PREVENTING MATHEMATICS DIFFICULTIES IN THE PRIMARY GRADES: THE CRITICAL FEATURES OF INSTRUCTION IN TEXTBOOKS AS PART OF THE EQUATION

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Abstract. **High-quality core instruction in kindergarten and first and second grade is critical to prevent mathematics difficulties. Evidence-based critical features of instruction should be part of core instruction and be included in mathematics textbooks. This study examined lessons from kindergarten and first- and second-grade basal mathematics textbooks to determine the extent to which 11 critical features of instruction were present. Overall, results showed an "Approaching Acceptable" rating, meaning that the features were not fully incorporated. Implications include the need for textbook adoption committees to be mindful of the importance of including effective instructional practices when making textbook decisions and for teachers to scrutinize the components of lessons to determine if these features of effective instruction are included.**

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Mathematical literacy refers to the ability to apply concepts to reason, solve problems, and communicate about mathematical situations in the classroom and everyday life (National Council of Teachers of Mathematics [NCTM], 2000). According to the NCTM's *Principles and Standards for School Mathematics* (2000), "those who understand and can do mathematics will have significantly enhanced opportunities and options for shaping their futures. A lack of mathematical competence keeps those doors closed" (p. 5).

Unfortunately, the mathematics performance of fourth- and eighth-grade students with disabilities who took the 2007 National Assessment of Educational Progress (NAEP; Lee, Grigg, & Dion, 2007) continues to lag behind that of their typically achieving peers even when accommodations are permitted in the testing situation. Much like current practices in early reading instruction, the achievement gap of students with mathematics disabilities compared to their typically achieving peers will remain problematic without preventive practices initiated in the primary grades (i.e., kindergarten, first, and second grade). Preventive practices should include evidence-based critical features of instruction (i.e., instructional design) that help these students access the core or primary mathematics curriculum and instruction typically found in general education classrooms. "Access to the general education curriculum" refers to students with learning difficulties receiving and benefiting from evidence-based instruction that is designed, delivered, and evaluated for effectiveness (D. Bryant, Smith, & Bryant, 2008).

While students are not usually identified as having mathematics disabilities in the primary grades, recent studies have identified procedures to determine students who are at risk for mathematics difficulties at a young age (e.g., kindergarten, first, and second grade) (B. Bryant, Bryant, Gersten, Scammacca, & Chavez, in press; B. Bryant & Bryant, 2007; L. S. Fuchs et al., 2007; Jordan, Kaplan, Oláh, & Locuniak, 2006). As part of the Individuals with Education Improvement Act (IDEA, 2004), the Response to Intervention (RtI) process allows schools the opportunity to identify young children who are struggling with the core instruction and to provide secondary interventions in hopes of remediating academic weaknesses and preventing learning failure (D. Fuchs & Deshler, 2007). Core or primary instruction should include the critical features of effective instruction to enhance the ability of students at risk for mathematics difficulties to learn the core mathematics instruction.

Critical Features of Core Instruction for At-Risk Students

A key ingredient of the RtI process is the provision of high-quality core classroom instruction that is based on research (Mellard, 2004). Core mathematics instruction should be responsive to the needs of *all* students and include instructional design features that have been found to be critical for at-risk students. For example, a meta-analysis of academic treatment outcomes, including mathematics, for students with learning disabilities (LD) identified the positive contribution (i.e., higher effect sizes) of a combined method of instruction consisting of explicit and strategic instructional procedures compared to other instructional approaches (Swanson, Hoskyn, & Lee, 1999). Features of the combined method included sequenced subskills, instruction on prerequisite skills, multiple practice opportunities, small groupings, feedback, procedural strategies, and progress monitoring.

It stands to reason that these more general procedures could be used with younger students who are experiencing mathematics difficulties. Additionally, in the area of mathematics, the use of manipulatives to represent mathematical concepts concretely is as an effective practice for all students, and particularly so for students with mathematics difficulties (Marsh & Cook, 1996; Miller & Mercer, 1993b). Finally, Gersten, Jordan, and Flojo (2005) recommended that instruction for students with mathematics difficulties include procedures to help them learn the vocabulary of mathematics. Kindergarten teachers who participated in a focus group study on mathematics instruction supported this recommendation. Specifically, these teachers emphasized the importance of vocabulary knowledge in the early mathematics curriculum and the difficulties struggling students demonstrate with learning and applying the language (vocabulary) of mathematics instruction (D. Bryant, Bryant, Kethley, Kim, & Pool, 2004). Thus, teachers need to help students make connections among new vocabulary and prior knowledge and provide multiple opportunities to engage students in meaningful ways to apply the vocabulary across situations (D. Bryant, 2005).

It is essential that general education teachers who are teaching young students with risk status for mathematics difficulties employ evidence-based instructional practices found to improve mathematical performance and preventing learning problems (D. Bryant et al., 2008). In the general education classroom, the mathematics textbook or basal is an important component of early mathematics education. Textbooks play a crucial role in what teachers do during instruction (Nathan, Long, & Alibali, 2002). Further, how the lessons are implemented and supplemented by the classroom teacher has a major influence on student learning (Sood & Jitendra, 2007).

In recent years, core reading programs have undergone considerable scrutiny to determine the presence of evidence-based practices (Simmons & Kame'enui, 2000). Carnine (1991) called for a similar critical review of mathematics textbooks. Unfortunately, such a review showed that "A close look at traditional basals suggests that publishers are not meeting their responsibilities to assist teachers in providing suitable development for students" (Carnine, 1991, p. 55). In the years since, several mathematics textbooks examinations have been conducted, as outlined below.

Mathematics Textbook Evaluation

A number of mathematics textbook evaluations have been conducted to examine the extent to which components of effective instructional design (i.e., critical features of effective instruction) are present as well as the extent to which textbooks include instructional content that reflects trends (e.g., reform-based mathematics instruction, "number sense") in mathematics education. Additionally, evaluations have focused on a particular grade (e.g., fourth grade, fifth grade) and content area (e.g., division, addition, subtraction).

Findings from these evaluations have been interpreted in terms of the instructional implications for students with mild disabilities. For example, Jitendra, Carnine, and Silbert (1996) examined fifth-grade basal instruction for teaching division. They looked at two basal textbooks published before and after the NCTM Standards (1989) in light of nine components of effective instruction (prior knowledge, introducing new concepts, coherence, clarity of teacher communication, manipulative activities, guided practice, initial practice, later practice, and review) to determine the extent to which the elements of effective instruction were built into division lessons. These researchers concluded that "the inadequacy of traditional basals to meet the needs of most students will continue to widen the gap between students with mild disabilities and the nondisabled population" (Jitendra et al., 1996, p. 401).

In another study, Carnine, Jitendra, and Silbert (1997) used what they termed "pedagogical criteria" to analyze three fifth-grade basal programs for teaching adding and subtracting fractions. Pedagogical criteria were described as fundamental concepts and principles, big ideas, pacing of instructional content introduction, teaching demonstrations, manipulative activities, and review. The researchers viewed these components as particularly relevant when dealing with students who have mild disabilities. Carnine et al. concluded that their analysis of traditional basals resulted in disturbing findings and that the lack of pedagogical criteria should be of concern to teachers of diverse learners.

In yet another textbook evaluation, Jitendra, Salmento, and Haydt (1999) examined fourth-grade subtraction instruction. Using nine components of instructional design (clarity of objective, additional concepts and skills taught, prerequisite skills taught, explicit teaching explanations, efficient use of instructional time, sufficient and appropriate teaching examples, adequate practice, appropriate review, and effective feedback), they evaluated seven math basals to determine the extent to which the components were included in the subtraction lessons. Only two of the basals incorporated most (seven or eight) of the instructional components examined. Further, only two components (clarity of objective and number of additional concepts) were present across all of the basals. Based on these findings, Jitendra et al. concluded that students with learning disabilities will need instructional adaptations if they are to benefit sufficiently from typical textbook-based, fourth-grade subtraction instruction.

The adoption of standards-based mathematics instruction (i.e., NCTM, 2000), inspired by lackluster student performance on national assessments, initiated efforts to focus instruction on higher order thinking and problem solving. An inquiry-based approach to instruction (e.g., discovery approach) was embraced as an effective way to help students construct their understanding of mathematical relationships and share their mathematical reasoning and solutions (Baxter, Woodward, & Olson, 2001). In this type of learning environment, students assume responsibility for organizing and integrating their learning experiences. Jitendra et al. (2005) examined five third-grade mathematics textbooks to determine the extent to which the textbook publishers adhered to the emphasis on problem solving espoused in the Standards (NCTM, 2000) and addressed instructional design features that are critical for students with learning disabilities.

The authors found that while problem-solving opportunities were typically present, textbooks were less likely to include activities for students to generate representations or identify problem-solution representations. In the area of instructional design, the authors noted improvements in the extent to which the design features occurred compared to their previous studies. However, such improvement was found in only three out of the five textbooks reviewed.

In a more recent analysis, Sood and Jitendra (2007) reviewed four first-grade textbooks to determine how "number sense" instruction occurs in what they termed traditional mathematics textbooks and reform-based texts. Number sense refers to the ability to understand the magnitude of numbers, facility with using mental computation, and ability to employ appropriate representations (Gersten et al., 2005; Okamoto & Case, 1996). Lessons within the texts were examined for the following critical features: big ideas, conspicuous (i.e., direct and explicit) instruction, mediated scaffolding, and judicious review. The researchers found variations in meeting the principles of effective instruction, not only between traditional and reform-based textbooks but among traditional textbooks as well.

Other means for evaluating basals exist. What Works Clearinghouse (WWC) evaluates research studies on elementary mathematics programs and basals and assigns ratings based on the quality of the research designed to evaluate the effects of the intervention (i.e., basal in this example). Ratings include positive, potentially positive, mixed, no discernible effects, potentially negative, or negative. The ratings assigned take into consideration the quality of the research design, the statistical significance of the findings (calculated by WWC), the magnitude of the difference between treatment and comparison groups, and consistency of findings across research studies (WWC, 2006). For each text, WWC provides an overview of the basal, a summary of the research related to the program, and a statement about the effectiveness of the program. For information about the WWC's findings, refer to their website (http://ies.ed.gov/ncee/wwc/pdf/rating_scheme.pdf).

In sum, students who are at risk for mathematics difficulties in kindergarten and first and second grade must receive mathematics instruction that includes the critical features of effective instruction such as the use of manipulatives (e.g., physical representations of mathematical concepts) and an emphasis on vocabulary (L. S. Fuchs & Fuchs, 2001; Gersten et al., 2005; Sood & Jitendra, 2007). Textbooks continue to be a critical component of classroom instruction (Nathan et al., 2002). Although textbook evaluations have been conducted over the years, none of them has examined and compared kindergarten and first- and second-grade textbooks for adherence to the critical features of instruction.

Given the emphasis on early identification and high-quality core instruction as a result of the RtI process, it is important for educators to be cognizant of the criteria they can use to evaluate textbooks for the presence of design features most critical for effective core instruction for at-risk students.

The purpose of this study was to examine lessons from three grade levels, kindergarten, first and second grade, to determine the extent to which critical features of instruction, including manipulatives and vocabulary instruction, were present as part of the instructional routine across basals that could be part of core instruction. Additionally, although the Standards include the Content Standard - Number and Operations, Algebra, Geometry, Measurement, Data Analysis and Probability, and the Process Standards - Problem Solving, Reasoning and Proof, Communication, Connections, and Representation, we chose to examine lessons that focused on Number and Operations because of the early numeracy literature (e.g., Jordan, Hanich, & Kaplan, 2003; Jordan et al., 2006), which describes number and operation skills (e.g., number sense, counting strategies, arithmetic combinations) as being problematic for young students and potentially predictive of mathematics difficulties.

METHOD

Textbook Lessons Selection Procedures

To identify a sample of textbook for our analysis, we contacted the textbook coordinator at the Texas Education Agency (TEA), who (a) gave us the URL for the website that contains the state-adopted list of mathematics texts, and (b) provided us with a list of the most popular basal series used in the state.

We selected four popular textbooks from the list of approved mathematics textbooks in the 2004-2005 academic year, exemplifying basals used to teach core early mathematics skills and concepts. Of the four textbooks, one was reform-based, and three were traditional textbooks. We elected to follow the lead of Carnine et al. (1997), who did not to disclose the identities of the publishers of the basals examined. Thus, our examination focused on the extent to which the critical features of instruction were represented in core instruction materials without comparing basals to one another.

We examined the Texas Essential Knowledge and Skills (TEKS) and selected objectives from number, operation, and quantitative reasoning in kindergarten, first- and second-grade textbooks (for both volumes 1 & 2 of the textbooks if applicable). The mathematics TEKS is based on the NCTM's (2000) Standards. To select individual lessons to review, we divided each basal textbook into thirds and selected the lesson at that point in the textbook that taught the number, operation, and quantitative reasoning TEKS. If the objective was not taught in the prescribed third of the text, we used the lesson closest to the section we had assigned.

Only the core lesson was reviewed. Thus, we did not address additional features such as literature connections, optional activities, enrichment activities, and extended activities, reasoning that teachers would likely use the core lessons but that their use of the additional features might vary. For the core lesson, we began the ratings with the lesson organizer and continued until the lesson ended.

Rating Procedures, Critical Features of Instruction, and Data Analyses

Three reviewers examined the lessons that had been selected based on the TEKS number, operation, and quantitative reasoning, and location in the textbooks (beginning, middle, and end). Copies were made of the three lessons from each of the textbooks and distributed to the reviewers for individual evaluation using the features and criteria described below.

The reviewers examined 11 critical features of instruction and assigned a rating of 1, 2, or 3 to each. A score of 1 was the lowest rating, indicating the absence of a given feature or the presence of a variation of the feature with limited support in the literature for students with LD. On the other hand, a score of 3 indicated full presence of the instructional feature supported in the disability literature. The midpoint score of 2 meant that the feature was included as part of the lesson but did not fully meet the criterion for acceptable practice (i.e., a score of 3) for students with mathematics difficulties. One week after receiving copies of the lessons, the reviewers convened to compare ratings. If ratings differed, the group examined the lesson together and arrived at a consensus rating for each lesson.

We identified evidence-based features proven effective for students with LD based on the assumption that effective strategies for students who have LD would also be of value when working with young struggling students. We examined the work of Jitendra et al. (1999) and also used the features of effective instruction the two lead authors in this article had identified in previous work (University of Texas Center for Reading and Language Arts, 2002), arriving at the following features and the criteria that were used to rate (score) each lesson.

Clarity of objective. An instructional objective is the part of a lesson that is a specific, outcome-based, and measurable descriptive student behavior that is the focus of study (Ediger, 2004). Objectives should be stated as specific behaviors (e.g., specific kinds of problems used to teach a strategy) that can be observed and evaluated (i.e., measured against a criterion) (Carnine, Silbert, Kame'enui, & Tarver, 2004). Behavioral or learning objectives provide a means to directly measure student behavior and determine student mastery of the learning outcomes of the lesson (Ellis & Worthington, 1994).

A three-point scoring system was used to examine the clarity of the objective. A score of 1 was given if the lesson provided no objective; a score of 2 was assigned if an objective was provided but lacked appropriate specificity (i.e., failed to state the specific observable and measurable student behavior and/or the criteria for determining student mastery). Finally, a score of 3, the highest score possible, was awarded to objectives that were complete and specific.

Additional skills/concepts taught. When considering struggling students, teachers should focus on teaching only one skill or concept at a time. Carnine and his colleagues (2004) made this recommendation for two reasons. First, teaching more than one skill may create an excessive learning load on the student. Second, student failure to master learning outcomes when more than one skill is being taught can result in difficulty identifying the specific problem the student is having. That is, when only one new skill or concept is the focus of the lesson, the teacher can examine the student's performance in relation to that skill and more easily determine where the problem lies.

For this feature, we counted the number of skills or concepts described in the stated learning objective. The introduction of more than two new skills or concepts resulted in a score of 1; two skills or concepts introduced in the objective were given a score of 2, and when only one skill or concept was introduced in the objective, a rating of 3 was assigned.

Use of manipulatives and representations. Manipulatives were defined as concrete objects that "appeal to several senses and that can be touched, moved about, rearranged, and otherwise handled by children" (Kennedy, 1986, p. 6). Representations have been defined as "external manifestations of mathematical concepts" (Pape & Tchoshanov, 2001) expressed or designated by some term, character, or symbol. The purpose of using manipulatives is to facilitate conceptual mathematics learning by making problems tangible. Instruction that makes explicit the connection or relationship between manipulatives and symbolic representations of mathematics concepts is critical for young or struggling students (Ball, 1992; Kame'enui & Carnine, 1998; Uttal, Scudder, & DeLoache, 1997; Wearne & Hiebert, 1988). The usefulness of manipulatives has been linked to Piaget's theories (1970), which described children's learning as concrete, and to Bruner (1966), who emphasized the use of concrete objects in instruction of young children.

A score of 1 was given for the criterion of neither manipulatives nor representations used in the lesson. A score of 2 was awarded when only representations were presented. Finally, a score of 3 was given when manipulatives were presented, or when both manipulatives and representations were included.

Instructional approach. To examine the instructional approach, we first identified and operationally defined approaches that have demonstrated effectiveness in mathematics instruction, explicit instruction, and discovery instruction. Explicit instruction is a teacher-directed instructional approach that is systematic and structured with a step-by-step format requiring student mastery at each step. It includes continuous modeling or demonstration by teachers and ample practice opportunities for students to learn and apply target concepts or skills under the teacher's direction and guidance (Jitendra et al., 1999).

Numerous researchers have determined that the use of explicit instruction is crucial for students with or without LD to achieve high mathematics performance (Darch, Carnine, & Gersten, 1984; Jitendra, Kame'enui, & Carnine, 1994; Steel, 2002). For example, Jones, Wilson, and Bhojwani (1997) found that teaching mathematics to students through explicit instruction ensured more predictable, generalizable, and functional achievement. Steel (2002) argued that mathematical concepts and skills are hierarchically interrelated, so each concept, skill, and relationship must be taught explicitly with a carefully structured plan for students with LD.

Discovery instruction (also known as inquiry-based instruction) refers to any instruction in which students have opportunities to find the answers to the questions and to process available information by themselves so that they can construct their own understandings and ideas (Baxter et al., 2001). In the discovery instruction approach, guidance, demonstrations, and instructions by teachers are limited. Instead, teachers facilitate students' discovery activities and communication about their understandings of mathematical relationships and concepts.

We examined the main teaching portion of each lesson to determine which instructional approach was applied to explain the target concept or skill. Lessons that only included the discovery approach without teacher modeling or facilitation received a rating of 1. If a guided discovery approach was applied, including information about teachers' facilitative questioning, the lesson was given a rating of 2. The lesson received a rating of 3 if (a) a guided discovery approach was used with information about teachers' facilitative questioning and explicit instruction, such as modeling and explanation of steps; or (b) explicit instructional procedures were presented to teach the lesson.

Provision of teacher examples. It is crucial for students with or without LD to be presented with sufficient teacher examples of mathematical concepts before moving on to new instructional tasks (Carnine, Jones, & Dixon 1994; Cawley, Parmar, Yan, & Miller, 1996). Sufficient teacher examples are particularly critical for students with LD, because they often do not have generalization skills to solve complex and multi-step mathematical problems (Cawley et al., 1996; Jones et al., 1997; Silbert, Carnine, & Stein, 1990). With sufficient opportunities to work with teacher examples, students are able to build the confidence necessary to solve problems independently with a minimum number of errors (Jones et al., 1997; Steel, 2002).

Teacher examples should illustrate the lesson objective and be provided before and during the lesson. For this instructional feature, we counted the number of teacher examples provided to teach the target concept or skill. The following criteria were applied for rating purposes. If no example was presented, a rating of 1 was assigned to the lesson. A rating of 2 indicated that one or two examples were provided for each target concept or skill. Finally, the lesson received a rating of 3 if three or more examples were presented to teach the target concept or skill.

Adequate practice opportunities. Practice is an essential component of mathematical instruction by providing important opportunities for students to apply knowledge and skills that they have learned (Carnine & Jones, 1994; Jitendra et al., 1999; Jones et al., 1997; Porter, 1989). Sufficient practice also allows students to achieve an adequate level of automaticity, generalization, and maintenance (Carnine & Jones, 1994). According to Goldman and Pellegrino (1987), through repeated practice, students can execute their strategy knowledge more quickly, thus facilitating memorization and storage of knowledge in long-term memory. Practice opportunities, therefore, must be carefully designed and provided in sufficient numbers to help students solve advanced mathematical problems, such as multi-digit addition, subtraction, and word problems without assistance from a teacher or parent (Goldman, Mertz, & Pellegrino, 1989; Jitendra et al., 1999).

Practice opportunities for each target concept or skill were identified to evaluate whether adequate opportunities were provided in the lesson. We searched for a section that included practice problems, such as "Practice," and computed the number of practice problems listed. If practice problems included the features of teacher-guided instruction, such as teacher-facilitated questionings or discussion, they were not considered as practice for our rating purposes. In addition, if practice opportunities were provided as additional activities in supplemental sections, such as "Follow-Up," they were not counted either.

We applied the following criteria in assigning ratings. If no practice opportunities were provided in the lesson for each target concept or skill, a rating of 1 was given. The lesson received a rating of 2 if practice opportunities were presented, but in insufficient numbers (i.e., one to three problems). A rating of 3 was given if the lesson included four or more practice opportunities. (With four practice opportunities, the student can miss one item and still achieve 75% accuracy, which is reasonably acceptable.)

Review of prerequisite mathematical skills. Prerequisite skills are the skills necessary for acquiring new content (Hudson & Miller, 2006). To increase learning with new content, students must possess the background knowledge prior to the new skills being introduced (Carnine, Dixon, & Silbert, 1998; Jitendra et al., 1999). Since mathematics knowledge and skills are hierarchically connected to each other, mastery of prior knowledge and skills is especially critical to the learning of new, higher order skills (Hudson & Miller, 2006). For example, understanding the concept of doubles and memorizing the addition facts of doubles play important roles in understanding and applying "doubles plus one" as a strategy to answer certain addition facts. Thus, mathematics instruction should be designed to include the review of critical prerequisite skills or simpler component skills (e.g., the concept of doubles and the facts of doubles) to facilitate student learning with the new skills (e.g., doubles plus one).

We examined each lesson to determine if it was teaching the skills that were prerequisite for the higher order skills taught in the lesson. A score of 1 was given if the lesson included neither a review nor a mention of prerequisite skills. A score of 2 was assigned if at least one prerequisite skill was mentioned, but not reviewed.

Finally, a score of 3 was assigned if the lesson included and reviewed at least one prerequisite skill.

Error correction and corrective feedback. Feedback is "the transmission of evaluative or corrective information about an action, event, or process to the original or controlling source" (Merriam-Webster, 2000, p. 426). Corrective feedback is teacher response to a student error that the correct answer or guides the student to the correct response (Carnine, Silbert, & Kame'enui, 1997). Corrective feedback triggers students to modify their understanding of concepts and skills by helping them to detect the discrepancies between their output and the correct answer (Gass & Varonis, 1994) and develop reference standards for learning (Travers & Sheckley, 2000).

Researchers consistently report that corrective feedback is associated with positive outcomes for struggling learners across content areas, including reading and spelling (Swanson et al., 1999; Vaughn, Gersten, & Chard, 2000; Wanzek et al., 2006) and mathematics (Kroesbergen & Van Luit, 2003). For students with learning difficulties, accordingly, explicit instruction involving corrective feedback should be integrated into core mathematics instruction (Miller & Hudson, 2007).

In this analysis, we examined each lesson for the presence of information about error correction and feedback using the following criteria. We gave a score of 1 if the lesson did not mention what to do about possible errors or how to provide feedback. We assigned a score of 2 if the lesson provided information about possible errors but did not provide any corrective feedback suggestions. A score of 3 was awarded if the lesson included instructive or elaborative feedback that specified necessary steps, rules, or prompts to help students derive the correct answer.

Vocabulary. In *Principles and Standards for School Mathematics,* NCTM (2000) noted that the ability to communicate mathematically should be addressed in all areas of assessment and instruction. Clearly, vocabulary, or the knowledge of words and their meanings, is a critical component of mathematics communication (Monroe, 2006). Many years ago, Wiig and Semel (1984) commented that mathematics is "conceptually dense," meaning that students must comprehend the meaning of terms and mathematical symbols because, unlike in reading, there are few context clues to help aid meaning. Other researchers agree (Miller, 1993; Schell, 1982), noting that mathematics language is complex and particularly abstract.

Several authorities (Miller, 1993; Monroe & Orme, 2002) have noted that unfamiliar vocabulary is a leading cause of mathematics difficulties. Similarly, Bryant, Bryant, and Hammill (2000) agreed that difficulties with the language of mathematics is a distinguishing characteristic of mathematics LD. Along the same lines, Capps and Cox (1991) suggested that the language of mathematics must be directly taught during the course of a mathematics lesson. Monroe (1998) agreed noting that mathematics vocabulary cannot be taught incidentally.

We used the following criteria to rate the way in which vocabulary was taught in a lesson. A rating of 1 was assigned if no key vocabulary terms were identified. A rating of 2 was given if key vocabulary terms were identified, but no instruction was provided on their definitions. Finally, a 3 was awarded if key vocabulary terms were identified and instruction on their definitions was presented.

Strategies. Strategies are "deliberate, consciously applied procedures that aid in the storage and subsequent retrieval of information and solving of problems" (Swanson, 1999, p. 417). Research has helped identify specific instructional strategies that produce positive learning outcomes for students who have special learning needs (Deshler, Ellis, & Lenz, 1996; Miller & Mercer, 1993b; Swanson, 2001; Wong, 1993). Strategy instruction focuses on the process of learning by using cognitive strategies (i.e., steps for facilitating the learning process) and metacognitive (i.e., self-regulatory) cues. In mathematics, strategies help students apply specific problem-solving approaches and plans to derive correct solutions to a variety of problems.

As reviewers examined each lesson, they used the following criteria to assign their ratings. If no cognitive strategies were listed, a rating of 1 was given. If cognitive strategies were listed, but no explicit instruction was presented as a lesson segment, a 2 was assigned. A 3 was awarded if cognitive strategies were listed and were accompanied by explicit instruction and application as part of the lesson.

Progress monitoring. Progress monitoring refers to a set of techniques for assessing student performance on a regular and frequent basis to make instructional decisions (Quenemoen, Thurlow, Moen, Thompson, & Morse, 2003). Considerable research has documented the importance of progress monitoring and its positive effect on learning and achievement (Deno, Fuchs, Marston, & Shin, 2001; L. S. Fuchs et al., 2007; Safer & Fleischman, 2005).

B. Bryant and Bryant (2007) distinguished four levels of progress monitoring that ask distinct questions pertaining to pupil progress. Daily Check progress monitoring asks the question, "Did the student learn the content that was taught in today's lesson?" To answer that question, teachers provide several problems that assess the lesson's objective. Unit Check progress monitoring asks the question, "Did the student maintain what was taught daily across an instructional unit (over

Table 1
Summary of Kindergarten Ratings

Feature	Basal 1	Basal 2	Basal 3	Basal 4	Median
1. Clarity of Objective	3	3	3	3	3
2. Additional Skills/ Concepts Taught	2	3	2	1.33	1.67
3. Use of Manipulatives and Representation	3	2.33	3	3	3
4. Instructional Approach	2	2	3	2.67	2.34
5. Provision of Teacher Examples	2.67	2.33	3	2.33	2.5
6. Adequate Practice Opportunities	1	2.67	2	2.33	2.17
7. Review of Prerequisite Mathematical Skills	1	1	1	2.33	1
8. Error Correction and Corrective Feedback	1.33	2.67	3	1.67	2.17
9. Vocabulary	2.33	2	3	1.67	2.17
10. Strategies	1	1.33	1	1	1.17
11. Progress Monitoring	1	2	3	2.33	2.17

a 1- or 2-week period)?" Students may demonstrate mastery of content on a daily basis but, when assessed on the aggregate skills of a unit in a traditional testing format, may not be able to demonstrate their achievement gains. Aim Check progress monitoring asks the question, "Is the student's learning making progress towards his or her long term goal, which usually involves meeting a semester benchmark?" Students may be making progress as a result of lessons and units but may not be making sufficient progress to narrow the gap between his or her performance and that of peers. Finally, Benchmark Check progress monitoring asks the question, "Where does the student stand in relation to performance benchmarks that have been established?" This form of progress monitoring occurs at the beginning, middle, and end of the school year.

For purposes of this study, we focused on Daily Checks, asking the question, "Does the lesson contain opportunities for the teacher to assess whether the student has mastered the content taught in the lesson?" Thus, progress monitoring should be (a) beyond checking for understanding; (b) conducted after the lesson; (c) individual, with observation of a product; and (d) tangible.

The criterion for a rating of 1 was that no progress monitoring was present. A 2 was awarded if progress monitoring was implied but not specified (e.g., teachers are told to test to determine whether the objective was met, but no specific items are given to test). A 3 was assigned if progress monitoring was specified and procedures described.

Interrater Reliability

After identifying the rating criteria, and prior to reviewing the lessons, four reviewers independently rated the instructional features across three lessons. We selected the goal of 80% set forth in McLoughlin and Lewis (2001); an agreement of 83% provided evidence of inter-rater reliability. However, we decided that we wanted 100% agreement on our ratings. Thus, when reviewing the lessons and if disagreement existed among the raters, we met to discuss the lesson and criteria until we all agreed on the proper rating to be assigned.

RESULTS

Tables 1 (kindergarten), 2 (first grade), and 3 (second grade) show the results of the reviewers' ratings. The tables include the instructional features that were examined (column 1), the average reviewer ratings across the three lessons for each feature (columns 2-5), and median ratings for the features across the four basals (column 6).

We interpreted a rating of 1.00-1.99 as being "Unacceptable" (no evidence of the feature), a rating of 2.0-2.99 as being "Approaching Acceptable" (some evidence of the feature but not sufficient), and a rating of 3 as being "Acceptable" (sufficient evidence of the feature). For example in Table 1, a rating of 2.67 for Provision of Teacher Examples for Basal 1 means that the reviewers' ratings for each of the three lessons may have been 2, 3, and 3; hence the average rating of 2.67 ("Approaching Acceptable"). We analyzed the data in several ways, including by grade level, critical feature, and categories (content and procedures).

Grade-Level Analyses

For grade level, we examined the total possible number of ratings ($N = 44$) and computed percentages (totals may not equal 100 due to rounding) across all 11 features. For kindergarten, 13 ratings out of 44 or 30% were "Unacceptable," 18 or 41% were "Approaching Acceptable," and 13 or 30% were "Acceptable." For first grade, 9 or 20% of the ratings were "Unacceptable," 23 ratings or 52% were "Approaching Acceptable," and 12 or 27% were "Acceptable" ratings. For second grade, 11 ratings or 25% were at the "Unacceptable" level, 26 ratings or 59% were "Approaching Acceptable," and 7 ratings or 16% were viewed as "Acceptable." Thus, examining all possible ratings by grade level, for kindergarten almost one third of the ratings were "Acceptable," for first grade a little over one fourth of the ratings were "Acceptable," and a low 16% of the ratings were "Acceptable" at the second grade level.

Next, we examined the median ratings for each feature across all four textbooks by grade level. For the kindergarten lessons, 3 (features #2, 7, 10) of the 11 medians were rated as "Unacceptable," 6 (features #4, 5, 6, 8, 9, 11) were "Approaching Acceptable," and 2 (features #1, 3) were "Acceptable." In the first-grade analysis, only 1 (feature #10) of the 11 features earned a median rating of "Unacceptable," 9 (features # 2, 3, 4, 5, 6, 7, 8, 9, 11) features were rated as "Approaching Acceptable," and 1 (feature #1) feature earned a median rating at the "Acceptable" level. For second grade,

Table 2
Summary of Grade 1 Ratings

Feature	Basal 1	Basal 2	Basal 3	Basal 4	Median
1. Clarity of Objective	3	3	3	3	3
2. Additional Skills/ Concepts Taught	2	2.33	2.33	1.67	2.17
3. Use of Manipulatives and Representation	2.33	2.67	3	3	2.84
4. Instructional Approach	2.33	2.33	2.67	2.33	2.33
5. Provision of Teacher Examples	2.67	2	2.67	2.67	2.67
6. Adequate Practice Opportunities	2.67	3	2	2	2.34
7. Review of Prerequisite Mathematical Skills	3	1.67	3	1.67	2.34
8. Error Correction and Corrective Feedback	2.33	2.33	3	1.33	2.34
9. Vocabulary	2	3	3	1.67	2.5
10. Strategies	2	1	1	1	1
11. Progress Monitoring	1.67	2.67	2.67	2	2.34

Table 3
Summary of Grade 2 Ratings

Feature	Basal 1	Basal 2	Basal 3	Basal 4	Median
1. Clarity of Objective	3	3	2.67	3	3
2. Additional Skills/ Concepts Taught	1.67	2.67	2.33	2	2.17
3. Use of Manipulatives and Representation	2.67	2.67	2.33	2.67	2.67
4. Instructional Approach	1.67	2.33	2	2.33	2.17
5. Provision of Teacher Examples	1.67	2.33	2	2.33	2.17
6. Adequate Practice Opportunities	2	3	2.67	2.33	2.5
7. Review of Prerequisite Mathematical Skills	2	3	3	2	2.5
8. Error Correction and Corrective Feedback	2	1	3	1	1.5
9. Vocabulary	2.33	2.33	2.33	1	2.33
10. Strategies	2.33	1.67	1.33	1.67	1.67
11. Progress Monitoring	1.33	1.67	2.67	2	1.84

3 (features #8, 10, 11) of the 11 median ratings were at the "Unacceptable" level, 7 (feature #2, 3, 4, 5, 6, 7, 9) were rated "Approaching Acceptable," and 1 (feature #1) was at the "Acceptable" level.

Critical-Features Analyses

Each critical feature of effective instruction for struggling students received a total of 12 ratings across the three grades and four basals. Clarity of Objective (#1) ratings ranged from 2.67 to 3. The median across the 12 ratings was 3, which represents an "Acceptable" level, indicating that teachers using these basals can expect objectives that are specific and clearly written for the intent of the lesson.

For Additional Skills/Concepts Taught (#2), ratings ranged from 1.33 through 3, with a median of 2, resulting in an "Approaching Acceptable" rating. This rating meant that one additional skill was taught in a lesson besides the skill specified in the objective.

Use of Manipulatives and Representation (#3) received ratings ranging from 2.33 to 3, with a median of 2.67, signifying an "Approaching Acceptable" level. This level indicates that only representations were used for illustrating concepts in the lessons; the use of manipulatives was absent from these lessons.

Instructional Approach (#4) showed ratings ranging from 1.67 to 3, with a median rating of 2.33, signifying an "Approaching Acceptable." Thus, the use of explicit instruction, including instructions for modeling or demonstration, was not evident in the lessons selected for this study.

Provision of Teacher Examples (#5) had ratings ranging from 1.67 to 3, with a median rating of 2.33. This "Approaching Acceptable" level was assigned because of the limited number of examples provided for teacher to use to teach the concepts.

Adequate Practice Opportunities (#6) included ratings ranging from 1 to 3, with a median rating of 2.33, earning an "Approaching Acceptable" level. That is, one to three practice opportunities were provided for student engagement on the concept being taught.

For Review of Prerequisite Mathematical Skills (#7), ratings ranged from 1 to 3, with a median rating of 2, signifying an "Approaching Acceptable" level. Thus, one prerequisite skill was identified in the lesson but no review was provided.

Error Correction and Corrective Feedback (#8) showed ratings ranging from 1 to 3, with a median rating of 2.17 with an assigned "Approaching Acceptable" level. In this case, possible student error patterns were identified, but no suggestions for corrective feedback were noted.

Vocabulary (#9) received ratings ranging from 1 to 3, with a median rating of 2.33. Once again, an "Approaching Acceptable" level was assigned for this feature of instruction. Although vocabulary words for the lessons were identified, no instructional suggestions for teaching the vocabulary were offered.

Strategies (#10) received ratings ranging from 1 to 2.33, with a median rating of 1.17, which meant an "Unacceptable" level score. Strategies were identified for the skills in the lessons examined, but no explicit instructional procedures were provided for teaching the strategies.

Finally, Progress Monitoring (#11) earned ratings ranging from 1 to 3, with a median rating of 2, signifying an "Approaching Acceptable" level. This rating indicated that teachers were instructed to assess students to determine if the lesson's objective was achieved, but no guidance was provided on how to conduct the assessment. Thus, out of 11 critical features of instruction to help struggling students learn the objective of the lessons, across the grades, feature #1, Clarity of Objective, achieved an "Acceptable" level, 9 (features #2, 3, 4, 5, 6, 7, 8, 9, 11) achieved an "Approaching Acceptable" level, and 1 (feature #10) was rated as "Unacceptable."

Content and Procedures Analyses

We divided the 11 features into two categories, Content and Procedures. Content, in this case, referred to what was being taught whereas Procedures referred to how the lesson was taught. Under Content, we included Clarity of Objective, Additional Skills/Concepts Taught, Review of Prerequisite Mathematical Skills, and Vocabulary. The following features were classified as Procedures: Use of Manipulatives and Representation, Instructional Approach, Provision of Teacher Examples, Adequate Practice Opportunities, Error Correction and Feedback, Strategies, and Progress Monitoring.

Looking at each grade individually, we found that Content in kindergarten texts had ratings ranging from 1 through 3, with a median rating of 2.17, "Approaching Acceptable." For Procedures, ratings also ranged from 1 to 3, a median of 2.33 was computed. Across grade 1 texts, Content ratings ranged from 1.67 through 3, with a median of 2.65. Procedures ratings ranged from 1 through 3, with a computed median of 2.33. Thus, both areas were rated as "Approaching Acceptable." Finally, grade 2 text ratings were examined. Content ratings ranged from a low of 1 to a high of 3. The median rating for Content was 2.33. Procedure ratings ranged from 1 to 3 as well, with a median rating computed to be 2.17. Thus, across the grades, both Content and Procedures received a median rating of "Approaching Acceptable."

DISCUSSION

Mathematics textbooks play an important role in core instruction of primary-grade students. The instructional design features of textbook lessons influence how students learn and apply mathematical concepts (Carnine et al., 1998). For students who are at risk for mathematics difficulties in the early grades, core instruction should include the critical features of effective instruction to help children access the curriculum (Jitendra et al., 2005), and early instruction should provide quality core instruction. Based on research findings of students with mathematics LD, we know that features of explicit and strategic instruction are highly effective in helping students to learn (Swanson et al., 1999). We can surmise that these features can be implemented with children who manifest mathematics difficulties in the primary grades as preventive measures to reduce inappropriate referrals to special education because of inadequate or poor instruction. For example, recent findings have shown significant program effects for first- (D. Bryant et al., 2007) and second-grade (D. Bryant et al., in press) at-risk students when implementing booster lessons that included explicit and strategic instruction. Similarly, Fuchs, Fuchs, Hamlett, and Appleton (2002) used explicit instruction procedures to successfully teach transfer effects in word problem solving to elementary-aged students with mathematics disabilities. Vocabulary knowledge is a critical feature of mathematics instruction. Therefore, students who lack adequate vocabulary development can benefit from representations of conceptual knowledge, including the use of manipulatives (L. S. Fuchs & Fuchs, 2001; Marsh et al., 1996) and vocabulary.

This study examined representative sample lessons on number, operation, and quantitative reasoning from three grade levels, kindergarten, first and second grade, to determine the extent to which critical features of instruction (i.e., explicit and strategic instruction), including manipulatives and vocabulary, were present as part of the instructional routine across textbooks, which conceivable could be part of core instruction.

The data were analyzed in three ways, by grade level, critical features, and content and procedures. When examining each rating by grade level, an "Acceptable" level was achieved for approximately one third of the ratings in kindergarten, a little over one fourth of the ratings in first grade, and only 16% of the ratings in second grade. Findings for the median ratings for each feature across all four textbooks by grade level revealed that for first and second grade, only feature #1, Clarity of Objective, achieved an "Acceptable" level. For kindergarten, Clarity of Objective and Use of Manipulatives and Representation achieved an "Acceptable" rating. In the "Unacceptable" category, Strategies scored consistently poorly across all three grade levels. Also, Additional Skills and Concepts Taught and Review of Prerequisite Skills for kindergarten, and Error Correction and Corrective Feedback and Progress Monitoring for second grade, were "Unacceptable."

In examining the critical features of effective instruction for struggling students in totality across the three grades and four basals ($N = 12$), it was disconcerting to find that only one feature, Clarity of Objective, received an "Acceptable" rating. One feature, Strategies, came up short as "Unacceptable." The remaining nine features were rated as "Approaching Acceptable" for all three grade levels. Finally, overall across the grades, both Content and Procedures received a median rating of "Approaching Acceptable."

Overall, the extent to which the critical features of effective instruction are included in textbooks received an "Approaching Acceptable" rating. Comparable to earlier findings (Jitendra et al., 1999), the textbooks analyzed here seem to be including objectives that are clear for teachers to understand. However, strategies for teaching concepts scored poorly across all of the analyses. This is problematic because students with mathematical learning difficulties benefit from strategic instruction (L. S. Fuchs, Fuchs, Prentice, Burch, Hamlett, Owen, et al., 2003). In sum, kindergarten lessons fared somewhat better than those for first and second grade in terms of specific "Acceptable" ratings. The percentage of "Acceptable" ratings was particularly disappointing for second-grade textbooks.

Results of this study show that the critical features of effective instruction are not being fully incorporated into textbook instruction in kindergarten, first, and second grade. These findings are similar to those of earlier studies (e.g., Jitendra et al., 1999; Jitendra et al., 2005) and thus warrant attention as educators make decisions about how to use textbooks for mathematics instruction. Given that early high-quality core instruction is critical to helping students respond to mathematics instruction successfully, the findings from this study suggest core instruction needs to be boosted with effective features of instruction.

To ensure that lessons are suitable for students with mathematics difficulties, teachers are advised to examine them beforehand and provide adaptations so that all students in the classroom can benefit from instruction. Examples of instructional adaptations for core instruction include peer-assisted tutors (Baker, Gersten, & Less, 2002; D. Fuchs, Fuchs, & Karns, 2001; L. S. Fuchs, Fuchs, Yazdian, L., & Powell, 2002); explicit instruction in teaching procedural and conceptual strategies (e.g., calculations principles) (Baker et al., 2002; Gersten et al. 2005); verbalizations of cognitive strategies (L.S. Fuchs & Fuchs, 2001); physical and visual representations of number concepts (L. S. Fuchs et al., 2001; Gersten et al., 2005); and the ADAPT framework, as described by D. Bryant et al. (2008).

Limitations of the Study

The findings from this study should be interpreted cautiously. First, the results are limited by the number of lessons examined in each basal. Thus, it is conceivable that more acceptable evidence of the critical features was included in lessons that were not included in our examination. Second, the investigation was limited to textbooks that were available at the time of the study. Newer editions of textbooks may be more inclusive of the critical features of instruction.

Future Research and Implications for Practice

As publishers revise textbook editions, additional studies on the inclusion of the critical features of instruction are warranted. It is hoped that publishers will heed the findings from this and other studies as they make revisions to fully support the instructional needs of all students. Teachers need materials that include instructional practices that can be implemented without a great deal of preparation time.

Several implications for practice may be drawn from this study. First, as educators examine textbooks to make decisions about which basals to adopt at the state level, sufficient evidence of the inclusion of the critical features of instruction should be factored into the decision-making process. Second, as teachers prepare textbook-based lessons, they should carefully scrutinize the components of the lesson to determine if the features of instruction are indeed included. Features that are only marginally addressed will require supplemental adaptations, such as those described in this section, to ensure that students who are at risk for mathematics difficulties receive the type of instruction that helps them access and master learning.

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