Supplemental Mathematics Intervention: How and Why Special Educators Intensify Intervention for Students With Learning Disabilities

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Abstract
Researchers design scripted supplemental mathematics programs for struggling students, such as students with learning disabilities (LD), to encourage an evidence-based presentation of concepts and use of instructional language in teachers’ implementation. In practice, teachers may or may not implement these programs with high fidelity, resulting in slight to substantial curriculum alterations. Yet there is a dearth of studies detailing the nature of changes teachers make during instruction or their perceptions of why the changes were necessary. We present a qualitative analysis of 10 special educators’ employment of a Base Ten Numeration and Multiplication/Division Strategies intervention with students with LD. Results show that teachers altered modeled practice and guided practice lesson components more than any other lesson component. Three interrelated themes illustrate reasons for pedagogy, materials, and tasks alterations: (a) scripted tasks/script, (b) connections, and (c) lesson delivery methods.

Keywords
intensive intervention, mathematics, research to practice, teacher perceptions, learning disabilities

Increasingly, interventions are becoming available for teachers to use with students who display gaps in knowledge following instruction in the general education mathematics classroom and may include students with learning disabilities (LD). Mathematics interventions conceptualized in research are often standardized through explicit, scripted instructional procedures and routines for implementation. This standardization is done to promote consistent instructional delivery close to that which was found to promote mathematical achievement in field-based testing (Gersten et al., 2009). Yet, teachers may not adhere to the instructional delivery practices promoted in the script and instead use slight to substantial curricular modifications in areas they perceive as not applicable to or insufficient for their instruction. As differences between intended versus actual intervention implementation in mathematics continue, very little is known about how teachers alter the interventions and why they perceive the changes as necessary. Such information can help researchers better understand the continued research to practice gap in mathematics intervention implementation and enhance supplemental curriculum development and classroom utility for students with LD.

Mathematics Performance of Struggling Learners
Designing instruction to improve mathematics performance for students with LD is critical given the disparities in mathematics achievement as compared with non-disabled peers. For example, on standardized tests of mathematics achievement, such as the National Assessment of Educational Progress (NAEP), students with disabilities consistently score lower than their peers without disabilities in areas such as Base Ten Numeration and operations involving multiplicative thinking (National Center for Education Statistics, 2009). Not surprisingly and unfortunately, recent test scores show only 19% of fourth graders with disabilities had overall performance of “at or above proficient,” in comparison with 41% without disabilities. In particular, elementary students with LD show significantly less
improvement in their ability to solve problems, estimate, and apply computational procedures in mathematics compared with peers with mathematics difficulties (Hecht, Vagi, & Torgesen, 2007). Opportunities for students with LD to bolster their mathematics conceptual and procedural understanding and performance are critical to ensure successful secondary and post-secondary outcomes (National Mathematics Advisory Panel, 2008).

**Intervention to Bolster Mathematics Performance**

Supplemental interventions are becoming increasingly available for teachers to use with students who display lower than expected performance despite general education, core mathematics instruction (e.g., D. P. Bryant, Bryant, Gersten, Scammacca, & Chavez, 2008; L. S. Fuchs, Seethaler, et al., 2008). Supplemental interventions are designed for use alongside whole class mathematics curricula and are often administered daily in small groups for 30 to 40 min several times a week over 10 to 20 weeks. Typically, such intervention programs incorporate evidence-based features of explicit, systematic instruction (Coyne, Kame’enui, & Carnine, 2011) and mathematical practices that are described as necessary when teaching struggling students, including students with LD (Gersten et al., 2009).

Evidence-based features of explicit, systematic instructional design include (a) a focus on big ideas within key content; (b) specific strategies to be used by students to learn new material; (c) teacher-directed learning (i.e., ownership or modeling of thinking) when new ideas are introduced, with student’s restatement of that thinking practiced; (d) a purposeful review of previously mastered content; and (e) active engagement through multiple opportunities for students to respond. Many times, students who participate in such intervention programs display increases in mathematics performance (e.g., D. P. Bryant et al., 2008; L. S. Fuchs, Seethaler, et al., 2008).

Despite the reported effectiveness of researcher-delivered supplemental interventions, teachers of students with LD may or may not implement the programs as designed, reflecting a continued gap between research and practice (D. Fuchs, Fuchs, & Compton, 2012). Two competing explanations for this gap can be garnered from the literature. Both rest on the notion that mathematics interventions intended for struggling students may or may not provide the intensified instruction required by students with LD (D. Fuchs et al., 2012). In fact, Compton et al. (2012) report many students with LD continue to exhibit consistent and pervasive problems learning mathematics content despite inclusion in mathematics interventions designed for struggling students. Teachers may perceive that intervention programs need intensification to increase success for students with LD as compared with peers who display difficulties learning mathematics but do not have disabilities.

**Possible Perceived Reasons for Intensification of Intervention**

It is possible that teachers may perceive intensification as a means for decreasing the level of cognitive complexity associated with various mathematical concepts. For example, researchers (e.g., L. S. Fuchs, Fuchs, et al., 2008) suggest students with LD may need difficult tasks broken into smaller tasks or mathematical ideas to minimize the learning challenge. For instance, a teacher may present fact strategies strategically (e.g., all addition problems equaling six with subtraction problems with six as the minuend, then sevens, and so on) and give additional lesson-specific practice in various formats. Or, teachers may alter tasks (e.g., breaking a large task on adding two-digit numbers with regrouping into two smaller tasks, one without and one with regrouping) or representations depicted by materials used in supplemental lessons in an effort to provide a tighter sequence (i.e., concrete-representational-abstract flow of representations as lessons progress; Butler, Miller, Crehan, Babbitt, & Pierce, 2003); this may result in the use of different tasks or manipulative materials than the original design. Another way a teacher may adjust the cognitive complexity is by varying the level of guidance given to make mathematical concepts and/or procedures explicit (B. R. Bryant et al., 2014; L. S. Fuchs, Fuchs, et al., 2008). For example, teachers may model problem-solving strategies in an effort to emphasize efficient strategies for students to learn and provide increased and/or varied opportunities for students to practice and review acquired strategies and build mastery.

Conversely, teachers may perceive intensified instruction for students with LD not as a lessening of cognitive function but as an increased emphasis on student’s active development of knowledge (Hunt & Empson, 2014; Tzur & Lambart, 2011; Vukovic, 2012). Teaching and learning priorities in elementary mathematics instruction for all students, including those with LD, continue to shift from purely procedural and factual knowledge to more fully include students’ development of conceptual understanding and use of mathematical practices (National Governors Association Center for Best Practices, Council of Chief State School Officers, 2010). Research findings (Hecht et al., 2007; Vukovic, 2012) prove the necessity of this shift; conceptual knowledge, often underdeveloped in students with LD, mediates differences in overall mathematics performance between students with and without LD above and beyond cognitive factors (e.g., working memory). Thus, teachers may intensify instruction by refocusing the content presented in the intervention program from a procedural understanding delivered onto students by the teacher to a
conceputal understanding constructed by the student. Put differently, teachers may alter materials, questioning, or tasks to attach to prior and evolving conceptions, increase students’ “doing” and reflection within a sequence of tasks, and facilitate students’ sense making and connections across mathematical ideas.

The Current Study

Intensification of mathematics interventions designed for struggling students and used by special education teachers when teaching students with LD is an area that warrants research. Little is known regarding the nature of alterations teachers make to intensify existing mathematics intervention programs as they work with students with LD. Learning more about teachers’ perceptions of what constitutes intensification of interventions could help inform future instructional design and reduce gaps between research and practice. This study presents a qualitative analysis of 10 teachers’ implementation of a Base Ten Numeration and Multiplication/Division Strategies intervention designed for struggling students but implemented with students with LD. Because decisions on how to alter instruction are made in the midst of teaching, understanding alterations and intensification as a function of teachers’ perceived need for change served as the basis for analysis.

Specifically, we report on the extent to which teachers did or did not adhere to the instructional script, the overall nature of the alterations they made, and their perceptions concerning factors that necessitated alterations to intensify instruction. The study addresses the following research questions:

**Research Question 1:** To what degree did special education teachers alter Base Ten Numeration and Multiplication/Division Strategies interventions designed for struggling students when teaching students with LD?

**Research Question 2:** What was the nature of alterations special education teachers made to intervention lessons during instruction for students with LD?

**Research Question 3:** What factors, from the perspectives of the special education teacher, led to such alterations?

Method

Participants

**Teachers.** Recruitment of elementary school special education teachers in a large urban district in the Southwestern United States consisted of several inclusion criteria. Teachers had to be (a) teaching mathematics interventions as part of daily instructional responsibilities (i.e., Tier 2 instruction within a Response to Intervention [RtI] model); (b) teaching mathematics interventions to third-, fourth-, and/or fifth-grade students with Individualized Education Program (IEP) goals in mathematics (LD in particular); (c) experienced with at least 3 years teaching mathematics intervention lessons; and (d) currently teaching students in intervention settings who had IEP goals in numeration and/or basic operations. Recruitment of teachers was accomplished by (a) identifying possible school sites supplied by the district as willing and interested to participate in the research study, (b) arranging school site meetings with special education teachers who met the inclusion criteria for the study, (c) conducting meetings with teachers to establish interest and ability to participate, and (d) obtaining consent from teachers and their students.

Researchers selected a sample of 10 special education teachers from three elementary schools. A majority of the teachers were female (n = 9) and White (n = 7). One teacher was Black and 2 teachers were Hispanic (1 being male). At the time of the study, all teachers held bachelor’s degrees, 2 teachers held master’s degrees or master’s degrees plus additional credit hours. All teachers had at least 5 years of teaching experience, 4 teachers had 6 to 10 years of teaching experience, and 2 teachers had 11 to 20 years of teaching experience. Teaching certification included special education (n = 3), elementary education (n = 1), or both (n = 6).

Four teachers taught the third-grade intervention lessons (i.e., Base Ten Numeration, see below for a description) and 6 teachers taught the fourth-grade intervention lessons (i.e., Multiplication/Division Strategies).

**Students.** Twenty-three students constituted the student sample and were (a) in the third, fourth, or fifth grade; (b) identified as LD on their IEP; (c) had IEP goals in the areas targeted by the intervention (i.e., numeration and basic operations); and (d) scored below 50% on a curriculum-based measure (CBM). A score below 50% on the CBMs substantiated students’ existing IEP goals made by the district in the targeted area (i.e., place value and basic operations) and thus their need for further instruction. The district identified students as LD using the duel discrepancy approach (difference between achievement and IQ). One student was identified as having intellectual disabilities (ID); the student was included in the study because he or she was a natural part of the instructional group utilized in the school setting. Nine students completed the Base Ten Numeration module, and 14 students completed the Multiplication/Division Strategies module.

**Base Ten Numeration and Multiplication/Division Fact Modules**

**Lesson content.** A Tier 2 intervention served as the supplemental mathematics intervention in this study. *Elementary Students and Teachers Algebra-Readiness for Grades 3 and
Lesson components. Each lesson included instructional design elements consistent with recommendations for mathematics instruction for students with LD (Gersten et al., 2009) and included the following components: (a) cumulative review, (b) engage prior knowledge, (c) modeled practice, (d) guided practice, and (e) independent practice. Instructional time for each component varied: 3 min each for cumulative review and engagement of prior knowledge with modeled practice, guided practice, and independent practice generally lasting 10 min, 8 min, and 6 min, respectively. Intervention duration was 30 min 3 days per week.

Delivery of instruction. Each supplemental instruction lesson was scripted. Design of lesson scripts was based on research-supported features of mathematics intervention for struggling learners outlined in the review of literature (i.e., teacher modeling of strategies to be used by students to learn new material, student restatement of teacher-modeled ideas during practice, purposeful review of previously mastered content, and active engagement through providing students with multiple opportunities for students to respond). The following paragraphs explicate varying teacher and student actions included in the specific lesson components described earlier.

First, in modeled practice, explicit, systematic instructional procedures were included in the script (Gersten et al., 2009). Procedures included an emphasis on clear, transparent modeling of strategies for solving problems, checking for understanding, individual and choral response, and immediate correction of erroneous responses using suggested error correction strategies within the lesson. For instance, when teaching multiplication of a two-digit number by factors of 9, the teacher may say, “When multiplying a number with two digits by a factor of 9, we use the strategy ‘10 minus the factor.’ What strategy? Get ready . . . .” If quick and accurate responses are given, the teacher praises and continues with demonstrating the steps of the strategy or how to use varying levels of representation to model the procedural steps (Butler et al., 2003). Levels of representation were grounded in tactile materials/representations when concepts were newly introduced; tactile representations were replaced with figurative and symbolic representations as concepts were repetitively modeled and explained.

Second, during guided practice, the script directed teachers to work several examples with students using scaffolded levels of questions to support the transition of strategy and procedure usage to solve problems from the teacher to the student (Coyne et al., 2011). The script began with high-level support questions. If students responded to teacher questions with a low degree of error, the script transitions to medium-level support questions. When utilizing medium-level support questions, the teacher continues to look for students’ correct and quick recitation of taught procedures and strategies. The difference was that questions are used in fewer numbers in an effort to relinquish some control or authority for mathematical “doing” onto students. Finally, the teacher shifts to low-level support questions (fewer questions allowing elaboration of steps or procedures on the part of the student) as students practice the taught procedures and strategies with little support from the teacher. Activities were also introduced at this point to reinforce learned strategies or procedures to solve problems.

Third, in independent practice, the script directed the teachers to eliminate questioning and supports altogether. Students were given several problems that were modeled during modeled practice and practiced together during guided practice. To consider the lesson successful, students needed to correctly solve 75% to 80% of problems (dependent on amount of problems given) independently.

Measures

Screening. To confirm students’ need for intervention, students’ initial performance in the targeted areas was assessed through a distal CBM for each intervention module. The CBMs were created from the Independent Practice sheets. The CBMs contained 40 items, 2 items from each lesson’s Independent Practice. Items included situated problems and
abstract problems. Researchers calculated split half reliability of the measures in a pilot study. Results of the reliability analyses generated an alpha coefficient of .87 for the Base Ten Numeration module and .91 for the Strategies module (Nunnally & Bernstein, 1994). Content validity was established because the items on the screening CBM were drawn from the independent practice items for each module.

**Fidelity of implementation.** Researchers utilized lesson observation forms to record the extent to which each teacher adhered to the instructional script for each lesson observed. Construction of the observation forms began from copies of each lesson script used by teachers in both the Base Ten Numeration module and the Multiplication/Division Strategies module. Researchers inserted a column into the left and right margins of each scripted page of each lesson. The researchers recorded whether teachers were (a) implementing each scripted phrase or directive as they taught the intervention (i.e., a checkmark in the left margin of the observation form indicating each statement/directive was completed) or (b) making changes to the script relative to each lesson component (i.e., modeled practice; guided practice) as they taught it (i.e., a checkmark in the right hand margin of the observation form indicated a change, and the change was noted). Eighteen lessons were observed for each teacher in third grade, and 15 lessons were observed for each teacher in fourth grade.

Inter-observer agreement (IOA) was established through an examination of 30% of all observation forms completed over the course of the study. The number of times observers agreed (i.e., observers agreed that a lesson element was performed without a change or observers agreed that a lesson element was performed with a change) was 103 (M = 145). Disagreements were 21. We determined inter-rater reliability using Cohen’s (1960) kappa. The statistic produces a possible range of agreement between −1 and +1 and is a strong gauge of observed agreement between coders as it corrects for agreement that would be expected by chance. The analysis (i.e., agreements, adjusted for chance divided by agreements + disagreements, adjusted for chance) yielded a kappa of 0.87, suggesting substantial agreement among coders (Hallgren, 2012).

**Pedagogy alteration form.** The second data source was information gathered from teachers concerning how lessons were altered. Teachers were asked to record their alterations by writing any alterations they made to the lessons in the margins of the lesson booklets. Alterations were broadly defined to teachers as any change they made to scripted phrases, activities, tasks, or materials called for in the lessons in each lesson component.

**Focus group.** A 2-hr focus group was held at the conclusion of the study. The focus group was utilized to obtain a holistic account of the nature of alterations made during instruction and teachers’ perspectives on why the changes were needed during instruction. Ten questions were developed at the onset of the study to uncover perceptions of intensification of instruction and perceived need (or the lack thereof) for altering lesson components grounded the focus group discussion. Each question contained 1 to 3 probing questions; a standard protocol was used to guide questioning. The focus group discussion was audiotaped; anecdotal notes were also gathered to triangulate data collection (Krueger, 2009).

**Study Procedures**

**Student consent, assent, and CBM administration.** Approval for conducting the study was obtained through the Institutional Review Board and the research division of the school district. All 10 teachers identified for the study signed and returned the consent forms. Identified students were then given parental consent forms for study participation. Student assent was collected through a signature on the bottom of the consent form. All students who met the selection criteria returned consent forms. Next, all identified students completed the researcher-developed CBM screener for either the Base Ten Numeration or the Multiplication/Division Strategies module. CBMs were given to students as a group. Students were told they were going to complete questions about base ten or multiplication/division strategies and to do their best; no other direction was provided. Word problems contained in the tests were read out loud to students who requested assistance. All students scored below 50% on the CBMs.

**Teacher training and lesson implementation.** Prior to lesson implementation, teachers received 3 hr of training on all lessons in the modules. The training included an overview of the lesson components and content areas as well as a detailed explanation and modeling of each lesson element. The project coordinator and a second member of the research team acted as the teacher for a selected lesson from each grade level; teachers acted as students as the content was delivered. In addition, teachers were given time to examine the lessons in groups and practice delivering lesson components. Teachers were instructed to deliver all lesson components as presented but to make alterations when warranted by student needs. Teachers completed feedback forms at the conclusion of the professional development. Scores from the feedback forms reflected a high degree of satisfaction with the content and structure of the training. Instruction commenced over a 7-week period beginning in February and concluding in March. The participating students received instruction within a special education resource classroom during their assigned mathematics time as defined in students’ IEP. The lessons were taught in
groups of two to three students at a semi-circular table; there were no other students present in the room. Students were instructed with the module lessons three times per week for 30 min per session. The 3 days varied across schools as a result of individual school schedules; district standardized testing schedules, and available instructional time per school site.

Lesson implementation and alteration data. Lesson implementation data were collected through researchers’ observations of lessons (i.e., fidelity of implementation lesson observation forms) and teacher’s own descriptions of alterations (i.e., pedagogy alteration forms). Prior to observing teachers in instruction, the first author trained the research team on the use of the observation forms used to collect data for the study. Researchers met for a period of 3 hr to discuss the lesson components and how to use the observation forms. Two researchers were present and observed each teacher as they implemented the modules over the 7-week intervention period. At the conclusion of the study, researchers also collected teachers’ notations on the lesson booklets of the alterations they made as they implemented the intervention modules.

Focus group data. Prior to the focus group, all researchers reviewed the processes of interview skills and content analysis procedures to increase the analytic consistency among the researchers with another researcher to assure reliability and validity within the later created process audit trail (Krueger, 2009). One researcher was assigned the role of facilitator. The facilitator posed questions to the teachers, encouraged discussion, and probed for elaboration of ideas brought to bear during discussion. The other researchers were assigned the roles of anecdotal note takers and took detailed accounts of responses to facilitator questions and who was responding, and directions of discourse (flow of conversations). This was done to ensure an audit trail and consistency of data collected (Glaser & Strauss, 1967).

At the outset of the focus group, permission from the teachers to be audiotaped was obtained. An explanation of each participating researcher’s role and purpose for the focus group was provided. Participants were guided using a semi-structured interview format (Glaser & Strauss, 1967). The questions related to overall perceptions of the lessons, their implementation, teachers’ alterations to the intervention lessons, and the factors that, from the perceptions of the teachers, influenced the alterations. Questioning also sought to uncover the teachers’ perceptions of intensification related to alteration of varying lesson components. Member checks were completed for each question before asking subsequent questions. The facilitator concluded the focus group with a summary statement, requested additions from the group as a further means of member checking, and ceased audiotaping.

Data Analyses

Research Question 1: Extent of lesson alterations. Descriptive statistics were calculated to obtain an overall gauge of how much change was or was not being made to lessons in each lesson component for each module. To do this, researchers gathered all lesson observation forms conducted across all teachers who taught that module. Researchers focused on a particular lesson component (e.g., modeled practice) and counted how many instructional statements and/or directions in that component were delivered with changes and divided that amount by the total number of instructional statements and/or directions in that lesson component (e.g., 13 statements/directives changed within modeled practice out of 15 total statements/directives within modeled practice yields a change percentage of 87%). Researchers repeated this process for all remaining observation forms for that particular component. Finally, an average was taken across all lessons for that component to obtain an overall percentage reflective of the extent to which teachers, in their instruction, were altering various lesson components within each instructional module.

Research Question 2: Nature of lesson alterations. Researchers utilized a constant comparison method (Glaser & Strauss, 1967) and classical content analysis (Leech & Onwuegbuzie, 2007) to delineate the nature and number of observed lesson alterations. Data included the completed observation forms from researchers and the teachers’ completed lesson booklets with self-reported alterations. First, researchers read through all completed observation forms and teacher’s lesson booklets as a team. Next, the data were chunked into smaller, more meaningful parts. Researchers negotiated a mutual set of codes, with examples for each, to assure content validity of the analysis. Codes were defined as pedagogy alterations, materials alterations, and task alterations (see “Results” section for further details on the codes). After independently coding sub-samples of data sets using the defined categories, the researchers conferred to compare responses. Interrater reliability, agreements / (agreements + disagreements), indicated a range of agreement from 87.9% to 91.4% (M = 89.8%). Next, researchers used classical content analysis to discern how many times certain types of alterations were used by teachers across the essential elements in each lesson observed. This descriptive information about the data was complementary to the constant comparative analysis. Researchers used the codes delineated during the constant comparison analysis to count how many occurrences comprised each code in the data set and in which lesson component these codes were observed.

Research Question 3: Perceived need for alterations. Researchers used constant comparison methods (Glaser & Strauss, 1967) using transcription from the focus group audiotapes.
Categories for analysis were generated and defined by the researchers who independently examined the data. For each issue or question, the responses were reviewed for common ideas and themes, which were used to develop an initial list of categories and analyzed using guidelines suggested by Glaser & Strauss (1967). Verification was conducted through the group process and through a final check of inter-rater reliability to ensure consensus (range = 83.0%–89.4%; M = 86.2%).

Results

The purpose of this study was to determine how special education teachers alter Tier 2 interventions to better accommodate the learning needs of their students with LD. Specifically, it is important to understand how and why these alterations are made to better inform researchers and curriculum developers who focus on interventions for students with LD.

Research Question 1: Extent of Lesson Alterations

Base Ten Numeration module. For cumulative review, the overall change percentage was 12%, whereas the change percentage for fluency was 4%. The percentage of changes was highest (21%) for modeled practice. Changes for guided practice and independent practice were 15% and 9%, respectively. Overall, the percentage of changes data indicated that the cumulative review, fluency, and independent practice components received a relatively low degree of teacher alterations, while guided practice and modeled practice were the lesson components teachers changed the most.

Multiplication/division strategies module. For cumulative review, the overall change percentage was 9%. For fluency, the change percentage was 6%. Interestingly the change percentage for modeled practice was high at 43%, whereas for guided practice and independent practice change, percentages were 27% and 12%, respectively. Thus, like the Base Ten Numeration module, cumulative review, fluency, and independent practice were slightly altered compared with guided practice and modeled practice, which received the most changes.

Research Question 2: Nature of Lesson Alterations

Constant comparison analysis of the lesson alterations revealed three broad categories: (a) pedagogy, (b) lesson materials, and (c) lesson tasks. First, pedagogical alterations involved teachers providing more, less, or different verbal instructions than what were original to the lesson script. Teachers deleted, added, or changed pieces of the script based on students’ responses about how they were conceptualizing the mathematics content. For example, teachers provided connections to students’ informal or present level of understanding; facilitated connections across mathematical ideas by relating the content to students’ lives; added gestures, visuals, or sounds as “cues” associated with mathematical concepts or terms; provided additional examples or practice opportunities; or pressed for more explanations. Teachers made alterations to pedagogy across all lesson elements in the Base Ten Numeration (82% of all observed module lesson alterations) and Multiplication/Division Strategies (65% of all observed module lesson alterations) intervention module. Pedagogical alterations occurred most frequently for the modeled practice and guided practice lesson components throughout both intervention modules.

Materials alterations were deletions, additions, or substitutions of materials stipulated in the lessons (i.e., representations, mathematical tools). Materials alterations comprised 11% of all observed Base Ten Numeration module alterations and 21% of all observed Multiplication/Division Strategies intervention module alterations. As with pedagogical alterations, materials alterations occurred most frequently during the modeled practice and guided practice components throughout both intervention modules.

Finally, task alterations constituted any change to a mathematical task or activity included in a lesson. Task alterations generally involved replacing a task with one that fit more closely with concepts students currently understood, altering the problem complexity, changing decontextualized problems to contextualized problems, or altering the nature of task delivery. These changes comprised 6% of all observed Base Ten Numeration module alterations and 15% of all observed when Multiplication/Division Strategies intervention module alterations. Again, the changes were observed mostly during the modeled practice and guided practice essential lesson components.

Research Question 3: Teacher Perceptions About Lesson Alterations

We were interested in the factors, from the perspectives of the special education teacher, which led to lesson alterations to intensify the interventions to benefit students with LD. Constant comparison analysis of the focus group data
revealed three interconnected themes: (a) Scripted Lessons and Tasks, (b) Connections, and (c) Lesson Delivery Methods. Most of the themes triangulated with pedagogy or task alterations and illustrate how these alterations occurred within lesson components and, most importantly, why they were altered with respect to intensifying intervention.

Scripted lessons and tasks. The first theme related to special educators’ appraisals of the scripted lessons and tasks within the lessons, which are typical for a standard protocol for supplemental interventions (D. P. Bryant et al., 2011; L. S. Fuchs, Fuchs, et al., 2008). Nineteen teacher statements focused on alterations to (a) bridge to students’ prior and informal knowledge, (b) differentiate among varying levels of students’ understanding or missing skills, and (c) provide additional opportunities for practice. Six statements coded within this theme illustrated teachers making changes to the instructional script when they felt it was insufficient for relating to notions students did possess. One teacher explained,

... with respect to having to do things a certain way—that might not always connect to what the student could do or wanted to do. Lots of assumptions of ways kids do things, like strategies students used that were correct but different than what was modeled due to how they were thinking about the math.

Seven statements illuminated some of the teachers’ attempts to differentiate lesson content to address specific areas of student need (e.g., address certain “missing” skills or misconceptions), which is important for students with LD who demonstrate mathematics difficulties.

Finally, six statements elucidated some of the teachers’ propensity to intensify the lessons by incorporating additional opportunities for practice. The insertion of additional practice opportunities usually involved an effort to ensure students’ mastery of the content. One teacher explained,

... And so I’ve found that I’ve had to... add more examples for me to feel confident to move on and to demonstrate. So it’s like I just make sure that it’s... at least an 80 or above at that point, before we move on to practice. Some days I go, oh we’ll be done with this in 30 minutes and it’s a 3-day lesson. I mean it’s just, so I just never know what it’s going to be, but I’ll stay and demonstrate for 2 days if I have to until I feel confident that they can go on. Because I’m not trying to “finish,” I’m trying to teach them math.

Connections. The second theme revealed a perceived need to alter the modeled practice and guided practice components of the lessons to intensify the interventions by providing additional connections. The connections teachers spoke of in the 23 statements that fell under this theme referred to (a) decontextualized tasks or lesson scripts that did not connect to students’ daily life experiences; (b) lessons delivered in a largely procedural manner that did not seem to connect to a larger concept; and (c) the addition of visual, kinesthetic, or verbal “cues” to assist students in associating or remembering a concept. Seven of the statements that fell under this theme referenced adding or altering the context of modeled practice and guided practice scripts and tasks to make them more familiar to students’ daily lives:

You know like if you’re going to talk about division maybe if they would just have prior to going into that, some real life examples of where you use division... And I think that you know the story problems are good and the application part, but you’ve already taught all the stuff and now you’re doing that. And so I sort of added a lot of those prior to trying to teach it. You know trying to get them to connect [the concept].

Five other statements spoke of teachers needing to scaffold the lesson scripts to bridge procedural aspects of mathematics skills delivered in the lessons to a more conceptual base:

Yeah I guess I’m not saying the procedures aren’t right, but I guess they, they’re getting so caught up in the procedures of where the numbers go that they’re not connecting to what the procedures are trying to teach them... They’re not getting it. They’re not getting the big picture.

Teachers did not perceive students’ misuse of procedural steps as a deficit in knowledge on the part of the student; instead, teachers commented the lessons did not present procedures in a manner that would promote adaptive procedural expertise. One teacher commented,

I just felt that we got caught up in a lot of the procedure of doing something... there were too many procedures, there were too many steps [in that] we completely lost the focus of what we were trying to learn: the distributive property.

Other statements that fell into this theme spoke of connections as visual, verbal, or gestures-based “cues” to aid students’ recall of the content; 11 statements defined “connections” in this way:

So it’s incorporating those different pieces and maybe relying a little less on the language—just my talking—versus them being able to know they can go to that visual piece. For example, doubling is one concept that just continues to confound them. But with a visual picture of things doubling, or the manipulative they’re doubling, it reconnects that concept.
opportunities for students to explain and justify their thinking (four statements). Some teachers viewed the lesson delivery as too teacher-centered for the students they instructed, with an insufficient emphasis given to students’ role in their own learning of mathematics.

In the demonstrate part . . . even though I’m showing them what to do, I find myself trying to get different response methods from them because it’s like they rely entirely on me and not on their own minds. So I changed it to asking . . . can you explain that back to me or is there another way you were thinking about it. Somehow, there has got to be more; activity . . . thinking . . . from them.

Other teachers identified mathematical reasoning and justification as a missing student activity.

And the question that I’ve been saying to them is . . . if I know that’s wrong, I go “well prove it” and ask why it’s right. And I have them teach it back to me how they got that answer and then I say to the other person, “do you agree with that?” So the whole thing, the premise behind when they teach another child, they learn it better, then it becomes real to them.

**Discussion**

The purpose of this study was threefold. First, we sought to understand the extent to which special education teachers altered existing supplemental mathematics Tier 2 interventions when teaching students with LD. Second, we were interested in the nature of the alterations, and third, we sought to identify the perceived factors that led teachers to alter the lessons. When using supplemental mathematics programs, which are designed for Tier 2 intervention, special education teachers likely will have to intensify intervention to support their students’ learning (National Center on Intensive Intervention [NCII], 2013). Intensifying interventions can be viewed as quantitative (e.g., more cues and prompts, more time) and qualitative (e.g., altering the content, providing more practice opportunities, providing more feedback; NCII, 2013).

Results of the present study reflect that teachers indeed did alter all components of the supplemental lessons to better address the needs of their students with LD both in quantitative and qualitative ways. Although this may not be particularly surprising, it is important to understand why and how special education teachers alter instructional materials for teaching students with LD as researchers and curriculum developers continue to develop and study intensive intervention materials for students with disabilities.

In this study, alterations focused on pedagogy, materials, and tasks and occurred predominantly in the modeled practice and guided practice lesson components. Teachers added visual, kinesthetic, or verbal cuing to provide connections to concepts, altered contexts of scripts and tasks to connect to students’ life experiences, and changed tasks and pedagogy to relate to the informal understandings of the mathematics expressed by students. Teachers also increased time for additional (or different forms of) practice to work toward content mastery and differentiated the lessons and tasks to address “pockets” of misunderstanding or misconceptions. Finally, some of the teachers altered the lesson delivery to include more student interaction and active development of knowledge and increased opportunities for students to explain their mathematical reasoning.

There are several explanations for why special education teachers alter the supplemental tier interventions and how they go about doing so. The first explanation is that teachers make alterations because they feel that they need to adjust (i.e., lessen) the level of cognitive complexity their students are experiencing as they learn (Butler et al., 2003; L. S. Fuchs, Fuchs, et al., 2008). The second explanation is that teachers make alterations because they feel they need to shift instructional emphasis within the lessons to increase student’s active development of knowledge (Hunt & Empson, 2014; Tzur & Lambert, 2011). Results of this study support both explanations. That is, many of the pedagogical and task alterations, along with statements teachers made regarding the need for intensification, reflected the addition of lesson-specific practice in various formats, a tighter sequence of mathematical ideas, and increased opportunities for students to practice and review acquired strategies and build mastery (B. R. Bryant et al., 2014; Butler et al., 2003; L. S. Fuchs, Fuchs, et al., 2008). Also, many of the pedagogical and task alterations were made to increase opportunities for students’ active development of knowledge through their informal notions of mathematics and to foster more student verbalization of mathematical reasoning (Tzur et al., 2013). Thus, task, pedagogy, and materials alterations reflect a focus on the teacher’s response to student notions of mathematics within the intervention and, correspondingly, what teachers perceived their students needed to further benefit from instruction.

Arguably, teacher’s perspectives are a function of the idiosyncratic needs and present understandings of their students along with their own preparation, backgrounds, and beliefs regarding mathematics and intervention for special populations. Clearly, some of the alterations (e.g., kinesthetic cues) have lost favor in special education instruction, whereas the use of visuals and increased practice opportunities are examples of evidence-based practices supported in the literature (Gersten et al., 2009). Backgrounds (e.g., certification, education, content knowledge, including knowledge of mathematics for teaching) and beliefs (e.g., what mathematics is, what learning disability is) of the special educators may affect lesson intensification in qualitatively different ways (Ball, Hill, & Bass, 2005). More research is needed to test this assertion.
Limitations and Future Research

There are several important limitations in this study. First, focus group data, although valuable, are not generalizable and do not allow for a determination of the extent to which individual participants have particular perspectives compared with others. The present study did not report on teacher’s perspectives relative to their teaching background or certification level. Future studies could document whether teachers with certain certifications have similar or different perspectives than others with respect to decreasing cognitive complexity of tasks or increasing student-directed learning opportunities. Future research could utilize individual interviews with teachers. A qualitative content analysis could illustrate the perspectives of teachers with varying certifications and backgrounds, lesson alterations, and discernable relationships between these variables and lesson alterations.

A second limitation of this study is that we did not report on the mathematics education backgrounds of teachers who participated in the intervention implementation. It is possible that the teachers’ depth of conceptual understanding of the mathematics contained in the interventions affected the alterations they made in some way. Also, the level of expertise special educators had in terms of implementing interventions with students with LD may also have affected study results in qualitatively different ways. Future studies could utilize measures of teachers’ mathematics knowledge for teaching (Ball et al., 2005) to gain further insight into the extent to which teacher’s mathematical knowledge for teaching might impact the alterations they make. Furthermore, individual interviews and teacher talk alouds as they view videos of their own teaching could provide rich accounts of the alterations teachers make and reasons for their changes that may or may not relate to their level of content knowledge for teaching, expertise in delivering mathematics interventions, and understanding of contemporary evidence-based practices.

Finally, the present study reports on alterations from the perspective of teachers that were necessary to promote students’ successful mathematics learning. No information was obtained on the extent to which, if any, altered intervention programs such as these yielded improvements in mathematics performance for students with LD or if they are more powerful compared with traditional interventions. Furthermore, we did not test differences between teacher alterations for students with and without LD. It is possible that the alterations reflect concerns with the content or use of scripted materials rather than specific differences related to students with LD. Future research could document specific alterations teachers make along the extent to which, if any, the alterations improves student learning and compared with non-altered implementations. These lines of research might utilize mixed methods to measure student performance (e.g., single case designs measures performance along with strategy use paired with clinical interviews to obtain a gauge of student’s conceptual change).

Implications for Practice

Findings from this study offer promising practices for teaching mathematics to students with LD and for researchers and curriculum developers. Although the alterations made by teachers were not linked to measures of student improvement, which is a follow-up study, the alterations suggested from a clinical perspective help us better understand how interventions can be intensified and why this is important for students with LD. Intensifying interventions can be accomplished by using quantitative changes and qualitative adaptations (NCII, 2013). Based on the findings from this study, suggestions for intensifying intensive include providing more prompts to help students think about the mathematical ideas and problem responses. Increasing the amount of time for interventions may be necessary. Lessons that are designed for 30 to 40 min may in fact require several days because of the need to make adaptations to lesson components (e.g., modeling, guided practice) to foster mathematical thinking and responding. Providing more connections among students’ informal mathematics knowledge, their background knowledge, and the concepts being taught may promote more understanding. Also, providing problem solving to elicit, support, and extend mathematical ideas appear to be needed to facilitate connections between students’ informal and abstract knowledge of mathematics (Carpenter, Fennema, Peterson, Chiang, & Loe, 1989). Finally, providing more practice opportunities with mathematical concepts and reducing cognitive load through task analysis could be other alterations or adaptations that are necessary for students who demonstrate mathematics difficulties.

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