching behaviors: logical sequencing (i.e., lessons build on one another), review of previous content, teacher-directed presentation and modeling, guided and repeated practice with specific feedback, independent practice by learners, curriculum-based assessments, and periodic review (Archer & Hughes, 2011; Gersten et al., 2009; Rosenshine & Stevens, 1986). Although Direct Instruction (DI; Carnine,1997; Tarver, 1999), the scripted and sequenced program of instruction, represents one model of explicit instruction, most forms of explicit instruction omit some specific elements of DI (e.g., scripted teaching).

For Whom Is It Intended?

Many aspects of explicit instruction—such as teacher instruction and modeling, previewing and reviewing instruction, checking for understanding and providing feedback, formative assessment, and repeated guided and independent practice—are supported as generally effective for nondisabled learners (e.g., Brophy & Good, 1986; Rosenshine, 2012; Rosenshine & Stevens, 1986). Explicit instruction also addresses many of the learning characteristics and needs of students with LD. For instance, previewing content, providing clear directions, and carefully sequencing instructional content may address difficulties students with LD typically experience when integrating and applying information due to problems with executive function. Similarly, repeated practice and frequent review, essential elements of explicit instruction, may help address memory problems, another common type of difficulty experienced by students with LD (Geary, 2004). Indeed, multiple studies and research reviews have shown that explicit instruction has large effects on the mathematics performance of students with LD (e.g., Gersten et al., 2009). Research has also shown explicit instruction to be effective for improving outcomes in mathematics for students experiencing math difficulties and at risk for LD (e.g., Baker, Gersten, & Lee, 2002; Bryant et al., 2008; Clarke et al., 2014). Accordingly, the Institute of Education Sciences (IES) recommended that math instruction for struggling learners, including students with LD, include explicit and systematic instruction (National Center for Education Evaluation and Regional Assistance, 2009).

How Does It Work?

Explicit instruction is a model of instruction that provides a series of instructional supports and scaffolds in a logical sequence. Doabler and Fien (2013) described three general elements of explicit instruction in math: teacher modeling, guided practice, and academic feedback. See Table 1 *(on page 2)* for a list of essential elements typically involved in explicit instruction (Archer & Hughes, 2011; Coyne, Kame'enui, & Carnine, 2011; Doabler et al., 2012; Gersten et al., 2009; National Math Advisory Panel, 2008). Explicit instruction should be used frequently (e.g., daily) when teaching mathematics and can be used in whole class, small group, and 1:1 settings (e.g., Baker et al., 2002; Coyne et al., 2011; Gersten et al., 2009; National Mathematics Advisory Panel, 2008). Doabler and Fien (2013) suggested research-based strategies to maximize the effectiveness of explicit instruction in math, including involving students and using clear and consistent language in teacher modeling, using purposeful verbal prompts during guided practice, and using positive and specific language when providing corrective feedback (see also Doabler et al., 2012).

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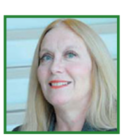
ABOUT THE AUTHORS



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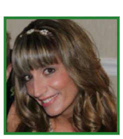

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How Adequate is the Research Knowledge Base?

In a review of published research, Gersten and colleagues (2009) identified eleven experimental and quasi-experimental studies investigating the effects of explicit instruction in math on students with LD. Table 2 *(on page 3)* presents the salient features of the studies and their effect sizes. These studies showed positive effects for explicit instruction in the areas of computation, word problems, and rational numbers (e.g., fractions). The studies involved participants with LD in elementary, middle, and high school settings; and predominantly used random assignment to groups. Across the studies reviewed, when explicit instruction was used, researchers reported large and meaningful effects on student outcomes (mean effect size = 1.22, which was statistically significant). Although all of the studies used explicit instruction, some also included other models of instruction, such as meta-cognitive strategies taught explicitly to students. Therefore, it is not clear the degree to which explicit instruction, other instructional strategies, or the combination of explicit instruction with additional strategies caused the positive effects observed. Another body of research, consisting of experimental, quasi-experimental, and single-case studies, has documented the effectiveness of Tier 1, Tier 2, and Tier 3 interventions using explicit instruction in mathematics for young students with math difficulties who are at risk for LD (e.g., Bryant et al., 2008, 2011, 2014; Clarke et al., 2011, 2014). Collectively, this research provides substantial evidence regarding the effectiveness of explicit instruction for students with and at risk for LD.

How Practical Is It?

Archer and Hughes (2011) consider explicit instruction an efficient and practical approach for teaching math to students with LD and math difficulties (see also Doabler & Fien, 2013). It is designed to maximize the impact of instructional time and tends to produce large effects on student outcomes. Furthermore, studies have shown that researchers, teachers, and instructional assistants can implement explicit instruction in math as designed and with high levels of fidelity (e.g., Clarke et al., 2014; Jitendra et al., 1998; Owen & Fuchs, 2002; Swanson, Moran, Lussier, & Fung, 2014; Witzel, Mercer, & Miller, 2003; Xin et al., 2005), which may be due to its direct, step-by-step nature. Other considerations that support the practicality of explicit instruction include its low cost (it is not a commercially available curriculum or package that must be purchased) and broad applicability (it can be used in whole class, small group, and 1:1 settings to teach virtually any content in mathematics). Although some instructors may consider explicit instruction heavily teacher-directed, it can be combined effectively with other instructional approaches to provide a balanced instructional program.

What Questions Remain?

One question that remains regarding explicit instruction is whether and how it can be used to help students with LD achieve new standards for college- and career-readiness. Forty-six states have adopted the Common Core State Standards in Mathematics (CCSS-M) with the goal of increasing mathematical performance related to rigorous content standards (NCTM, 2013). With the adoption of the CCSS-M and revised graduation requirements, which require passing assessments in content areas such as algebra in most states, future research should examine whether and how explicit instruction can enable students with LD to meet the more rigorous curriculum standards (Bottge, Rueda, LaRoque, Serlin, & Kwon, 2007). Research in algebra in the last decade (e.g., Foegen & Morrison, 2010; Maccini & Hughes, 2000; Scheuermann, Deshler, & Schumaker, 2009; Swanson et al., 2014; Witzel et al., 2003) suggests that explicit instruction can be used to help students with LD attain rigorous content standards. Other questions remaining include:

- What are the exclusive contributions of explicit instruction in packaged interventions?
- How effective is explicit instruction with diverse learners? What adaptations can be made to explicit instruction to optimize its effectiveness for diverse learners?
- What is the optimal intensity (e.g., group size, frequency) for explicit instruction in mathematics for students with LD?

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TABLE 1. CRITICAL ELEMENTS OF EXPLICIT INSTRUCTION

1.	Prioritize instruction based upon critical content and students' learning needs
2.	Strategically sequence content into manageable instructional units
3.	Review related, previous instruction to reinforce essential content and skills
4.	Pre-teach prerequisite skills to ensure students' understanding of new content
5.	Provide clear and concise directions
6.	Model and demonstrate instructional tasks and concepts using multiple examples
7.	Scaffold instruction to promote learner independence
8.	Provide ongoing, targeted, and affirmative corrective feedback
9.	Provide frequent and meaningful practice and review opportunities (guided and independent practice)
10.	Monitor students' progress

TABLE 2. CHARACTERISTICS OF STUDIES IN META-ANALYSIS BY GERSTEN ET AL. (2009)

RESEARCHERS	PARTICIPANTS	RESEARCH DESIGN	MATH DOMAIN	RESEARCH FOCUS	EFFECT SIZE
Fuchs, Fuchs, Hamlett, & Appleton (2002)	38 3rd graders with math disabilities (>1 SD between intelligence and mathematics achievement)	Randomized Trial	Word Problems	Problem-solving tutoring using explicit instruction vs. basal curriculum (typical practice)	1.78
Jitendra, Griffin, McGoey, Gardill, Bhat, & Riley (1998)	34 elementary students with poor world-problem solving skills, 17 with LD	Randomized Trial	Word Problems	Explicit instruction in diagrammatic representations vs. basal curriculum (typical practice)	0.67
Kelly, Gersten, & Carnine (1990)	28 low performing high school students, 17 with LD	Randomized Trial	Rational Numbers-Fractions	Explicit instruction incorporating principles of curriculum design vs. basal curriculum (typical practice)	0.88
Lee (1992)	33 4th – 6th graders with LD	Randomized Trial	Word Problems	Explicit instruction using visual cues vs. basal curriculum and textbook (typical practice)	0.86
Marzola (1987)	60 5th and 6th graders with LD	Randomized Trial	Word Problems	Explicit problem solving instruction with verbalizations vs. feedback only (no systematic instruction)	2.01
Owen & Fuchs (2002)	24 3rd graders with disabilities, 20 with LD	Randomized Trial	Word Problems	Explicit visual strategy instruction vs. basal curriculum (typical practice)	1.39
Ross & Braden (1991)	94 elementary students with LD	Randomized Trial	Computation	Explicit strategy instruction with verbalization vs. basal curriculum (typical practice plus token reinforcement)	0.08
Tournaki (1993)	84 3rd – 5th graders, 42 with LD	Quasi-experimental	Computation	Explicit self-instruction vs. drill and practice	1.74
Tournaki (2003)	84 students; 42 non-disabled 2nd graders, 42 (8 - 10 year-olds) with LD	Randomized Trial	Computation	Explicit instruction with verbalization vs. drill and practice	1.61
Wilson & Sindelar (1991)	62 elementary students with LD	Randomized Trial	Word Problems	Explicit strategy instruction vs. sequential instruction from simple to increasingly complex problems	0.91
Xin, Jitendra, & Deatline-Buchman (2005)	22 at-risk students, 18 with LD	Randomized Trial	Word Problems	Explicit, schema-based instruction vs. general strategy instruction	2.15

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How Do I Learn More?

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Listed below are several sources that provide more information on using explicit instruction in classroom settings. Additional information on implementing explicit instruction in mathematics for students with LD can be found in works referenced at the end of this *Current Practice Alert.*

Archer, A. L., & Hughes, C. A. (2011). *Explicit instruction: Effective and efficient teaching.* New York, NY: Guilford Press. This textbook provides detailed descriptions of guidelines for planning and implementing explicit instruction. Video examples of elements of explicit instruction are available on the accompanying website (http://explicitinstruction.org).

The Access Center. (2004). *Direct/explicit instruction and mathematics.* Washington DC: American Institutes for Research http://165.139.150.129/intervention/math/DirecIinstruction.pdf This brief report describes direct/explicit instruction and how it can be used to teach mathematics.

Gersten, R., & Clarke, B. S. (2007). *Effective strategies for teaching students with difficulties in mathematics.* Reston, VA: National Council of Teachers of Mathematics. http://www.nctm.org/uploadedFiles/ResearchNewsandAdvocacy/Research/ClipsandBriefs/Researchbrief02-EffectiveStrategies.pdf This research brief provides a description of six instructional approaches, including explicit instruction, shown to be effective for teaching math to students with disabilities and math difficulties.

Hall, T. (2002). *Explicit instruction.* National Center on Accessible Instructional Materials http://aim.cast.org/sites/aim.cast.org/files/ExpInstrucNov2.pdf This report provides a summary of using explicit instruction, including definition, instructional delivery components, implications for access to the general curriculum, and evidence of effectiveness.

Jayanthi, M., Gersten, R., & Baker, S. (2008). *Mathematics instruction for students with learning disabilities or difficulty learning mathematics: A guide for teachers.* Portsmouth, NH: RMC Research Corporation, Center on Instruction. http://www.centeroninstruction.org/files/Mathematics%20Instruction%20LD%20Guide%20for%20Teachers.pdf This guide for teachers provides seven research-based recommendations for teaching math to students with LD and math difficulties, including a discussion on using explicit instruction.

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About the Alert Series

Current Practice Alerts is a joint publication of the **Division for Learning Disabilities** and the **Division for Research of the Council for Exceptional Children**. The series is intended to provide an authoritative resource concerning the effectiveness of current practices intended for individuals with specific learning disabilities.

Each *Alerts* issue focuses on a single practice or family of practices that is widely used or discussed in the LD field. The *Alert* describes the target practice and provides a critical overview of the existing data regarding its effectiveness for individuals with learning disabilities. Practices judged by the Alerts Editorial Committee to be well validated and reliably used are featured under the rubric of **Go For It**. Those practices judged to have insufficient evidence of effectiveness are featured as **Use Caution**.

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